Value Elicitation in
Value Based Software Engineering

A Thesis Presented to

Department of Computer Sciences
Faculty of Basic & Applied Sciences

In Partial Fulfillment

of the requirement for the degree

Of

Master of Sciences (Software Engineering)

By

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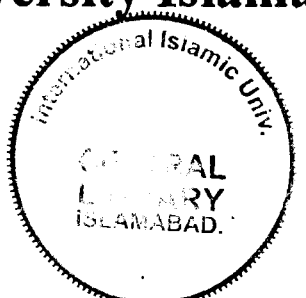
(111-FAS/MSSE/F06)

nternational Islamic University Islamabad

(2009)



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Dated: January 18, 2009

FINAL APPROVAL

It is certified that we have read the thesis, entitled **"Value Elicitation in Value Based Software Engineering"**, submitted by Ghulam Murtaza Reg. No. 111-FAS/MSSE/F06 .It is our judgment that this thesis is of sufficient standard to warrant its acceptance by the International Islamic University Islamabad for MS Degree in Software Engineering.

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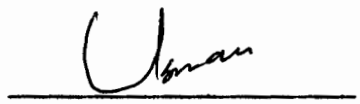

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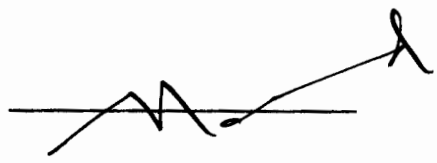

Abstract

The research aims to give detail insight into the concept of value with the context of value based software engineering. The value dimensions are highlighted with their importance to the business decisions at various stages of software development lifecycle. The value dimensions are grouped together by studying their relationship that exists in their characteristics. The value dimensions from different fields of study are classified into the six major classes of Business Value, Economic Value, Technical Value, Epistemic Value, Personal Value and Social Value. A Value Elicitation Framework (VEF) is proposed on the relationship of value dimensions, value owners and value elicitation techniques to select the appropriate value elicitation technique for a particular situation. The VEF is validated through specially designed case study on a software development project to provide an easy to select the appropriate value elicitation technique according to the given situation. The results of the case study are presented in discrete manners to conduct further research on the same concept especially in the area of application methods of value elicitation techniques.

Acknowledgment

I would like to thank **Dr. Naveed Ikram** for his continued support and guidance for the completion of this work. He has been a great source of knowledge of guidance during the difficult stages of the research work.

I express my gratitude to my colleagues, peers, friends and family members for their unprecedented support through difficult situations. I am also thankful to the company for allowing me to conduct the case study and provisioning of necessary data, access to the company resources and overall support.

I am very thankful to my friends Abdul Basit, Arshad Farooq, Naeem Ahmed, Nadeem Iqbal, Abid Khan and Kamran Safdar for their extensive moral support and courage to meet the challenges in completing the thesis.

Last but not the least my parents for their erstwhile love!

Declaration

I hereby declare and affirm that this thesis neither as a whole nor as part thereof has been copied out from any source. It is further declared that I have completed this thesis entirely on the basis of my personal effort, made under the sincere guidance of our supervisor. If any part of this report is proven to be copied out or found to be a reproduction of some other, we shall stand by the consequences. No portion of the work presented in this report has been submitted in support of an application for other degree or qualification of this or any other University or Institute of learning.

Ghulam Murtaza

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Dedication

I would like to dedicate my work to

ALMIGHTY ALLAH,

Who has always showered His endless blessings upon me;

I also dedicate this work to my

PAYRENTS

whose sincere prayers and love were a source of strength for me
and made this project successful.

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Chapter 1 – Introduction

The concept of value was introduced during early 1970s in management literature but in software engineering this concept is relatively new and getting popularity during last years [2][4]. During earlier times, the software engineering practice and research was based upon the value neutral manners in which every requirement, use case, object and defect is treated with equal importance. The Methods are presented and practiced as largely logical activities in the value neutral practices. Also, the progress of the project is tracked through the concept of Earned Value [49] rather by the stake-holder or the business value. In addition to this, the responsibilities of software engineers are limited only to turn software requirements to verifiable code. So resultantly, the software decisions had relatively minor influences on System's cost, schedule and value making the value neutral approach workable. However, today and increasingly in future, software has major influence on most Projecct's cost, schedule and value resulting project decisions extraordinary intertwined with System level decisions [5].

The core of Value Based Software Engineering [2] [4] is the "stakeholder win-win Theory W" [3], which addresses the questions of "which values are important?" and "how success is assured?" for a given software engineering enterprise. The four additional theories that it draws upon are utility theory (how important are the values?), decision theory (how do stakeholders' values determine decisions?), dependency theory (how do dependencies affect value realization?), and control theory (how to adapt to change and control value realization?).

Value Based Software Engineering [4] is based on traditional software principals and practices but it extends these principles and practices by introducing the concept of value into them. In traditional software engineering/development the success of the software project depends on successful completion of software product on time and within specified budget with less or consideration of stakeholders' value. Value Based Software Engineering also focuses on timely and within budget development of software product but here the success criteria are different than the traditional software engineering. In Value Based Software Engineering the success of a software development project also depends on fulfillment of stakeholder's values about the software and system. The project cannot be successful unless the stakeholder's get their perceived value from the software. In software domain, stakeholders are not limited to just customers and financers, but the stakeholder can be

anyone who can affect or get affected by the system in any means (financially, personally etc.), that makes the elicitation and fulfillment of stakeholder's value difficult. So, the Value Based Software Engineering is aimed at making Success Critical Stakeholders (SCSs) the winners and to ensure stakeholder satisfaction besides focusing just the successful product development [2], [3], [4], [12], [1], [8], [14], [15].

Theory of value-based software engineering connects software engineering's value-neutral computer science theories with major value-based theories such as utility theory, decision theory, dependency theory, and control theory; and it provides a process framework for guiding VBSE activities. The process framework consists of seven key elements which provide a starting point for realizing the value-based software engineering agenda [2]. They are: Benefit Realization Analysis, Stakeholder Value Proposition Elicitation and Reconciliation, Business Case Analysis, Continuous Risk and Opportunity Management, Concurrent System and Software Engineering, Value-Based Monitoring and Control and Change as Opportunity.

Value based software engineering is diverse field of study that integrates the multiple areas of management and social literature with software engineering in each and every step of VBSE framework. Till now we have mentioned briefly seven elements of software engineering framework presented by Berry Boehm. In the next section we shall be having a detailed discussion on the second element of VBSE framework "Value Elicitation", details of rest of the elements is not in the scope of this research. In the next section we tried to answer the following questions related to value elicitation:

- What is value?
- Where the value comes from? and
- How can we elicit value?

1.1. Value Elicitation

As the value based software engineering mainly depends on the value of software or requirements, the correctness of value and value elicitation process becomes more critical. Barry Boehm presents value elicitation as one of the seven key elements of value based software engineering. In software engineering value elicitation is not a simple task, because there are a lot of intangibles elements involved in software domain. Dealing with different

kinds of objects requires different techniques to be used and different parameters to be taken into consideration. On the other hand value itself has its own dimensions and the most important consideration is the value owners "the stakeholders". Every stakeholder has different value propositions about the software or the requirements. All these considerations make the value elicitation process more complex and require clear understanding of value, value dimensions, stakeholders and value elicitation techniques. Clarification of the concept of value is presented in the next section, however; the literature surveys on success critical stakeholders, value dimensions and value elicitation techniques are presented in separate chapters respectively.

1.1.1. What is Value?

To address any issues related to value based software engineering, first we need to clearly understand the concept of value. According to [8] it is one of the most overused and misused concepts in social sciences and management literatures. It is used in different fields such as finance, economics, management, information systems, ethics, aesthetics, justice, social equity and fairness, etc. [16], [8], however; in software engineering this concept is relatively new. Each of the mentioned field has its own value theories that try to investigate how people positively and/or negatively value things and concepts, reasons they use in making their evaluations, and the scope of applications of legitimate evaluations across the social world [53], [5].

According to [17], there are two main approaches to use the concept of value. According to the first approach value is the *one-dimensional* single overall concept where as the second approach reports it as *multi-dimensional* concept having different dimensions and attributes. Both these approaches are also reported in [5] but first approach is practically used for value elicitation in [5] & [6].

Multiple definitions of value are presented in the literature, some of which are quoted here for clarification and reference purpose as under:

> *"Value implies a 'trade-off' between benefits and sacrifices; moreover, it implies an interaction between a customer and a product or service. [18]"*

> *"Value is derived by the customers according to the difference between the 'utility' provided by the attributes of a product and the 'disutility' represented by the price paid.*

It is thus apparent that perceived value is a broader and richer construct than a mere trade-off between 'utility' and 'price'.[19]

There are four different definitions of value: (i) value as low price; (ii) value as whatever the consumer wants in a product; (iii) value as the quality obtained for the price paid; and (iv) value as what the consumer gets for what he or she gives.[19]

Value is customer's perceived preference for an evaluation of product attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations. [20]

Some other variables are also presented in the literature to understand the concept of value including; Corporate Image, Quality and Sacrifice, Social Value, Aesthetics, Benefits, Personal Preferences, Perceived Risk and Experience etc.

Further analyzing the concept of value, we found that there are two efforts that have made the categorization of concept. Fist one is based upon the nature of value where three categories are defined i.e. extrinsic value, intrinsic value, and systemic value [21] [22]. This categorization is also supported by [53] with a little difference. However; the second categorization of value based upon the types of stakeholder, according to which value can be defined into three categories: *shareholder value*, *customer value*, *stakeholder value*. Customer value, however, is the source of all other values [8].

Among all the theories and definitions of value, economic theory of value has its own importance, which describes that the value is meant by "the exchange value or price of goods and services" [53]. According to economic theory, value is more financial in nature but we cannot neglect social, personal, technical and other dimensions of value.

There is a serious lack of agreement among scholars with respect to the conceptualization and measurement of value which shows that the concept of value is of somewhat nebulous nature, which has variously been described as complex, multifaceted, dynamic, and subjective [8], [19], [23]. On the other hand among all these disagreements there is a general agreement in literature that value is determined by customers' perception not by suppliers' assumptions or intentions [8].

The analysis of the available literature identifies that value is determined by the stakeholders according to their domains or areas of expertise. These areas of expertise or the domains are

referred as value dimensions. So, it is now clear that value is determined by the stakeholders keeping the value dimensions into consideration. This also identifies the need of literature review on these two areas: stakeholders and value dimensions, which are presented in next sections.

1.2. Research Aim

This research aims to focus on value elicitation in Value Based Software Engineering. This will depict the importance of value elicitation, its process, identification of success critical stakeholders and value dimensions. Finally, a framework for value elicitation will be presented that will help to apply appropriate value elicitation techniques for the given situation in the software development project. The research shall result into simplified value elicitation process by relating the value elicitation techniques to the project situation/decisions through means of value dimensions.

1.3. Significance

Value Based Software Engineering aims to assign values to the things and concept. Assigned values are then used for decision making at different stages and situations in software development projects. The values are determined by the success critical stakeholders [2]. [4] by taking value dimensions into consideration [5], [6] using value elicitation techniques. Different value elicitation techniques are available in software engineering and management literature but, it is very difficult to select appropriated technique(s) for the given situation. Most of these techniques are from management sciences and their focus is mainly on economic/financial profit or the expert judgments about the things. This subjective judgment or the focus on only one aspect of the value may lead towards the wrong value elicitation hence to the less than appropriate decision making in software development projects. However, the value based software engineering intends to put some additional focus on other dimensions of value that are normally neglected in the whole process. But, there is a compelling need of a framework that categorizes the available value elicitation technique depending upon their focused value dimension in order to simplify the selection of appropriate value elicitation technique taking the value dimensions into consideration.

This research shall focus on the entire process of value elicitation in order to introduce a framework for value elicitation. The thesis will present the introduction to value elicitation process, review and analysis of success critical stakeholder identification techniques, review,

analysis and grouping of value dimensions, review and analysis of value elicitation techniques and at the end a framework for value elicitation shall be introduced in order to simplify the value elicitation process. The research shall provide great deal of benefits to the project managers, practitioners of software engineering, risk managers, requirements manager, software developers, business owners and executive management.

1.4. Related Work

In software engineering value-based concept was introduced by Berry Boehm in 1989 through stakeholder's win-win theory W. The theme of the Theory W is that everyone should be winner by getting its value from the software [2], [3], [4]. There is significant shortage of literature in Value Based Software Engineering as it is evolving since recent past. Few authors have contributed in elaboration and extension of this field of study but there are still too many grey areas those need to be studied and presented. This research is focusing on one of these grey areas of "Value Elicitation".

As the whole process of value based software engineering depends upon the value propositions, B. Boehm presents value elicitation as one of the seven key elements of value based software engineering. Boehm further elaborates the process of value elicitation [2] and presents the following five approaches to improve the effectiveness of value elicitation process. **Expectation Management** – deals with the conflicting value propositions of different stakeholders and tries to reduce their less critical desires. **Visualization Analysis and Trade-off Analysis Techniques** – like prototypes, scenarios, and estimation models enable stakeholders to obtain a better mutual understanding that which aspects of an application are most important and achievable. **Prioritization** – of system capabilities is an effective approach to determine which combination of capabilities will best satisfy stakeholders' most critical needs within available resource constraints. **Groupware** – Some of the prioritization aids are available in groupware tools, along with collaboration-oriented support for brainstorming, discussion, and win-win negotiation of conflict situations. **Business Case Analysis** – determines which capabilities provide the best return on investment and can help stakeholders prioritize and reconcile their value propositions.

Furthermore, Stefan Biffl emphasized on the element of negotiations in the value elicitation process. He has identified negotiation challenges and suggested to use the easy win-win [7] negotiation model of B. Boehm to mitigate risks and overcome the limitations and challenges

of negotiations with stakeholders. As the Easy win-win Model primarily designed for requirements negotiation rather that value elicitation, he recommends some possible extensions for the subject approach to use it effectively for value elicitation.

Negotiation is important value elicitation technique but it is not the only technique available for value elicitation. A comprehensive survey of value elicitation techniques is done by [8] with in-depth focus on customer's value. This survey presents different techniques (Value Component Model, Benefits/Cost Ration Model, Means-end Model, Value Exchange Model, Value Buildup Model and Value Dynamic Model) to determine customer's value. These techniques are very much in practice in management field but the question is, that "can we use the concept of customer value and its techniques in software engineering?" The answer to this question is based upon three primary reasons:

- The basic and foremost reason is VBSE itself originated from management literature and depends upon the concept of value
- The VBSE is based on the Theory W of software project management, presented by B. Boehm. This theory uses base theories of "Utility Theory", "Decision Theory", "Dependency Theory", and "Control Theory" which are again extracted from management literature
- It is referred in the literature to use Easy win-win negotiation model for value elicitation purposes that is also pointing to the management literature on the same subject

Till now we did talk about the importance of value elicitation process, value elicitation approaches, and value elicitation techniques but there is a missing element "value dimensions" about which most of the VBSE authors are silent. Recently, a very good literature survey [5], [6] on the subject is done and some value dimensions and perspectives are highlighted. Financial value, economic value, business value, organizational value, strategic value, technical value, end system value, personal value and environmental value are presented as value dimensions. Each of these value dimensions can be seen from three different perspectives technical, organizational and people where each of these three perspectives can be seen as a set of values represented in a specific domain.

Keeping in view the detail given above, this research aims to propose a framework for use of value elicitation techniques. The proposed framework shall ease the application of value elicitation technique depending upon the required value dimension.

1.5. Research Objectives

The main objective of this research is the simplification of value elicitation process however; it will answer the following questions:

- How can we identify success critical stakeholders?
- What are the dimensions of value?
- What are the available value elicitation techniques?
- How to select appropriate value elicitation technique(s) for the given situation(s)?

1.6. Expected Outcome

The outcome of this research will be a value elicitation framework that will help to apply appropriate value elicitation technique depending upon the given situation.

1.7. Research Methodology

- The research method shall comprise of following components in the given order:
- The detailed literature review and critical analysis shall be conducted to identify and group the value dimensions.
- The detailed literature review shall be conducted to identify the available value elicitation techniques. This activity shall result into the list of available value elicitation techniques with their focused value dimensions.
- After analysis of value elicitation techniques and value dimensions, the value elicitation framework shall be proposed to enable practitioners to apply the right value elicitation technique for the given situation to determine the required value for decision making.

- Proposed value elicitation framework shall be applied on a pilot project in order to validate its applicability and effectiveness.
- Recommendations for the future work shall be given at the end.

1.8. Thesis Structure

Following table presents the overall structure of the thesis:

S N	Structure Elements	Description
1	Introduction	Overall introduction, background and related work of thesis
2	Literature Survey	Detailed review of available literature on the subject
2.1	Value Based Software Engineering	Brief Introduction to the basic concepts of VBSE
2.2	Identification of Success Critical Stakeholders	Survey, analysis & recommendations to stakeholder identification
2.2.1	Literature Survey of stakeholder identification techniques	Review of Stakeholder Identification techniques
2.2.2	Literature Survey of base Attributes for stakeholder identification	Identification & Review of base attributes required for stakeholder identification
2.2.3	Analysis of techniques and attributes	Analysis & Comparison of stakeholder identification techniques and stakeholders' base attributes
2.2.4	Techniques vs Attributes relationship Matrix	Developed a relationship matrix of techniques & attributes
2.3	Study of Value Dimensions	Review and analysis of available value dimensions
2.3.1	Literature Survey of value dimension	identification & review of value dimensions
2.3.2	Analysis & grouping of value dimensions	Grouping of value dimensions on the basis of their similarity and focus areas
2.4	Literature survey of Value Elicitation Techniques	Review and Analysis of available Value Elicitation Techniques
3	Value Elicitation Framework	Proposed a new Value Elicitation Framework (VEF) to help in selection of appropriation value elicitation techniques.
4	Case Study on Value Elicitation Framework	Validation of VEF
4.1	Case Study Design	Case Study Design
4.2	Implementation of VEF	Activity vise implementation of VEF
4.3	Results	Results of the Case Study
5	Conclusion & Future work	

Table 0-1: Thesis Structure

Chapter 2 – Introduction and Identification of Success Critical Stakeholders

As the value based software engineering is based on the Theory W of Software Project Management "Make everyone a winner", the project success depends upon the satisfaction of stakeholders, which means that the project cannot be successful until all stakeholders get their perceived value from the software project [2], [3], [4]. Similarly literature has an agreement that "value is determined by customer's perception not by supplier's assumptions or intentions" [8]. So, the management literature emphasizes more on customer's satisfaction and declares the customer as critical stakeholder. Another noticeable point is that the general value concept is based mainly on two things: stakeholder satisfaction and stakeholders' win-win conditions that clearly highlights the significance of this entity as prominent value holder [1], [7], [12] & [8].

If we look at the generic definition "the stakeholder is every one who can affect or get affected by the software or system directly or indirectly", the list of stakeholder seems to bee too large. It looks un-realistic or very difficult to manage such a large number of stakeholders. On the other hand Theory W, which is the base of value based software engineering, requires making every stakeholder a winner. To overcome this problem, value based software engineering introduces the concept of success critical stakeholders. In management literature success critical stakeholders are referred to as primary stakeholders. It is impossible to successfully complete a project, if Success Critical Stakeholders do not get their perceived value from the software projects. Similarly, according to [29] Stakeholders' judgments contribute a lot in the success and failure of the projects. So, software development and project management teams should focus only on success critical stakeholder rather than everyone.

After understanding the concept of success critical stakeholders, the first question that arises is that how can we identify success critical stakeholders? In reply to this question, we have conducted a full length literature review and analysis presented in the next section on the subject and made some recommendations.

2.1. Identification of Success Critical Stakeholders

Identification and management of Success Critical stakeholders is of great importance for success of the project. The project management team should effectively manage the expectations of SCS from beginning to end of the software development project. The expectations are originally the software requirements or the intended services expected from the software system. The identification of SCS is very essential in the context of software development projects as the software requirements originates from the stakeholders [49]. The chances of missing out software requirements exist due to non identification of SCS that leads to the failure of software projects. The management of software requirements becomes trivial as it may change during execution of the project. However, one good reason could be a change of stakeholders involved in the project. This phenomenon triggers the need of SCS' identification quite often [28], [65].

The wide variety of techniques is available to identify the success critical stakeholders [34], [35], [37], [38], [39], [41], [43], [45], [47]. Most of these techniques are rooted in the management literature and can be adopted in the context of software engineering. However, the usage of appropriate technique always been a challenge due to the dynamism that exist in the situations. The desired results can only be achieved if the suitable technique is applied to identify the success critical stakeholders. It is suggested to have some recommended techniques covering the necessary behavioral attributes of stakeholders, however; a detailed analysis of techniques is required to come up with these recommendations. As the stakeholders are identified and classified on the basis of the said attributes, the analysis of techniques should also be done by having an in-depth review of the base attributes.
Value based software engineering also emphasizes the need for identification of success critical stakeholders as software requirements and their value comes from them which are the foundation to the software development [2], [4], [6]. However, the Software Management Processes do not suggest any specific technique to be used on the given situation. Further, the Project Management Standard like PMI does focus on the need to identify the stakeholders but application of appropriate technique is left with the judgment of project management team.

In this section we present attributes, SCS identification techniques and their relationship for evaluation and recommendation of success critical stakeholder identification techniques.

After critical review, the attributes are grouped together based upon the characteristics and relationship among them. The recommended techniques are highlighted as a result of the evaluation of techniques on the basis of attributes. This all is done to provide basis to choose from the recommended techniques.

2.1.1. Basic Attributes Used for Stakeholder Identification

The study of base attributes is of utmost importance in understanding their basic purpose and utilization in overall software engineering and management environment. Stakeholder identification techniques use one or more attributes for the identification and analysis of stakeholders. The base attributes are given as under:

Power – Power is described as the ability of one stakeholder to make another stakeholder do something that he would not otherwise have done. Its importance in stakeholder identification can be observed by the statement "stakeholders can only be people or groups who have the power to directly affect the organization's future; absent that power, they are not stakeholders [34], [37].

Legitimacy – Legitimacy is the degree to which the firm and the stakeholder find each other's actions, desirable, proper, or appropriate [34]. A distinction should be made between "formal legitimacy" and "perceived legitimacy". Almost every stakeholder is formally legitimate. However, significance of the stakeholders largely depends on his perceived legitimacy [43].

Urgency – Urgency is "the degree to which stakeholder claims call for immediate attention" [34]. In IT projects urgency normally exists when two conditions are met [34]: (1) requirements are time sensitive and/or (2) requirements are very critical.

Influence – Influence can be defined as effect, impact or action of a stakeholder which affects another stakeholder. A stakeholder can influence the other one using different tools like, formal or informal power, knowledge, social relationships etc. However; power is the most commonly used tools for the subject purpose [44], [45].

Interest – Interest is something that concerns, involves or draws the attention of, or arouses the curiosity of a person. Interest is one of most commonly used parameter for stakeholder identification. Another definition of the interest is the feeling of a stakeholder whose attention or concern is particularly engaged by something [44], [45], [52].

Interaction/Involvement – Interaction/Involvement is normally referred to as participation of stakeholders during the project lifecycle. It is becoming more important to manage the stakeholder's participation in information technology projects [34], [37], [45].

Requirements – Requirements are something wanted or needed; something essential to the existence or occurrence of something else [35]. In systems engineering, a requirement can be a description of what a system must do (Functional Requirement) and specification of something about the system itself, and how well it performs its functions (Non-functional requirements). In software engineering, the same meanings of requirements apply, except that the focus of interest is the software itself [53].

Roles & Responsibility – Role is the function or position assigned to a particular stakeholder during the software project lifecycle. In this perspective stakeholders' responsibilities act as base for identification and classification of stakeholder [47]. The phenomenon highlights the need for careful analysis while assigning project responsibilities to the individuals and/or teams.

2.1.2. Analysis of Stakeholder Base Attributes

It is quite clear from literature that power is one of the most important attribute used for stakeholder identification [34], [37], [44] & [45]. However, it is an abstract terminology used to refer its various types and sub attributes. Power may be formal (authority, democracy, ownership etc.) or in-formal (force, expertise, social influence etc.) and can be used positively or negatively. Similarly, influence is also a set of attributes. It is the process of impacting the organization, stakeholders or projects through any mean like power, skills, force, charisma, support, opposition and others. All these attributes are either types of the influence or means/tools used to influence. So, we can combine all these small attributes into influence to avoid duplications.

Power and Influence are used synonymously in the literature [48]. The classical techniques like Theory of Salience and Power-Interest grid also use either of the attributes "Power or Influence". The both are not used in opposite or different meanings in any of the reviewed techniques. Also, the literature does not cite any evidence where the relationship or independent position of Power and Influence is clearly identified with respect to their usage. However; the analysis shows that Power is a tool to influence the project positively or negatively. In other words, influence is a resultant achieved by exerting the power in any

form by the stakeholders but the core purpose is to influence the project for desired outcomes using the chartered tool of Power. The same purpose can be achieved through the use of other tools like knowledge, skills or others. However; the selection of tool is the sole choice of stakeholders. It cannot be generalized with the context of prevailing situation. After analysis we strongly recommend to merge the attributes of Power into Influence.

On the other side Interest, Requirements and Involvement are of the same nature. In stakeholder literature Interest is referred to as the expectations (financial, social, technical etc.) of the stakeholders. Requirements are also the same but it is more specifically used in the software engineering literature. Involvement refers to the participation of stakeholders in the project depending upon their Interest. Analysis of Interest, Requirement and Involvement shows that stakeholder's Interest is the base for all three attributes and other attributes of Requirements and Involvements are its different representations [37], [44], [52] & [53]. So, we can club these attributes into one broader term of "Interest".

Remaining three attributes Legitimacy, Urgency and Roles and Responsibilities have distinct meanings in themselves and provide the basis for multiple stakeholder identification techniques. These attributes must be considered independently.

We found strong arguments about the importance of the Influence, Legitimacy, Urgency, and Interest in the available literature [34], [37], [47]. These are the classic attributes used in almost every technique with some edition. But, we could not find necessary evidences for Roles and Responsibilities as important attribute. According to [47], "role perspective on stakeholders does not resolve the identification on its own. It facilitates the identification because the search for stakeholders can be accomplished in a more directed way". So, stakeholders identified on the basis of their role in the project may include such stakeholders which have low values for the other important attributes. This all reduces the degree of importance required to be given to Roles and Responsibilities in the analysis of stakeholder identification techniques.

The analysis resulted into the final set of distinct attributes of "Influence, Legitimacy, Urgency, Interest and Role & Responsibilities". These five are the core attributes used by stakeholder identification techniques. Hence, these attributes must be used for analysis of stakeholder identification techniques.

2.1.3. Stakeholder Identification Techniques

The general term of "stakeholders" is very wide covering a large domain of the individuals and the entities who are affecting or get affected by the project. However, there are the stakeholders which are very vital for the success of the project and can be named as "Success Critical Stakeholders (SCS)". The literature reveals that there are number of techniques available to identify the stakeholders of the project. All of these techniques are based upon the categorization of stakeholders on particular attributes or given criterion. These attributes are presented in various techniques with different titles containing the same underlying concept [34], [35], [37], [38], [39], [41], [43], [45], [47].

Theory of Stakeholders Identification and Salience – This theory of stakeholders' identification and salience is based on possessing one or more of three relationship attributes of Power, Legitimacy and Urgency. The stakeholders can possess single attribute, two attributes or combination of any of them. A clear dynamism exists in this model. The stakeholders possessing two attributes can acquire the third attribute to become "Definitive Stakeholder". The levels of attributes can vary from issue to issue and from time to time. This technique introduced vital dimensions of Legitimacy and Urgency to the techniques those emphasize power and interests. This also helps in creating more discipline in relationship between stakeholders and managers hence strengthening the management in the organization. Further, this could be very useful in understanding the circumstances where a type of stakeholders try or may acquire the other attributes. The managers can also predict the behavior of stakeholders if they have the knowledge of such circumstances [34], [37], and [45].

Baseline-Outward Approach – This technique focuses on the identification of stakeholders during the process of requirements engineering. It is a domain independent, effective and pragmatic. It sets the focus on a set of stakeholders as baseline stakeholders. The baseline stakeholders are further recognized as "supplier stakeholders" and "client stakeholders". The supplier stakeholders provide information and support tasks to the baseline stakeholders. But the client stakeholders inspect and receive the products. The rest of the stakeholders are defined as satellite stakeholders who interact with baseline stakeholders. The potential flaw in this technique could be the too much time spending in identifying the roles and relationship and when to stop the process of identifying the stakeholders [28].

The Basic Stakeholder Analysis Technique – This technique is useful in case of involvement of large set of the stakeholders and groups. It is effective identifying the stakeholders. This technique involves sequential undertaking of several steps by a large analysis group. Also, its successful execution entirely depends upon the persons executing the whole exercise. The wisdom of group participation is missing in this technique [37], [45].

Power versus Interest Grid – This technique arrays the stakeholders on a two-by-two matrix. On x-axis there is *Interest* that represents degree to which the stakeholder is concerned to the organization or issue at hand and y-axis shows the degree of stakeholder's *Power* to affect the organization's or issue's future. The analysis resulted in four categories of stakeholders comprise of "Players", "Subjects", Context Setters" and "Crowd". The Power – Interest grid provides help in determining which players' interests and power bases must be taken into account in order to address the problem or issue at hand. The analysis is required to come up with the right application [37], [44] and [45].

Stakeholder's Influence Diagram - This technique indicates that how the stakeholders influence each other using power-interest grid. This involves several steps starting from drawing power-interest grid. Points or areas are identified where the two-way influences are possible. Then, after discussion on importance and primary direction of influence relationship, the influential or central stakeholders can be ranked based upon the results and implications of the resulting diagram [44], [45].

Participation Planning Matrix – The purpose to design this technique is to plan the stakeholders' participation during the project lifecycle. Degree of participation varies among stakeholders; multiple levels exist to represent the degree of participation. At lowest level of participation there are informing stakeholders and the top level of participation is for those who have authority to make decisions. At each level stakeholder or group of stakeholder may vary and there is also a unique goal for each level for which different types of commitments are required to achieve that goal. The subject technique should be used as early as possible in the project lifecycle. The matrix is revised several times with the elaboration of the change efforts [37], [45] and [54].

Bases of Power–Directions of Interest Diagrams – The bases for this technique are power-interest grid and stakeholder influence diagram. This is an adaptation of Eder and Ackermann's "Star Diagram" (1998) and Bryson (2002). This technique highlights different sources of power that are available to stakeholders and indicates the objectives and interest

that stakeholders want to achieve. It helps the project management team to find the commonalities among stakeholders especially in the form of their interest. Further, the detailed information about stakeholders is also given to help achieving their objectives [37], [44] and [45].

Finding the Common Good and Structure of a Winning Argument – This technique is built upon the technique of bases of power and direction of interest. The common usage of this technique is in the context of socio-economics. The end resultant is a map which is created based upon the identified themes that indicate the strongest relationship among the supra-interests. So, the final map represents the supra-interest which binds the interest of individual stakeholders as well as the relationship among the supra-interests [37], [45].

Tapping Individual Stakeholder Interests to Pursue the Common Good – This technique helps in identification and classification of stakeholders by identifying the way to inspire and mobilize the stakeholders to achieve the common objectives. This may work for an individual or for a group of stakeholders. Multiple diagrams are created during the implementation of this technique on the basis of stakeholders' interest and behavior to help identifying the set of stakeholders [37], [55]. The power-interest diagram is base of this technique.

Stakeholder-Issue Interrelationship Diagrams – This diagram represents the interest of individual stakeholders with different issues. It also focuses on the relationship among the stakeholders with respect to the issues. These relationships highlight the actual and potential areas of cooperation and conflicts and the interest of stakeholders on the issues. The interests may vary from stakeholder to stakeholder. The construction of diagram starts by having power-interest grid and stakeholder's influence diagram and taking into consideration the basic technique of stakeholder's analysis [56].

Problem-Frame Stakeholder Maps – Anderson et al. adapted this technique from the technique of Nutt and Backoff (1992). This technique is extremely useful in the development of problem definitions likely to lead to winning coalition. The first step in this analysis is to link stakeholders to alternative problem definitions by using the problem-definition stakeholder map. Then the stakeholders are drawn upon a grid of "support" and "opposition" against the "power" based upon the implications by the range of problem definitions. The facilitation process is the key to the successful conclusion of this technique [55], [45].

Stakeholder Analysis Diagram – This is based upon the Power-Interest technique for stakeholders' identification. The principle of stakeholders' analysis is that different stakeholder groups are managed according to their level of influence on the project outcomes. The horizontal axis represents the Buy-in or interest of the stakeholders while the vertical axis represents Power or Influence of the stakeholders exerted on the project or issue. The both axis are having the scale from low to high. The four quadrants of the grid segregate the stakeholders in categories of "Key Player", "Monitor", "Manage", and "Support". The "Monitor" group must be monitored all the times in case they get the high interest or high influence hence impacting the overall objectives of the project [47].

Three-Way Stakeholder Structure – This technique gives a way to structure the teams. This gives an exposure to the interplay of three roles of stakeholders including "Developers", "Managers" and "Customers". The Managers manage the project and interface with Customers for effective management of their expectations. Developers deliver the product to Customers taking into consideration their expectations. The division of stakeholders is done on their roles which are changeable. The core concept behind structuring the team is to understand the complexities involved in dealing with other two groups while performing their role in the capacity of third group [38].

Project Sociology – This technique provides the clear distinction in group of stakeholders with their roles on the project. It draws the stakeholders into two circles. The inner circle contains the stakeholders (Producers) who are responsible for development and delivery of required software/product with appropriate quality and customer satisfaction [41]. In the outer circle there are stakeholders who are not responsible for delivery of product but they have knowledge and skills which are required successful development of software/product. However, success of project is not the primary concern of those stakeholders who belong to outer circle [41]. The project manager and project management team brainstorms to identify all the possible roles related to project and the actors/ stakeholders to perform those roles. The stakeholders may change with the passage of time but roles prevail till the logical conclusion of the project. The Project Sociology Analysis also helps to negotiate with the stakeholders the needs of expertise required in order to achieve the project success [41].

Stakeholders Identification (Tool#8) - The International Association for Public Participation has released the guidelines for identifying the potential stakeholders. These guidelines should be used for wide variety and large set of the stakeholders on the projects where public

participation is required. The focus group comprising of individuals and community leaders are formed to carry out the identification of potential stakeholders. These guidelines are very open and large in number as they are intended for the issues related to public participation. The consultation process should be effective in order to ensure the proper stakeholder identification. Further, the events should be monitored carefully as they may change the stakeholders [51].

Stakeholder Identifications in Standardized Processes – This technique is presented to identify the potential participants in the standardization committee, working groups or other organization forms where standards are developed. This technique is based on stakeholder theory and addresses the existing unbalances in standardization process. It consists of two parts. The first is a set of search heuristics to identify all relevant stakeholders. And the second is a typology used to differentiate b/w essential and less important stakeholders. This typology is not only based on characteristics of stakeholders but on determinants of stakeholder salience i.e. "the degree to which managers give priority to stakeholder claims" [43].

Method for Stakeholder Identification in Inter-Organizational Environments – This technique helps to carry out the identification of stakeholders considering the diverse dimensions (organizational, inter-organizational and external) involved in inter-organizational environments. A systematic approach is used to group different stakeholder who can directly on indirectly affect or get affected by the inter-organizational system [39]. Three main dimension of organization's environment are highlighted above that are used by this technique primarily, however; it is a flexible method as new criteria and roles for selection can be added for enhancement of information and knowledge about the involved dimensions [39].

Stakeholder Identification by Classification – Drawn from the Systems Theory, four basic generic types of stakeholders are sufficient to be able to derive a specialized set of stakeholders for any considered system and domain of inquiry. This model classifies the stakeholders based on the Systems Science Principles. The four basic types of stakeholders can be applied to any system. The classification made into Goal and Means stakeholders for Suprasystem and System under Considerations [27].

Stakeholder Identification Model – The method comprises of two components. One is the model for classification of stakeholders while the second highlights the additional procedure

for identification of stakeholders by taking the dynamism of innovation circumstances into account. This model has two underlying pillars. The first is the stakeholders' role pillar, and the second innovation pillar. These two pillars make the model embedded within the identification method and fit for the context of innovation projects. The procedure uses the roles and phases to come up with possible parties involved. The procedure is entirely dependent upon the execution of brainstorming sessions by individuals and focused groups [47].

Stakeholder Identification using Use Case Diagram – This technique represents a unique method of identification of stakeholders by using the use case diagrams. The identification of stakeholders has a very strong relation with use case diagrams as they have the concept of actors which is a first approximation of stakeholders. The method takes into consideration the use case diagrams and finds its relationship with the actors and eventually to the stakeholders. This can only be practiced in the organization having maturity level in terms of maintaining the technical documentation of projects. The involved manual steps demand the development of software tools to for analysis of use case diagrams and their comparisons. Apparently, this method cannot handle stakeholders that are related to the development process like software designers and programmers [35].

2.1.4. Analysis of Techniques & Recommendations

The literature review and techniques v/s attributes relationship matrix show that there are eighteen stakeholder identification techniques which cover selected five basic stakeholder attributes of "Influence, Legitimacy, Urgency, Interest and Role & Responsibilities" and are termed as core attributes. The analysis highlights that two techniques of Theory of Salience and Power-Interest Grid are the basic and core techniques to be used for identification of stakeholders. Depending upon the situations, the techniques derived from these two techniques can also be used to get the betters results.

Theory of Stakeholder Identification and Salience, Baseline-outward approach for Stakeholder Identification, the basic stakeholder analysis technique, Power-Interest grid and Stakeholders' influence diagrams are the basic techniques used for stakeholder identification using the core attributes. This is quite clear from the case studies that these five techniques provide better results and can be applied to almost every situation. So, these are more trustworthy and advisable to use for stakeholder identification and classification. The other techniques are extensions to these basic techniques and are situation dependent. However; the

techniques covering the core attributes can provide good results if the selection of the techniques is done by analyzing the situation carefully. Another point that motivates us to put these extended techniques on second priority is that, we could not find any case study done using these techniques on real scenarios. So, we recommend using basic five techniques for stakeholder identification to get better results.

There is no single technique covering all the core attributes that can serve as standard technique. Same is stated in [34] that "It is clear that no individual organizational theory offers systematic answers to questions about stakeholder identification and salience, although most such theories have much to tell us about the role of Power or Legitimacy (but not both". In the literature it is claimed that the stakeholder identification problem is solved, by applying the salience model but, the prevailing classification models are insufficient for identifying stakeholders.

Based upon the in-depth review, we find that the Theory of Salience is the more suitable technique to be used for identification of stakeholders. This technique should be used repetitively to address the dynamism exists in the involvement of stakeholders to the project. However, another very important attribute of interest should be introduced into this theory to make it a kind of standard technique for identification of stakeholders. But this requires further research and investigation to the matter hence addressing insufficiencies.

S No	Stakeholder Identification Techniques	Attributes				
		Influence	Legitimacy	Urgency	Interest	Role
1	Theory of Stakeholder Identification and Salience	√	√	√		
2	Baseline-outward approach for Stakeholder Identification	√			√	
3	The basic stakeholder analysis technique				√	
4	Power versus interest grid	√			√	
5	Stakeholder influence diagrams	√			√	
6	Participation planning matrix	√			√	
7	Bases of power and directions of interest diagrams	√			√	
8	Finding the common good and the structure e of a winning argument	√			√	
9	Tapping individual stakeholder interests to pursue the common good				√	

S No	Stakeholder Identification Techniques	Attributes				
		Influence	Legitimacy	Urgency	Interest	Role
10	Stakeholder issues interrelationship diagram	√			√	
11	Problem frame stakeholder maps	√			√	
12	Stakeholder analysis diagram	√				√
13	Stakeholder Identification (Tool No. 8)				√	
14	Stakeholder identification in Standardized Process	√		√		
15	Inter-organizational environment	√			√	
16	Stakeholder Identification Model				√	
17	Stakeholder Identification by Classification.				√	
18	Stakeholder Identification using Use case diagrams.				√	√
19	Three-way Stakeholder Structure					√
20	Project Sociology					√

Table 0-1: Stakeholder Attributes v/s Techniques Relationship Matrix

Chapter 3 – Study of Value Dimensions

As we have discussed in the previous chapters that value dimensions are different components of overall customer value, further elaboration and exploration of the subject is required to put more visibility and clarity. There is significant shortage of literature on the value dimensions, however; a very good literature survey on the subject is done and some value dimensions and perspectives are highlighted. Financial value, economic value, business value, organizational value, strategic value, technical value, end system value, personal value and environmental value are presented as value dimensions. Each of these value dimensions can be seen from three different perspectives technical, organizational and people where each of these three perspectives can be seen as a set of values represented in a specific domain [5]. Extending the existing literature review, we have identified some more value dimensions available in the literature and grouped these value dimensions based upon their nature and focus area as many of the value dimensions are similar in nature and also the large set of value dimensions is relatively difficult to manage.

Stakeholders value the things and concepts in different dimensions, according to their area of business and requirement. For example: stock marketers are concerned with "financial value, economists want to consider "economic value (financial + non-financial), strategic and business literatures put more focus on "organizational, strategic and business values, developers and implementer are concerned with "technical value" and there may be an impact of the system on society which is considered as "social and personal value" [8], [26], [14], [58] and [59]. The perceived value can vary with respect to time which means that a stakeholder can have different value propositions about a software product or requirement at different times [2], [5], and then these value dimensions can be seen into three perspectives "Technical, Organizational & Personal", where each of these three perspectives can be seen as a set of values represented in a specific domain [5], [24].

As we have seen in the previous section that concept of value in software engineering is more complex than it is in mathematics, an indication of the complexity that is inherent in this area of research can be found in the work of Woodall (2003), who proposed *five* distinct notions of value ('net value', 'marketing value', 'derived value', 'sale value', and 'rational value') and *four* temporal categorizations of these notions of value ('ex-ante', 'transaction', 'ex-post', and 'disposal') [17]. Now the question is that, what are the value dimensions that we

need to take into consideration while working on projects using value based software engineering approach?

Based on existing literature survey done by [5] and our extended literature review, the identified value dimensions are: Technical value [8][12][5][21][36][59][60], Economic value [12][25][8][5], Personal Value [5][8][12][36][59][60], Financial value [5][8][12][60][36], Strategic value[5][12], Business value [5][14], Esteem value[59], Exchange value [8][12], Utility value [21][36][8], Psychic value[60], Organizational value[5][8][60], End system [36], value, Environmental value [12][5], Emotional Value [36], Practical Value [36], Logical Value [21], Hedonic Value [60], Functional Value [21][36], Social Value [5][8][12][36], Epistemic Value [36], Conditional Value [60][36].

3.1. Analysis and Grouping of Value Dimensions

The above literature review revealed the number of value dimensions presented by the various authors. These value dimensions can be grouped together on the bases of their commonalities and focus areas. The grouping of identified value dimensions with brief description is given as under:

Business Value - In management literature, business value is an informal term that expands concept of value beyond just economic value to include other forms of value such as employee value, customer value, supplier value, managerial value, and societal value [5], [6]. Most of the value dimensions are not quantifiable and cannot be measured like financial value. Business value does not hold only tangible benefits but also intangibles [9]. The Balanced scorecard methodology is one of the most popular methods for measuring and managing business value. Business Value is traditionally measured in terms of Customer Satisfaction, Revenue Growth, Profitability, Market Share and others [53].

In Software Engineering and Information Technology, the Business Value is aligned with some important factors, business processes, organization structures, and strategies. At the highest levels, this alignment is achieved through proper integration of enterprise architecture, business architecture, process design, organization design, and performance metrics. Performance/Quality factors "Usability, Functionality, Availability, Reliability, recoverability, Performance, Security, Agility" constrain and partially determine the business value of software or system. As these quality factors participate in determination of business

value and quality is part of overall Business Value, we can merge the value dimension "Quality" with business value [14], [15], [5], [6] and [53].

An interesting discovery here is that, more or less similar concepts are used for "Organizational Value" and "Strategic Value" [5]. Organizational value is defined as "benefits which enhance strategic position of organization" [14]. As the organization comprises of people and technology and has some functionality to perform [25], [58] Organizational value is generally assumed to comprise of many other value dimensions like financial, social, economic, technical and stakeholder etc [25], [58], [14], [8] and [59]. Secondly, Strategic value at some places is also used alternately for business value [17], [8], [58] and [25]. To achieve strategic values, the business strategies and focus of thinking should be broadened to incorporate customer values than just beating competitors as the sustainability of organization depends on customer satisfaction and loyalty (Khalifa, 2004) and [25]. This is also roughly similar to the concepts of business and organizational values. So, the both organizational and strategic values will be covered under broad term Business Value.

Economic Value - Economic Value is the value of an asset deriving from its ability to generate income. It is financial in nature but it also takes social, personal, technical and other value dimensions into consideration [15], [25], [53]. As the term Economic Value has its basics in social and political sciences, its introduction in IT and Management literature is an attempt to let the managers think beyond just the pure financial terms.

Financial Value is another important value dimension that comes under the umbrella of Economic Value. Being part of the overall Economic Value, financial value deals with purely monetary issues. It is referred to the price, cost or the exchange value of the product [60], [17] and [36]. In literature this is also defined as the monetary profits one can gain in exchange for the cost paid [8], [14]. Important point to be noticed here is that only monetary profits and costs are included here in Financial Value. In literature the terms Economic Values and Financial Value are used alternately. However; at some places the distinction is made with the assumption that financial values focus only on the monetary elements whereas economic values include non-financial elements too i.e. Economic values are defined as "financial + nonfinancial values". But it must be remembered anyways that generally these have a monetary relevance associated with them [25], [26], [5], [8], [7].

Technical Value - Technical value deal typically with the technology domain and its integration with other technologies, these are also defined as "value creating properties of an information system" [58]. As this is related to technology (itself) and technology integration (impact of the technology on an organization) [58] , [59] and [26], technical values help to improve functionality, usability, efficiency, maintainability and other quality constraints of software or system [5]. The literature highlights that the Technical Value is one of the most important value dimension to be considered while determining the overall value of the software or system because the technology brings the dynamism in the system due to its rapid change.

There are some other value dimensions that also come under the era of technical value. These include "Functional Value – pertains to whether software is able to perform its functional, utilitarian or physical purposes [21], [36] "End System Value – the values the stakeholders will expect to achieve from the development and integration of end-product" and "Practical Value – shows that how much effective and efficient the system is to solve the problems for which the system is designed". These all are directly related to the technology domain so, we shall cover all these into single broad category "Technical value".

Epistemic Value – The term Epistemic Value is used within feminist and social literature, which deals with the acquisition of knowledge from the lives and/or experiences of different individuals and/or societies. In Information technology and management literature this term is used to highlight the value that the project, software or system is or will be adding to the literature, advancement of technology, literacy and awareness of society. Very little literature on the subject is available which highlights that this aspect on value is neglected or not highlighted by the scholars. As this research is about classification of value elicitation techniques, we strongly recommend the active use of this value dimension.

Personal Value & Social Value – Literature also mentions some other value dimensions, which include values related to human and social issues. We have grouped these into two classes "Personal Values" and "Social Value". These groups contain a large number of values that range from peoples' social interests to their personal or moral values. This makes it difficult to define each and everyone of these but we have tried to identify almost all of the personal values indicated in literature [8], [25], [14], [15] & [26].

Personal and Social Values are considered subjective, vary across people and cultures and are in many ways aligned with belief and belief systems. These include: emotional value,

conditional value, Esteem Value, psychological value, utility value (need), psychic value, ethical value, spiritual value, Hedonic Value, aesthetic value, intrinsic-extrinsic value, active-reactive value and moral values, doctrinal/ideological (political, religious) values.

In literature, these all value dimensions are grouped into one class "Personal Value" (Javeria, 2008) but, we would like to highlight two aspects "Personal and Social" of these value dimensions. On the basis of this distinction we recommend to classify these value dimensions into two classes "Personal Value" and Social Value". The Personal Value include all the above mentioned value dimensions which are related to human's personal issues and behaviors and may very from person to person but, it deals only with the personal aspect of these value dimensions. On the other hand Social Value also include the same value dimensions but here the scope of these value dimensions is not limited to the individuals but to the society. It refers to an image that corresponds with the norms of a consumer's associates and/or with the social image the consumer.

As presented in the above literature analysis we have divided the value dimensions into six classes that include; Business Value, Economic Value, Technical Value, Epistemic Value, Personal Value and Social Value. This classification is done by analyzing the nature and focused area of these value dimensions. Now the question arises that what is the good use of these value dimensions? In the next section, we have discussed that how we can use these value dimensions for better decision making at different stages of projects. At last, the selected six value dimensions will be used in the next sections of the thesis to evaluate and categorize the value elicitation techniques.

Chapter 4 – Value Elicitation Techniques

In the above sections, we have analyzed all prerequisites of value elicitation process except the techniques for value elicitation. As this research focuses on the categorization of value elicitation techniques, it's necessary to conduct a literature survey on the subject.

4.1. Analysis of Value Elicitation Techniques

This section presents the comprehensive review and analysis of available value elicitation techniques to identify the techniques and their focused value dimensions. The identified value elicitation techniques are given as under:

4.1.1. Model of Customer Perception

This is a well known value component model in the customer behavior literature. This model presents the value in the form of satisfaction of stakeholders and classifies the value added features in to three main categories: dissatisfiers, satisfiers and delighters [30], [8].

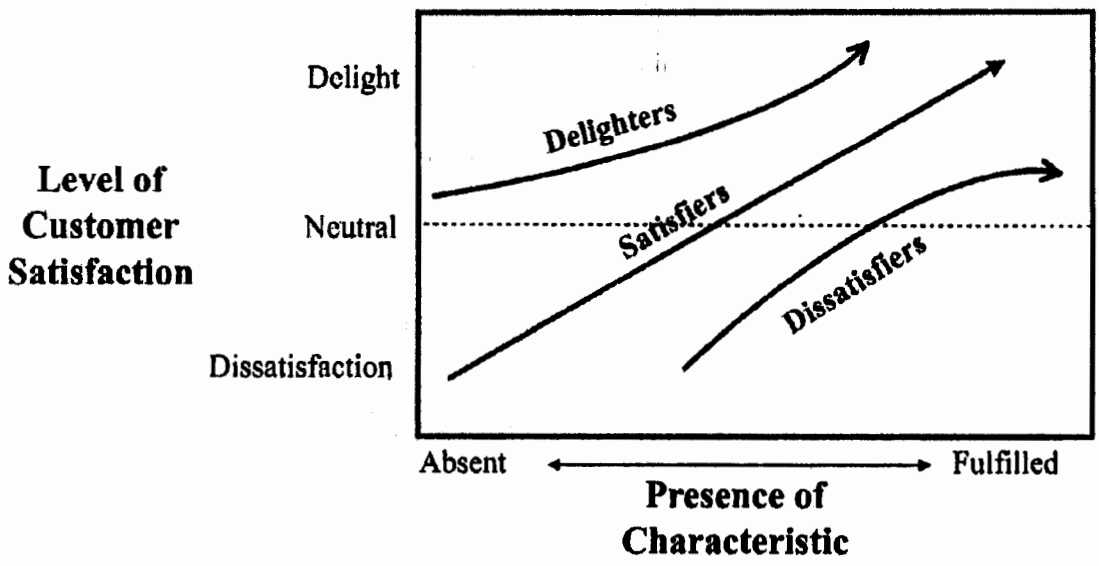

Figure 0-1: Kano's Model of Customer Perception [8]

Dissatisfiers – Characteristics or features that are expected in a product or service and generally taken for granted. Generally, these features are expected to be there. Their presence brings customers up the neutral but their absence annoys them.

Satisfiers – These features are expected and explicitly requested by customers. They typically meet performance related needs. Customers are disappointed if these needs are poorly met but have increasing satisfaction (and perhaps even delight) the better these needs are met. These features are often considered the minimum standards to stay in business.

Delighters – These are new or innovative features or characteristics that customers do not expect. These innovative features surprise them in a good way. They innovatively solve a latent need of the customer.

It is worth to think about the detailed requirements/necessary features during product development or while providing services. Also, it focuses on business value having direct impact on the relationship between customer and supplier. This relationship drives the business decisions and hence this value is categorized under the "Business" category of value dimensions [8].

4.1.2. The Exclusive Value Principle (EVP)

The EVP is based upon the concept that value of products or services is not based upon the only monitory value; other value dimensions should also be considered while determining the overall value of the product or service. EVP focuses on the benefits other than pure utilitarian value for fulfillment of psychic needs [Figure 4-2]. The psychic factors, contributing to Exclusive Value Premium (EVP), are *internal* and *external* in nature [31], [8].

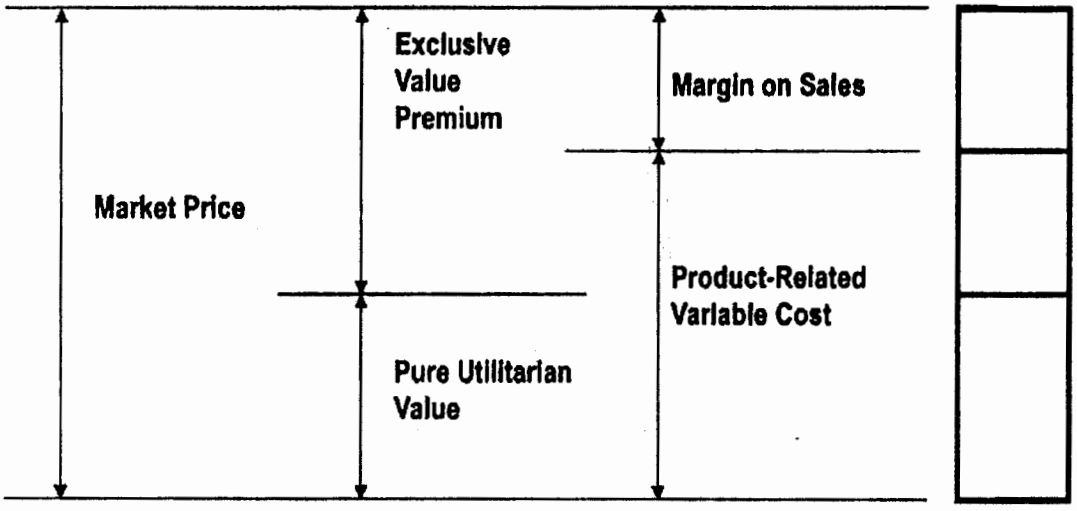

Figure 0-2 : Exclusive Value Principle [8]

Internal - Represent factors of importance independent of the opinions, influences, approval and suggestions of others.

External - Represent factors of importance because of the opinions, influences, approval, suggestions, interaction, and interpersonal relations of or with others. Here, the factor forces may be real or perceived.

This model defines the value in comparison to price as the difference of customer's perceived benefits and sacrifices incurred. The customer benefits may include tangible and intangible attributes of the product or service. So, the focus of this technique is on financial and personal value dimensions.

4.1.3. Cost Benefit Analysis Method

The CBAM enables project management team and other decision makers to identify the benefits that associated with a particular decision/system and costs to be paid to gain the required benefits [8]. Each and every decision of the project is and should be directly or indirectly linked with the project goal and each of the project goals must be aligned with company's business objectives [49]. The stakeholders can make important decisions like the investment of their finite resources in some quality attributes [8], [53].

The CBAM is not a decision making authority; but it's a tool that facilitates stakeholders to identify and document all the tangible and intangible benefits, cost to be paid against benefits and the uncertainty about the decision to provide a rational for decision-making. Typically; it's a two staged process. At first stage this analysis is done on high level where cost and benefits for the whole system are identified. This identification more likely depends upon the expert judgment of the engineers and managers. Detailed analysis is done at second stage where the whole concept of system is broken into small module and more manageable scenarios. More accurate value for the cost and benefits are elicited at this stage with detailed analysis smaller units.

The output CBAM is the values for costs and benefits, these values are further analyzed and decisions are made on the basis of elicited values. Along with the technical value this also includes the business and strategic measures to determine whether a particular change to the system provides a sufficiently high return on the investment.

4.1.4. Customer Perceived Value (CPV)

CPV can be calculated by using any of the following three equations:

CPV1 = (episode benefits + relationship benefits) / (episode sacrifice + relationship sacrifice)

CPV2 = (core solution + additional services) / (price + relationship cost)

CPV3 = core value ± added value

As per definition, the customer value is the relationship of total benefits perceived by the customer and the total sacrifice paid for the perceived benefits. Above equations are representations of same concept of customer value from three different angles. Keeping the all three perspectives into consideration gives better understanding to the concept of value and its components [8]. The core value means the benefits of a core solution compared with the price paid for that solution. The added value is created by additional services in the relationship compared with the relationship costs that occur over time. Relationship represents the one-time deal of customer and vendor and their long term relationship [8].

Customer Perceived Value covers the Business and Economic value dimensions and its episodic measurement of value allow the managers and engineers to apply this technique any time from beginning of the software development to the retirement of the product.

4.1.5. Customer Value Hierarchy

Woodruff consolidated the diverse definitions and proposed "Customer value is a customer's perceived preference for and evaluation of those product attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations". It is further emphasized that value stems from customers' learned perceptions, preferences, and evaluations [20].

In this model three level hierarchy of customer value is defined. Moving up and down to the customer hierarchy represent the change in perspective to perceive the overall value of the product. At lowest level value is perceived in form of product attributes and features, more features of the product represent more customer satisfaction. Going up one step brings the consequences based approach into play. Here customer requires the best suitable product for situation in hand. At the top level of the model there is a goal based approach. At this level

customer sets up certain goals/objective for the product and the satisfaction of customer entirely depends upon the successful achievement of set objectives. Moving up the hierarchy suggests that customers think about products as bundles of attributes and attribute performances. They form preferences for certain attributes based on their ability to facilitate desired consequences, reflected in value in use and possession value. Customers also learn to prefer those consequences that help them achieve their goals and purposes. Moving down the hierarchy, customers use goals and purposes to attach importance to consequences [61], which, in turn, guide customers when forming preferences of attributes. This technique covers the business value along with the economic value dimensions.

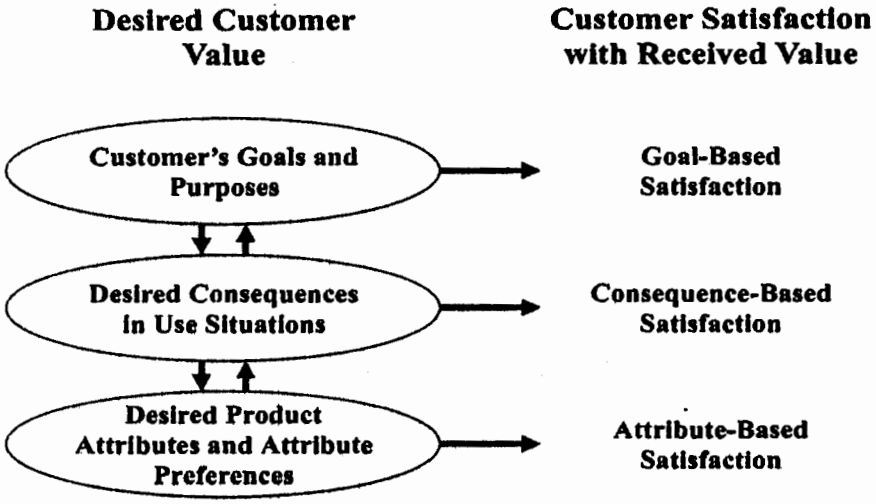

Figure 0-3 : Customer Value Hierarchy [8]

4.1.6. Value Exchange Model

This technique is basically a trade off model which is build upon the concept of CBAM. Customer gets his/her desired benefits in exchange of a certain amount of sacrifice. The sacrifice may be in terms of money, time, effort etc. The difference between total benefits and total sacrifices results in net customer value that leads to the decisions. The customer benefits include the personal and financial benefits, similarly total costs include the monetary and non-monetary values [8] which indicate that this technique also covers personal value along with business and economic value. By taking into account the value from exchange point of view, this is built based on [8], [32], [32] and [19].

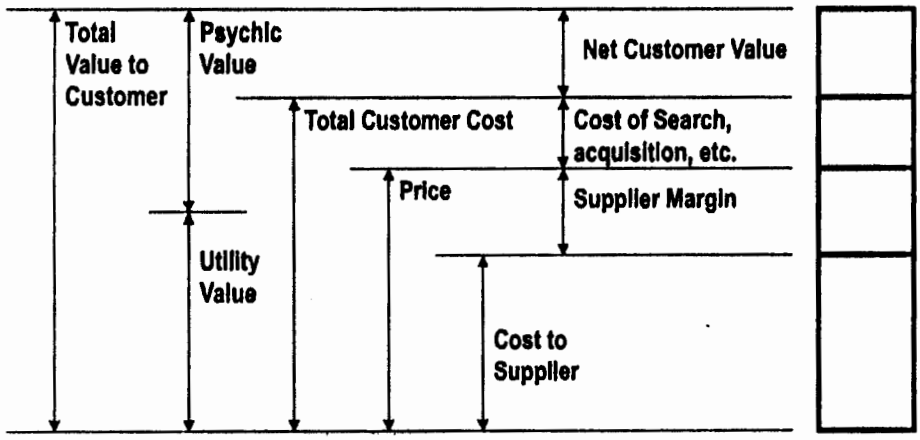

Figure 0-4 : Value Exchange Model [8]

4.1.7. Value Build up Model

This model focuses on the customer's benefits and covers the value dimensions of Business Value and Personal Value. It highlights the importance of long term relationship between customers and suppliers. There should be a respectful relationship between the both covering the Business Value and Personal Value. The relationship is based upon the four factors which present the overall Customer Value. The first two factors (View of Customer and View of Relationship) present the relationship of customer and suppliers while the other two (Customer Needs and Customer Benefits) show the aspects of satisfaction of customer needs. The model also presents two important ranges of "Customer Needs" and "Customer Benefits" which derives the Personal Satisfaction for the customers.

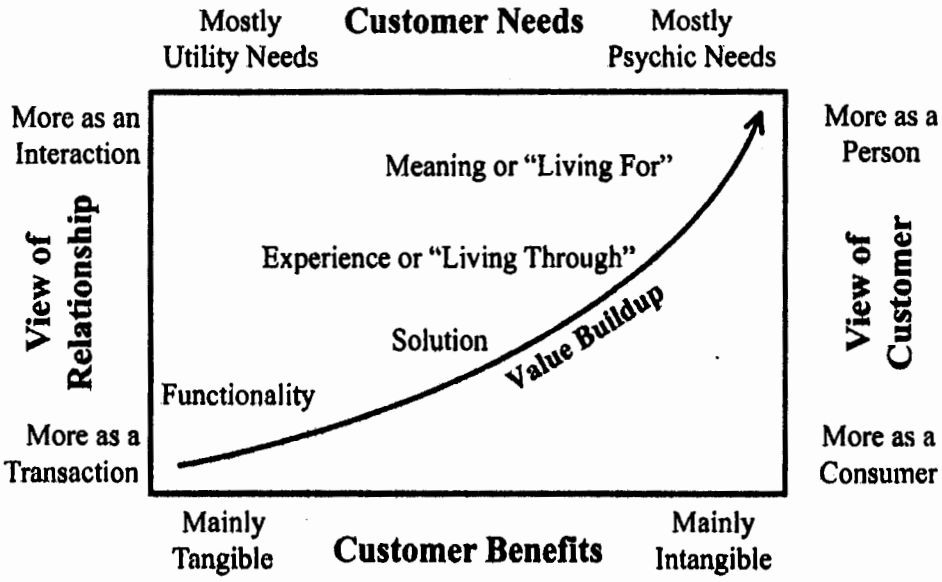

Figure 0-5 : Value Build up Model [8]

4.1.8. Value Dynamic Model

The model incorporates the dynamism exists in the concept of value. It gives a great insight into the overall process where customers evaluate the total offering of the supplier. The Business, Economic and Personal Values come into play at critical junctures of the model. These three values combined together to look at the gross value for the customer. This gross value built upon the relationship between customer and supplier which should be long lasting and respectful.

The model gives two dimensions of customer covering:

a) Consumer Dimension - residing on the concept of product/ services and the attributes related with their delivery

b) Personal Dimension – presenting customer as a person having core personal needs to be satisfied

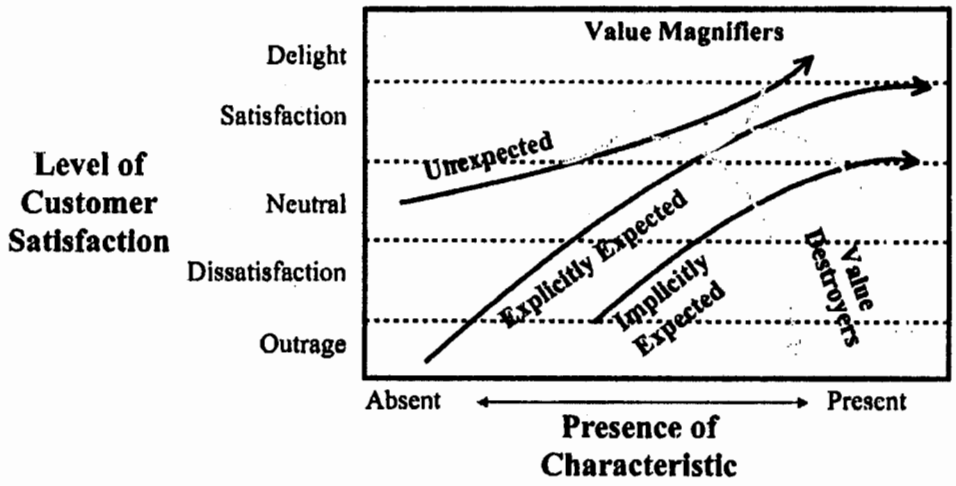

Figure 0-6 : Value Dynamic Model [8]

The implementation of the model can be viewed in the case of a software development project by dividing the product features into basic requirements, expected outcomes and innovative features. According to the model, the customers take the basic requirements and features set for granted which make them "neutral" that means "no outrage" and "no delight". However, the non-fulfillment of basic requirements does not lead to the repeat purchase and make the customer dissatisfied. Further, the expected outcomes of the software product lead to satisfaction but not delight the customers while their non-existence causes dissatisfaction.

The model also gives insight into fact that innovative features are not the expected features, hence, does not cause any dissatisfaction but their presence gives positive surprise. So, the satisfaction and dissatisfaction of the customer is purely a result of attributes for a product or service matching with the expectations of the customer.

4.1.9. Business Value Index (BVI)

Business Value Index was introduced by Intel Corporation in 2001 to ensure the return of maximum business value from its investments in information technology. This is very much simple methodology in order to calculate values for IT investments. This has the direct focus on the Business Value and Economic Value with regards to the concept of value based software engineering.

Business Value Index gives a framework to discuss and analyze the investments on information technology in the corporate portfolio. The business decisions can be more fruitful by adopting this framework. So, the assessment of value resulted through IT investments becomes more meaningful and understandable by using the common and standard criteria. This technique also gives great insight proactively to have an effective alignment of IT with corporate strategies.

The methodology considers more parameters apart from the financial information to decide about the business priorities and having informed decisions. This is named as "IT efficiency" which can be highlighted as given below:

- Business value measures both tangible and intangible benefits.
- IT efficiency measures its impact on the IT organization.
- Financial criteria measure financial attractiveness.
- Scores enable visual comparison of projects.

4.1.10. Total Economic Impact (TEI)

Total Economic Impact is proposed by Forrester to calculate the value of IT investments. Business Case remains a core of the whole process of valuation like the Business Value Impact. This technique can be positioned in between the Business Value Index methodology and Applied Information Economics. It gives the value by taking into account the

combination of financials and intangible benefits. It also focus on quantification of risks and the value associated with the flexibility.

TEI provides the approach of best practices to minimize the costs which can be determined through the use of traditional cost analysis, quantification of business benefits and allied flexibility. It includes:

- *Costs - the impact on IT* – The TEI cost category contains the changes in IT costs compared with maintaining the status quo.
- *Benefits - impact on the business* – This category captures the quantified data relating to changes in the non-IT departments.
- *Flexibility - future options* – Future options, or flexibility, can be looked at as the value of the option to take a second or third action in the future. It is much like a financial purchase option.
- *Risk* – The risk analysis translates the initial estimates for cost and benefits into a range of potential outcomes.

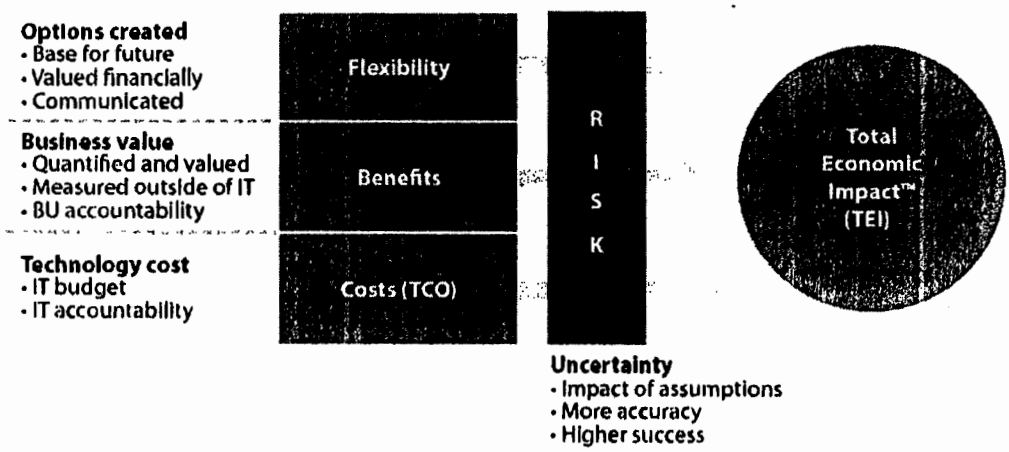

Figure 0-7 : Total Economic Impact [9]

4.1.11. Val IT

Val IT is a framework to measure the value of IT. This was proposed by IT Governance Institute (ITGI). Val IT "adds best practices for the end, providing the means to unambiguously measure, monitor and optimize the realization of business value from investment in IT." ITGI is planning to expand its scope to take into account all type of

services and assets related with IT. However, the present framework focuses only on new investments of information technology. The framework contains 41 key management practices categorized in three key processes which are given below:

- Value governance optimizes the value of IT investments. Value governance consists of 11 key management practices that cover the establishment of governance, monitoring, and control framework, provides strategic direction for investments, and defines the investment portfolio characteristics.

- Portfolio management ensures that the overall portfolio is optimized. Portfolio management consists of 15 key management practices that cover the identification and maintenance of resource profiles; define investment thresholds; provide for the evaluation, prioritization and selection, deferral or rejection of investments; manage the overall portfolio; and monitor and reports on portfolio performance.

- Investment management optimizes individual IT investment programs. Investment management consists of 15 key management practices that cover the identification of business requirements; develop a key understanding of candidate investment programs; analyze alternatives; define and document detailed business cases for programs; assign clear accountability and ownership; manage programs through their full economic life cycle; and monitor and report on program performance.

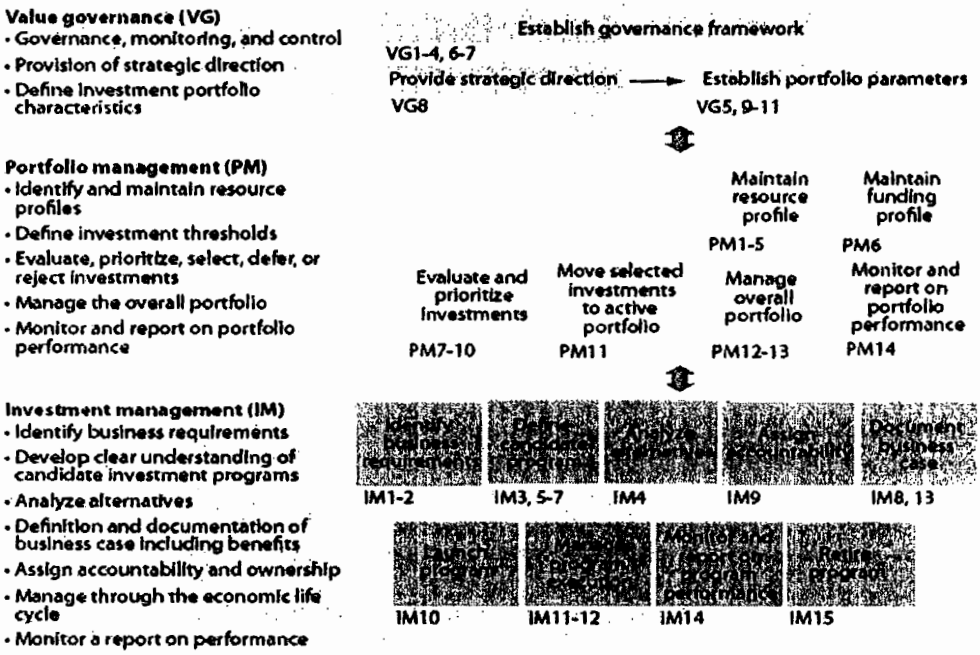

Figure 0-8 : Val IT [9]

4.1.12. Applied Information Economics (AIE)

Applied Information Economics (AIE) is a high level quantitative methodology to value the investments in information technology from last ten years or so. It takes into account the approach comprises of three stages of clarify, measure and optimize. It also combines the intangibles for the purpose. The constituent elements are:

a) Software metrics,

b) Operations research

c) Modern portfolio theory

d) Actuarial science

e) Options theory, and

f) Economics

AIE produces a risk/ return analysis and focuses on Business and Economic value:

- Improve cost/benefit analysis. Using mathematical models, AIE can be used to improve the cost/benefit analysis for better decisions at all levels of IT investment.
- Develop quality assurance measurements. Financially based quality assurance measurements can be developed to ensure that the implementation of IT decisions is effective.
- Strategic plan development. An IT strategic plan can be developed based on identifying the best opportunities for economic contribution by information systems.

AIE consists of a number of basic techniques that make it a powerful tool for valuing IT investments as part of an investment portfolio. These same methods are used by financial services firms to create financial products and by insurance companies to calculate premiums. These tools include:

Unit of measure definitions – AIE removes ambiguity from intangibles such as "customer satisfaction" and "strategic alignment" by focusing on definitions that can be expressed as units of measure.

Systematic uncertainty analysis – All investments have a measurable amount of uncertainty or risk. AIE's ability to quantify the risk of a given IT investment and compare its risk/return with other non-IT investments is a differentiator.

The calculation of the economic value of information – AIE is based on the premise that the value of information can be calculated as a dollar amount. Information reduces uncertainty, less uncertainty improves decisions, better decisions result in more effective actions, and effective actions improve profit or mission results. All of these can be mathematically calculated.

IT investments as an investment portfolio – AIE incorporates methods of modern portfolio theory and treats IT investments as another type of investment portfolio. AIE can find the optimum combination of investments by identifying the contribution or impact of multiple investments separately and together.

4.1.13. Earned value Management

Earned Value Management (EVM) is a very useful technique to measure the project's progress objectively. It provides the measurement on combination of project scope, schedule and cost in cohesive manners. It gives early warnings to project management team for appropriate preventive measures. The effective usage of this technique improves the confidence of stakeholders on the progress of project hence avoiding the scope creep and enhancing the communication among all the parties with conflicting interest. It provides a standard way of measuring the progress of project and estimating the efforts to complete the project at certain times. It is important to highlight that this technique does not take into account the project quality.

The basic components of this technique are described as under:

Planned Value (PV) – it describes how far along project work is supposed to be at any given point in the project schedule. It is a numeric reflection of the budgeted work that is scheduled to be performed and considered to be the established baseline.

Earned Value (EV) – it is a snapshot of work progress at a given point in time. It reflects the amount of work that has actually been accomplished to date, expressed as the planned value.

Actual Cost (AC) – it is an indication of the level of resources that have been expended to achieve the actual work performed to date.

The basic elements are applied in combination to know the estimates, forecasts and variance to the baselines of scope, schedule and cost. The sub-techniques of EVM are:

Estimate to complete (ETC) and estimate at completion (EAC) - The Planned Value (PV), Earned Value (EV), and Actual Cost (AC) values are used in combination to provide performance measures of whether or not work is being accomplished as planned at any given point in time. The most commonly used measures are Cost Variance (CV) and Schedule Variance (SV). The amount of variance of the CV and SV values tend to decrease as the project reaches completion due to the compensating effect of more work being accomplished. Predetermined acceptable variance values that will decrease over time as the project progresses towards completion can be established in the cost management plan.

Cost variance (CV) - The cost variance at the end of the project will be the difference between the budget at completion (BAC) and the actual amount spent. It can be calculated by applying the formula,

$$CV = EV - AC$$

Schedule variance (SV) - Schedule variance will ultimately equal zero when the project is completed because all of the planned values will have been earned. It can be calculated through

$$SV = EV - PV$$

These two values, the CV and SV, can be converted to efficiency indicators to reflect the cost and schedule performance of any project.

Cost performance index (CPI) - A CPI value less than 1.0 indicates a cost overrun of the estimates. A CPI value greater than 1.0 indicates a cost under-run of the estimates. CPI equals the ratio of the EV to the AC. The CPI is the most commonly used cost-efficiency indicator and can be calculated as Cost Performance Index (CPI) = EV/AC

Cumulative CPI (CPIC) - The cumulative CPI is widely used to forecast project costs at completion. CPIC equals the sum of the periodic earned values (EVC) divided by the sum of the individual actual costs (ACC); CPIC = EVC/ACC

Schedule performance index (SPI) - The SPI is used, in addition to the schedule status to predict the completion date and is sometimes used in conjunction with the CPI to forecast the project completion estimates. SPI equals the ratio of the EV to the PV; SPI = EV/PV

4.1.14. Net Present Value (NPV)

Net Present Value is a value elicitation technique to present the total of present value (PV) of cash flows against the time. This is used for projects of long duration for the purpose of capital budgeting and measurement of shortfall/ excess of cash flows in the form of present value on fulfillment of financing charges. It covers the value dimensions of Business and Economic Value.

The NPV can be calculate in the form of sum of all terms $R_t/(1 + i)^t$,

Where t is the time of cash flow while i represent the discount rate; and R_t is the net cash flow

The following indicators should be noted for better understanding. If,

NPV > 0; the investment would add value to the Company

NPV < 0; the investment would subtract value from the Company

NPV = 0; the investment would neither gain nor lose value for the Company

4.1.15. Total cost of ownership (TCO)

The technique of Total Cost of Ownership (TCO) determines the real attribute of costs associated with the infrastructure for information technology. It takes the costs into two streams of direct and indirect costs covering the whole attributes of the infrastructure. The direct costs are usual comprises of labor and capital cost. However, the indirect costs are more confusing and difficult to measure. The indirect costs are usually reflects the impact of direct costs and its related factors. This may include the quality of service or downtime of the systems. The extra care should be given during these calculations. It also takes the variances of industry for a particular business or the IT departments.

4.1.16. Return on Investment

This technique returns the net earnings of the company against the assets. The return value can be a positive or negative. The positive value shows that profits out of the investments while the negative value present loss to the company. Its calculation requires the total of all type of income and gives good results, if parameters are easily known. This can be calculated by applying the formula:

ROI = (Gains – Investment Costs)/ Investment Costs

This technique remains silent about the associated risks with the particular investment. The higher value of ROI is a good indication for the investment decisions. Its usage becomes very tricky in the complex environment and in the situations where constituent data elements are available in discretely manners. The other factors posing the risks are segregation of direct and indirect costs for a particular investment.

Chapter 5 – Value Elicitation Framework

This chapter focuses on the second objective of the thesis which is selection of right value elicitation technique for the given situation in software development lifecycle. We have presented a framework for easy selection of appropriate value elicitation technique for the given situation. The proposed framework will also facilitate the decision making process during the project lifecycle by introducing the concept of value into it. The proposed framework intends to develop the relationship between the value dimensions and the situations in the software development lifecycle. The relationship shall make it easy to select value elicitation techniques based upon the covering value dimensions. It is important to mention that value dimensions are the linkage between value elicitation techniques and the situations. Success Critical Stakeholders are the key players in the whole process as they are determining the value and ultimate decision making lies with them.

Value Elicitation framework consists of six high level activities. The activities include Success Critical Stakeholders' identification, identification of important value dimensions, Comparison of value dimension and value elicitation techniques, selection of value elicitation techniques, value elicitation and decision making. Figure 5-1 shows the flow of these activities. Three reference objects: Stakeholder Identification Techniques, Standard Analysis Techniques and Value Dimension vs Value Elicitation Techniques Matrix are also presented in the figure as the core activities communicate with these objects as and when required basis. All six activities are explained one by one in the following sections.

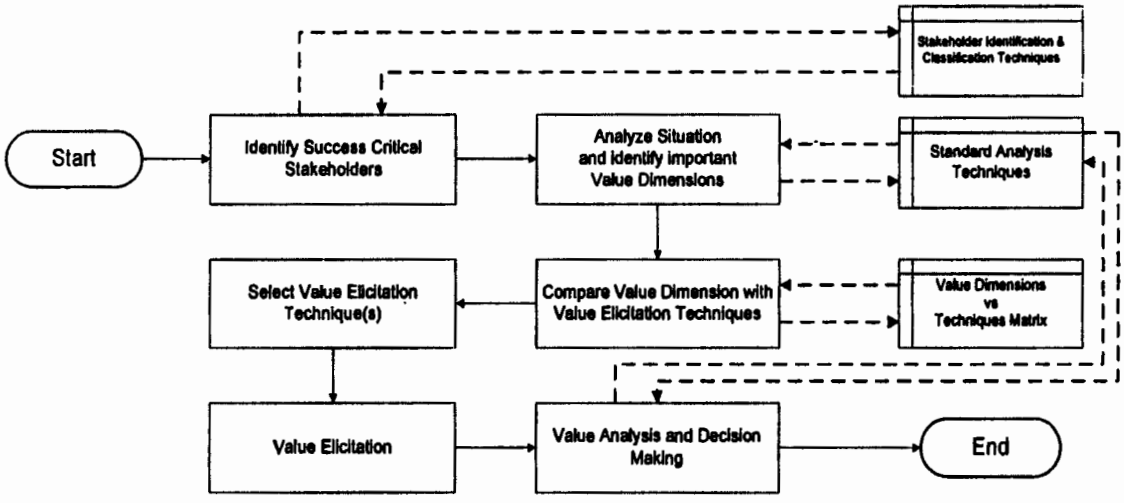

Figure 0-1 : Value Elicitation Framework

5.1. Identification of Success Critical Stakeholder

The decision making process using the Value Elicitation Framework starts with identification of Success Critical Stakeholders (SCSs). Project Management Team should have keen focus on identification of Success Critical Stakeholders for effective and valid decision making. The engagement of SCSs should remain from beginning to end of the project lifecycle. Identification of Success Critical stakeholders is of great importance for success of the projects especially in case of value based software engineering. The project management team should manage the expectations of SCSs from beginning to end of the software development project.

Identification of success critical stakeholders can be done by using stakeholder identification techniques. The selection of appropriate technique is a quite tricky job as multiple techniques are in practice for various situations. Chapter 3 presents a detailed analysis of stakeholder identification techniques to facilitate the overall stakeholders' identification process. The reference object "Stakeholder Identification and Classification Techniques" in the Figure 5-1 presents the same concept.

5.2. Identify Important Value Dimensions

Chapter 4 presents analysis of available value dimensions and classifies them on the basis of their nature, focus areas and application context. After performing the said analysis, we have six value dimensions; Business Value, Economic Value, Technical Value, Social Value, Personal Value and Epistemic Value. But the question remains open as what is the good use of these value dimensions in value based software engineering? To answer such questions, we need to look at the process of value-based software engineering according to which value based software engineering assigns value to the artifacts and concepts and recommends taking project decisions by keeping the assigned values into consideration. During project development lifecycle, project management team takes different type of decisions in line with the business objectives.

The stakeholder may have different value proposition for the system at different point of time. Keeping this phenomenon into consideration in the second activity of the Value Elicitation Framework, success critical stakeholders analyze the given situation carefully and identify that which of the six value dimension(s) are important at the given point of time and should be taken into consideration for decision making. The situation analysis can be done

using any of the standard analysis techniques. Large number of analysis techniques is available in the literature like; Brainstorming, Delphi technique, Pareto Analysis, Cause & Effect Diagram, SWOT Analysis, Decision Tree and others. The Project Management Team should rely on its experience to analyze the situation and use appropriate analysis technique for the purpose.

Declaring a value dimension important is entirely based upon the expert judgment of stakeholder and analysis of the situation. However, we have recommended the certain value dimensions to be used for decision making at different phases of the project. These recommendations are made after qualitative analysis of the results of case study and by keeping in focus the phases of Rational Unified Process (RUP). It is important to mention that VEF is not specific to RUP. It is equally applicable to all the SDLC process models because neither of the activities of VEF is dependent on any of the process model.

5.2.1. Inception

This is the most crucial phase in the Project Life Cycle, as it's the phase in which most of the business decisions are made. The Phase begins when management determines that it is necessary to enhance a business process through the application of information technology. Project is started by defining its objectives, scope, purpose and deliverables to be produced. Hiring of project team, setup the Project Office and review to the project is also done in this phases to gain approval to begin the project. The most common decisions in information technology projects are taken at this stage like: Go-No-Go decision, Make-or-Buy decision, selection of SW System (in case of COTS product), selections of technology (in case of custom development), definition of business objectives related to the project and others. It is quite clear that most of the decisions taken at this stage are directly related to the business objectives of the organization.

According to the value-based software engineering all these decisions should be made by keeping the value dimensions into considerations. It is worth to mention that the decisions taken at each stage eventually relates to the business objectives of the organization. Hence, the business decisions should be very candid and based upon the value to be achieved as a resultant of the decision. So, at this particular phase of the lifecycle, the considerations should be given to business, economic and technical value dimensions and the others are less important.

5.2.2. Elaboration

The Project Elaboration Phase is the second in the project life cycle. It involves creating a set of plans to help guide your team through the execution and closure phases of the project. The plans created during this phase will help you to manage time, cost, quality, change, risk and issues. They will also help you manage staff and external suppliers, to ensure that you deliver the project on time and within budget. Most common decisions that are taken at this stage include: Resource Division and Allocation, Quality Attributes and Related decisions, System Governance Rules, System Component Interaction/Integration and others. Elaboration phase of an IT project can make or break the project. If not conducted properly, the elaboration phase can cause a domino effect on the other life cycle phases and eventually cause the project failure.

At the project elaboration stage the decisions relates to the management of technical and human resources required to meet the customer requirement during software development that involve the economic perspective into it. So, the technical and economic values are having major contribution for better decision making. The other four value dimensions of business value, personal value, social value and epistemic value must also be focused moderately during the elaboration phase.

5.2.3. Construction

The Construction Phase is the third phase in the project life cycle. In this phase, the physical project deliverables are developed and presented to the customer for acceptance. The Construction Phase is usually the longest phase in the project life cycle and it typically consumes the most energy and resources. This phase usually overlaps the project elaboration phase and enables to revisit elaboration for possible errors to avoid failures. The range of management processes is implemented to monitor and control the project that help to manage time, cost, quality, change, risks, issues, procurements, customer acceptance and communication. Resources management, quality and change management related issues normally rise at this stage that may require major decisions to be taken.

Like elaboration phase, project construction also includes the decisions related to resource and quality management but with less focus on the business value. The core business decisions have already been taken prior to this phase. The critical decisions here are relate to change management that can also target business objectives. In VBSE perspective, technical

and economic value dimension are more important at this stage. Business, social, personal and epistemic values can also contribute to the better decision making but these are less important at this stage.

5.2.4. Transition

This phase is about transition of the project into business as usual. The focus of the transition phase is to ensure that software is available for its end users. The transition phase can span over several iterations, and includes testing the product in preparation for release, and making minor adjustments based on user feedback. At this stage of lifecycle, user's feedback should focus mainly on fine tuning of the product, configuring, and installing and usability issues. However, all the major structural issues are worked out much earlier in the project lifecycle. Quite often, this phase is managed by a swift hand over rather than a delayed transition.

Intervention of software into the business functions is the biggest challenge in transition phase of any developed software that requires the social and personal issues to be taken into considerations. So, along with the economic value social and personal values become important for better decision making at this stage. Business, technical and epistemic values are less important here but must not be neglected.

From the analysis of the above situation, it is now quite clear that Economic Value is the most important value dimension as it can influence the project and its decisions throughout the lifecycle. Technical and business values are more important during early and middle phases of the projects and social, personal and epistemic value are required to be considered normally at later phase. However, for the projects of research and development nature the epistemic should be one of the most important value dimension taken into consideration throughout the project lifecycle.

5.3. Compare Value Dimensions with Value Elicitation Techniques

After identifying the important value dimensions, this activity looks into the common linkage among value dimension, given project situations/decision and value elicitation techniques. As this research is an effort to facilitate the management team in selection of value elicitation techniques for any given situation, it is necessary to identify the linkage of value elicitation techniques with project decisions. Our analysis (in previous sections) shows that value dimensions are the common linkage between the project decision/situations and the value

elicitation techniques. This common linkage has been thoroughly reviewed and presented here in the discrete manners. In VBSE project decisions and value elicitation techniques both focus on value dimensions and provide greater assistance in understanding the foundation for relationship framework. Following table compares the available value elicitation technique with value dimensions to provide the bases for the technique selection process.

Value Elicitation Techniques		Value Dimensions					
SN	Techniques	Business	Economic	Technical	Epistemic	Personal	Social
1	Model of Customer Perception	√				√	
2	The Exclusive Value Principle		√			√	√
3	Cost Benefit Analysis Method	√	√	√			
4	Customer Perceived Value	√	√				
5	Customer Value Hierarchy	√	√				
6	Value Exchange Model	√	√			√	
7	Value Build up Model	√	√				
8	Value Dynamic Model	√	√			√	
9	Business Value Index (BVI)	√	√				
10	Total Economic Impact (TEI)	√	√				
11	Val IT	√	√				
12	Applied Information Economics (AIE)	√	√				
13	Earned value Method		√	√			
14	Net Present Value	√	√				
15	Total Cost of Ownership	√	√				
16	Return on Investment	√	√				

Table 0-1 : Value Dimensions vs Value Elicitation Techniques Matrix

5.4. Selection of Value Elicitation Technique(s)

The value elicitation techniques should be selected with the objective to elicit the required value for the software leading to the successful business decisions. The business decisions should be based upon certain values resulted by the execution of sophisticated process of technique applications instead just a mere guess.

Selection of value elicitation technique(s) is done using the Value Dimensions vs Value Elicitation Techniques Matrix. We take value dimensions identified in the second activity of the VEF as a base and compare them with value elicitation techniques. In this step, we choose only those techniques that cover the identified value dimensions. Multiple techniques can be

selected for a single decision if they cover the value dimensions required for the decision making. Multiple techniques can be applied to elicit the required value to put more accuracy in the process of value elicitation but it will depend on the nature of the decision, value dimension and available resources.

5.5. Value Elicitation

After selecting the appropriate value elicitation technique, it is now responsibility of project management team to apply the selected technique(s) and elicit the required values for important value dimensions. The application of technique is done following the guidelines of selected value elicitation techniques. The elicited values must be recorded along with the context carefully for the further reference in the decision making process.

5.6. Value Analysis and Decision Making

The recorded values are to be analyzed along with the context and should be presented to SCSs for facilitation purposes. The analysis techniques are given as an important reference object in the VEF, and should be used for Value Analysis. The Project Management Team should also analyze and record the advantages and disadvantages of decision alternatives carefully. The analysis should also result in removing the non-viable decision alternatives and must not be pursued. Along with the elicited values, the general management skills become important at this stage to choose from the viable alternate decisions. The final decision is much more competent to be presented to SCSs as resulted from the sophisticated process of decision making based upon the concept of value. The SCSs remains engaged at various stages by determining the values, analyzing the situations and alternate decisions hence making the overall process rich enough to eliminate the chances of wrong decisions which are necessary for success of software projects.

Chapter 6 – Case Study on Value Elicitation Framework

Value Elicitation Framework is designed to facilitate decision making in software projects using the value based approach. It helps project managers/project management team and decision makers to select appropriate value elicitation technique for a given situation in project lifecycle to get the desired value for decision making. Using Value Elicitation Framework first we need to identify the important value dimensions required for the decision making, it is done by the success critical stakeholders by analyzing the situation carefully. Secondly; the appropriate value elicitation technique(s) are selected with respect to the identified value dimensions. After the selection of value elicitation techniques the project management team can elicit the required value for further use in decision making process.

As the Value Elicitation Framework is newly proposed in this research work, its claims are yet to be validated. In this section a case study is presented to validate the claims of the Value Elicitation Framework. The case study will also serve as demonstration of Value Elicitation Framework, to clarify its execution process.

6.1. Case Study Objectives

Keeping in view the validation of claims of the Value Elicitation Framework, the objectives of this targeted case study is to answer the questions given as under:

- Does the Value Elicitation Framework simplify the process of value elicitation necessary for decision making?
- Is the Value Elicitation Framework practical for software development projects?
- What problems practitioners may face during implementation of the VEF?

Validation of VEF will result into answering the research question of "how to select appropriate value elicitation technique for the given situation". Simplified process of value elicitation will ultimately improve the decision making during project lifecycle.

6.2. Process & Design of Case Study

In order to meet the objectives highlighted above, the Value Elicitation Framework (VEF) is applied on a commercial software development project. The purpose of this software

application is to have an online market place in selling cellular products. The major features include Shopping, Trading, Ringtones, Mobile Reviews and Warranty Claim Management.

The VEF applied on the complete lifecycle of the project having duration of four weeks according to its recommendations and guidelines. It was kept in view the key decisions to be made during different phase of the project. All the , design, implementation and transition related issues were tackled through effective decision making using the recommendation of value elicitation framework. Following are the high level activities performed by project management team in order to implement this framework.

- Identification of success critical stakeholders
- Analyze the given situation and identify important value dimensions
- Selection of value elicitation technique(s) based on value dimensions.
- Value elicitation using selected technique(s)
- Recommendations for decision making

The case study designed using the following components to answer the questions given in the above section.

Propositions – The scope of the case study is to find out the answers of the research questions through implementation of VEF in commercial environment. It focuses on the validations of the claims presented through the VEF. It also provides the simplification of the process of making candid decisions through the application of appropriate value elicitation technique on any given situation. Here we propose that:

- Value Elicitation Frame simplifies the selection of appropriate value dimension and value elicitation technique for the given situation, ultimately simplifies and improves project decision making.

Unit of Analysis - The unit of analysis is the chosen commercial "software development project".

Logic Linking of Data to the Proposition - In order to meet objectives of the case study, data is collected multiple times at each phase of the project lifecycle. Following data was collected during the project implementation in order to validate VEF:

- List of Success Critical Stakeholders
- Key decision points/decisions required taken at each phase of project
- Value dimensions selected against each decision (selected by success critical stakeholders by analyzing the situation)
- Value elicitation techniques selected against each decision (identified by comparing value dimension with techniques)
- Value (elicited using value elicitation techniques)
- Decisions (decision recommendations made after analysis of elicited value)

6.3. Case Study Execution

The qualitative case study executed to answer the questions defined in above sections. The activity wise execution detail at different stages is given below.

6.3.1. Identification of Success Critical Stakeholders

First step taken during implementation was identification of success critical stakeholders. It was done very early during implementation and this exercise was not repeated during the next stages. "Theory of Salience" was applied in order to identify SCSs as we found this theory the best available stakeholder identified technique (discussed in chapter 2). Due to non availability of proper project management team, author himself was involved along with the Project Manager during the course of stakeholder identification. Following is the list of identified success critical stakeholders:

Stakeholders	Type	Attributes		
		Power	Legitimacy	Urgency
Customer	Definitive	Yes	Yes	Yes
Company Partner 1 (Designer)	Definitive	Yes	Yes	Yes
Company Partner 2 (Project Manager)	Definitive	Yes	Yes	Yes
Software Developer 1	Discretionary	No	Yes	Yes
Software Developer 2	Discretionary	No	Yes	Yes

Table 0-1 : Success Critical Stakeholders

6.3.2. Analyze Situation & Identify Important Value Dimensions

This activity of VEF is of greatest importance as this is the first step towards the value based decision making process. Here every decision was reviewed in detail with respect to the prevailing situation and appropriate value dimensions were selected. This activity ware repeated every time when a decision situation aroused. Using the brainstorming technique every decision was analyzed by success critical stakeholders and appropriated value dimensions were identified. Following table show the decisions analyzed at every stage of the project and their selected value dimensions.

Project Phase	Decision	Selected Value Dimensions
Inception	GO / No-Go	Business, Economic, Technical
	Selection of Technology	Economic, Technical
Elaboration	Software requirement analysis and prioritization	Technical
	Resource allocation and division	Economic, Technical
	Non functional requirements and quality attributes	Economic, Technical
	System design and integration	Economic, Technical
	Scope and schedule	Economic, Technical
Construction	Acceptance Criteria	Economic, Technical, Personal
	Acceptance of Change	Economic, Technical, Personal
Transition	System Governance Rules	Business, Economic, Technical, Personal,
	Intervention into the business functions	Business, Economic, Technical, Personal, Epistemic

Table 0-2: Selected Value Dimensions for Decisions

6.3.3. Compare Value Dimensions with Value Elicitation Techniques

This is simple comparison of dimensions with value elicitation techniques using the relationship matrix presented in Table 6-2. It shows the common linkage among value dimension, given project situations/decision and value elicitation techniques. As the project decisions and value elicitation techniques both focus on value dimensions and provide grater assistance in understanding the foundation for relationship framework, this common linkage has been thoroughly reviewed and presented in the discrete manners.

6.3.4. Selection of Value Elicitation Techniques

Selection of value elicitation technique(s) was done using the Value Dimensions vs Value Elicitation Techniques Matrix. We took value dimensions identified in the second activity of the VEF as a base and compared them with value elicitation techniques in the third activity. In this step, we choose only those techniques that cover the identified value dimensions. Situations occurred where multiple techniques were selected for a single decision as they cover the value dimensions required for the decision making. In such situation brainstorming sessions among success critical stakeholders were conducted for further selection of one value elicitation technique for application. In such session expert opinions of success critical stakeholders, nature of decision and available resources were kept into consideration in addition to the value dimensions. Following table shows the selected value elicitation techniques against each decision.

Project Phase	Decision	Selected Value Dimensions	Selected Value Elicitation Technique
Inception	GO / No-Go	Business, Economic, Technical	Return on Investment, Cost Benefit Analysis
	Selection of Technology	Economic, Technical	Cost Benefit Analysis
Elaboration	Software requirement analysis and prioritization	Technical	Cost Benefit Analysis, Earned Value
	Resource allocation and division	Economic, Technical	Earned Value Cost Benefit Analysis
	Non functional requirements and quality attributes	Economic, Technical	Cost Benefit Analysis
	System design and integration	Economic, Technical	Cost Benefit Analysis
	Scope and schedule	Economic, Technical	Cost Benefit Analysis, Earned Value Method
Construction	Acceptance Criteria	Economic, Technical, Personal	Earned Value Method
	Acceptance of Change	Economic, Technical, Personal	Cost Benefit Analysis
Transition	System Governance Rules	Business, Economic, Technical, Personal,	Earned Value Method
	Intervention into the business functions	Business, Economic, Technical, Personal, Epistemic	Cost Benefit Analysis, Earned Value Method

Table 0-3 : Selected Value Elicitation Techniques for Decisions

6.3.5. Value Elicitation

After selecting the appropriate value elicitation technique, it is now responsibility of project management team to apply the selected technique(s) and elicit the required values for important value dimensions. In our scenario there was no project management team available so, the activity was performed by project manager and author. The application of techniques is done following the guidelines of selected value elicitation techniques and elicited values were recorded.

6.3.6. Value Analysis and Decision Making

After value elicitation now the time comes to take decisions by keeping the elicited value dimensions into consideration. For this purpose once again brainstorming sessions among success critical stakeholders were conducted and decisions taken by analyzing the values. Here we present all decision of the project phase wise

Inception

The important decisions at the stage of project initiation were:

- Go–no–go decision at the conception stage of a project. The organization resources may be applied to proceed with the project elaboration. The project may be abandoned if the business case suggests otherwise.
- The selection of development technology for this particular project.

It was decided by success critical stakeholders to undertake the project by reviewing the results achieved through application of cost benefit analysis technique and return on investment. However, the decision also taken into accounts the previously developed software component especially the standard module of ecommerce. The company deployed the ecommerce module on various software development projects and yielded the benefits of reusability. Further, the company selected the Php language for server side scripting and MySql for the database due to having a history and experlence. The reason to select this technology remained the history of development experience and skill level of software development team. The decision also considered the reusability of already developed software components to be used for this new development.

These decisions at inception are very important as the organization is going to apply the resources in order to undertake the project. These decisions can be considered as successful if the project completes within specified time, cost and quality.

Elaboration

The key decisions at this stage were:

- Software requirement analysis and prioritization
- Resource allocation and division
- Non functional requirements and quality attributes
- System design and integration
- Scope and schedule

The Economic and Technical values were elicited for software requirements analysis and prioritization. The both values help in understanding the priorities of software requirements. The requirements outside the domain of chartered product of ecommerce module were scheduled for development from the beginning. The example is the user's interface of the software where the various components plugged in. The other parameter taken into account was the completion of critical requirements as early as possible to meet the deadlines. Further, some of the features were marked for inclusion in the standard modules at later stage. So they were designed accordingly.

Earned Value Technique opted for application during the course of execution especially with respect to the estimate time to complete on a given time. The resource sharing and leveling were utilized fully to remain within budget and have a maximum cost savings. The Graphic Designer and Quality Control Engineer were deployed only for the required duration of time. Earned Value helped a lot in order to have a strict control in terms of optimal usage of resources and eventually the cost savings.

The Economic and Technical values elicited to have important decision with regards to the non-functional requirements and quality attributes. The Technical value was considered initially to make necessary design decisions. Since, dealing with the business to business linkage, the software has to up and running 24x7x365 to make online transactions. Further, the contractual obligations were kept in focus to meet the critical requirements with regards

to the continuity of business. The quality attributes remained in focus was functionality, usability, reliability, efficiency and maintainability.

The Technical value was considered in critical design decisions with regards to the reusability of already developed software components. There interfaces and data sharing were the key issues to be resolved as several online channel partners to be plugged with this online software. The standard parameters were defined for seamless integration with web services of external systems and components internal to the software. Integration and sharing of data were the decisive factors for Technical value at this stage.

The Earned value elicited to have a tight control on scope, schedule and cost. The earned value becomes important especially in the scenario of changes in the scope of work which impact the overall baselines of scope, schedule and cost.

The company adopted a systematic approach to make all these decisions based upon the respective value considered at that time. The decisions at elaboration phase gave a business blue print for execution of the project during next stage.

Construction

The key decisions at stage were:

- Acceptance Criteria
- Acceptance of Change

The company considered the all values including Economic, Technical, Social, Personal and Epistemic to make a critical decision of Acceptance Criteria. The acceptance criteria provide a yardstick for final acceptance of the users and process owners. The users acceptance testing was conducted after agreeing with this criterion.

The company considered all given values or combination of them to accept a particular change during the course of execution. Though it was a small project with shorter duration but different values were considered during the process. Needless to say that business got the highest ranking regardless of the values elicited during the whole process. The changes could have caused a failure and may appear to be the loss towards the end if the company did not go through this exercise. The company management was much exited while having the

tangible reasons to make such critical decisions. Return on Investment, Cost Benefits Analysis and Earned Value Technique were used at this stage.

Project Transition

The important decisions at the stage were:

- System Governance Rules
- Intervention into the business functions

The company could not have the benefits to have System Governance Rules having a solid relationship with the IT spending. The governance of the system becomes very important in terms of its operations. The feedback is very important in terms of improving the decision making in IT spending and having an accountability needed to maximize value within given constraints.

The company considered the values of Business, Economic, Technical, Social and Personal for making the appropriate decisions required for its introduction to the manual business processes. The business value was considered in detail in terms of defining company role specific to the development and running the operations after concluding the transition phase. The clarity in the roles brought the savings of resources that may have utilized for running the operations. The company elicited the Economic value to understand the overall profits and gains earned from this project. The chartered product "ecommerce" improved in couple of areas by having specific features to the industry domain. The Social Personal gains also observed.

By eliciting these values systematically the company observed a smooth transition of the product of this project and had a formal closure of the contract. The company also focused on the areas where customer needs to align the manual business processes with their online execution. The assistance in cultural improvement created a good will with the customer for future work and reference to others potential customers.

6.4. Results

The discussion in the above sections shows the successful execution of Value Elicitation Framework (VEF) on a complete project lifecycle. VEF was successful in its applicability as observed by the author. The decision makers were comfortable by following the sophisticated process to make key decision ultimately impacting the future of company (Reported by SCSs in Post implementation interviews). VEF gives an easy to use relationship between project decisions and value dimensions. Further, the appropriate value elicitation technique can be selected based upon the value dimensions for eliciting a certain value.

Project where VEF was implemented remained successful. VEF played a major role in success of the project as none of the decision made using VEF impacted negatively on the project. Project was slightly delayed, but it was due to scope change rather than impact of any decision making or planning. The scope change is also a proof for the success of VEF as it was accepted after complete analysis using VEF.

Other important benefits of VEF were recorded by implementation team as under:

- VEF defines a structured way for value elicitation, ultimately a structured way of decision making
- Appropriate selection of Value Elicitation Techniques for a given situation
- Value based decision making
- More confident & comfortable decision making as decisions are taken on the basis of actual value rather than mere guess

6.5. Experiences

- Success critical stakeholders (SCSs) were keener with regards to Business, Economic & Technical Value where as they were less focused on Social, Personal and Epistemic Values. This variation in focus was due to the nature of value dimensions as Economic and Technical values have direct and immediate impact on business. The other reason for less focus on social, personal and epistemic value is the subjective nature of these value dimensions.

- Implementation team requires the appropriate training to the process of VEF and complete understanding of value based software engineering concepts.

- The great difficulty was observed due to non availability of defined methods for application of some value elicitation techniques. There are some value elicitation techniques available in literature for elicitation of personal value & social value but their processes need to be defined, so that these techniques can be used and appropriate value can be elicited. This also indicates the clear dearth of work in the area especially for the epistemic value, personal value & social value.

- SCSs/Decision makers were surprised to see the proposed VEF positively as they experienced the difficulties (decision making on basis of mare guess, less involvement of concerned stakeholders etc.) in making important decisions at various stages of projects in the past. However; they were confident while decision making using VEF (Reported by SCSs in post implementation interviews).

Chapter 7 – Conclusion & Future Work

Value based software engineering is an emerging concept in IT industry and getting more popularity in recent years. The purpose of value based software engineering is to plan and execute the software projects in value based manner by keeping the value propositions of success critical stakeholder into consideration. According to this the project success and failure depends upon the value propositions of success critical stakeholders that means, a project cannot be successful until all the success critical stakeholders get their perceived value from the project. Different stakeholders have different value proposition about the things and they assign values in different perspectives. These value propositions are measured through value elicitation techniques by keeping the value dimensions into considerations. As the concept of value is not rooted in software engineering field, multiple concepts of value and value dimensions are adopted from different fields of literature like management and social sciences. Similarly, multiple value elicitation techniques are available, but the relationship of value, value dimensions and value elicitation techniques with software development is not clearly defined in the literature. Value based software engineering recommends to take project decisions by keeping the value propositions of success critical stakeholders into considerations but this is not clear that how these value propositions can be acquired and used for decision making. This all highlights the importance of value elicitation process, because the wrong value elicitation leads to the wrong understanding of stakeholders' value proposition and wrong decision making. Hence; it can cause the project failure.

In this research work, we have highlighted the process of value elicitation, value owners (success critical stakeholders), stakeholder identification techniques, value dimensions (the drivers of overall value) and their grouping on the basis of their nature, focus area and application perspective. In the end, a relationship framework of value elicitation techniques with project execution decisions/situation is presented to help select the appropriate value elicitation techniques for the given situation. This framework indirectly relates the value elicitation techniques with the organization's business objectives associated with the software projects through means of decision making on the basis of success critical stakeholders' value proposition. Value proposition are measured through value dimensions [5] and the value dimensions are elicited using value elicitation techniques. So, the value dimensions act as

mediator in this relationship as the decision making and value elicitation techniques both have direct relationship with value dimensions.

This is quite clear from the literature analysis that there is no hard and fast rule for selection and application of techniques due to the reason that the clear categorization of the techniques on the basis of value dimensions is not possible. This is because of the "many to many" relationship between the value elicitation techniques and value dimensions. However; recommendations can be given for the selection of techniques at given situations with reference to the value dimensions. The proposed framework helps in arbitrary decision making rather than rule based. It is very hard to get better results from value based software engineering without keeping the organization's policies in the focus. So, the organizational policies, especially the policies about the software development projects should also be tailored to give importance to the value dimensions.

In this research project first we have explained the concept of value, the value elicitation process, the actors (success critical stakeholders) involved in the process and value dimensions. Secondly, we have explored the stakeholder identification techniques and their base attributes from the available literature and then we have evaluated the stakeholder identification techniques against the base attributes. Third important contribution to the literature that is made during this effort is the study of value dimensions. We have explored the value dimensions from the literature of different fields of study and classified them into the six major classes of Business Value, Economic Value, Technical Value, Epistemic Value, Personal Value and Social Value. In the next step, we have presented a review of value elicitation techniques and identified their relationship with the value dimensions to make the selection of value elicitation techniques easy and more appropriates. Lastly a Value Elicitation Framework (VEF) is presented to facilitate the whole process of value elicitation and decision making. VEF presents a structured approach for value based decision making by involving all success critical stakeholder into the process and keeping their value propositions into consideration.

In order to validate the newly proposed VEF, a case study is conducted on a commercial project by executing the Value Elicitation Framework (VEF) on a complete lifecycle. Case study remained successful; project management team used the appropriate value elicitation technique based upon the situation to elicit value. On the basis of elicited values appropriate decisions were taken with consultation of all success critical stakeholders.

The case study further revealed that stakeholders showed great interest where the economic, business and financial value taken into considerations. Further, they were having less interest in social and personal values. The involvement of stakeholders is also a key area to highlight as SCSs were involved in each and every step of the implementation. Another important point to highlight is that value elicitation become subjective in case of personal, social and epistemic values as none of the available value elicitation technique is applicable for elicitation of these value dimensions. So, this area requires further investigation and study.

The future course of work should focus on the following problem streams:

- Application of Value Elicitation Framework on a large scale project for an extensive validation
- Definition or extension in existing value elicitation techniques catering the epistemic value dimension

References

1. Biffl S. & Halling M. 2002; A Value-Based Framework for the Cost-Benefit Evaluation of Software Inspection Processes. In Proceedings of Workshop on Inspection in Software Engineering, 2002.

2. Boehm B. & Jain A. 2005. An Initial Theory of Value-Based Software Engineering. USC-CSE-2005-502, February 2005.

3. Boehm B. 1989; Theory-W Software Project Management: Principles and Examples. IEEE Transactions on Software Engineering, Vol. 15, No. 7. July 1989

4. Boehm B. 2003; Value Based Software Engineering. ACM SIGSOFT, Software Engineering Notes, Vol. 28 No 2. 1-11

5. Samad J. 2008; VRRM: A Value-based Requirements' Risk Management Process. Thesis present at Muhammad Ali Jinnah University, Pakistan.

6. Samad J. & Ikram N. 2008; "Value based Requirements' Risk Management Process Model". Proceedings of IEEE International Multitopic Conference.

7. Biffl S., Boehm B., Erdogmus H., Aurum A., & Grunbacher P. 2006; Value Based Software Engineering. Germany: Springer-Verlag Berlin Heidelberg 2006, (ISBN-10 3-540-25993-7 Springer Berlin Heidelberg).

8. Khalifa A. S. 2004; Customer Value: A Review of Recent Literature and an Integrative Configuration. Management Decision, Volume Number 5. 645-666.

9. Symons C. 2006; "Measuring the Business Value of IT". White paper published at Forrester Research Inc.

10. Chen L. & Pearl P., 2004; Survey of Preference Elicitation Methods Human Computer Interaction Group Ecole Politechnique Federale de Lausanne (EPFL) CH-1015 Lausanne, Switzerland

11. Debrue G., 1972; Theory of Value: An Axiomatic Analysis of Economic Equilibrium. Cowles Foundation Monograph, Naval Research and the Social Science Research Council.

12. Heindl M., & Biffl S. 2005; A Case Study on Value-based Requirements Tracing. Proceedings of ACM, ESEC-FSE'05, 60-69.

13. Kothari A., & Lackner J., 2006; Value Based Approach to Management. Journal of Business & Industrial Marketing 21/4 (2006). 243–249.

14. Simmons P., 1996; Quality Outcomes: Determining Business Value. Published in IEEE Software. 25-32.

15. Sivzattian S., & Nuseibeh B., 2001; Linking the Selection of Requirements to Market Value: A Portfolio-Based Approach. 7th International Workshop on Requirements Engineering: Foundation for Software Quality (REFS 2001). Interlaken, Switzerland.

16. De Chernatony L., Harris F., and Riley F. 2000; "Added value: its nature, roles and sustainability", European Journal of Marketing, Vol. 34 No. 1/2, pp. 39-54.

17. Fernández R. & Bonillo A., 2007; Marketing Theory: The concept of perceived value: a systematic review of the research. Copyright © SAGE Publication, 2007

18. Payne A., Halt S. & Frow P. 2000; "Integrating employee, customer and shareholder value through an enterprise performance model: an opportunity for financial services", The International Journal of Bank Marketing, Vol. 18 No. 6, pp. 258-73.

19. Zeithaml V, 1988; "Consumer perception of price, quality and value: a means-end model and synthesis of evidence", Journal of Marketing, Vol. 52 July, pp. 2-22.

20. Woodruff, R.B. 1997; "Customer value: the next source for competitive advantage", Journal of the Academy of Marketing Science, Vol. 25 No. 2, pp. 139-53.

21. Hartman R.S. 1967; The Structure of Value: Foundations of a Scientific Axiology. Carbondale, IL: Southern Illinois Press.

22. Hartman, R.S. 1973; The Hartman Value Profile (HVP): Manual of Interpretation. Muskegon, MI: Research Concepts.

23. Parasuraman A. 1997; ""Reflections on gaining competitive advantage through customer value", Journal of the Academy of Marketing Science, Vol. 25 No. 2, pp. 154-61.

24. Susan A.S. 1995; The Three Dimensions of Software Risk: Technical, Organizational and People. Proceedings of the 28th Annual Hawaii International Conference on System Sciences (HICSS '95). 369-378.

25. Wieringa R., Gordijn J & van Eck P., 2004; Value Framing: A Prelude to Software Problem Framing. 1st International Workshop on Advances and Applications of Problem Frames, Edinburgh, IEEE.

26. Gordijn A., & Akkermans J.M. 2003; Value Based Requirements Engineering: Exploring Innovative e-Commerce Ideas. Requirements Engineering, 2003- Published by Springer-Verlag London Limited.

27. Preiss O. and Wegmann A. 2001; "Stakeholder's Discovery and Classification based on System Science Principles", 0-7695-1287-9/01 © 2001 IEEE.

28. Sharp H., Finkelstein A. & Galal Galal, 1999; "Stakeholder Identification in the Requirements Engineering Process". 0-7695-0281-4/99, 1999 IEEE.

29. McManus J. 2004; "A Stakeholder Perspective within Software Engineering Projects". International Engineering Management Conference 2004. 0-7803-8519-5/04, 2004 IEEE.

30. Joiner B.L. 1994; Fourth Generation Management: The New Business Consciousness, McGraw-Hill, New York, NY.

31. Groth J.C. 1994; "The exclusive value principle: a concept for marketing", Journal of Product and Brand Management, Vol. 3 No. 3, pp. 8-18.

32. Parolini C. 1999; The Value Net: A Tool for Competitive Strategy, John Wiley, Chichester.

33. Woolridge W., McManus J. & Hale E. 2007; "Stakeholder Risk Assessment: An Outcome-Based Approach". Published by the IEEE Computer Society 0740-7459/07 2007 IEEE.

34. Mitchell R., Agle B. & Wood D., 1997; "Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts". The Academy of Management Review, Vol. 22, No. 4 (Oct., 1997), pp. 853-886.

35. Kaiya H., Osada A. & Kaijiri K. 2004; "Identifying Stakeholders and Their Preferences about NFR by Comparing Use Case Diagrams of Several Existing Systems". Proceedings of the 12th IEEE International Requirements Engineering Conference (RE'04), 1090-705X/04 IEEE.

36. Sheth J.N., Newman B., & Gross B.L. 1991; "Why we buy what we buy: a theory of consumption values", Journal of Business Research, Vol. 22, pp. 159-70.

37. Bryson J.M. 2003; "What To Do When Stakeholders Matter: A Guide to Stakeholder Identification and Analysis Techniques" London School of Economics and Political Science 10 February 2003.

38. Hawker J., 2003; "A Three-Way Stakeholder Structure for Software Engineering Course Projects", International Conference on Software Engineering, 2003.

39. Ballejos L., & Montagna J. 2008; "Method for stakeholder identification in inter-organizational Environments", Requirements Eng (2008), Springer Verlag London Limited, September 2008.

40. Sheth J.N., Newman B., & Gross B.L. 1991; "Why we buy what we buy: a theory of consumption values", Journal of Business Research, Vol. 22, pp. 159-70.

41. Robertson S. 2000; "Project Sociology: Identifying and involving the stakeholders", Copyright © 2000 The Atlantic Systems Guild Ltd.

42. Parent M. & Deephouse D., 2007; "A Case Study of Stakeholder Identification and Prioritization by Managers", Journal of Business Ethics (2007) 75:1–23 _ Springer 2007.

43. Vries H., Verheul H. & Willemse H. 2004; "Stakeholder Identification in IT Standardization Processes", Standard Making: A Critical Research Frontier for Information Systems, MISQ Special Issue Workshop, 2004.

44. Eden C., & Ackermann F., 1998; Marketing Strategy: The Journal of Strategic Management London: Sage Publications.

45. Bryson J.M. 2004; "What to do when Stakeholders Matter: Stakeholder Identification and Analysis Techniques", Vol. 6 Issue 1 2004 21-53 Public Management Review, 2004 Taylor & Francis Ltd.

46. Pacheco & Tovar, 2007; "Stakeholder Identification as an Issue in the Improvement of Software Requirements Quality", J. Krogstie, A.L. Opdahl, and G. Sindre (Eds.): CAiSE 2007, LNCS 4495, pp. 370–380, 2007.© Springer-Verlag Berlin Heidelberg 2007.

47. Janita C., & Marjolein E. 2006; "Stakeholder identification in innovation projects Going beyond classification", European Journal of Innovation Management, 2006. Emerald Group Publishing.

48. DFID, 2001; Sustainable Likely hood Guidance Sheet, Department for International Development, London.

49. PMI, 2004; "A Guide to Project Management Body of Knowledge. Third Edition", PMI Standard.

50. McManus J., & Wood-Harper T. 2008, "A Study in Project Failure". British Computer Society, 2008. http://www.bcs.org

51. AIPP, 2001; Stakeholder Identification Tool # 8; International Association for Public Participation, 2001.

52. Merriam-Webster Dictionary

53. Wikipedia, 2008-09; The online Encyclopedia.

54. Bryson J.M., 1995; Strategic Planning for Public and Nonprofit Organizations (rev. edn), San Francisco, CA: Jossey-Bass.

55. Anderson S.R., Bryson J.M., & Crosby C.B. 1999; Leadership for the Common Good Fieldbook, St. Paul, MN: University of Minnesota Extension Service.

56. Bryant J., 2003; The Six Dilemmas of Collaboration: Inter-Organizational Relationships as Drama, Chichester, England: John Wiley & Sons.

57. Nutt P., & Backoff R, 1992; Strategic Management of Public and Third Sector Organizations: A Handbook for Leaders, San Francisco, CA: Jossey-Bass.

58. Bach C., Belardo S., & Faerman S.R. 2004; Employing the Intellectual Bandwidth Model to Measure Value Creation In Collaborative Environments. Proceedings of The 37th Hawaii International Conference On System Sciences, 2004.

59. Zhu K., Xu S. & Dadrick J., 2003; Assessing Drivers of E-Business Value: Results of a Cross-Country Study. Twenty-Fourth International Conference on Information Systems.

60. Kothari A. & Lackner J., 2006; Value Based Approach to Management. Journal of Business & Industrial Marketing 21/4 (2006). 243–249.

61. Clemons D.S. and Woodruff R.B. 1992; "Broadening the view of consumer (dis)satisfaction: a proposed means-end disconfirmation model of CS/D", in Allen et al. (Eds), Marketing.

62. Theory and Applications, American Marketing Association, Chicago, IL, pp. 209-16

63. Glinz M., & Wieringa R., 2007; Stakeholders in Requirements Engineering, IEEE Computer Society, 0740-7459/07/© 2007 IEEE.