A Framework for Eliciting Value Proposition from Stakeholders

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Abstract: - Eliciting the value proposition in Value Based Software Engineering (VBSE) is critical. Everything within VBSE is dependent on the value propositions of success critical stakeholder (SCSs). This paper present presents a novel approach for elicitation of value from the SCSs from different dimensions. We propose a Value Elicitation Framework (VEF) in order to resolve the problem of selection and application of appropriated value elicitation technique for a given situation. We applied the VEF on a small commercial project to demonstrate the execution of VEF in practice and evaluate its effectiveness. Results show that decision makers felt more confident in decision making while using VEF as decisions are taken on basis of actual value rather than mere guess. We also found that SCSs were mainly using Business, Economic and Technical Values in making decisions.

Key-Words: - Value Elicitation, Success Critical Stakeholders (SCS), Stakeholder Identification, Stakeholder Identification Techniques, Value Elicitation Techniques, Value Elicitation Framework.

1 Introduction

Value based software engineering depends upon the value of software and its requirements due to which the correctness of value and value elicitation process becomes very critical. In literature value elicitation is presented as one of the seven key elements of value based software engineering [3]. Value elicitation is not a simple task as there are a lot of intangibles 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 other side value has its own dimensions and perspectives. SCSs are the most important to consider as every stakeholder may have different value propositions and these propositions may change over the period on time [4]. All these components of value elicitation process make it more complex and require more in-depth analysis of the process. In this paper value elicitation process is presented with all its necessary details that include: review and analysis of stakeholder identification techniques, analysis & grouping of value dimensions and review and analysis of value elicitation techniques. After detailed analysis of all components, a Value Elicitation Framework (VEF) is presented in order to facilitate practitioners in value elicitation. VEF shall provide great deal of benefits to project managers, software engineering practitioners, risk managers, requirements engineers, software developers, business owners and executive management.

Before going into details, it is better to highlight the problem with a little background. In software engineering, the concept of value was first introduced in late 1980s with introduction of Theory W [2] of Software Project Management. In recent years VBSE is getting more popularity hence; it is an active research area in the software industry. Value based software engineering claims that a software project/product cannot be successful unless all SCSs get their perceived value from the project [1]. This is due to the reason that today and increasingly in future, software has major influence on most System's cost, schedule and value resulting software decisions extraordinary intertwined with System level decisions [4].

VBSE assigns values to the things and concept that are used for decision making at different situations in project life cycle. The values are determined by the SCSs [1], [3] taking value dimensions into consideration [4], [5] using value elicitation techniques. Different value elicitation techniques are available in software engineering, management and behavioral sciences but, it is very difficult to select appropriate value elicitation technique(s) for a given situation as there are no such criteria defined that can help in this regard. The techniques which are in practice mostly focus on financial value, however focusing only one aspect of value may lead towards wrong value elicitation hence to the less appropriate decision making. Value based software engineering intends to pay the required attention to all dimensions of value that are normally neglected in the whole process. The proposed Value Elicitation Framework is an attempt to simplify and structure the value elicitation process, in order elicit more accurate value and use it in an effective way. The ultimate objective is enhanced decision making

2 SCSs Identification

The general term of "stakeholders" is very broad and covers a wide range of individuals and entities those can affect or get affected by the project. However, some stakeholders become very important for the success of the project. In VBSE such stakeholders are referred as "Success Critical Stakeholders (SCSs)" [4]. Identification of SCSs is critical in context of software engineering as the software requirements originate from them. The chances of missing out software requirements exist due to identification of wrong SCSs that may leads to project failure [33]. Similarly in VBSE, value is determined by SCSs [1] [4] and identification of wrong SCSs may lead to the wrong value perception and decision making, hence; to the project failure.

2.1 Stakeholder Attributes

Literature reveals that a number of techniques are available for identification of SCSs however evaluation of these techniques is required in order to find the best suitable techniques for stakeholder identification. Identification of SCs is done based upon some stakeholder attributes. The said attributes are available in all techniques with different titles containing the same underlying concepts [21] [27] and can be used as criteria for evaluation of stakeholder identification techniques. Attributes that are discussed in the literature include:

- 1. Power [21] [19] The ability of one stakeholder to make another stakeholder do something that he would not otherwise have done.
- 2. Influence [27] Influence can be defined as effect, impact or action of a stakeholder which affects another stakeholder.
- 3. Legitimacy [21] Legitimacy is the degree to which the firm and the stakeholder find each other's actions, desirable, proper, or appropriate.
- 4. Urgency [21] The degree to which stakeholder claims or calls for immediate attention.
- 5. Interest [27] [19] Interest is something that concerns, involves or draws the attention of, or arouses the curiosity of a person.
- 6. Interaction/Involvement [21] [27] Normally referred to as participation of stakeholders during the project lifecycle.
- Role & Responsibilities [24] Role is the function or position assigned to a particular stakeholder during the software project lifecycle.
- 8. Requirements Requirements are something wanted or needed; something essential to the existence or occurrence of something else.

Similarity and duplication of concept among different attributes were found after careful analysis and need of grouping of attributes based upon their similarities and importance came into existence. It is quite clear from literature that power is one of the most important attribute used for stakeholder identification. 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. Power is also a too used to influence. So, we can combine all these attributes into one abstract terminology "influence" to avoid duplications.

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. 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.

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.

2.2 Stakeholder Identification Techniques

The general term of "stakeholders" is very wide covering a large domain of the individuals and the entities which 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 1. 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 "Definitive the third attribute to become 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 [21], [27].
- Baseline-Outward Approach This technique 2. 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 [19].
- 3. 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 [27].
- 4. 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 [26], [27].

- 5. 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 twoway 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 [26].
- 6. 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 [27], [35].
- 7. 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 [26], [27].
- 8. 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 [27].

- 9. 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 [27], [36]. The power-interest diagram is base of this technique.
- 10. 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 [27], [37].
- 11. 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 [27], [36].
- 12. 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 [28].
- 13. 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].

- 14. 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" [25].
- 15. 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 interorganizational environments. A systematic approach is used to group different stakeholder who can directly on indirectly affect or get affected by the inter-organizational system [23]. 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 [23].
- 16. 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 [28].

- 17. 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 [38].
- 18. 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 can not handle stakeholders that are related to the development process like software designers and programmers [34].
- 19. 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 [22].
- 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 [24]. 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 [24]. 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 [24].

2.3 Analysis & recommendations

After reviewing the available literature, total set of twenty stakeholder identification techniques were found and evaluated against the final five stakeholder attributes. Techniques v/s Attributes Relationship Matrix is designed and presented here (Table: 1) in order to evaluate stakeholder identification techniques. The matrix shows the relationship between techniques and attributes and highlights the focused attributes against each technique. Selection of appropriate technique is left with the expert judgment of project management team after carefully analyzing the given situation. However, the base for this selection is provided in terms of techniques v/s attributes relationship matrix.

The analysis highlights that there is no single technique available covering all core attributes that can serve as standard technique to answers the questions about stakeholder identification. However, two techniques: Theory of Salience and Power-Interest Grid are basic techniques that are used for identification of stakeholders. Many techniques are derived from these two that can also be used depending upon the situations to get the betters results. Some case studies are also reported about Theory of Stakeholder Identification and Salience, Baseline-outward approach for Stakeholder Identification, the basic stakeholder analysis technique, Power-Interest and Stakeholders' grid influence diagrams that is proof for their success. So, these are more trustworthy and advisable to use however, other techniques can provide good results if the selection of the techniques is done by analyzing the situation carefully.

CN	Stakeholder Identification Techniques	Attributes					
5IN		Influence	Legitimacy	Urgency	Interest	Role	
1	Theory of Stakeholder Identification and Salience [21] [27]	\checkmark	\checkmark	\checkmark			
2	Baseline-outward approach for Stakeholder Identification [19]	\checkmark			\checkmark		
3	The basic stakeholder analysis technique [27]	\checkmark			\checkmark		
4	Power versus interest grid [26] [27]	\checkmark			\checkmark		
5	Stakeholder influence diagrams [26]	\checkmark			\checkmark		
6	Participation planning matrix [35]	\checkmark			\checkmark		
7	Bases of power and directions of interest diagrams [26] [27]	\checkmark			\checkmark		
8	Finding the common good and the structure e of a winning argument [27]	\checkmark			\checkmark		
9	Tapping individual stakeholder interests to pursue the common good [27][36]				\checkmark		
10	Stakeholder issues interrelationship diagram [27] [37]	\checkmark			\checkmark		
11	Problem frame stakeholder maps [27] [36]	\checkmark			\checkmark		
12	Stakeholder analysis diagram [28]	\checkmark				\checkmark	
13	Stakeholder Identification (Tool No. 8) [31]				\checkmark		
14	Stakeholder identification in Standardized Process [25]	\checkmark		\checkmark			
15	Inter-organizational environment [23]	\checkmark			\checkmark		
16	Stakeholder Identification Model [28]				\checkmark		
17	Stakeholder Identification by Classification. [38]				\checkmark		
18	Stakeholder Identification using Use case diagrams. [34]				\checkmark	\checkmark	
19	Three-way Stakeholder Structure [22]					\checkmark	
20	Project Sociology [24]					\checkmark	

Table 1: Stakeholder Identification Techniques v/s Attributes Relationship	Matrix
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3 Value Dimensions

As we discussed that value is determined by success critical stakeholders [1], however; stakeholders do this according to their knowledge, expertise and work domain [4]. Classification of value according to stakeholders' domains results into different types/classes of overall value. In VBSE these types/classes are termed as value dimensions. As far as total no. of value dimensions is concerned existing literature review presents financial value, economic value, business value, organizational value, strategic value, technical value, end system value, personal value and environmental value as value dimensions [4]. Extending the existing literature review, some more value dimensions are identified so the total set of value dimensions include: Technical value, Economic value, Personal Value, Financial value, Strategic value, Business value, Esteem value, Exchange value, Utility value, Psychic value, Organizational value, End system, value, Environmental value, Emotional Value, Practical Value, Logical Value, Hedonic Value,

Functional Value, Social Value, Epistemic Value, Conditional Value.

The management of such a large number of value dimensions is a big question that identifies the need of grouping or classification of these value dimensions. So, we have grouped these value dimensions according to their nature and focus area and finalized total set of six value dimensions. The grouping is done after careful analysis of literature on the subject. Final value dimensions are:

- Business Value is a term used to expand the concept of value beyond just economics. It refers to the short and long term business objectives [4] [5]. Business value does not hold only tangible benefits but also intangibles [9]. In Software Engineering and Information Technology, the Business Value is aligned with some important factors, business processes, organization structures, and strategies.
- 2. Economic Value is the value of an asset deriving from its ability to generate income. It is financial in nature but not limited to finance only [4] [5] [6].

- 3. Technical Value deals with technology and its integration with other domains. It refers to the value creating properties of information system [4] [6].
- 4. Epistemic Value deals with the acquisition of knowledge from the lives and/or experiences of individuals and society. In IT and management 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 [11].
- Personal Value deals with human's personal issues and behaviors and may very from person to person. It includes emotional, conditional, psychological, psychic, ethical etc. type of value [4].
- 6. 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 of consumer [6].

4 Value Elicitation Techniques

Value elicitation techniques are necessary for realistic value elicitation. Currently the value elicitation is done in subjective manner based upon expert judgment of success critical stakeholders [4]. This subjective value can give a qualitative value of system features but you cannot judge the actual value of the system in monitory terms. Here we have investigated some value elicitation techniques that are being used in different domains including project management, general management, behavioral science etc. Some of these techniques are already used in software domains but in different contexts. In order to find the available techniques, a detailed literature survey is conducted and 16 techniques are identified and presented that can be used for elicitation of different value dimensions.

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 [6].

Such like other models of the same kind 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 [4]. 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. The psychic factors, contributing to Exclusive Value Premium (EVP), are internal and external in nature [31], [6].

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.

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 [6]. 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 [30]. The stakeholders can make important decisions like the investment of their finite resources in some quality attributes [6].

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. 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)
 - $CPV3 = core value \pm added value$

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 [6]. 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 [6].

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.

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 [14].

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 over all 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. This technique covers the business value along with the economic value dimensions.

- 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 financials benefits, similarly total costs include the monetary and non-monetary values [6] 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 [6], [39] and [13].
- 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 [6]. 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. [13]

- 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 [6]. 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:
- 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 [7].

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.

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 [7].

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 including Costs, Benefits, Flexibility and Risk analysis. 11. Val IT – Val IT is a framework to measure the value of IT. This was proposed by IT Governance Institute (ITGI) [7]. 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.

- 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 [7]. It also combines the intangibles for the purpose. The constituent elements are: Software metrics. Operations research, Modern portfolio theory, Actuarial science, Options theory and 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.
- 13. Earned value Management Earned Value Management (EVM) is a very useful technique to

measure the project's progress objectively [30]. 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 are: Planned Value (PV), Earned Value (EV), Actual Cost (AC).

The basic elements are applied in combination to know the estimates, forecasts and variances to the baselines of scope, schedule and cost. The subtechniques of EVM are:

Cost Variance (CV) = EV - ACSchedule variance (SV) = EV - PVCost Performance Index (CPI) = EV/ACCumulative CPI (CPIC) = EVC/ACCSchedule performance index (SPI) = EV/PV

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 [30]. It covers the value dimensions of Business and Economic Value. The NPV can be calculate in the form of sum of all terms

Rt/(1 + i)t, Where t is the time of cash flow while i represent the discount rate; and Rt 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
- 15. Total cost of ownership (TCO) determines the real attribute of costs associated with the infrastructure for information technology. It takes the costs into

	Value Elicitation Techniques	Value Dimensions					
SN	Techniques	Business	Economic	Technical	Epistemic	Personal	Social
1	Model of Customer Perception [6]	\checkmark				\checkmark	
2	The Exclusive Value Principle [6] [20]		\checkmark			\checkmark	\checkmark
3	Cost Benefit Analysis Method [6] [30]		\checkmark	\checkmark			
4	Customer Perceived Value [6]		\checkmark				
5	Customer Value Hierarchy [12]		\checkmark				
6	Value Exchange Model [6] [13]		\checkmark			\checkmark	
7	Value Build up Model [6]		\checkmark				
8	Value Dynamic Model [6]		\checkmark			\checkmark	
9	Business Value Index (BVI) [7]		\checkmark				
10	Total Economic Impact (TEI) [7]		\checkmark				
11	Val IT [7]		\checkmark				
12	Applied Information Economics (AIE) [7]		\checkmark				
13	Earned value Method [30]		\checkmark	\checkmark			
14	Net Present Value [30]		\checkmark				
15	Total Cost of Ownership [30]		\checkmark				
16	Return on Investment [30]		\checkmark				

Table 2: Value Elicitation Techniques v/s Value Dimensions Matrix

two streams of direct and indirect costs covering all the attributes of the infrastructure [30]. 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.

16. Return on Investment – This technique returns the net earning 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 [30]. 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.

Identified value elicitation techniques were carefully analyzed against the six value dimensions and relationship between value dimensions and techniques are highlighted (presented in Table 2). This relationship will be further used for selection of appropriate value elicitation technique based upon required value dimensions for the given situation

5 Value Elicitation Framework

After analyzing all the components of value elicitation process here we propose Value Elicitation Framework (VEF) in order to resolve the problem of selection and application of appropriated value elicitation technique for a given situation. In addition to this proposed framework facilitates 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 value dimensions, value elicitation techniques and the given project situation. It is important to mention that value dimensions are the common linkage between value elicitation techniques and project situations hence can serve as criteria for selection of appropriate technique. SCSs are the key players in the whole process as the value determination and lie with them.

Value Elicitation framework consists of six high level activities. Figure: 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. The activities of VEF are:

5.1 Identification of SCSs

VEF starts with identification of SCSs. Project Management Team should have keen focus on it for effective decision making. The engagement of SCSs should remain from beginning to end of the project lifecycle.

Identification of success critical stakeholders can be done using any appropriate stakeholder identification technique. Selection of appropriate technique is quite a tricky job as multiple techniques are in practice. However, following the criteria and guidelines presented in section 2 can make this selection easy and provide better results.

5.2 Identification of Important Value Dimensions

Different SCSs may have different value proposition for the system at different point of time [4]. Keeping this phenomenon into consideration, SCSs analyze the given situation carefully and identify that which of the six value dimensions 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 like; Brainstorming, Delphi technique, SWOT Analysis, Decision Tree etc. The Project Management Team and SCSs should rely on their experience to analyze 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. Selected value dimensions will be further used as criteria for selection of value elicitation technique.

5.3 Comparison of Value Dimensions and Value Elicitation Techniques

After identifying the important value dimensions, this activity looks of the common linkage among value dimension, given project situations/decision and value elicitation techniques. As VEF facilitates the project management team to select appropriate value elicitation techniques for any given situation, it is necessary to identify the linkage of value elicitation techniques with project decisions. The analysis (presented in previous sections) shows that value dimensions are the common linkage between the project decision/situations and the value elicitation techniques as the project decisions and value elicitation techniques both focus on value dimensions and provide grater assistance in foundation understanding the for relationship

Figure 1: Value Elicitation Framework



framework. Table 2 compares the available value elicitation technique with value dimensions to provide the bases for the technique selection process.

5.4 Selection of Value Elicitation Technique

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

Selection of value elicitation technique(s) is done using the Value Dimensions vs Value Elicitation Techniques Matrix. Value dimensions identified in the second activity of the VEF serve as criteria and techniques covering the important value dimensions are selected. Multiple techniques can be selected and applied for a single decision if they cover the value dimensions required for the decision making. Application of multiple techniques to elicit the required value put more accuracy in the resulted value.

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 by strictly following the guidelines of selected value elicitation techniques. The elicited values must be recorded along with the context carefully for further reference in the decision making process.

5.6 Value Analysis & Decision Making

The recorded values are now analyzed along with the context and should be presented to SCSs for facilitation in decision making. The analysis techniques given as reference object can 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 from the process. Along with the elicited values, the general management skills become important at this stage to choose viable alternate decisions. The final decision is much more competent to be presented to SCSs as it is resulted from the sophisticated process of decision making based upon the concept of value. The SCSs remain 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 less appropriate decisions.

6 Case Study

As the VEF is a newly proposed framework for value elicitation and decision making, its effectiveness and practicality is yet to be validated. In order to validate the claims of VEF we have conducted a case study on a small scale commercial project. The objectives of said case study were to answer the questions given as under:

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

Validation of VEF resulted into answering the research question of "how to select appropriate value elicitation technique for the given situation". It was also required to be validated that simplified process of value elicitation will ultimately improve the decision making during project lifecycle. In addition to this all case study served as a demonstration of VEF to clarify its execution process.

6.1 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.

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

Table 3: Project Decisions, Value Dimensions & Selected Value Elicitation Techniques

<u>**Propositions**</u> – 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.

<u>Unit of Analysis</u> – The unit of analysis is the chosen commercial "software development project".

<u>Logic Linking of Data to the Proposition</u> – 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)

9.1 Case Study Execution

The qualitative case study executed to answer the questions defined in above sections. All the activities of Value Elicitation Framework were executed as per its guidelines and results were documented at each stage. Table: 3 presents the decision points during the project lifecycle, important value dimensions and value elicitation techniques selected for value elicitation and decision making. Identification of important value dimensions was done by success critical stakeholders analyzing the situation carefully. After that appropriate value elicitation techniques were selected using value elicitation techniques vs value dimensions matrix presented in Table 2. After selection of techniques values were elicited and decision alternatives along with their associated values were presented to success critical stakeholders for analysis and decision making.

6.3 Results

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 basis of actual value rather than mere guess

6.4 Experiences

Following experiences were recorded during the execution of case study:

- 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).

Case study resulted into successful validation of VEF; however it was a small scale implementation and cannot justify the decision making on a large scale project.

7 Conclusion

VEF simplifies and structure the value elicitation and decision making during project lifecycle. It introduces concept of value in decision making that provides a solid base for decision making rather than mere guess. VEF is designed after in-depth analysis of all prerequisites of value elicitation process including identification of SCSs, analysis of value dimensions and survey and analysis of value elicitation techniques. VEF defines criteria for selection and application of value elicitation techniques for decision making in the form of elicited value. VEF is successfully validated on a small scale commercial project and experiences are shared. However; we feel that this validation is not enough to declare VEF a successful framework for the purpose.

We recommend another validation of VEF on a large scale project as future work, so that all aspects of value can be covered. Another future work in this context should be designing the value elicitation techniques for elicitation of Personal, Social and Epistemic value.

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