Advancing Risk and Value Management Practices for Processes and Products

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ABSTRACT

During the last decades software has become an important part of our everyday life in the form of various information processing intensive products and services. The competition between software companies has risen considerably and at the same time the importance of cost efficient and value creating software development has been recognized in many companies.

Value Engineering has been a usable to method for developing high value products for several years. Earlier it has been applied successfully to software process as well as to software product development. Normally the development of high value products contains also several risks. Combination of efficient value management practices and risk management is one possibility to try to avoid the most dangerous risks to realize for planned value.

This research combines Value Engineering and risk management practices into a usable new method in order to better respond to the challenges that risks might cause to the value of software products and their development. This is done in part by defining the concepts of value, worth and cost and in part by defining the Value Engineering process with necessary risk management practices.

Three practical industrial cases show that proposed two-dimensional method works in practise and is useful to assessed companies.

Keywords: software product and process improvement, value, worth, cost, Value Engineering and risk management.

1. INTRODUCTION

The objective of the value-based approach [8] is to find ways to eliminate value loss in software development, software products, and software process improvement (SPI) using the value assessment framework of Koskela and Huovila [3]. Value-based approach uses economic-driven tools, which are based on economic studies including, for example, the areas of cost estimation, cost calculation (for example ABC and life cycle costing) and investment calculation. The value-based approach prefers calculating costs instead of estimating them, and also considers software development and SPI as investments, on which it is possible to spend too much money [2, 10]. In practice, it takes care that the customer requirements are met in the best possible manner, ensuring quality, timeliness and value in products as well as in processes, over their entire life cycle. In particular, the aim of ensuring quality connects it to the other methods aiming for quality improvement.

The value-based approach indicates a clear dependency between the process and products. It sees that we need to develop and optimize process activities so that processes produce the products needed. Furthermore, it sees that we must analyze products in order to reveal problems in processes and develop processes from the product point of view as well. This is vitally important, especially for companies respecting customer opinions and aiming to optimize costs in their processes, because the customers are the ones paying for the products and product-related services, and companies have to allocate all costs to products to be able to price them. The happier the customer is, the more worth he sees in buying the products from us. It is also clear that when we know our process and product costs, worth and value, our ability to estimate, budget and control future risks will improve significantly.

Value-based approach combined with risk management integrates value and risk management together in a way, which takes into account risks when developing high value products. It enables efficient value creating software development, where the economical effects of risks are taken into account.

The purpose of this study is to collect experiences of combined value-based approach and risk management using value assessment combined with risk management. In more detail the purpose is to answer to following questions:

- How the proposed value assessment combined with risks management works in practice?
- Whether the company assessed sees the value assessment combined with risk management useful?

2. VALUEAND VALUE ENGINEERING PROCESS

Value Engineering (VE) methodology is widely known and accepted in the industry. It is an organized process with a history of improving value and quality. The VE process identifies areas in which unnecessary costs can be removed, while assuring that quality, reliability, capability, and other critical factors will meet or exceed the customer's expectations.

Even though there are several definitions in the literature for the VE process, they all have similarities. They state that VE collects and analyzes value-related information, to create new ideas using the analyzed results and to evaluate and further develop them into a meaningful package, with the reduction of costs or the increase of worth and improvement of value as ultimate goals. [8,9]

In practice, the value improvements developed are the result of recommendations made by a multidisciplinary team representing all the parties involved in the subject studied, and led by a facilitator. Development ideas are systematic efforts to improve the value and optimize the life cycle cost of a function or facility. It is vitally important that the VE team has technical as well as cost-accounting knowledge. A wide range of companies and establishments have used VE effectively, to achieve their continuous goal of improvement in the decision-making process.

This study categorizes VE process into three main phases: pre-study (orientation), value study (information, function analysis, creativity, evaluation, development, presentation), and post-study (monitoring, implementation). These phases are considered appropriate since they constitute independent areas of VE and have been justified in earlier discussion.

According to VE, value is a measure – usually in currency, effort or exchange, or on a comparative scale – which reflects the desire to obtain or retain an item, service or ideal. Cost is the price paid or to be paid. It can be divided into elements and, to some extent, functions. Park [9] defines cost as "an expenditure of money, time, labor, etc., to obtain a requirement." Worth is usually defined as the lowest cost to perform the required function, or the cost of the lowest-cost functional equivalent. The most typical definition for value, is perhaps (1):

$$Value = \frac{Worth}{Cost} \qquad (1)$$

where:

Value = The value of some object, product, service or process.
Worth = The least cost to perform the required function (product, service or process), or the cost of the least cost functional equivalent. If possible can also be the worth in money, what customer sees in product, service or process.
Cost = The life cycle cost of the object, product, service or process (price paid or to be paid).

Since VE has a rather long history it has been improved, combined and used together with several other methods. Syverson [12] has stated that Quality Function Deployment (QFD) is a problem/opportunity identification; VA is a problem/opportunity solving method and therefore, they compliment each other. In his opinion QFD provides a method to convert customer expectations into quantified technical design characteristics and development of the product plan. Furthermore, it assures that you are developing a "right product" and VE assures that you are doing it the "best way."

Noda & Tanaka [4] have seen VE as: "an essential technique to Target Cost Management (TCM)." They also state that TCM will not be successful without VE because it is very difficult to achieve the tight target cost within a limited period of time by R&D staff efforts alone. They continue that there are two kinds of VE procedures: one is "schedule type" and the other one is "problem-solution type." In the former type of procedure, VE is regarded as a step in the development and design phase and is implemented as an important step in development and design activities. "Problem-solution type" VE is designed to solve unexpected issues such as functional problems or other issues that will interrupt achievement of the target cost. Furthermore, Tanaka & Noda [4] state that VE's role in TCM is most important and essential for cost and value improvement.

In reference to VE and cost accounting, Smith *et al.* [11] have proposed a managerial framework containing an Activity-Based Costing, Target Costing and VE combination to achieve superior improvement in supply chain processes' performance.

Al-Yousefi & Hayden [1] have combined VE with TQM. They state that: "…as our firms continue their VE/TQM journey, the notion of re-inventing or re-engineering is surfacing. The mind-set for re-engineering moves back from solving the apparent problem, and takes a "what if …" approach to major portions of the process. This immediate moving to problem-solving is referred to by many as "the

soft side" of TQM." They continue that at times they hear firms rejecting the soft side of TQM, wanting to get to the "hard part", process improvement using VE as well.

In the following chapters this study discusses about the possibilities to combine value and risk into each other. Furthermore, the last chapter outlines the experiences of using proposed enhancement in practice.

3. COMBINING VALUE AND RISK

The general objective of the value-based approach [8] is to find ways to eliminate value loss in software development, software products, and software process improvement (SPI) using the value assessment framework of Koskela and Huovila [3]. Therefore it is natural that value management aims to define value in developed processes and products.

As customers understanding of worth in a product can change during the development, there is a risk for worth losses. As well even manufacturing and development costs would have been defined using the best possible understanding they can change during the development process, which can be seen as cost risk.

Value-based approach combined with risk management takes into account all risks in processes and product development. The definition for the value including risk effect (=Value R) is therefore (2):

Value R = (Worth – Worth risk) / (Cost – Cost risk) (2)
where:

Value R = The value after risk effect.
Worth risk = The amount of worth risk.
Cost risk = The amount of cost risk.

There are probably several ways to calculate the effects of risk for worth and cost. One possible way is to see that all risks can be evaluated using their probability and severity. According to this possibility the probability shows how likely risk will occur and severity how big the impact of it is. Using an example we could see that there is 20% likelihood that costs are overrun. If the severity of it is for example 10 000€, the potential cost risk is 0.2x10 000€ =2 000€. On the other hand if there is 10% likelihood that customers do not see as much worth in our product as defined (they come for example too late to the markets) and this severity is 10 000€ is the worth risk 0.1x10 000€ = 1 000€. If the planned value = 20 000€ / 10 000€ =2 is the value if defined risks will realize, value = (20 000€-1000€) / (10 000€+2 000€) = 1.58.

4. VALUE BASED ENHANCEMENTS TO SOFTWARE ASSESSMENT

In the earlier discussion it has been shown that there are four ways to enhance a standard software process assessment using VE [5, 6, 7, 8]. The first possibility includes an addition of defined VE process into the existing process models of used capability assessment method (for example in CMMI or SPICE).

How can we then take into account the risks related to the process value when implementing the capability assessment? One possibility is to assess the capability of value management process together with risk management process and combine the results together. This would enable us to see better how capable we are in understanding the value creation in our company and what are the risks related to it. The second possibility is that we use capability assessment method which already includes risk management process and we assess risk management process separately. If we then are also interested in of value we can define a new value management process to the used method and also assess it separately as part of capability assessment method in question. [5, 6, 7, 8] In both examples we get capability information of both processes.

The second possibility has covered Value Assessment for processes defined in used process model. The main idea of this enhancement is to run through all defined VE phases and as part of it calculate costs, worth and value for each assessed process existing in used process model. If company has implemented also a normal capability assessment, after Value Assessment it knows both value and capability of each assessed process and has a significantly better start for its process improvement work. [5, 6, 7, 8]

In this alternative perhaps the most usable way to take the risk into consideration is first to assess the value as proposed in the earlier discussion. [5, 6, 7, 8] In the second (new) phase it would then be possible to implement the value assessment again using the same process and/or product structure with the difference that in this assessment we would concentrate on finding out all risks and evaluate their effects for the worth, cost and value.

The third possibility for assessing value has included Value Assessment for processes without process model. The purpose of this enhancement is to find out from company's own defined process descriptions all process practises which are then examined from cost, worth and value point of views using VE process. [5, 6, 7, 8] As this alternative is similar from the value point of view to the second

alternative it seems possible and natural to take risks into account in a similar way in this alternative.

The fourth possibility has included Value Assessment of a product. This enhancement examines Value of product components and requirements and reveals value improvement possibilities in them. This possibility sees that partially, the product improvement ideas are reflected also to process development work, because in this enhancement, product is seen as an output of processes. [5, 6, 7, 8] In practise, it would be most recommended to assess first the product value and then the product risks for the same product. This is because this way risk management work would have a more solid basis and could be completed better.

5. EXPERIENCES OF INDUSTRIAL ASSESSMENTS USING VALUE ENHANCED ASSESSMENT

The usability of proposed method was experimented in three industrial assessments. These assessments were implemented in 2007. Assessed companies represent typical international electronic companies producing products containing software.

Assessment in Company A

In the first capability-maturity -based assessment including VE and risk management processes, new points arose. First, it was observed that people were performing value analysis, risk management and improvement actions at the SPU (Software Producing Unit) as well as at the project level. Mostly these actions were planned on many occasions but often they were not improved at all. It was rather surprising to see that human resources-related functions were planned with the most precision, and included improvement planning for value and risk management, whereas many technical functions were lacking systematic value improvement and risk management related actions. The capability-maturity -based assessment including VE and risk management processes was seen as usable help for the assessed company. The highest capability levels, company achieved in phases related to value data collection and lowest in phases related to its evaluation and development. Company also got low capability level in taking into account risks related to value creation.

In practical terms, the capability-maturity -based assessment for the VE and risk management processes worked well in Company A. In the final assessment meeting, the discussion seemed to bring up several possibilities for the improvement of quality, customer satisfaction, and the reduction of production cost and risks.

As conclusion several interviewed persons saw that capability information of value and risks is not necessarily enough. They stated that it would be clearly better if there would be a possibility to calculate monetary value for processes and monetary value for the risks as well.

Assessment in Company B

The value assessment in Company B was based on focused evaluation of both processes and products. The results show that there exists a practical need to enhance the scope of software engineering in a value-driven direction combined with risk management. This is because Company B showed an interest not only in value assessment itself, but also in building up a cost accounting system for process practices and product components to be able to track value and costs of risks.

The results also show that Company B needed a two-dimensional assessment, which evaluated both processes and products. Therefore, the theoretical claim that process-focused assessment alone is not enough to start improvement was also justified. As well, the results show that risk management view completes assessed value by indicating to the company which are the most important areas to be managed from both value and risk point of views.

According to Company B the assessment process worked as planned, and the phases from creativity to presentation were also useful in combining value and capability-maturity -based assessment results. From Company B's point of view the information collection phase collected enough information for the next VE phases. It also provided opportunities to discuss the needs of the company. The most significant result of the information phase was perhaps that Company B already knew that it needed a better cost accounting system which would justify the areas in which process- and product-related improvement should be done. Cost estimation alone was not seen as enough for these purposes even estimations were made using the main cost-driving variables, such as working hours, from the time-keeping system. Actual costs were clearly preferred to estimated ones. Company B's top-level management also agreed that the previous capability-maturity -based assessments neglected two important points of view concerning software engineering. They did not take the product and business points of view into account sufficiently. Instead, they assumed that money is "always"

given to process-related improvements if capability is low, even if there is no guarantee that these investments will ever pay back the costs incurred.

The importance of actual cost, worth, value and risk effect (rather than estimates) was considered to be so great that the representatives of Company B wanted to postpone the full value assessment combined with risk effect assessment further, until the cost accounting system was working properly.

As conclusion this focused assessment showed that Value Assessment including risk effect evaluation has a significant place when improving software product profitability in relation to software process improvement. It also showed that risk management work is a crucial part of software-value engineering.

Assessment in Company C

The product-focused assessment in Company C had several strengths. It was seen to give more customer-oriented improvement proposals than process assessments and product-related improvement was the language that the customer understood and was in a way "buying". Company C also saw that when the assessment is undertaken together with the customer, it can keep the customer more satisfied, which is a good basis for business. As well it emphasized that if value assessment is done in the planning phase of a product and risks are evaluated together with the value, it is cheaper for the company to continue development work. When risks are known and discussed in the company has it a better possibility to try to mitigate them beforehand.

The results also show that Company C had a need for two-dimensional assessment, which evaluated both processes and products. Capability-maturity -based assessment results formed a good basis for value assessment in Company C. By using them, it was possible to gain an understanding of the capability of the processes producing the product in question.

The assessment results for Company C also support the use of Activity Based Costing (ABC) in improving the software engineering area. When discussing cost, worth, value and risk effect it seemed clear that these should be calculated for processes as well as products, which is the purpose of ABC.

6. CONCLUSION

In conclusion, the value-based approach to software engineering appreciates the clear dependency between process and product. It helps in developing and even optimizing process activities, while ensuring that processes still produce the services and products needed. Furthermore, it analyzes products to reveal problems in processes, and develops processes from a product point of view. This is vitally important, especially for companies who respect customer opinions and aim to optimize costs in their processes. Customers pay for products and services, and companies have to allocate all costs to products to be able to price them.

It is also evident that when we know the risks related to our processes and products beforehand we have clearly more time to try to manage them. However, for business purposes this might not always be enough. A company which is able to price the risks in relation to the value has a competitive advantage against the other companies.

Generally, all the assessment results found are reliable. The reliability of the results was also improved significantly because the assessor interviewed several people and went through the same questions with all of them. The interview results were also compared to existing written material to check that they matched.

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