Products in Development: Using Requirements to Determine the Value of Activities in a Development Project

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ABSTRACT
Product delivering companies invest resources in software development activities in order to create value. Still, when performance in software development is to be measured, focus easily turns to time, cost, and quality in the later stages of the development process. Time, cost, and quality are important dimensions of performance but they are not revealing the complete picture. Missing is the value perspective. This paper outlines a method for how customer value can be used to evaluate performance and improve decision making during the development of a new product. The first step in the method is to value each requirement in the development project according to their perceived customer value. Hence, the value propagation can be monitored as the activities related the requirements are completed during the development. This information can then be used in order to decide on changed priorities through an understanding of the value propagation and performance during the development.

1. INTRODUCTION
Organizations developing products aim at creating value for their current and future customers, for the own organization, and ultimately for the owner. Despite the objective of product development to create something new, product development projects are typically not evaluated from this perspective. Traditionally time, cost, and quality is used to evaluate the performance of the developing organization. These are important dimensions to measure but are not revealing the complete picture, and need to be complemented with a value perspective. If no value for the customer is created it does not matter how efficient it has been developed.

2. USING REQUIREMENTS TO UNDERSTAND VALUE
In order to describe the development target at a level of detail that can be used for the investigation of the project value, requirements are proposed as the unit of analysis of the value created during the development process. Requirements are an interface that product managers, line managers, engineers, customers and other stakeholders can discuss and agree upon. Formulating requirements is also a key step in developing a new product. When the requirements have been agreed upon, the development activities escalate and the more costly activities begin accumulating. Once a requirement is formulated from a customer need, it is easier to determine if it is feasible or not to incorporate the requirement in the new product, and it should be possible to determine the value of each requirement.

3. THE PRODUCTS IN DEVELOPMENT METHOD
In [1] and [2] and, a method is described that defines the steps for integrating perceived customer value as a measure of performance during the development of new products. In this way, a bridge between the business case and the sales of new products can be made. Developing a product usually involves numerous steps and activities. Looking at the activities involved in software-development it is evident that different activities play different roles in the creation of value. Hence it is difficult to compare e.g. test and implementation activities. However, common for all the development activities is that they are initiated in order to satisfy specific requirements that can be valued according to their perceived customer value. The proposed framework for analyzing the value flow in product development enables the analysis and evaluation of performance. This is comparable to the evaluation of production processes where goods in the process are called "Work in Process". These items are not yet completed but either just being fabricated or waiting in a queue for further processing or in a buffer storage. In this paper we focus on the development value flow defining the results from the activities carried out as "Products in Development (PiD)".

The activities in a software-development project can typically be categorized as requirements and design, implementation, integration, and verification and validation. The objective of the PiD method is to determine how value is being created in these categories of activities during the development. In order to perform this detailed level of analysis, requirements are proposed as the unit of analysis in order to evaluate the value created during the development. An overview of the proposed framework is shown in Figure 1.
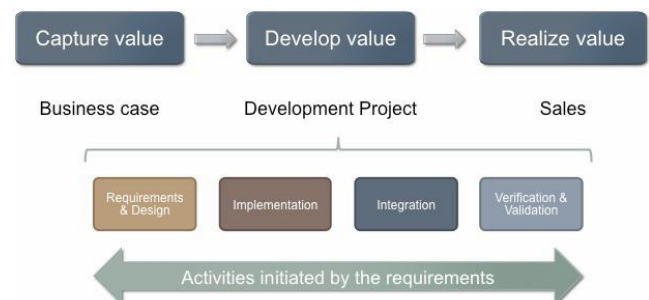

Figure 1. Framework overview

The set of requirements is an interface that product managers, line managers, engineers, customers, and other stakeholders can discuss and agree upon. Also, it is the requirements that generate

different activities that in their turn contribute to the Development value.

3.1 Generic Outline of the PiD method

The different steps and prerequisites included in a general version of the proposed method for evaluating value during the development are presented in this section. The PiD method requires a set of inputs that are assumed given, and they are:

- A set of n requirements
- An initial assessment of the perceived customer value for each of the n requirements
- A set of m activity categories (or phases) in the development value flow

The terminology for describing value in the PiD method is defined according to:

- The *Captured value* is the sum of the perceived customer value of the n requirements.
- The *Developed value* is the current value of the activities related to the n requirements for each of the m activity categories in the development value flow. A snapshot example of the Developed value can be seen in Figure 2
- The *Developed value completed* is the minimum value of the m activity categories of the developed value.

Given these assumptions and definitions the PiD method can be described by the following steps:

> Step 1:
> The Captured value is equaled to the value set in the business case. The Developed value and the Developed value completed are both set to 0. Step 1 is to be conducted as the development project is initiated.

> Step N:
> The Captured value is reassessed according to the changes in requirements from Step N-1. Requirements can be added and/or subtracted during the development. This is followed by an updating of the perceived customer value of the updated set of requirements.

As the activities in the development project are continued to completion, the Developed value and the Developed value completed are updated accordingly. The number (N) of steps of the PiD method depends on the complexity of the development project. They can be performed in conjunction with a gate review, when the next iteration is planned, or on some other occasion depending on the contextual needs. The responsibility of assessing the value of the requirements should be allocated to the product manager or other representative of the organization financing the development project.
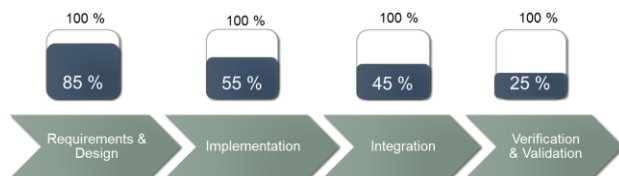

Figure 2 Example of snapshot of Developed value

3.2 Re-evaluating value

When evaluating and analyzing the value created in a product-development project there are two important dimensions of value to focus on:

1) The internal value -
   Where are we gaining/losing value during the product-development implementation?

2) The external value -
   Are there any market changes in value, or scope changes in the requirements during the development?

These two dimensions of value are to be viewed as internal and external to the development project. From an organizational point of view, it is important that both these dimensions are taken in to consideration since the overall value will depend on the result of both the internal and external dimensions. The project manager is ultimately responsible for the internal value dimension i.e. for developing the value according to the Captured value. The product manager is responsible for the external value dimension i.e. for monitoring market changes or other similar changes in the captured value that will affect the overall created value. On the basis of the captured value as assessed at Gn, the developed value increases progressively as the activities related to the specific requirement are completed. For example, if a requirement is valued as 7, then 7 is earned when the activities related to that requirement and gate have been completed. There can, however, be changes in the set of requirements, some of the requirements may be difficult to implement or have been omitted for other reasons. It is important to illustrate the effect this will have on the overall value created during the development of the new product

4. DISCUSSION

It is typically easier to estimate the value of a new product that consists of new features added to an evolving product, than that of a completely new product, developed for a new market. Given that the wish list of features and improvements often is longer than what the organization can satisfy with its limited resources, these need to be prioritized in a way that gives the organization the optimal return. This is important in the development of complex products with large software content and it is often referred to as release planning. When the scope of the development project is not agreed on it is difficult to track the value progress since requirements may be added or subtracted. This situation is difficult to manage, but the proposed method helps visualize the effect these changes have in terms of value. When requirements are deleted, the effort already invested in partly realizing these requirements is wasted.

The introduction of a value perspective also assists in the identification of waste i.e. work performed that will not add to customer value and future profit for the company. Other challenges to and limitations of the proposed evaluation method include the fact the value used in the evaluation system is the customer value perceived by product management and not necessarily the realized value. It is important to acknowledge this and not rely too strongly on measured results. The strength of the method is instead that it illustrates how value is destroyed or wasted by changes in requirements made late in the project, and by the focus of the project not being on what is perceived to create value. Late changes in development scope can be due to poor planning, e.g. overestimating the organization's capabilities, or poor market intelligence, poor performance in the implementation

phase, etc. One direct benefit of adopting a valuation of the requirements is that low quality requirements will be identified by the difficulty or impossibility experienced in their valuation due to inadequate definition. Valuation of the requirements could also be viewed as an additional quality assessment of the requirements.

5. CONCLUSION

We have described a method for integrating perceived customer value in order to illustrate how value is created in real time during the development of a product. This way of using value to assess customer value by linking it explicitly to the requirements is a unique initiative. The majority of the valuation methods identified in the literature focus on the project or firm level, and we found no performance measurement methods focusing on the requirements level in projects. This method is still under development and there is still substantial research to be done. However, some initial conclusions, both positive and negative, from using the method have been made. Advantages of the method from a managerial perspective include:

- A small extra effort to get an understanding of the value creation during the development. As the method is outlined, it is easy to add the evaluation of requirements and then monitor how the value progresses during the development.

- Easy to detect waste i.e. activities not creating customer value. There are many possible sources of waste during product development. However, by focusing on what creates value, by definition, the activities not contributing to the value creation are waste. If for example a requirement is disregarded in a late stage of the development, the effort invested in satisfying that requirement is waste from the development project perspective.

- Balancing the focus on time and cost with a value perspective. This is not possible if there is no way of evaluating the value. By using this method such a balanced perspective can be obtained.

- If the valuation can be agreed on, the stakeholder perception of what is important is aligned. When different solutions or opinions are discussed and evaluated, the value perspective could be used as a method in assisting in the decision making process. This is especially important when the requirement situation is dynamic, and often changes during the project execution.

- Changing focus from cost minimization to value optimization. Since time and cost are easy to measure, it is easy to focus on these dimensions in the search for increased productivity. If a value perspective can be integrated as part of the performance measurement system this can be balanced in a better way.

- Focus is on the complete value chain of product development. Value needs to be captured and developed before it can be realized. By applying a system perspective to these processes, weak areas can be identified and strengthened.

Challenges in using the method from a managerial point of view:

- It may be difficult to achieve a high degree of validity of the value of requirements. For example, the value of architectural requirements can be difficult to determine as they often may be beneficial for the organization long-term, but are resource demanding.

- Since the product is under development, the assessed value of the requirements must be treated accordingly. This can also lead to possible manipulation of the assessed value if there are for example reward systems based on the value being created. On the basis of the limited experience we have gathered, we recommend that the method be primarily used by managers within product development and not reported to external stakeholders.

- To reduce the preoccupation of the organization with cost to permit the development of an awareness of value could be a challenge because it has long been rooted in the organization.

- The method may be less beneficial for non-iterative development, since the *Developed value completed* is 0 until the final stage of the development.

6. REFERENCES

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