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ICT in Business

Requirements prioritization in Agile environments:
a model for effective prioritization

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Abstract

Requirements prioritization is a topic of high importance as a wrong prioritization can lead to deliverables that do not cover customers' needs. In agile environments the focus is on people over processes and on the team level (especially in Scrum) instead of the priority level of requirements. This thesis attempts to design a model for requirements prioritization, in agile organizations, based on business value and other concrete metrics. For the purposes of this research, interviews were conducted in different agile teams, examining and analyzing their processes and metrics for requirements prioritization. The results show that even though companies strive to deliver business value, their focus and effort of adopting or developing a requirements prioritization method is very limited. In most cases prioritization is based on intuition and the "louder" voice rather than on a structured process. The people who interviewed were not aware of existing methods of prioritization and that it is difficult to convince people to use one of those. It can be concluded that for being effective, the process of requirements prioritization should be simple, well communicated and agreed with all involved parties. In addition, it is important to agree on the metrics, the processes and the people before adopting a model. However, the used model only provides the means to improve decision making and should not be considered as the absolute driver for the final requirements prioritization.

1. Problem definition

1.1 Introduction

The main focus of this thesis is to design a model for requirements prioritization in an agile environment working across different teams and markets. All companies are concerned on how to deliver faster, with the lowest possible cost and how to satisfy customer's needs at the most. In order to achieve that the right priorities should be set, something that makes requirements prioritization an important process.

There are several methods used by companies for requirements prioritization, though they are often incomplete or need changes in order to fit in each company's context. The existing methods in agile software development are not widely used or the companies use a combination of techniques in order to define their customized requirements prioritization model. This is because software development methodologies like Scrum, do not define how to deal with customers that are not embedded in the organization, but how the internal processes can be improved. Thus requirements prioritization models that already exist do not fit to Scrum environments and therefore not widely used by companies.

Requirements prioritization is the way through which the teams are prioritizing features, based on the importance. Even the whole company may use a requirements prioritization model in order to build its portfolio and roadmap. For this reason the method which is going to be used is essential as it should give a valid result based on the company's needs. The requirements prioritization method should be clear and simple, taking into account all aspects that are of value for the company. For this reason the model which a company uses for requirements prioritization should fit in company's needs and be as customizable as possible.

The specification of metrics that measure the business values of a product can be considered as a critical issue for every organization as the needed outcome is to develop products that have high business value. It is important for every organization to find the right metrics that can reveal if and how much valuable their products are. This business value can be measured in terms of quantitative metrics (ROI, NPV etc.), which are the most commonly used metrics. However, this thesis is focused on defining qualitative metrics that measure the business value of a product developed in a portfolio of an agile environment and that can be used in requirements prioritization.

1.2 Research question

The main focus of this thesis is to design a model for requirements prioritization in an agile environment. So the main research question is formulated as follows: “How can we design a model for requirements prioritization in agile software development?”.

Sub-questions that are going to be addressed are:

- How do companies measure business value from customer’s perspective?
- How do companies prioritize across different markets?
- How do companies prioritize requirements in agile environments?

This research was conducted within big and smaller organizations which apply Agile Software development, some of them by using the Scaled Agile Framework, and is focused on defining social, qualitative oriented metrics.

1.3 Scope of research

The purpose of this thesis is to design a model, which can make the process of requirements prioritization more efficient, effective, clear and less time consuming. One of the most important aspects that should be taken into account when it comes to features prioritization should be the business value of it. So it is important to have a well-structured way of measuring the business value. The results of the analysis of the business value can affect the way that a company operates with regards to its priorities and goals. The business value of a product (feature) within a portfolio under the umbrella of Agile is going to be investigated; by defining the metrics that are being used.

2. Related work

This research is focused on: requirements prioritization on agile companies and specifically on the processes and metrics that can be used to prioritize based on business value. Thus the following section presents the literature studies conducted on these topics. The literature section starts with the main findings on agile and then it goes deeper to requirements engineering, requirements prioritization methods and business value definitions and metrics.

2.1 Agile Software Development

In recent years the Agile Software development has been widely adopted, known for its iterative nature that delivers products based on customers' needs and continuous delivery of working software. The combination of Agility and a well-organized portfolio can contribute to the achievement of the desired business value that each organization has as goal.

Agile methodologies have emerged due to the continuous change in requirements, regarding software development, and the lack in customers' specification needs. The main idea behind the Agile Software Development is to enhance communication among stakeholders, evolve customer in the whole process of development, rapid response to change and to increase team performance (Beck, 2001). The Agile Manifesto (Fowler & Highsmith, 2001) states that the focus of Agile is on: individuals and interactions, working software, customer engagement and response in change. The iterative nature of Agile allows companies to adopt changes in an early phase of development improving quality and customer satisfaction. Requirements prioritization is the process during which the customer is actively involved, in order to specify the value creation. Customer involvement is done by the product owner (in Scrum) who represents the customers' needs, the voice of the customer.

According to the Agile Manifesto (2001), the number one Agile principal is to satisfy the customer needs, through the flexibility in requirements change and the continuous delivery of new increments. Thus, the main target of Agile is to create business value for the customer through fast delivery, quality and having the customer as priority.

There are several Agile processes mentioned in the literature, differing in the way that teams and responsibilities are distributed. Some of them are: Extreme Programming (XP), Lean Software Development, Scrum, Dynamic Systems Development, Feature Driven Development, Adaptive Software Development and Crystal. (Beck et al., 2001) As the under research organizations apply the Scrum methodology, it is going to be analyzed in more details.

2.1.1 Agility at large organizations

Sutherland (2001) stated that: “I can confidently say that SCRUM works in any environment and can scale into programming in the large. In all cases, it will radically improve communication and delivery of working code”. However this is not the complete truth as Agile (and Scrum consequently) is efficient only for software development organizations and it needs a lot of adjustments in order to scale and fit in a large organization.

There have been contacted researches regarding the implementation of agile software development (either XP or SCRUM) in large organizations, presenting success stories, proving that agile can scale and can be adopted by large organizations, improving the working process (Sutherland 2001, Benefield 2008, Laanti 2011). As agile software development has been introduced as suitable for small organizations, Lindvall et al. (2004) mention that large organizations tend to introduce pilot agile projects before they adopt agile software development, making adjustments in order to get full advantage of Agile. They also present the successful cases of Nokia, Motorola and Daimler Chrysler by concluding that “these projects succeeded in terms of increased agility and improvements to one or more of the following attributes: customer satisfaction, quality, productivity, and cost.”

There are some key differences between small and large organizations so it is crucial to identify the basic factors that scale. Amabler (2009) analyses the eight factors that should scale in order to adopt agile practices in big organizations. These factors are:

- Team size: in case of a small organization the team size can be limited to a maximum of ten developers whereas a large company can even have thousands of developers.
- Geographical distribution: the challenge in this case is that globally distributed developers should be coordinated and cooperate in a daily basis from distance when small companies only have collocated developers.
- Regulatory compliance: low risk in case of a small company can be escalated to critical when regulations are more complex and difficult to be interpreted in case of big organizations.
- Domain complexity: it is increasing while the size of the company increasing and the domain is becoming more complex.
- Organizational distribution: when it comes to big organizations there are many contractors that do not have a full picture of the company for security reasons, something that does not allow a collaborative environment to be built.

- Technical complexity: simple over complex platforms and systems.
- Organizational complexity: this factor is referring to organizational structure and culture that can become rigid when it comes to changes in order to scale agile.
- Enterprise discipline: in order to scale agile the focus should be transferred from the project level to the enterprise level. The way that people used to work should change in order to reflect to the new agile mindset and processes.

The first four factors can be addressed easily with adopting the right practices, tooling and team structures. But when it comes to culture, organizational structure, technical complexities and enterprise (business and technical) architecture then more sophisticated solutions need to be integrated in the current environment (Amabler, 2009).

Leffingwell (2007) in his book is presenting the seven agile team practices that scale. These are: the built/define/test team, mastering the iteration, two-levels of planning and tracking, smaller more frequent releases, concurrent testing, continuous integration, regular reflection and adaptation.

2.1.2 Scrum Methodology

Schwaber (1999) defines Scrum as “an unpredictable, complicated process...an enhancement of the commonly used iterative/incremental object-oriented development cycle”. The Scrum methodology involves the following roles (Leffingwell, 2010):

- Product owner: is the one who is prioritizing the product backlog (requirements to be delivered) based on customer needs. The product owner is the representative of the customer.
- Scrum master: is the one who spreads Scrum ideas, rules and practices towards achieving team goals.
- Team: the people implementing the functionality (developers, testers, etc.) who are self-organized and cross-functional.

The team (no more than 8 people) works in sprints of 1-4 weeks, delivering working features that are valuable for the customer. Every team is having a daily meeting, reporting progress and problems, called “stand-up” and it lasts 15 minutes.

2.2 Requirements Engineering

As requirements prioritization in part of the overall requirements engineering (RE) process, requirements engineering main components are going to be presented in order to get an overall picture of requirements flow. A definition that well describes what requirements engineering is comes from Zave (1997).

“Requirements engineering is the branch of software engineering concerned with the real-world goals for functions and for constraints on software systems. It is also concerned with the relationship of these factors to precise specifications of software behavior, and to their evolution over time and across software families.”

Requirements engineering is focusing on (Paetsch et al., 2003):

- Requirements elicitation: refers to the identification and gathering of the requirements based on system's limitations, taking into account stakeholders' needs. Interviews, use cases, observation and social analysis, brainstorming, focus groups and prototyping are some of the techniques used for requirements elicitation.
- Requirements analysis: the nature of the requirements is analyzed in order to ensure necessity, consistency, correctness and feasibility. The main techniques are Joint Application development (JAD), prioritization and modelling.
- Requirements documentation: a complete documentation that communicates the requirements to stakeholders and engineers.
- Requirements validation: is about the problems that can be raised and proposed solutions together with requirements review and testing as proposed techniques.
- Requirements management: is about capturing all related information, monitoring changes and status of requirements.

However, traditional requirements management differs from requirements management in agile environments as agile has an iterative character, where requirements are continuously changing. Thus it is difficult to follow a strict framework as requirements are not clearly defined before implementation starts (Ramesh et al., 2010). Furthermore, agile supports the minimum documentation whereas as we see in the traditional requirements engineering, documentation is an important part of the process.

Ramesh (2010) proposes a framework for requirements engineering in agile software developments which consists of six elements: face to face communication over written

specifications, iterative RE, managing requirements change through constant planning, extreme requirements prioritization, prototyping and review meetings and tests. This means that RE in agile is based on personal communication rather than documentation. Also as requirements are becoming more certain after each iteration, there is an initial high level requirements overview which is becoming more specific. The requirements can change during development cycle in order to be always up to date and satisfy customers' needs. Prioritization is one of the most important processes due to financial and time constraints and thus features (requirements) should be in priority in order to make sure that the most valuable ones are on the top. Prototyping is the way to validate and refine requirements, communicate with the customers and take feedback. Finally, review meetings are organized at the end of each sprint (with all stakeholders involved) in order to demonstrate the already delivered requirements and functionality and take prompt feedback.

2.2.1 Requirements Prioritization

Agile methods promise, as mentioned above, to fulfill customers' needs by creating products which can satisfy customers. In order to have customers happy companies should provide products that are of value for the customer and they are going to be used. Towards delivering business value agile development has established a value-driven requirements prioritization which is based on customers' needs (Racheva et al., 2010).

Requirements prioritization is part of Portfolio Management which is a topic that has raising interest since 90's and is the tool that many companies use to manage the way they are doing business. Portfolio Management is the way that organizations use in order to take strategic decisions regarding products markets and technologies that are going to be used and how the resource allocation is going to be done (Cooper, 1998). After analyzing the available options and determining what is going to be implemented, Portfolio Management is the tool used for prioritization and resource allocation. According to Leffingwell, Program Portfolio Management is the triangle which combines strategy and investment funding, program management and governance (Leffingwell, 2010). Programs are being selected based on the business strategy, resource allocation is taking place and portfolio management is the tool that assists program execution and measures the outcome. Portfolio Management is considered as a critical component as it aims in maximizing profit, strategic alignment between portfolio and strategy and finally to an effective resource allocation planning (Cooper, 2001).

Due to time constraints, focus on cost reduction and customer satisfaction, companies that apply agile methodologies are aiming on delivering the requirements that have the highest value (both from organizational and customer's perspective). Though, the problem is that agile software development methodology does not define how exactly requirements prioritization should be done. There is not a process with concrete steps and criteria that can drive us to a well prioritized backlog. We can find one from the Scaled Agile Framework as described below (WSJF).

Furthermore, many times the person or team that prioritizes the requirements take wrong decisions as many of the requirements are not clear and well defined. So the first thing that needs to be defined is how we evaluate a requirement in order to prioritize it correctly.

Before getting into details about the methods that are used for requirements prioritization in agile it is essential to define "requirements" and "requirements prioritization". According to Herrmann and Daneva (2008) a requirement has the following characteristics: type, estimated benefit to stakeholders, estimated size of software that embeds the requirement, estimated cost to build what embeds the requirement, priority and requirement dependencies (how a requirement is depending on cost, value, time or other requirements).

Another definition for requirements is that "it is something that the product should do to support the owner's business, or a quality it must have to make it attractive to the owner. A requirement exists either because the type of the product demands certain functions and qualities or because the client asks for that requirement to be part of the delivered product" (Robertson, 2012).

Robertson (like Herrmann & Daneva) distinguishes requirements into functional and non-functional. Functional requirements are actually describing how the product should operate in order to be useful, whereas non-functional requirements are referring to properties or qualities that the product should have. "A requirement is a desired end-state whose successful integration into the solution delivers specific, measurable and incremental business value to the organization" (Wysocki, 2011).

Requirements prioritization is a fundamental process which affects product's success as through this the organization identifies the most valuable and critical requirements from a set of requirements, based on time and cost company's framework (Berander & Andrews, 2005). A description of requirements prioritization is given by Ta'ani who is defining it as an action where the most important system requirements are defined and ordered according to importance. The purpose is to achieve customer satisfaction by implementing first requirements that have high priority (Ta'ani & Razali, 2013). Requirements prioritization especially in Agile has as driving

factor customer's business value, which means that requirements are prioritized based on what the customer wants to see after the release (Cao, 2008).

2.3 Requirement prioritization criteria and methods

Agile development has as main goal to deliver business value (Agile Manifesto) and a way to achieve that is "the continuous and value-driven requirements prioritization from customer's perspective" (Racheva et al, 2010). As resources and time are limited, agile requirements prioritization is based on business value that the customer defines, so requirements with the highest business value have the highest priority and they are implemented first. This process is being done repeatedly if features are added or modified (changes in existing functionality, bug fixes, refactoring) (Cao, 2008). Common criteria that are used for requirements prioritization are business value, cost (of implementation and cost of delay), risk, time, effort, profit and dependences.

Business value: the degree that the customer finds the specific requirement useful and to what extent it would increase customer's willingness to buy the final product. In order to identify the business value of a requirement an extensive market research and a close contact with the customer is needed (business value from customer's view is discussed in more details in section 2.3.2).

Cost of implementation: the cost of implementing a requirement should be calculated as the resources in every organization are limited (Firesmith, 2004). This means that a requirement might have a high "score" regarding other aspects like business value and profit but the cost of implementation might be prohibitive.

Cost of delay: this is referring to the loss if the company will not implement a specific requirement and it is the exact opposite of estimating the risk of a requirement that is going to be implemented. This aspect should be also taken into account when prioritizing requirements especially for requirements that are related to safety and security, and would cost to the company if these requirements are not going to be implemented (Firesmith, 2004).

Risk: it is related to the relative risk that the organization has to deal with if a requirement is going to be implemented. The risk can be product-related resulting to a product that is not functional or does not have the required quality or process-related which affects the objectives of development process (Van Lamsweerde, 2009). According to Firesmith (2004), a company might

choose to implement a requirement of high risk first in order to deal with the upcoming risk during development, or choose to put high risk requirements lower in priority in order to have more time to analyze possible risks and identify ways to avoid possible complications. Also implementing lower risk requirements ensure that the available resources will be distributed to requirements that have a high success rate.

Time: time is a constraint that every organization has to deal with and it is referring to the time that a company needs to implement and release a requirement. Time to market is a critical aspect when it comes to prioritization, as every company wants to be competitive or overcome the competition with new requirements compared to those that competitors recently presented (Firesmith, 20404).

Dependences: in order to prioritize requirements in a way that the chosen requirements can be implemented, interdependencies should be taken into account. This means that in order to implement a requirement, another requirement might need to be ready first (Davis, 2003). Dependences between requirements affect time and the final result as we cannot put high in priority one requirement which is depending on a requirement low in priority. This will cause delays and inefficiency. Thus, requirements which are dependent to others should be close in the prioritized list (Firesmith, 2004).

Although these are valuable criteria for requirements prioritization there is not a method that contains all these, explaining how the process should be in order to come up with an efficient, reliable and standardized process for requirements prioritization. The existing methods and references to requirements prioritization are fuzzy and incomplete in terms of the steps that should be followed and the metrics a company should use to prioritize its requirements. Below, the most well know requirements prioritization methods are described.

In the table below, an overview of the methods that are analyzed in this section is provided (table 2.3).

Method	Qualitative/Quantitative	Used in case organizations	Other characteristics
Wiegiers' matrix	Qualitative	No	It uses a matrix of 10 metrics that are scaled from 1-9
MoSCoW	Qualitative	Yes	Based on qualitative metrics
Planning game	Qualitative	Yes	Collective prioritization that uses business value
Cost-Value Approach	Quantitative	No	A process with specific steps based on value and cost
Kano Model	Qualitative	Yes	Based on customer satisfaction and classification of requirements
WSJF (Weighted Shortest Job First)	Quantitative	Yes	A qualitative method that assesses business value, time, risk and cost of delay
Cumulative voting (\$100 Allocation)	Qualitative	No	A simple process where the stakeholders put their “money” on the requirements
Analytic Hierarchy Process (AHP)	Quantitative	No	A mathematical process based on specific metrics
Binary Search Tree (BST)	Qualitative	No	Is based on comparing requirements with other leaves of the tree
Quantitative Win-Win	Quantitative	No	An algorithmic approach that applies AHP iteratively
EVOLVE	Quantitative	No	Uses an algorithm with constraints until optimization
Delphi	Qualitative	No	A method that offers a structured set of prioritization steps

Table 2.3: Comparison between different existing requirements prioritization methods

2.3.1 Wiegiers' matrix approach

Wiegiers proposes a prioritization matrix which has 10 columns (Wieger, 1999). The first column is the list of requirements; all at the same level of abstraction and the rest of the columns have metrics which give as the final priority of the given requirements. The metrics that are used are

described from Wiegers as follows using a scale from 1-9, where 1 is less important and 9 the maximum:

- Relative benefit: is the benefit that the feature provides to the customer
- Relative penalty: what the organization will lose by not implementing the specific feature
- Total value: the column with the sum of relative benefit and relative penalty which are by default equal
- Value %: the percentage of value delivered from this feature compared with the others
- Relative cost: the cost of implementation
- Cost %: the percentage of the total cost for each feature
- Relative risk: developers estimate the relative risk of each feature
- Priority number: the priority is calculated from the formula $\text{Priority} = \text{value\%} / (\text{cost\%} * \text{cost weight} + \text{risk\%} * \text{risk weight})$

The features with the highest priority number are those which balance better cost, value and risk.

2.3.2 MoSCoW

It is an easy way to prioritize software requirements determining in which of the four categories they fall into: must have, should have, could have and won't have (Waters, 2009). Must have are requirements that are within the minimum scope in order to have a potential shippable increment, features that must be in place before we launch the product. Should have are features that are not crucial but they are considered as highly valuable. Could have are requirements that can be excluded from the scope but they are nice to have and won't have are those features that will be excluded from the scope and will might be part of a future increment. According to Waters (2009) "It's a good idea to make sure a project has a healthy number of Should Have and Could Have requirements" in case that the project becomes longer than expected.

2.3.3 Planning game

In planning game the customer is the one who decides the scope of requirements. The customer prioritizes the requirements by using three piles: those without which the system will be non-functional, those that are less essential but provide significant business value, and those that would be nice to have (Karlsson, 2007). The programmers estimate the time required to implement each requirements and also put them into three piles: those that they can estimate precisely, those they can estimate well, and those that they can't estimate.

2.3.4 Cost-Value Approach

This requirements prioritization method takes into account the value (what is the contribution to customer's satisfaction and value for the company) and the cost (cost of implementation) of each candidate requirement. The cost-value approach has five steps as explained by Karlsson (1997):

1. Requirements engineers examine the candidate requirements in order to ensure that they are stated in a complete and well defined way.
2. Customers apply the Analytical Hierarchy process for pairwise assessment of the candidate requirements.
3. Software engineers are using AHP pairwise comparison to estimate the cost of each requirement.
4. A software engineer uses AHP to calculate the value and cost of each requirement and puts there value into a cost-value diagram.
5. The stakeholders are analyzing the requirements using the cost-value diagram. Through this discussion software managers prioritize the requirements.

2.3.5 Kano model

Kano model is a method of analyzing customers' needs by analyzing objective and subjective quality. It helps on understanding customers' needs better than they really do. A Kano analysis is a two dimensional model, showing the correlation between objective and subjective quality and customer's satisfactions "for the product as a whole and each element of product quality" (Kano et al., 1984). Kano et al. (1984) on their analysis describe how "physical fulfillment and user satisfaction" are related and provides five quality element categories as below:

Attractive quality elements: elements that provide satisfaction if exist but do not cause dissatisfaction if not.

One-dimensional quality elements: elements that provide satisfaction if they exist and dissatisfaction if not.

Must-be quality elements: elements that are taken as granted and give satisfaction, thus elements that cause dissatisfaction if they are not fulfilled.

Indifferent quality elements: elements that either they are fulfilled or not they do not cause satisfaction or dissatisfaction.

Reverse quality elements: elements that result in dissatisfaction when available and satisfaction when not.

Kano model can be used for customer needs analysis and can be involved in requirements prioritization and classification (Xu et al., 2009).

2.3.6. WSJF (Weighted Shortest Job First)

WSJF (Weighted Shortest Job First) is calculated as the cost of delay divided by the job duration, jobs that deliver the most value and are of shortest duration are selected to be implemented first (Reinertsen, 2009).

Cost of delay is calculating using:

- User business value (do the user prefer this feature over the other, what is the revenue impact, is there a potential penalty if we delay?)
- Time criticality (how does the user/business value decay over time, is there a fixed deadline, to they wait for us to move to another solution, what is current effect on customer satisfaction?)
- Risk reduction-opportunity enablement value (what else does this do for our business, does it reduce the risk of this or future delivery, is there value in the information we will receive?)

Cost of delay = User business value + Time criticality + RR-OE

$$WSJF = \frac{\text{User business value} + \text{Time criticality} + \text{RR-OE}}{\text{Job size}}$$
 where each parameter is graded in the scale of 1,2,3,5,8,13,20

2.3.7. Cumulative voting (\$100 Allocation)

This is a simple requirements prioritization technique where 100 units (dollars, hours, etc.) are given to the stakeholders to allocate them to the different requirements. Each stakeholder is asked to write down how much money would they spend on each requirement. After this process the result is an ordered list with the requirements that have the highest priority (Leffingwell & Widrig, 2000). This method doesn't specify the criteria on which the stakeholders are taking a decision, thus it has a high degree of subjectivity. Stakeholders tend to allocate more money to their "favorite" requirements in order to put them in higher priority. Another drawback of

cumulative voting is that it treats all requirements as equally important. It looks like a straightforward method but it becomes more complex when the number of stakeholders is increasing.

2.3.8 Analytic Hierarchy Process (AHP)

The Analytical Hierarchy process is a decision making model to set priorities based on pairwise comparison matrices where each element is compared to the one below it (Shaaty, 2008). In order to make the comparison we assess the relative value and cost based on a scale of number which shows how many times one element is more important over the other. The next step is to plot each requirement's cost and value in a cost-value diagram and use it to analyze the corresponding requirement. Shaaty explains the AHP method using the table (2.3.8) below.

Intensity of importance	Definition	Explanation
1	<i>Equal importance</i>	<i>Two activities contribute equally to the objective</i>
2	<i>Weak or slight</i>	
3	<i>Moderate importance</i>	<i>Experience and judgment slightly favor one activity over the other</i>
4	<i>Moderate plus</i>	
5	<i>Strong importance</i>	<i>Experience and judgment strongly favor one activity over the other</i>
6	<i>Strong plus</i>	
7	<i>Very strong or demonstrated importance</i>	<i>Activity is very favored over the other; its dominance demonstrated in practice</i>
8	<i>Very, very strong</i>	
9	<i>Extreme importance</i>	<i>The evidence favoring one activity or another is of the highest possible order of affirmation</i>
Reciprocals of above	<i>If activity i has one of the above non-zero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared to i</i>	

Table 2.3.8: The fundamental scale of absolute numbers (Shaaty, 2008)

2.3.9 Binary Search Tree (BST)

Binary search tree is a tree which has nodes with at most two children. These nodes are labeled with elements of a set. According to Karlsson (1998) the binary search tree can be used as a method to prioritize requirements the elements of a set are the requirements that need to be prioritized and he describes how it works as a prioritization method. The idea is that each node is one requirement. In the left sub tree of node x are all requirement with lower priority than the one in node x. The right sub tree is consisting of requirements with highest priority compared to the requirement in node x.

2.3.10 Quantitative Win-Win

This prioritization method is actually an algorithm which uses iteratively the Analytical Hierarchy Process and the stimulation model GENSIM (Ruhe, 2001). Quantitative WinWin method has three steps:

1. It uses the AHP to determine the stakeholders' preferences in qualitative terms.
2. The feasibility of the selected requirements, in terms of implementation effort, is evaluated by combining the results from (1) with other effort specification methods.
3. Reflection of the increasing degree of knowledge, in each iteration, that was gained regarding the requirements

The qualitative WinWin approach is using the simulation model GENSIM for effort estimation by simulating the development process (requirements analysis to system testing).

2.3.11 EVOLVE

EVOLVE is requirements prioritization approach which is an iterative approach that uses genetic algorithms (Greer, 2004). The algorithm is applied in order to determine the optimal requirements based on the given set of constraints. This approach has as target to maximize a given function, and several optimization steps are contacted using the genetic algorithm. If there are no more improvement, the algorithm is going to stop at that point.

2.3.12 Delphi technique

This technique has been first used for forecasting by RAND Corporation and later on as a decision making tool and prioritization method as well (Cline, 2000).

Delphi as a prioritization method requires some short meetings until we get the final prioritized list. The process of prioritization using Delphi is described by Cline as follows (Cline, 2000). As

a first step we need to identify the right people that need to participate in the sessions. These are the facilitator and the panelist. The facilitator should not be part of the stakeholders and should know about data collection. The panelist can be any person that is really familiar and knowledgeable about the project and they usually are management members or stakeholders.

When the people have been identified, the next step is a brainstorming session to define the criteria that are going to be used for prioritization. They should all agree on primary and secondary ones, no matter if they look correct or not. Then all the panelists give a number from 1-3 (1 is very important, 2 is neutral and 3 is not important) to each of the previously selected criteria. This process is anonymous and individual in order to avoid any bias. After this process a list of criteria is produced, that all the panelists agreed as the most important ones.

Once the criteria are in place, in order to narrow down the number of requirements the panelist can choose projects based on the constraints and preferences. The constraints are the hard limits like budget or regulatory requirements, whereas preferences are based on the panelist personal preference. So each of the panelists can rank the projects based on both constraints and preferences. At the end we have a table with ranked projects where the outliers (out of 25th and 27th quartile) can be discussed further. On more round of ranking is taking place in order to find out the real outliers and come to a consensus. After the second round we have the table with the most highly ranked projects in priorities.

2.4 Measuring Value

This section is going to provide an insight with regards to measurement of value of work that is being done within an organization as well as measuring the business value.

2.4.1 Measuring value of Work

In order to identify the business value of the way that the work is being done, there are concepts like Value Management, Benefits realization management that are going to be analyzed in order to get an insight of how things should be done in a way which creates valuable results. These concepts are working towards the identification of the right way of working and as a result taking the right decisions. In this research it will help the author to see how the whole process and research should be organized and structured.

Value Management

According to The Institute of Value Management (2014), Value Management (VM) has as target the added value that an organization can gain through balancing stakeholders' desire and resources needed by forcing innovation and people's motivation.

Value Management is also defined as a process which fully aligns project's benefits with customer's value definition (Kelly et al., 2008). Male and Kelly (2007) state that VM is a powerful practice based on team work and process-driven methodology that focuses on the analysis and delivery of a product of high functionality and quality, and low cost. According to British Standards Institution (2000) VM has as target to align the different stakeholders' view on order to achieve value given the customers' need and available recourses.

A summarized definition of Value management can be the following: "a systematic and multi-disciplinary process directed towards analyzing the functions of projects from its inception to completion and commissioning (through auditing or examination) for the purpose of achieving best value and return on investment at lowest possible overall life cycle cost" (Oke, 2011).

Value Management can be divided into three phases (Male, 2007):

- The orientation and diagnostic phase: involves all stakeholders in order to review and assess all angles around the project. Value team is analyzing the situation, pointing out possible implications and solutions. According to Jaapar et al. (2012) this is the value assessment stage where the planning of the project is taking place. In this phase the projects that are going to be implemented are assessed in order to find out how they can be improved in terms of cost and performance.
- The workshop phase: is the stage where all the different perspectives are taken into account towards the solution of the problem. All the participants should be fully aware of the project is, in order to ensure that the proposed ideas are aligned with what is needed. All the ideas are being assessed to ensure success (Jaapar, 2012).
- The implementation phase: the final stage of the process where after the assessment the project is going to be implemented, making sure that all the required resources are in place for future sustainability (Jaapar, 2012).

According to the Institute of Value Management (2014) there are several techniques that can be used during the process of VM, some of them are mentioned below.

- Brainstorming: where everyone has the opportunity to express an idea, without criticism and rejection. This creates a pool of ideas that can be assessed later.
- Cost Benefit analysis
- Function Analysis System Technique (FAST)
- Pareto analysis
- Risk analysis
- Stakeholder analysis
- SWOT analysis
- Value analysis
- 5 W's & H

2.4.2 Measuring Business Value of a product (customer's perspective)

In order to define metrics for the business value of a product, from customer's point of view, in an agile environment it is first necessary to define what metrics and business value are. According to Neap (1999) "value is a measure expressed in currency, effort, exchange, or on a comparative scale which reflects the desire to obtain or retain an item, service or ideal". Another definition of business value is given by Patton: "Business value is something that delivers profit to the organization paying for the software in the form of an increase in revenue, an avoidance of costs, or an improvement in service." (Patton, 2008). Finally, the definition for business value by Rawsthorne (2012) is that business value is "what the management is willing to pay for". Despite the fact that the term "business value" is mentioned in a lot of researches, it is not explicitly defined and analyzed. The way that the term "business value" is going to be used in this thesis is as the way to see how the customer assess the product delivered and the degree in which it fulfills his or her desire. Based on the definition that Oxford dictionary provides a metric in business is "a set of figures or statistics that measure results" (Oxford Dictionary, 2008).

Most of the existing work in the field of Portfolio is focused on the processes, how it can be adopted and implemented into an organization. Emphasis is given on the methods and procedures that are used and less are mentioned for the real business value of the products within the Portfolio especially for requirements prioritization. Widely used metrics for the business value of products are mainly financial metrics, using the values of Return on Investment (ROI), Net

Present Value (NPV), Economic Value Added (EVA) and Expected Commercial Value (ECV) to validate the results of the choices that have been made (Cooper, 2001).

Financial metrics can be characterized as quantitative ones, whereas our target is to find out and define qualitative metrics. Qualitative metrics that are already mentioned in the literature (and the main focus of this thesis) are going to be discussed in more details. The focus will be in methods and processes that can be used in order to give a better insight on how a company can measure the real business value of a project, especially in an agile environment.

Measuring Customer's satisfaction

On this direction, customer satisfaction can be considered as a metric of the value of a product (Müller, 2008). For this purpose it is important to hear the voice of the customer, complaints and areas of improvement, advantages and a general feedback from the customer that can contribute to an increasing product value. Customer satisfaction is highly important for every organization as it provides a direct and effective way of evaluating customer's preferences. Oliver (2010) defines satisfaction as "the consumer's fulfillment response. It is a judgment that a product/service feature, or the product or service itself, provides (or is providing) a pleasurable level of consumption-related fulfillment, including levels of under or over fulfillment". In order to define these levels of fulfillment there are several measures that reveal what customers think about a product or feature.

Questionnaires are another way to have an insight of customer's perspective regarding what you offer and how the customer perceives that. Questionnaires can be focused on specific questions for which the company needs to know the customer's opinion. One more instance that can also measure customer satisfaction is the Net Promoter Score (NPS). Peichheld (2003) was the first that referred to the Net Promoter, characterizing it as "The one number you need to grow". The Net Promoter Score is a number that shows customer's loyalty, the intention of the customer to buy again and again from the same supplier. In consequence, the loyal customer will propose and promote the company to friends and family, bringing new customers to the company.

Conjoint analysis

"Conjoint analysis is a widely used marketing method for analyzing costumer trade-offs" (Green et al, 2001). Conjoint analysis is described by Green (2001) as a method that deals with a central marketing question "Why do consumers choose one brand over another?", when multiple options

are available. This method analyses survey responses about their preferences and intention to buy and also customer's reaction in new products or changes in the existing product (Green, 2001).

Kleef (2005) characterizes conjoint analysis as a product-driven method where products have attributes and each attribute can have two or more alternative levels. According to Kleef (2005) by using conjoint analysis we can see which attributes consumers prefer and how much they value the different attributes. The process is described by Green & Srinivasan (1990) and it starts with the selection of the preference function which can be: the vector model (estimates the fewest parameters by assuming the linear functional form), the part-worth model (estimates the largest number of parameters using the most general function form) and the ideal point model which is a balance between the other two. The next step is to define the data collection method. The full-profile method calculates customer's preferences based on behavioral oriented constructs through real buying situations. The other method is the two-factor method where incentives are partially described. Then stimulus representation, measurement scale for the dependent variable and estimation method are selected. An overview is provided in table 2.4.2 below (Green & Srinivasan, 1990).

Process	Methods
Preference Model	Vector model, part-worth model, ideal point model
Data collection method	Fill-profile, two-factor
Stimulus set construction	Fractional factorial design, random sampling from a multivariate distribution, Pareto designs
Stimulus presentation	Verbal description, paragraph description, pictorial/three-dimension model, physical product
Measurement scale for the dependent variable	Rating scale, rank order, paired comparisons, constant-sum paired comparisons, graded paired comparisons, category assignment
Estimation method	Metric methods, non-metric methods, choice probability based methods

Table 2.4.2: Conjoint analysis process

3. Methodology

The methodology that is going to be followed is a case study. Starting with the literature review, the target is to get deep into all aspects regarding metrics of projects/products developed within a portfolio, get a solid understanding about the state of the art in this field, metrics that are currently used, especially in an agile environment. Case study is the method that is going to be used for this problem's solution, in collaboration with the researching organization.

3.1 Case study

Starting from which is the best method that should be used for serving the needs of this thesis research, the table below gives an overview of the most common research methodologies (Yin, 2013). Considering the options as presented in table 3.1 and the definitions that follow, case study has been chosen as the most appropriate methodology for the purpose of this research.

Method Form of Research	Question	Requires Control of Behavioral Events?	Focuses on Contemporary Events?
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival analysis	Who, what, where, how many, how much?	No	Yes/no
History	How, why?	No	No
Case study	How, why?	No	Yes

Table 3.1: Relevant situations for different research methods (Yin, 2013)

A clear definition of case study is given by Benbasat (1987) as follows:

“A case study examines a phenomenon in its natural setting, employing multiple methods of data collection to gather information from one or a few entities (people, groups, or organizations). The boundaries of the phenomenon are not clearly evident at the outset of the research and no experimental control or manipulation is used.”

Another definition of case study stated that “case study is the methodology of collecting data from one or more sources in order to examine a phenomenon in a real-world situation” (Yin, 2013). Figure 3.1 (Yin, 2013) describes a case study as an interaction between designing and preparing the study, collecting the data, analyzing and sharing.

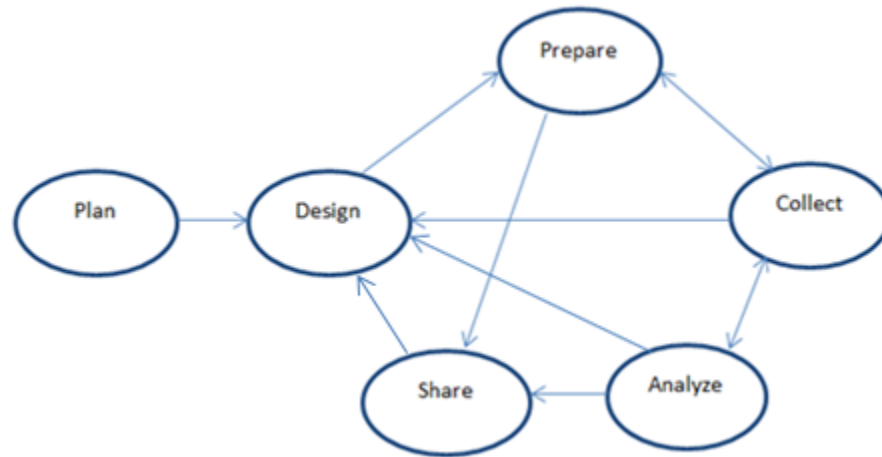


Figure 3.1: Case study: a linear but iterative process

More specifically this research is based on multiple-case study in order to provide a more wide and robust outcome. Benbasat (1987) also mentions that multiple-case study is appropriate when the research’s goal is to describe, build or test a theory. In this case this is a suitable methodology as little is mentioned in the literature about requirements prioritization in agile. So the intention is to describe the situation in practice and try to create a theory for it.

3.2 Validity

In order to ensure that the outcome of this research is of a desired quality, Yin (2013) described the widely accepted tests for case study quality validation.

Tests	Case Study Tactic	Phase or Research in which Tactic Occurs
Construct Validity	• use multiple sources of evidence	Data collection
	• establish chain of evidence	Data collection
	• have key informants review draft case study report	Composition
Internal Validity	• do pattern matching	Data analysis
	• do explanation building	Data analysis
	• address rival explanations	Data analysis
	• use logic models	Data analysis
External Validity	• use theory in single-case studies	Research design
	• use replication logic in multiple-case studies	Research design
Reliability	• use case study protocol	Data collection
	• develop case study database	Data collection

Table 3.2: Case study tactics for four design tests (Yin 2013)

Construct validity

Construct validity is about finding out the right measures for the field that is being studied and making sure that the results are based on specific concepts and not subjective measures (Yin, 2013). In this research we first set the concept of requirements prioritization and specifically in agile environments. Then specific metrics are being examined as mentioned in the literature and we assess their contribution to requirements prioritization. Then the focus is on business value due to its importance and also other metrics that were derived from the interviews. In order to make sure that the data collected can establish a chain of evidence, multiple companies and people with different roles have been interviewed. The data are then analyzed, coded and the most important information has been mentioned and analyzed further (section 4.2).

Internal validity

Not applicable for this study as it is for exploratory and causal studies only. In this case we try to find a causal relationship between a condition and its cause (Yin, 2013).

External validity

External validity is about “defining the domain to which a study’s findings can be generalized” (Yin, 2013). According to Yin (2013) this is mainly for studies that try to answer the “how” or “why” questions. In this study the findings are falling under the umbrella of requirements managements and more specifically under requirements prioritization practices (section 2.2).

Reliability

Reliability is referring to the fact that if another research will be conducted, following the same procedures, it should come to the same findings (Yin, 2013). In section 3.3 the procedures are described so that it is possible that this study can be conducted again and be expected to give the same findings. Also a code book and a code diagram are provided in Appendix 2.

3.3 Data collection

As a data collection method, interviews have been selected in order to get the desired information from the interviewed organizations. Yin (2013), states that interviews are of high importance when it comes to data collection for case analysis. In this case analysis, since it is focused on people and processes, the interviews were semi-structured. This way there can be more interaction with the interviewee and have a “guided” conversation as Yin (2013) mentions.

The interview questions started with a set of general questions that came out of the literature study. After having a couple of “draft” interviews with experienced people in agile and discussing the questions with the supervisor of this research, we enhanced the questions and divided them into categories in order to have a better overview and guide the interview in an easy manner.

The main topics of the interviews were:

- a. Questions about the interview (role, experience with agile, etc.)
- b. Questions about the organization and its structure in order to get an understanding of the how people and roles interact
- c. Questions about processes and specific questions for requirements prioritization

Unstructured interviews and observations from the organization the author has worked in, also contributed to the research. Observations took place in different meetings while the research was on and contributed to the case study as extra evidence from the real workplace (Yin 2013). There were also interviews in a more conversational tone where the questions were emerging from the conversation and were based on the answers that the interviewee was giving. According to Joy (2007) informal interviews “increase the relevance of questions and can be matched the circumstances”.

The interviews were conducted in six organizations that all had an average of 2 years of experience with agile practices. The people that were interviewed were closely working with agile teams and holding a key role in requirements prioritization process.

3.4 Data analysis

Data analysis started with an overview of all the researched organizations. This overview includes the type, size, people and experience with agile practices. This gave a first indication of the variation of the collected data and then a more in depth analysis followed. As a next step the data collected from the interviews were grouped into the following categories: people, processes, metrics, challenges and proposed improvements.

Furthermore, in order to identify any relationships between the interviewed organizations, given their answers a coding process was used. After analyzing the interviews, and based on common points between the answers, a set of codes was created. The coding process helped to identify similarities and differences and define the key points from the interviews.

4. Results

This chapter presents the interviews' results as they performed in 6 different companies (10 interviews). Plain text and graphical representation are the two ways in which the results are represented.

Section 4.1 provides an overview of the organizations and the people that were interviewed. In section 4.2 the interviews are analyzed and the most important findings about requirements prioritization are presented per case.

4.1 Case overview

In this section an overview of all organizations that were interviewed is presented. The organizations that took part in this research are from different industries as shown in table 4.1.1. All interviewed people are working on software development companies or in the software development department. They are also members of agile teams that apply Scrum methodology. The names of the organizations are confidential so they are named with a letter from A to E.

Most of the interviewees had at least 1 year of experience in agile environments and were holding one of the following roles: program director, vice president, senior product manager, product manager, senior product owner, senior business analyst, agile coach. All the companies that were researched are applying agile software development methodologies where the level of maturity is fluctuating between 1 to 6 years.

Case	Organization Size	Industry Domain	Interviewee Role	Interviewee Experience	Agile Experience
Organization A	3.600	Consumer electronics	Product manager	14 years	3 years
			Program director	12 years	6 years
			Senior Product Line manager	14 years	2 years
			Product Owner	8 years	3 years
			Vice president	10 years	5 years
Organization B	52.000	Banking and financial services	Product manager	10 year	4 years
Organization C	25	Web design	Senior Product owner	6 years	4 years
Organization D	32.000	Retail banking	Project manager	8 year	1 year
			Agile coach	5 years	4 years
Organization E	85+	Visual Management Software	Business Developer	6 years	4 years
Organization F	48.200	Financial services	Product manager/owner	30 years	2 years

Table 4.1.1: Overview of the researched organizations

From the overview in the below table (Table 4.1.2) we can see that most of the organizations do not have a standardized and well-structured process when it comes to requirements prioritization. Most of the interviewees also stated that they are not satisfied with the current process but people will not easily apply a structured process that includes tools and calculations. The table is organized as follows:

- Process of requirements prioritization: it can be structured when the company follows specific steps always, semi-structured when there are some steps but not well defined and communicated or unstructured when the decisions are made in an abstract way and only a small part of the process is standardized.
- Satisfaction of the current process: the interviewees were asked whether they are satisfied with the process they follow or if it just works at the moment and their answers are grouped as no, yes or neutral. It was observed that in cases where the

interviewee was not depending on other teams, they stated that they are satisfied with the current process. Whereas in more complex projects, where involvement of different stakeholders was required, they stated that the process does not work efficiently and needs improvements.

- Agile contribution to prioritization: according to the interviewees agile methodologies only contribute to prioritization methods and process indirectly, if at all. This means that according to them agile doesn't offer something of value regarding prioritization, only affects it in an indirect way in some cases.

Case	Process of requirements prioritization	Satisfaction of the current process	Agile contribution to prioritization
Organization A	PU1: semi-structured	No	No
	PU2: semi-structured	No	Indirectly
	PU3: unstructured	Neutral	No
	PU4: unstructured	No	No
	PU5: unstructured	Yes	No
Organization B	Unstructured	Neutral	No
Organization C	Unstructured	Neutral	Indirectly
Organization D	Semi-structured	No	Indirectly
Organization E	Structured	Yes	Indirectly
Organization F	Unstructured	Yes	No

Table 4.1.2: High lever overview of results

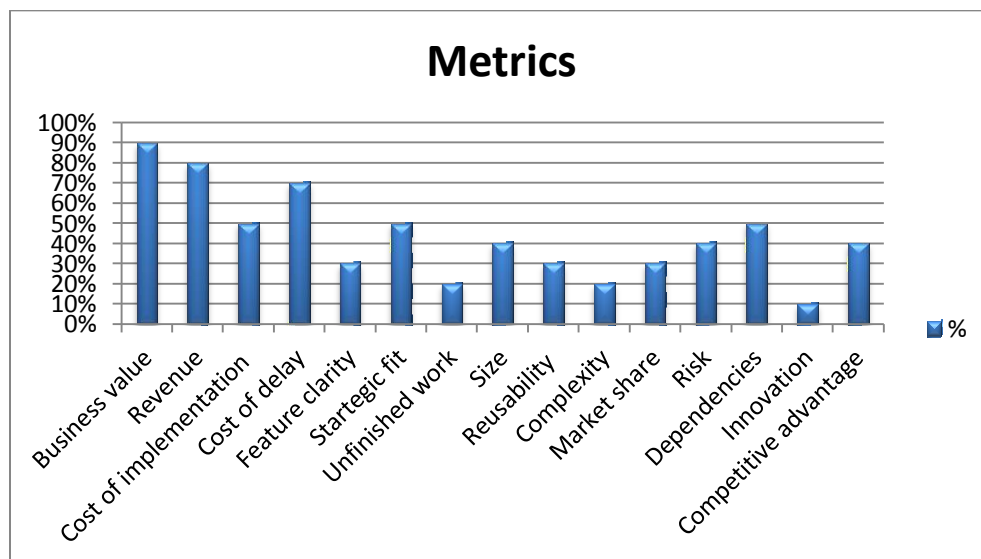
4.1.1 Interview results

As part of the interview, the interviewees were asked “What are the goals of your organization? Are they clearly defined and communicated?” The answer to this question was surprisingly not positive (chart 4.1.1.1). The goals were either unclear or not well communicated and in some cases even unknown. What is interesting here, is that the same interviewees that mentioned that the goals are known and clear; they also mentioned that “strategic fit” is an important metric for requirements prioritization.



Graph 4.1.1.1: Understanding of organizational goals

When it comes to metrics, the interviewees both ranked metrics that were provided in the content of the interview, but also mentioned further metrics that they might use for requirements prioritization. As it is displayed in the below bar chart (4.1.1.2), business value is the metric that used in almost all cases with revenue and cost of delay following.

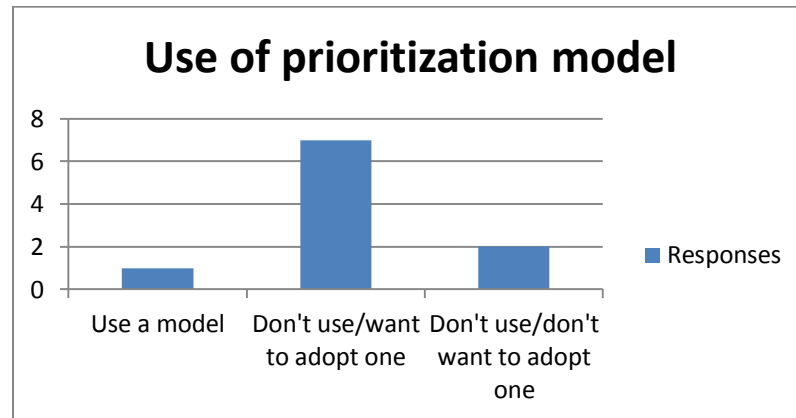


Graph 4.1.1.2: Metrics used in requirements prioritization

Another result that is important for this research is that 70% of the participants stated that they are not aware of any requirements prioritization techniques, while the rest mentioned that they know some but never applied one. In line with this result is that only one participant mentioned that they have a well-structured method, one that they try to build a model and the rest just do it in an unstructured way based on “intuition and experience” as a senior product manager stated (Chart 4.1.1.3).

When they were asked why they don't try to adopt a model the answers were as follows:

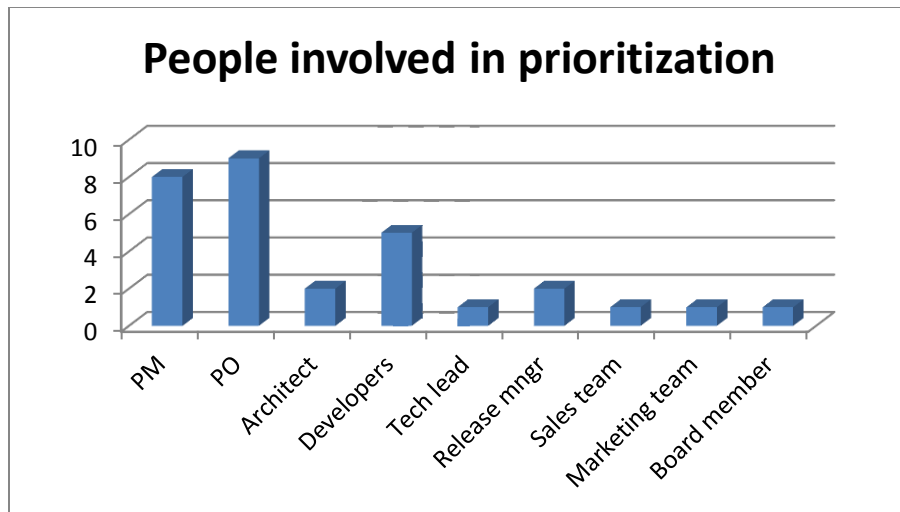
- Applying models is time consuming
- People resist, do not easily accept new models
- Human intervention is highly important
- They do not want to rely only on numbers



Graph 4.1.1.3: Requirements prioritization models in practice

With regards to the process, usually it is a continuous alignment between stakeholders and PMs with either weekly or bi-weekly meetings before the final alignment for the next release. People that are commonly involved in the process are the PMs, POs, architects and costumers. Most of the interviewees said that weekly meetings are usually between PMs and POs, bi-weekly meetings are with the PM team and monthly meetings with customers.

When it comes to people that are involved this appeared to be another problem as for example PPM can be either too much involved or not present. In most of the cases people that were involved are: PMs, POs, development team, sales representatives and architects. The graph below (4.1.1.4) gives an overview of the people that usually take part in requirements prioritization process.



Graph 4.1.1.4: Roles involved in requirements prioritization

4.1.2 Challenges

The main challenges that were mentioned regarding the process of requirements prioritization as mentioned by people take part in it are summarized below.

Missing trust: people do not trust each other's opinion and point of view. There are broken relationships as stakeholders mainly care for their requirements to be highly prioritized and not about the feasibility of them. Thus conflicts are created and prioritization becomes even more complicated. Also due to the missing clarity of the process people do not trust the outcome of it and as a result conflicts are created.

Long term strategy is not clear: one challenge that was mentioned clearly was the fact that long term strategy has not been defined or is not clearly communicated. Thus it makes decision making a difficult process as requirements prioritization should be driven by organizational goals.

Visibility is missing: visibility between different products and teams is missing and as a result communication and implementation becomes more difficult. Dependencies are not clearly defined or even taken into account when it comes to prioritization. ("We don't take dependencies into account; we prioritize based on our own needs" Program Director)

PPM over/under involved: there were cases where PPM was either too much involved or not involved at all. In cases that PPM was over involved it was mentioned that they tend to create more pressure and have more influence which can result in wrong prioritization. On the other hand there were cases where PPM was missing from the prioritization process and as a result there was a misalignment and different expectations. ("In some cases PPM is pushing towards the

wrong direction and we can see later that a wrong decision was taken due to pressure” Agile coach)

Time: time was mentioned as challenges in cases where a lot of people were involved and cases with many different stakeholders. The fact that the process is not structured and specific creates a lot of delays due to miscommunication and misalignment.

Case	People involved in prioritization	Process for requirements prioritization	Metrics	Challenges
Org. A (PU1)	Products owners, product managers, architects and release managers	A 5 steps process based on discussions first with POs, PMs & customers to understand business value, then involving architects & RM for the minimum scope and then a final round with all stakeholders.	Business value, revenue, margin, time, risk and strategic fit	Keep innovating, alignment with stakeholders, time consuming & unstructured process
Org. A (PU2)	PMs, architects, release managers and scrum team	Define goals and prioritize based on them, discuss with scrum teams and re-prioritize, align with all stakeholders.	Business value, feature clarity, unfinished work	Alignment with stakeholders, people don't easily accept using formulas and methods
Org. A (PU3)	PM, POs & scrum team	There are weekly meeting between the PM and POs that give a first priority list and after that it is discussed with scrum teams for the final prioritization.	Product strategy, business value, ROI, competitive advantage	Prioritization for different markets and segments
Org. A (PU4)	PM, POs & technical leads	It is based on discussion between POs, PM & tech leads. They have some metrics in place but they don't have a process that defines how the prioritization works.	Business value, size of work, reusability of a feature, feature clarity, risk & dependencies	Conflicts between roles and responsibilities, unclear goals
Org. A (PU5)	PM, POs & scrum teams	Normal meetings for discussing the requirements but the final saying in on the PM.	Commercial success, revenue, alignment with long term goals, technical restrictions, future product value	Conflict between stakeholders due to lack of clarity or budget
Org. B	PMs & POs	First the PM team set the priorities and then the top priorities are being discussed with POs. they re-prioritize and after that marketing & risk management is getting involved to provide more clarity.	Intuition, experience, value for the business, costs, time, dependencies, profit, NPS	Clarity of feature and their future potential and goals
Org. C	PO, management team, scrum team	Based on discussion between involved parties.	Business value, reusability, tech. constraints, dependencies, throughput time	Not available
Org. D	PO, one person from board of directors, scrum team	The process starts with the goals and then prioritize in such a way that goals are achieved. Goal & mission drives priorities.	Cost, revenue, risk, business value	High impact of PPM that results in wrong prioritization
Org. E	PO, marketing & sales team, product specialists	Two rounds with different criteria each. The first round gives the top 20 and then they prioritized on the second round which is a strong input for discussion.	#of users, size, cost of delay, reusability, org. goals, time, revenue, ROI, Kano model	No major contribution from agile
Org. F	PM, PO, scrum team	Based on discussion between stakeholders and setting priorities together with the team.	Urgency, security compliance	Not available

Table 4.1.2: Results overview

4.2 Case organizations

This section provides an overview of the main findings of the interviews. The results are presented per case organization and the main focus is on the people who are involved in prioritization, the structure of the process, metrics, business value metrics, challenges and proposed improvements by the interviewees.

Case	People involved in prioritization	Process for requirements prioritization	Metrics	Challenges
Org. A (PU1)	Products owners, product managers, architects and release managers	A 5 steps process based on discussions first with POs, PMs & customers to understand business value, then involving architects & RM for the minimum scope and then a final round with all stakeholders.	Business value, revenue, margin, time, risk and strategic fit	Keep innovating, alignment with stakeholders, time consuming & unstructured process
Org. A (PU2)	PMs, architects, release managers and scrum team	Define goals and prioritize based on them, discuss with scrum teams and re-prioritize, align with all stakeholders.	Business value, feature clarity, unfinished work	Alignment with stakeholders, people don't easily accept using formulas and methods
Org. A (PU3)	PM, POs & scrum team	There are weekly meeting between the PM and POs that give a first priority list and after that it is discussed with scrum teams for the final prioritization.	Product strategy, business value, ROI, competitive advantage	Prioritization for different markets and segments
Org. A (PU4)	PM, POs & technical leads	It is based on discussion between POs, PM & tech leads. They have some metrics in place but they don't have a process that defines how the prioritization works.	Business value, size of work, reusability of a feature, feature clarity, risk & dependencies	Conflicts between roles and responsibilities, unclear goals
Org. A (PU5)	PM, POs & scrum teams	Normal meetings for discussing the requirements but the final saying in on the PM.	Commercial success, revenue, alignment with long term goals, technical restrictions, future product value	Conflict between stakeholders due to lack of clarity or budget
Org. B	PMs & POs	First the PM team set the priorities and then the top priorities are being discussed with POs. they re-prioritize and after that marketing & risk management is getting involved to provide more clarity.	Intuition, experience, value for the business, costs, time, dependencies, profit, NPS	Clarity of feature and their future potential and goals
Org. C	PO, management team, scrum team	Based on discussion between involved parties.	Business value, reusability, tech. constraints, dependencies, throughput time	Not available
Org. D	PO, one person from board of directors, scrum team	The process starts with the goals and then prioritizes in such a way that goals are achieved. Goal & mission drives priorities.	Cost, revenue, risk, business value	High impact of PPM that results in wrong prioritization
Org. E	PO, marketing & sales team, product specialists	Two rounds with different criteria each. The first round gives the top 20 and then they prioritized on the second round which is a strong input for discussion.	#of users, size, cost of delay, reusability, org. goals, time, revenue, ROI, Kano model	No major contribution from agile
Org. F	PM, PO, scrum team	Based on discussion between stakeholders and setting priorities together with the team.	Urgency, security compliance	Not available

Table 4.2: High level results overview

4.2.1 Organization A

Organization A is an international, consumer electronic organization, specialized in navigation devices and maps. The consumer products include Personal Navigation Devices, navigation apps, and GPS sports watches. The main business products are custom in-dash navigation systems and a fleet management system, which is offered to fleet owners as an online service with integrated in-vehicle cellular devices. Organization A was a case that was investigated in depth, across its different product units in order to get an overall understanding of the way it works. The products units that were researched are Navigation (which is separated in NavApp and NavKit), PND, Places and Mobile. All these product units, even if they are in the same company they use completely different methodologies then it comes to requirements prioritization. They have their own process, either structured or unstructured. The company has 3.600 employees and apply agile practices over the last 3 years.

They started applying agile 3 years ago and specifically the SAFe framework 2 years now. In this organization 5 people were interviewed with the following roles: strategic product owner, product manager, senior product line manager, product owner, vice president of product management. All the interviewees were from different product units (PU) where each of it has its own process and methodology for requirements prioritization.

4.2.1.1 Product Unit 1

People involved in prioritization

The interviewee (senior product owner) from this PU named the following roles that are involved in the prioritization process: products owners, product managers, architects and release managers.

The customers are represented by the PMs that gather the requirements and align them with the senior product owner who has the main responsibility for prioritization. After they have the first priority list the product owners are also involved and can propose changes. Architects and release managers are also part of the prioritization so the senior PO can understand some more details about the selected features and finalize the prioritization of requirements. The decisions are taken collectively and there is not a person/role that affects prioritization the most.

Process for requirements prioritization

The process that is followed in this PU is semi structured, using some generic metrics. They have 5 steps that give the final priority list. As a first step the senior PO and PMs have the requirements and align on what the customers really want. In this step it is important to ensure

that what the customers want is also of value for the business. As a second step what is also important is the combined value as mentioned, meaning that requirements that have value for more than one customer have higher priority. These two rounds give a prioritized list which is based on business value. The third step is the communication with the POs, architects and release managers to understand the minimum scope of the requirements. A key aspect here is that they always decide to go with the minimum scope of each requirement. This is because they want to deliver more and keep all customers “equally unhappy” as the interviewee mentioned. Lastly, the initial prioritized list is re-prioritized, taking account the input of more people, and the final one is discussed again with the stakeholders (figure 4.2.1.1).

The frequency that requirements are discussed is in monthly but also weekly meetings. The monthly meetings are with the PMs where the roadmap for the release is presented and priorities are discussed. Then there are also weekly meetings with PMs as the priorities are discussed on an ongoing basis. Weekly meetings are also with POs to see their point of view.

Metrics

The main metrics that are used in this PU of organization A are: business value, revenue, margin, time, risk and strategic fit. These metrics don't have weights and decisions are taken under discussion. Business value has the most impact especially when the requirement has value for more than one customer. Another interesting thing was about risk and how it works as a metric: risk is taken into account and more risky issues have priority as they don't want to leave them for later when the urgency is higher.

Business value

Business value is measured using the following metrics: online product reviews, NPS, RFI's, RFQ's and also by taking the input from customer support team which is in constant communication with the customers.

Prioritization across different markets

Prioritization across different markets in this case is based on the rule that generic requirements have higher priority and the requirements for specific markets follow. The prioritization across the markets is based on the overall strategy, business value and the revenue in each specific market.

Challenges

The fact that the requirements are based on customers' needs might affect innovation. The challenge here is to ensure that there is always space for innovation. Another challenge is to align the need of all stakeholders. Stakeholders always want everything and consider their requirement as the most important. So there is need for finding out what is really important and has the highest priority. Furthermore, as time is one of the factors that are taken into account, a wrong estimation can lead to the need or re-prioritization and that conflicts with stakeholders can be created. Lastly, as the interviewee states that there is not one aligned prioritized backlog and the process is not structured and clear. There are a lot of interdependencies that are currently not taken into account that actively.

Improvements

More structured and clear process, better alignment with dependencies.

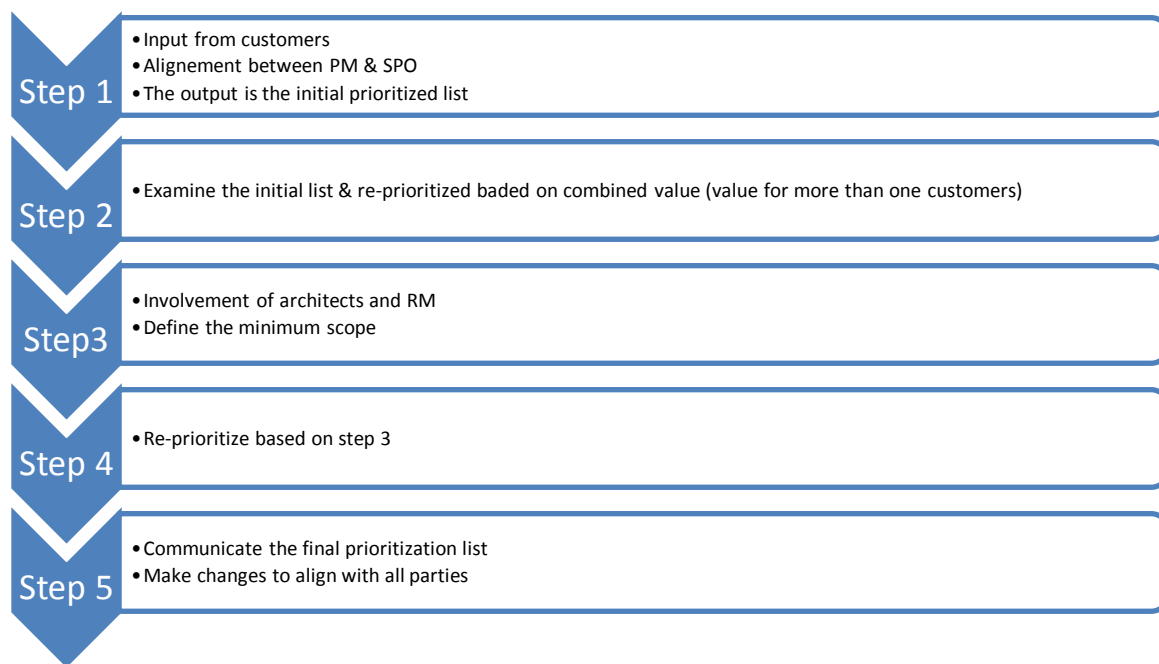


Figure 4.2.1.1: Process overview

4.2.1.2 Product Unit 2

People involved in prioritization

In this part of the organization there is a team called “product team” who is responsible for setting the priorities. This team is comprised by the following roles: 2 PMs, 2 architects and 2 release

managers. Apart from the product team, development teams are also involved and contribute to prioritization (developers, PO, scrum master). When conflicts arise between the product team and the stakeholders, at the end the product team decides how the final prioritized list will be.

Process for requirements prioritization

As a first round of prioritization the product team defines the goals and the priority of the goals and based on that they have a first priority list. After that they present and discuss this list with the feature teams and they can also propose new priorities or even new features that the product team didn't take into account. When the product team has the input from the teams, the final prioritization is being done (figure 4.2.1.2).

Metrics

The metrics that are taken into account during the process of prioritization do not have weights and they are not in a priority list. As the interviewee explains they have a list of prioritization rules. This list helps to identify the need of each feature and together with size and urgency estimation they get a first prioritized list. Clarity of the feature is another metric that can also be a blocker when they prioritize requirements. This means that if a feature is not clear enough to the team it is excluded from the list until it gets clear. Another metric that is used is if the feature is new one or it is unfinished work from the previous release. Unfinished features have higher priority than others. As a really important metric closed deals with customers were mentioned. Then features that are part of the deal have the highest priority.

Prioritization is not based only on the metrics but priorities are set mostly after open discussion with all stakeholders.

Business value

Business value is measured through the NPS and complaints received from the customers through the customer support team.

Prioritization across different markets

Priorities for different markets are set up-front and different markets have higher priority than other based on the customers' needs and potential of bigger market share. For example European market has higher priority than China.

Challenges

One challenge is the alignment with the different stakeholders as they always want their requirements to have higher priority than others.

It is also difficult to make people use formulas and very concrete models for prioritization.

Improvements

The product team should better focus on prioritizing the goals that the features. The priorities should be set from the teams and the product team should not focus that much on details.

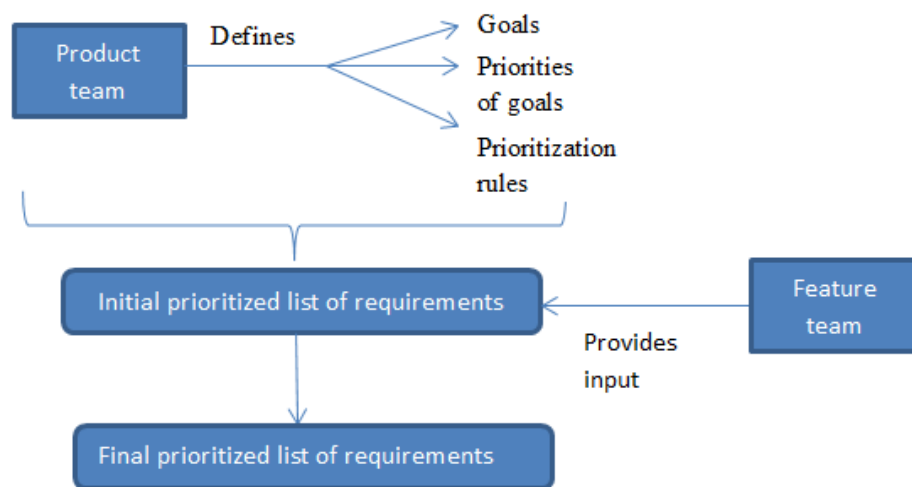


Figure 4.2.1.2: Process overview

4.2.1.3 Product Unit 3

People involved in prioritization

The product owners and the product managers are mainly involved and less the scrum masters. There are weekly meetings where they review the requirements and set priorities. In case of conflicts there is not a clear hierarchy on who will affect more the final decision.

Process for requirements prioritization

The product managers have weekly meetings with the POs where they give their requirements to the product owners and then there is a discussion of how the priority can be set. First the product managers provide a priority list and then they assess it together with the POs. The scrum master

here has a technical background and he/she provides some input from a technical point of view (figure 4.2.1.3).

Metrics

The product strategy is what drives prioritization in this PU, what they want to achieve such as being leaders for example. Together with that business value (what the customer wants), ROI, revenue and competitive advantage are also metrics taken into account.

Business value

No metrics for business value were mentioned.

Prioritization across different markets

Prioritization for different markets in this PU is a challenge as the interviewee stated. It is part of the product strategy and where they want the product to be in different markets. It is also related to the success that the product has in each market and currently they are focusing on the successful markets rather than the markets that they are still behind the competition.

Challenges

A challenge mentioned is how to set priorities for different markets and what should be the balance between markets that are successful and those that are less successful.

Unclear scope is also a challenge as it creates conflicts as priorities cannot be set properly.

Improvements

More transparent process is needed and the metrics that drive prioritization.

A prioritization model can be used as a sanity check but they do not want to rely on a model.

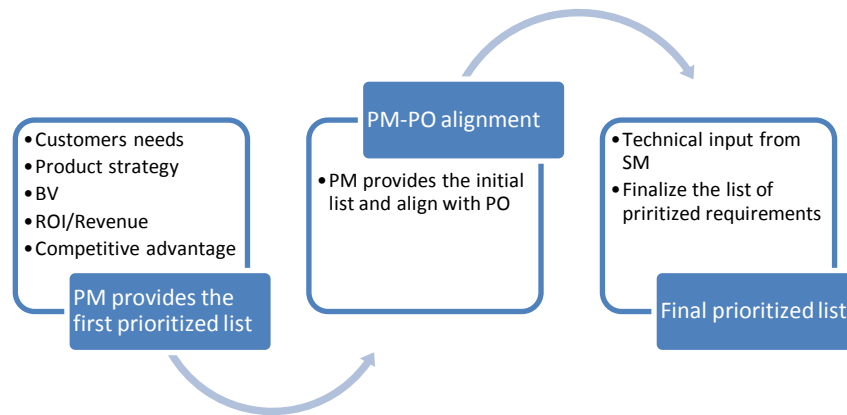


Figure 4.2.1.3: Process overview

4.2.1.4 Product Unit 4

People involved in prioritization

In this product unit of organization A the people that are involved in the process of requirements prioritization are: product manager, product owner and the technical leaders or the scrum teams. The product owner represents the customers but also provides them support and helps them define what they really want. In addition, he communicates with other teams in order to clarify issues that need attention. The product manager mainly considers the costs of implementation. When there are disagreements on the priorities they are resolved through discussions. They try to understand why there is a different perspective of priorities and how they can align.

Process for requirements prioritization

The process in this PU is unclear. It is based on discussion between the product owner, the product manager and the tech leads. They have some metrics in place but they don't have a process that defines how the prioritization works.

Metrics

The metrics that are taken into account are: business value, size of work, reusability and clarity. Business value and size are the two driving metrics that give a priority. Together with those it was mentioned that of a requirement is not something that contributes to the product's value, this is excluded from the list. Risk and dependencies are two metrics that help prioritization but don't

drive it; they only exist to give a sense of how complicated the requirement is. Cost of implementation is coming as the input of the product manager.

Business value

In this product unit there is no concrete way of measuring business value as the interviewee mentioned. They just try to contact their customers (emails and meetings) and get their feedback. They take customer satisfaction as a metric to measure business value.

Prioritization across different markets

Different markets are like different individuals. So prioritization across different market is a bigger set of unique customers. In order to invest in a market the main criterion is the potential growth and revenue.

Challenges

In this case the challenge is between roles and responsibilities. The interviewee stated that he is doing part of the job that the product manager should do. This is an important issue for him as it causes a lot of confusion. Another challenge in this process is that the goals are not clear, thus priorities are difficult to be set.

Improvements

The goals should be clear and communicated in order to make sure that what is implemented is for value for the product. Also before the stage of prioritization we should be sure why this requirement is needed and what is the added value of it. Another proposed improvement is the adoption of a concrete method as it will make people think more in a subjective way on how to set priorities. “Giving a number is way to have a step back and think more carefully” as the interviewee stated.

4.2.1.5 Product Unit 5

People involved in prioritization

The interviewee who is a product manager mentions that the people that are involved in the process of prioritizing requirements are: product manager, stakeholders with their requirements and engineers. He mentions also that the final saying relies on him to decide the priority of the requirements. Also in case of conflicts he is the one that takes the final decision.

Process for requirements prioritization

The process is not clearly defined and prioritization is made in an abstract way. They have meetings where they discuss priorities and then based on the criteria mentioned below they set priorities.

Metrics

The metrics that are used for prioritization purposes are: commercial success, revenue, alignment with long term plans, technical restrictions and future business value. The interview explains that in terms of business value they don't measure that the customer wants now only but also if the new functionality will be of value for the future or not. Even if customers support that a requirement is really important for them, they will not implement it if they cannot foresee any future value. The inconsistency in what the interviewee stated is lying on the fact that the goals are not clear and he just has the overall picture, though later he states that they prioritize based on long term plans.

Business value

In this case business value is considered as the overall understanding of what the market wants and thus it is translated into revenue.

Prioritization across different markets

This priority list is really flexible and follows the market needs. Depending on the demand and growth, the requirements coming from a specific market can go up and down from time to time. This priority is based on the market research that is conducted.

Challenges

The challenges in prioritization are basically the conflicts that arise between the product manager and the stakeholders. The main reason for them is the lack of capacity and budget something that the stakeholders don't consider when they request a new functionality.

Improvements

Even though the interviewee mentions that the process works well right now a more structured model of prioritization might enhance the process. It will make people look more carefully into the priorities and their pros and cons. Taking into account several metrics all the time will give

you a more consistent output. On the hand there is the danger of driving the results in the way you want in such cases. So it needs to be clear what the goal is and how it can help and improve the process of prioritization.

4.2.2 Organization B

Organization B offers banking and other financial services targeting on servicing from individuals to big corporations. It is multinational company with 52.000 employees around the globe, active in 18 countries. Agile practises started to be adopted 4 years ago, however the department that the interviewee belongs to starting working on an Agile way 2years ago.

People involved in prioritization

In this organization the main roles that maintain the priorities are the product manager and the product owners. The product manager is responsible for defining and prioritizing the high level requirements and then the product owners break them down and prioritize the pieces that will lead to a working functionality.

Process for requirements prioritization

The company has a team of product managers that first define the priorities of the requirements. When they are aligned, the product owner takes the top requirements and together with the product manager set the priorities for each team. After that the product owner together with marketing and risk management team analyze the requirements and make them clear. When they are all checked, the product owner set the priorities for the team (figure 4.2.2).

Metrics

As a first thing the interviewee mentioned that the prioritization is based on knowledge and intuition. He stated that they don't have to do any calculation based on specific metrics and formulas because they know what needs to be done first. The stakeholders are basically those that drive you to what needs to be done as they "scream" for what they want. Further metrics that they also consider together with the product manager are: value for the business (what will be improved in the company), cost of implementation, time, dependencies, profit and the NPS. The inconsistency here is that in the beginning the interviewee mentioned that they don't use any metrics, when he was asked about the process in general, but then when he was asked what metrics they use, he mentioned the metrics above.

Business value

In this organization, NPS and CES (customer effectiveness score) are the main metrics for business value. They also have direct calls with the customers and ask the question “How easy was it for you?”. Through this question they just take the generic feeling of the product usage and customer satisfaction.

Prioritization across different markets

They are targeting for generalization and they try to reduce as much as possible having customized products for different markets. This will lead to less costs and risk as it was mentioned in the interview.

Challenges

The challenge is that the requirements are most of the times not clear, especially what is not clear is whether something has to be implemented or not. So the decisions have to be made upfront so it would be better to put requirements in a priority. If the goal is clearer then it would be easier also to prioritize requirements.

Improvements

No improvements were proposed.

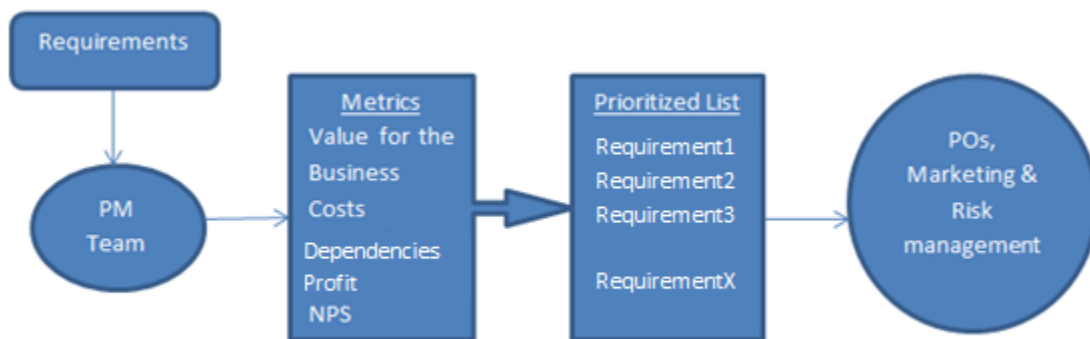


Figure 4.2.2: Process overview

4.2.3 Organization C

Organization C is a small company specialized in web design, focusing on e-commerce. They apply agile methodologies the last 4 years, working with distributed agile teams. There is not a strict hierarchy and apart from the product managers and product owners the developers are also involved in requirements prioritization. The communication with the customers is direct as they target in fast delivery.

People involved in prioritization

The product owner is the one communicating directly with the customers and gathers that requirements. When it comes to prioritization the product owner together with the management team (the 3 company owners) are those that prioritize. Sometimes the team (the developers) is also involved in the process of requirements prioritization.

Process for requirements prioritization

The process is simple and is based on discussion. The product owner gathers the requirements and then discusses the priorities with management team. The development team has also an active role in the process. They can challenge the priorities and propose their own priority list. They don't have a structured process to follow. When it comes to customized projects they put those that can be reused higher than others that only serve on customer's needs.

Metrics

The metrics that this organization takes into account during prioritization meetings are: business value, the reusability of the product, the technical constraints and dependencies and the throughput time. For them business value is the most important metric as the customer is the one who drives the decisions.

Business value

No clear metrics are applied apart from direct customers' feedback.

Prioritization across different markets

This organization is giving higher priority to products that can be reused for all markets. When it comes to prioritization across different markets the priority is given to the market that has higher potential revenue.

Challenges

No challenges mentioned.

Improvements

It was mentioned that agile does not contribute directly to requirements prioritization. It excels in requirements elicitation but has nothing to do with prioritization. What can be done to improve the process of prioritization is to introduce inside agile a requirements management method. This can help the process but it does not mean that if you don't have you cannot be successful.

4.2.4 Organization D

Organization D is a retail banking organization that has a wide set of products and services. It operates in 15 countries around the globe and 32.000 employees. The last year the organization is applying the agile methodologies and they try to expand it to all their IT departments. The interviewees are under the department that started applying agile only a couple of months ago.

People involved in prioritization

The people that are involved in the process of requirements prioritization are the product owners, the stakeholders and one person from the project board (board of directors). The product owner is the one that gathers the requirements from the customers and also internal stakeholders and then presents them to the project board member in order to set priorities together (figure 4.2.4). Lastly they also consult the team in order to assess the real need for the requirements.

Process for requirements prioritization

The process in this case as well is not structured but it is simple and straightforward. They always start with what the goal is and what this want to achieve. They always try to implement the minimum set of things toward the achievement of theirs goals. The product owner together with the project board member discusses the requirements and set the priorities. So first they set the goals and then they set the priorities. Only if one goal is achieved they go on to the next one. They have the high level goal and then create a mission statement that drives their decisions.

Customization for different markets is avoided as is it expensive and instead they go for more generic solutions.

Metrics

In this organization they use the MoSCoW method in order to set the priorities. But in order to find out what is a must have, should have etc they also take into account the business value, the risk, business impact, internal business value and cost. Here there was a contradiction in what the 2 interviewees mentioned: one said that the customer always comes first while the other said that unfortunately business value is not the most important thing for them at the moment and that the decisions are mainly budget driven. Another contradiction was that they said they first go for risky requirements while later they mentioned that for a specific requirement they proposed a less risky solution than the initial proposal.

Business value

Business value derives from two sources: NPS and direct customer's feedback through emails of their customer support team.

Prioritization across different markets

This is another example of a company that want to swift for offering customized solutions to standardized ones. As mentioned, the company even used to have dedicated teams for the different markets but nowadays they move towards removing customizations and work on more generic solutions.

Challenges

The challenge in this organization in the prioritization process is the impact that PPM has on it. There are cases that PPM affects the prioritization in a high degree and that results in wrong prioritization. It can be the case that PPM forces for something that at the end stops halfway because the budget is not sufficient.

Improvements

No improvements mentioned.

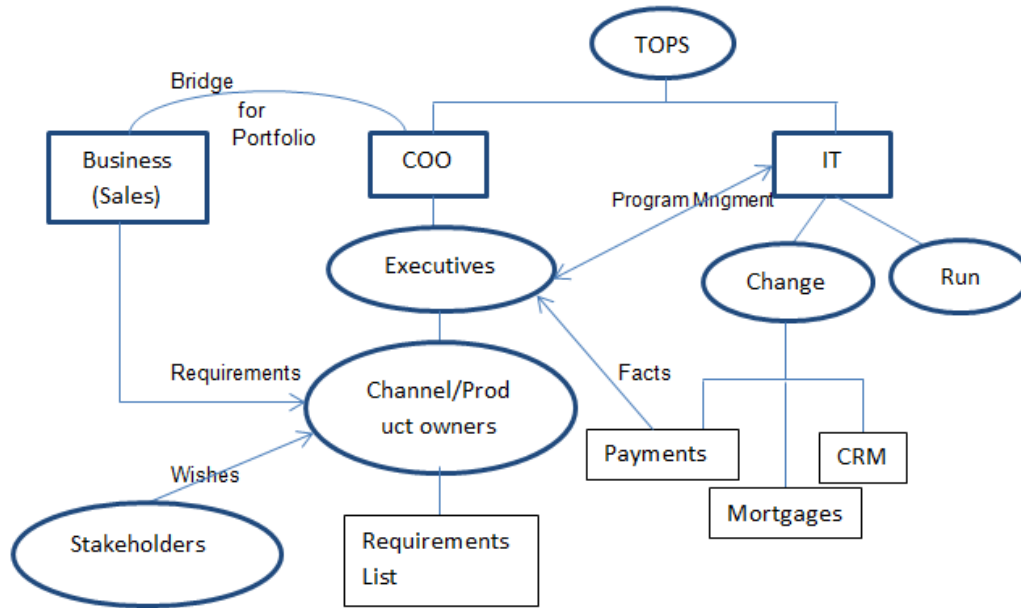


Figure 4.2.4: Process overview

4.2.5 Organization E

Organization E is a company that develops visual management software for companies that apply agile methodologies. This company is applying agile development methodologies the last 4 years.

People involved in prioritization

The people that take part in the prioritization process are those that know what the market want according to the interviewee. These are people from marketing, sales, product owner and the product specialists. Product specialists are those that take a product under their responsibility and have a substantial knowledge about it. There are also the product board that makes the product strategy decisions and the feature board that is responsible for one specific feature.

Process for requirements prioritization

The process in this organization is structured with specific steps and is comprised of 2 models: the ranking model and the refinement model.

The ranking model is basically the first round and it has a list of attributes with weights that gives a first ranking and priority to the requirements. All people involved in the prioritization process

give a number to for each of the metrics and at the end the top 20 requirements go to the second round which is the refinement model.

In the refinement model there are also metrics that give a final number to each feature but in this level the decisions are not based only in the numbers. The numbers give an overview and then the decisions are based on discussion between the people that are involved in the process.

Metrics

The metrics in the first round are: the spread (how many people have this problem), votes (from the user portal), size (how large the solution is), pain (how often customers ask about it), frequency (how often people will use it), and usage complexity (what the complexity in use will be). Some of the numbers are given based on experience and knowledge of what the customer wants and other are based on the outcome of surveys or from the user portal they have.

The refinement model is based on the organization's vision. So they have categories that they want to focus on each time and the requirements that fall under this category have higher priority. There are also other metrics used such as: time, revenue, Kano model (is the requirement a must have, an exciter or performance improvement), ROI and cost of delay.

Business value

For this organization measuring business value is mainly measured through their web page. The customer can vote for the new feature, leave a comment or "dislike" it, as mentioned. They also monitor user experience and take into account the frequency and ease of use for new features. They also use NPS as another metric.

Prioritization across different markets

Prioritization across different markets is based on the revenue that the company will have. Also on the long term potential for further development and improvement.

Challenges

The challenge of agile is that it helps prioritization but only indirectly. The iterative way of work, customer relations and feedback loop, decision meetings etc. help the company to move towards the right decisions; however it does not provide a clear way for requirements prioritization.

Improvements

No improvements mentioned.

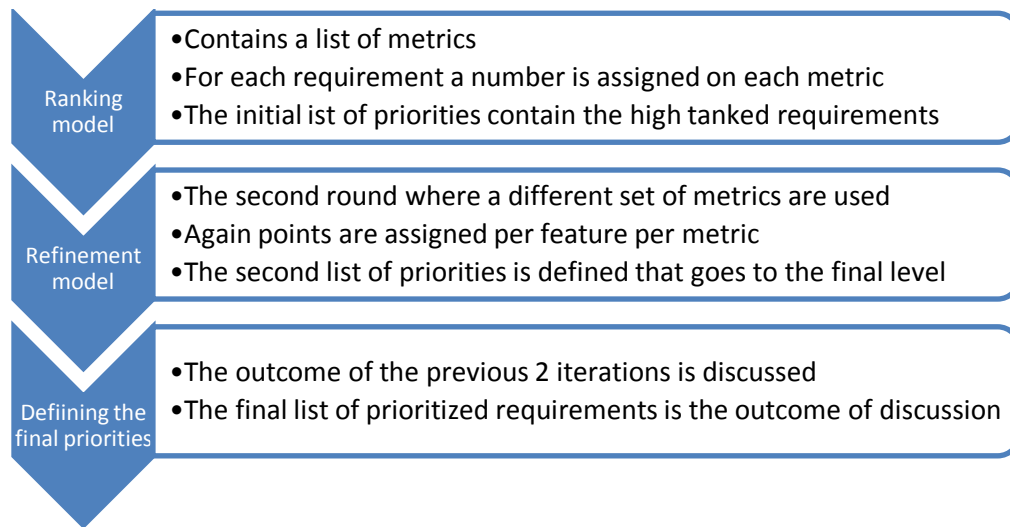


Figure 4.2.5: Process overview

4.2.6 Organization F

Organization F is a financial services provider with more than 48.000 employees. The organization started applying agile software methodologies the last 2 years with great success as the interview mentions. Interviewee's experience with agile projects started 1 year ago.

People involved in prioritization

The people that are involved in the process are: product manager/PO and the team.

Process for requirements prioritization

In this case no special process is followed for requirements prioritization. The product owner gets the requirements and prioritizes them based on his experience. The stakeholders take part in a session where requirements are discussed and prioritized.

Metrics

There are no specific metrics used for prioritization. The main driver is urgency and then compliance with security aspects that should be followed.

Business value

No metrics mentioned.

Prioritization across different markets

Standardization is also the goal of this organization due to the fact that this will reduce their costs.

Challenges

No challenges were mentioned. The interview mentioned that the process is working well enough until now.

Improvements

No improvements proposed.

5. Discussion

In this section (5.1-5.3), the research questions will be discussed based on the input from the interviews and related work. In section 5.4 a method for requirements prioritization in agile environments is described and analyzed.

5.1 How do we measure business value from customer's perspective?

As in literature so in practice business value is closely related to revenue. Even though people tend to rank business value high, when they are asked how they really measure business value they mainly stated that business value equals revenue or even that they don't have measures in place. While describing the steps for prioritization a Program Director mentioned that *"We measure business value in terms of revenue and margin"* and later in the question of "How you measure business value" the answer was not consistent with this statement. In this question the Program Director mentioned metrics that really refer to customers' business value. This observation (to more than one companies) lead to the conclusion that business value is a term that needs to be analyzed and defined within the company so everyone has a common understanding.

Of course at the end, business value of a product is related to revenue but the question here is whether business value should be only seen as revenue. The answer to this question is not trivial. One the one hand each organization is looking for products that can increase revenue, but on the other hand a satisfied customer is an asset for the company. He is the one that will come back and try new products because he feels valuable for the organization. So business value can be interpreted as a two-side term: one related to customer satisfaction and one that can be translated into revenue. The question that we attempt to answer here is how we can measure the business value when it comes to the customer.

Business value metrics

Online based reviews can offer a valuable input and an insight of customers' preferences. They can reveal what the customer considers important and what not, the real advantages and disadvantages of your product and how the customer values them. In organization A, this method for gathering customers' insight has an important role and taken seriously into account when they plan new features or improvements. *"There are dedicated people that constantly follow the reviews, even the CEO looks at them"* a product manager stated.

This way you can always have immediate feedback and hear the customer's voice.

“Weak points can be identified in order to be worked on the next release” (Vice President).

“Through the online reviews you can see where your product is standing and make quick changes. You don’t have to wait for internal market analysis” (Product manager)

However there are some limitations that should be taken into account:

- Customers probably give a grade for the overall performance of the product and not a specific feature launched. This means that when it comes to prioritization the input for the new features that were ranked highly is limited. At the end of the release you still do not know if your prioritization was correct or not.
- The customer that reviews the product might not be a valuable one, like someone who just buys once.
- Some of the customers can be too demanding or too indifferent.
- The input can be biased as customers can be affected by others comments and reviews or even initiated by competitors. *“We know that many of the comments and bad reviews are triggered by the competitors” (Line manager).*
- *“If a product has a defect doesn’t mean it’s not valuable” (Program Director)* so every comment should be taken into account but not considered as a failure to deliver value.
- Market segmentation is not taken into account. Different customers have different perception of value and what is important for them so there is a need for market segmentation before considering an online review as important.

Another way to measure a product’s business value is through questionnaires to customers with questions that reveal the business value of the product. These questionnaires can be customized, with focused questions in order to get feedback on specific features and functionality.

Furthermore, using this method the organization can concentrate on “valuable” customers. These are customers that are active and passionate with the company’s products and willing to provide their feedback. They can be identified using RFM (Recency, Frequency, Monetary), meaning finding out customers that are actively buying, frequently, spending money for the company’s products.

Business value is definitely an important factor for prioritization, which all interviewees mentioned, however it should always be combined with other metrics in order to result in an effective prioritization. As a Sales Manager mentioned *“We don’t want only to satisfy our clients*

but also keep our core assets and maintain our competitive advantage. That's why we also take into account market analysis, core assets and costs".

A research conducted in one of the interviewed organizations reveals the techniques that are used for measuring business value. The most important ones that are used to collect input from users are: online reviews, surveys with questions on specific functionality, one-question survey for multiple functionalities, direct complaints from customers (survey at organization A, 2014). The same survey also showed that this input is not always taken into account and some of the metrics have not been updated for the last 4 years.

As observed, different people in the same organization can have different view on what business value is and the importance of it. There is the need of the adoption of a holistic overview, definition of the term and the importance of it and how it should be integrated in the company's strategy and decision making. Table 5.1 provides an overview of the metrics that were mentioned from the interviewees.

Business value metrics	Description
Online reviews	Reviews from web pages where users can leave their comments. Direct feedback and easy to be analyzed.
NPS (Net promoter score)	It refers to the extent that a user would suggest a product to a friend or family. It can show how satisfied customers are.
Survey	A survey is a list of questions referring to product attributes, in order to understand user's opinion about it.
One-question survey	A survey that has only one focused question.
Direct customer input	Input that comes to the company directly from customers and it usually comes through the customer service of the company.

Table 5.1: Business value metrics

5.2 How do we prioritize requirements in agile environments?

Requirements prioritization is a process that belongs to portfolio management as mentioned in the literature section. This is something that was also validated through the interviews as people interviewed either mentioned that the process of prioritization is something that belongs to the portfolio level, or at least it should be part of it. As an overall remark, still there is the need for many changes until it can be fully operational and part of portfolio as it is analyzed below.

Agile Software development shows the way of how teams and processes within the teams should be organized but when it comes to prioritization (either in team or program level), agile offers a limited set of prioritization practices. Requirements prioritization is mentioned as something that is of utmost importance, but little guidelines or proposed methodologies are deriving through agile manifest. The main way that Agile proposes for requirements prioritization is a way that is based on the experience, intuition and business understanding of the PO and PM. The way that each team/company prioritizes the requirements is depending on the company's way of working and internal best practices. This is done by using the "backlog" which is basically a list of requirements that the PO is called to prioritize. However, this prioritization method is not based on concrete criteria or processes. Thus it makes prioritization a quite unstructured process.

In the question "Do agile methodologies and principals can/do contribute to the way that requirements prioritization is done?" the majority of the interviewees replied no, meaning that the perception is that agile does not have much to offer in that respect.

"Agile directly is not influencing our metrics, but indirectly yes" (Business Developer)
"I am not aware of any requirements prioritization process" (Product Manager)

As mentioned by an interviewee agile affects prioritization mostly indirectly. This indirect impact comes through the ceremonies (within the team and in the program level), the alignment meetings, quick customer feedback loop and all processes that agile defines. It creates the base ground for better business understanding and thus better prioritization.

On the other hand, SAFe offers the WSJF (Reinertsen, 2009) model which is based on a specific formula and metrics. Organizations that apply SAFe framework are aware of this method of prioritization but they do not actively apply it.

"We used to apply WSJF model but it turned out to be too complicated and not accepted by all people" (Senior Product Owner)

In one of weekly meeting where POs and PMs participate it was stated that there is a need for a structured way of prioritization and that WSJF would be a good candidate, however it is not supported by management. As a senior product manager mentioned *"People don't like formulas and numbers. It is difficult to convince them that such a method would bring better results"*.

Eight out of ten of the researched companies (and product units) have either no defined process for requirements prioritization, or the process is not structured. This means that even big companies that apply agile methodologies, they don't spend the required attention to requirements prioritization. The process is often driven by only one person and it is not a process that has been defined together with all the interested parties. This means that each person has a different understanding of what is crucial and needs to be ranked high, or what can wait and has no business value at the moment. This usually leads to the situation that just every stakeholder taking part in prioritization meetings loses the overall point of prioritization and just "fight" for his/her requirement. These meetings end up with frustration and no valuable result, as the "louder" stakeholder wins a high ranking of his/her requirement. *"The one who shouts the louder gets his requirements higher in the list" (Vice President).*

This situation is highly problematic for several reasons: there is not a feeling of urgency and importance created to the participants where everything is abstract and unstructured, the outcome is often of poor quality, it takes longer as there is not a strict agenda that can be followed and most of all the prioritized list does not take into account all parameters that are highly important for requirements prioritization. What is really interesting here is that many interviewees expressed their concern about having a structured way of prioritization, even if they have previously expressed their disagreement with the current state. The main concern was about the degree that such a method will be accepted and adopted by the management. These statements bring in questions of whether there are not structured requirement prioritization models or they are just not accepted and how can an organization work towards adopting such a methodology?

When it comes to metrics for requirements prioritization, they are vague and limited. In some cases, different organizations use a number of criteria to prioritize but they are not visible and clear enough. These metrics are known to some stakeholders and not clear to everyone. They are not well documented and they lack of extensive description. The most commonly used criteria are: business value, revenue, risk, cost of delay and time of implementation.

5.3 How to prioritize requirements across different markets?

Prioritization across different markets is another challenging process that needs a lot of management attention. Different markets are mainly handled as one more requirement and evaluated based on the revenue and the value that it will bring to the product *“A different market is just another requirement. It goes into the backlog and prioritized based on urgency” (Product Owner)*. In other cases different markets have higher priority than other, based on the investment that has already been done and also on the maturity level of the product in that market. Finally there were cases that the interviewees mentioned that they try to eliminate customization as much as possible so in that way they work more in having a common ground for all markets if possible. In this last case the main reason that drove towards this direction is risk elimination, better control and cost reduction *“We are trying to avoid customization for different markets. This is the goal of the project we are working on now, reduce costs and risk” (Project Manager)*.

5.4 Goal and Business Value oriented requirements prioritization model

In this section the proposed model for requirements prioritization is going to be presented and analyzed. Section 5.4.1 provides an overview of the model, in 5.4.2 the focus is on the people that should be involved and how to identify them, 5.4.3 described the metrics that this model is using for prioritization, 5.4.4 describes the whole process that should take place and finally in 5.4.5 gives some suggestions on how to close the process and make it successful.

5.4.1 An overview of the model

In the “Related work” section several requirements prioritization methods are analyzed, focusing on the criteria that can be used for this purpose. In this direction business value, cost, risk and other criteria are proposed as guidelines in order to build a well-structured and correctly prioritized backlog. However, in reality the whole process of prioritizing requirements does not work like this. Most of the people that were interviewed said that they do not use specific criteria or methodology. Furthermore, through the literature review it was not found a research that defines how the whole process needs to be structured when it comes to people, process, metrics and results processing.

Interviewees also stated the need for a change in this area, they need a structured process that can help them reduce time, risk and improve their collaboration between stakeholders. In the current state the process in most organizations was pretty abstract, based on intuition and little metrics,

with main driver the urgency that stakeholders create. This situation though, can lead to a wrong prioritization and thus in delivery of products with little business value.

The purpose of this section is to provide a model that defines the full process of prioritization. Even if there is some literature related to requirements prioritization, it was not found a method that proposes how the whole flow should work and requirements prioritization appears as a more complex and vague process (Lehtola, Kauppinen, & Kujala, 2004). The goal of this research is to provide a model based on the outcome of the interviews in combination with the related work that already exists. So, it will be a goal and business value oriented model that includes validated methods like WSJF and Kano Model. The last two parts will provide a solid ground for decision making as they also have characteristics that fit to this research.

This proposed model starts from how to define the process, the people that should be involved, what this process should include, what the used metrics should be up to the last step which is how to use the results. An overview of it contains the following (figure 5.4.1):

- Motivate your team to use the process. Create the urgency and point out the benefits
- Start building the process up with all interested parties involved
- Define the process and the requirements prioritization criteria: what, how, when
- Finalize the process and ceremonies
- Process the outcome and make decisions

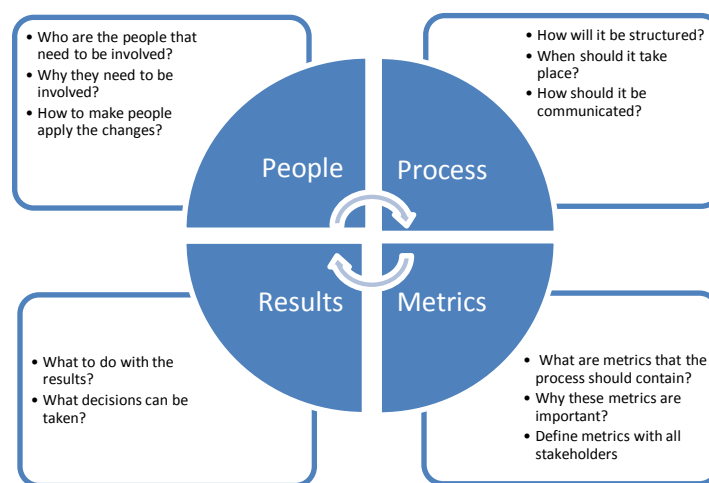


Figure 5.4.1: High level elements of requirements prioritization method

The first important step towards having an effective and efficient requirements prioritization model is to create the urgency and importance of it (Kotter, 1996). All stakeholders that take place in requirements prioritization should understand and feel the need of a change and why prioritization is important, what it can offer (Berander & Andrews, 2005).

As a next step they need to feel engaged with the transformation process, they should be part of it and have an active role in this transformation. The requirements prioritization model that will derive should be a result of team work, common understanding and agreement. Once agreeing on the process, the frequency that people need to be involved, the next step is to define the metrics that are going to drive prioritization. These metrics should derive from business needs as well as company's needs.

5.4.2 People involved

The people that need to take part in the process of prioritization need to be defined and be involved in all steps of prioritization (a person can play the role of the moderator). There should be people from program and team level, as well as customer and business representatives. From team level the POs are essential for requirements prioritization as they have both an understanding of the technical and business point of view. From the program level the PMs are those that have a more holistic view on the product combined with the insight they bring from customers and business side. They are also the budget holders, which is an essential part of prioritization.

In cases that companies have sales representatives they can be a critical part of the process. These are people that interact the most with customers and know the market needs. Finally there should also be a person from the high level management to always ensure that organizational goals are achieved and avoid misalignment.

The people that should take part in the requirements prioritization should not be too many in order to have timed sessions, and not too little in order to take into account all ideas that can contribute. For example, developers and architects can be excluded as they can have separate meetings with POs and PMs, definitely their opinion matters, but this should be done outside the prioritization meetings as they don't have a clear view of the business word (Lehtola, Kauppinen, & Kujala, 2004).

5.4.3 Metrics

As this model is goal and business value oriented there should be specific metrics that indicate the degree that requirements comply with them. After looking at the related work and also what is being done in practice, the following metrics can be used in the process of requirements prioritization next to the WSJF model (section 2.3.6).

- **Business value:** business value needs to be measurable through specific and concrete metrics as mentioned in section 5.1. One way can be to continuously receive customer feedback through surveys and questionnaires to “loyal” customers.
- **Alignment with organizational goals:** for this metric we first need to make sure that organizational goals are clear and then define requirements that are aligned with them. All requirements need to be aligned with high level goals and make sure that steps are made towards achieving these goals.
- **Cost of delay:** cost of delay is the loss if a specific requirement will not be implemented. This can mean loss of potential customers or even loss of existing market share which can easily be translated to monetary terms.
- **Risk:** is this requirements going to bring extra risk or this can be simply implanted? Does the company want to deal with a risky requirement or it is preferred to go first with safe and stable options? These are questions that need to be answered after estimating the technical risk of a requirement.
- **New opportunities:** it is wise to think whether the requirements that are discussed can bring any new opportunities. Such requirements can be new product development or even new features to existing product that can bring new customers and increase business value.
- **Competitive advantage:** it is important to also look in the market and go along with competition to make sure that what you develop is not out of date and of course you can follow market trends and be competitive at the end. It might me that there are a lot of requirements but none of them makes you competitive and market leader.
- **Dependencies:** before starting implementing a requirement it is important to step back and have a deeper look into your requirement and its dependencies with our requirements. If requirements that are highly ranked are depending on low priority ones (internal or external) then you end up with work that stays in progress until all dependencies are complete. The disadvantage of this is that you have your stakeholders waiting for a high priority requirement that in reality cannot be implemented as expected.

5.4.4 Process

The process of requirements prioritization is not a simple one and cannot be completed in one stage only (Lehtola, Kauppinen, & Kujala, 2004); it requires different steps until we reach the phase that we have a list with priorities. It should be a continuous process with a flow of requirements, due to fast changing environment, and people that know what is of value. The process though needs to be stable and structured in order to bring the desired outcome and also the required confidence and people's acceptance.

Set up meetings: the meeting should be scheduled in a regular basis in specific date and time. It is important to have discussions on the progress and team's capabilities in order to be able to build priorities and set target for the coming releases. The PM and POs should have weekly meeting so they can both align and have same expectations and also exchange ideas and insights of the market and implementation constraints and risks. Bi-weekly meetings should be set up with PM and other interested parties like sales team, board members, marketing etc. (depending on the nature of the product) in order to draw a full picture of business and market needs. Finally, there should also be bi-weekly meeting with all the stakeholders and customers representatives to exchange feedback, current statuses, discuss market needs and goals.

Define the structure of the meetings: create an agenda before each meeting in order to have a structured conversation on urgent issues and requirements of high importance. All topics need to be communicated in advance and all parties need to be prepared for them. Do not leave gaps and open questions, try to provide answers and talk with evidence. This way people can be convinced and a common trust will be created.

Define goals in advance: before going further with requirements prioritizations goals and vision need to be clear. People feel safe and useful when they work towards the achievement of specific goals. Only then motivation is increasing and people try to achieve more. Otherwise uncertainty is created and the level of involvement is decreasing.

Define business value and metrics: as mentioned business value is a term that in many cases is not clear and difficult to be measured. Thus is highly important to define what business value is for your organization and how you can really measure it. Agree on the metrics and provide concrete information on how and what.

After these first steps, when all rituals are in place and all stakeholders are aligned it is time for prioritization. Prioritization will be a two-phase process. The first phase will have as an output the

first priority list, including the top priority requirements and the second phase is where these requirements are being prioritized based on the WSJF and Kano model.

Phase 1: Goal oriented approach

In this first phase having organizational goals as drivers, the stakeholders discuss all requirements and exclude those that are not in line with the goals that have been set up front. This is an important first step as it will ensure that people are going to spend time only on requirements that are valuable for the company.

Of course this first step needs to also have some metrics as the goals need to be measurable. For example an organizational goal might be to increase competitive advantage, meaning that given a requirement it should contribute to this goal.

This first phase will not give prioritized requirements but the requirements that are the most valuable for the company. This way, people will have a common understanding of why requirements were excluded and can communicate that easier to the stakeholders.

Phase 2: Focus on business value

After having the first shorter list of requirements, there is now the need to give priorities to those. This will be done by using business value, WSJF (Reinertsen, 2009) and Kano model. In this case the definition and metrics of business value are incorporated in WSJF model that has business value as one of its parameters. As a next step Kano model will help the company to decide based on customer needs by grouping requirements into basic, expected and excitement needs.

WSJF model is giving a priority list based on specific criteria like: business value, time criticality, risk and size. Here in order to measure business value and give a number for each requirement several metrics need to be used and need to be decided before going further. After the research that has been conducted the proposed business value metrics are revenue and direct customer input as analyzed in section 5.1. So after giving a WSJF value to each requirement we have a list of requirements that are based on organizational goals and we know the relative order between them.

Having such a list, which already gives the high priority requirements based on two strong points, it is time to look more from a customer perspective as agile is focused on as well. Using the Kano

model we can identify which of the requirements are features that are basic functionality, which are expected functionality and which will give excitement if users receive them. In order to implement this step a market research has to be done, get the customers insight and offer what they really want. This process will both allow the company to compete and innovate by offering both “satisfiers” and “delighters”.

5.4.5 Results

After finishing this two-phase process the output is a list of prioritized requirements. However the process does not finish here, the next step is to have a final discussion with stakeholders and analyze the results. The added value of this analysis is multidimensional.

First of all, you give people the satisfaction that they are not only present but also active, their opinion matters and they can support it with evidence. This way they feel involved and useful to the whole process. Secondly, as mentioned people are usually reluctant in using and trusting formulas. Thus you give them the opportunity to discuss about their objections and make them feel part of the process.

This last part is highly important as numbers and formulas can give you good indications but they cannot and should not replace human input. Thus, this last round can bring some more changes in the prioritized list and give the final one after discussions and negotiations between stakeholders. An overview of the model is provided on figure 5.4.5.

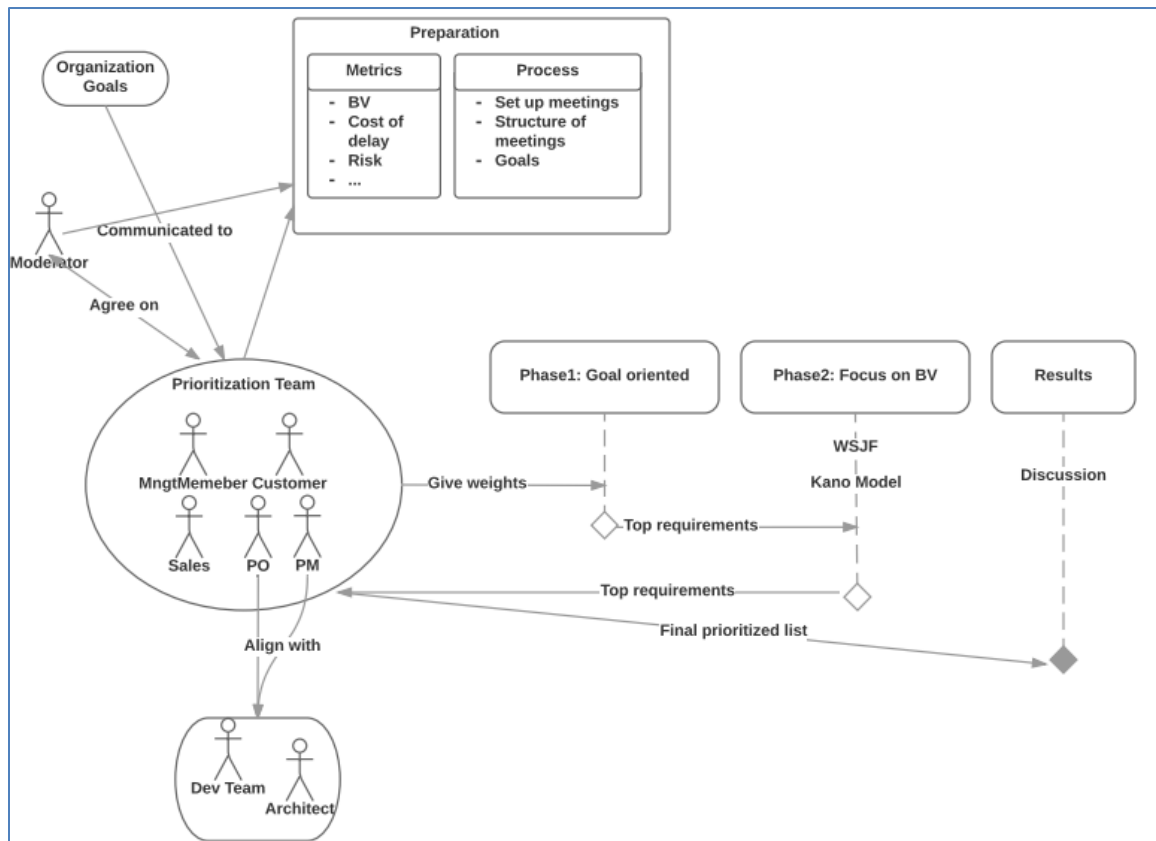


Figure 5.4.5: Goal and business value oriented requirements prioritization model.

6. Conclusions and recommendations

In this research the author took a deep look into the topic of requirements prioritization in Agile environments. The focus was on the process of requirements prioritization as well as the metrics that should be used for concrete and reliable results. For the purpose of this research six different organizations, for different markets, were interviewed. Ten interviewees participated in the research for almost one hour each, with most of the participants holding the role of the product manager.

Further in this section a conclusion is drawn with the main findings regarding requirements prioritization. In addition, limitations and proposals for further research are discussed in order to enhance the findings of this research.

6.1 Conclusions

The most important finding of this study is the fact that big organizations with big projects do not have a well-documented and clear process for requirements prioritization. Requirements prioritization is still a process that is done based on experience and intuition of participants and not on a well-defined and commonly accepted model. People are struggling to prioritize requirements in an efficient and effective way as they miss the means of doing so. They do not have a commonly accepted framework and this costs a lot of time and wrong prioritization. Furthermore, the knowledge regarding common practices of requirements prioritization is limited, as most of the participants were not aware of any existing model or process.

In addition, the agile software development method provides limited input regarding requirements prioritization as it is mainly focused on the team level. The Scaled Agile framework is one of the models (next to the product backlog) but it was either not known or not used in practice by the researched organizations.

In general, requirements prioritization is a process that is semi-structured (in most cases), based on some ceremonies and basic commonly used metrics that needs a lot of attention in order to optimize it and have better results in terms of delivering business value, time, costs and risks constraints and validity of priorities.

The strength of this research is the fact that it attempts to answer the critical question of “How we can measure business value”, which is still a vague and multidimensional term. It focuses on the customer’s perspective and it tries to provide the metrics that can help in measuring business value. Furthermore, it provides a theoretical model which is based on related work and practice

where you can find a gap on how requirements prioritization should be done. Furthermore, the research was not only limited in the input from the interviews but it also includes observations and unstructured interviews from one of the researched organizations. During the time that the author spent in the company she was involved (as an observer) in many meetings with people for program level, where a lot of discussions were about requirements prioritization. That gave an extra input and the opportunity to see things while they are happening and not only in the context of interviews.

6.2 Validity considerations

This research and its methodology can leave space for validity concerns. Due to constraints in time and resources the research is limited in six organizations and a small number of interviewees. In order to get a better understanding of the organization and processes, there is a need to talk to more people from each company and also increase the number of researched organizations. Furthermore the coding has been performed by one person, thus its subjectivity can be questioned. In order to find a balance for this, the author has associated findings with literature and also quoted the actual words of the interviewees.

In addition, not all metrics that were mentioned for requirements prioritization were analyzed in depth. The focus was on business value and less to the other metrics mentioned which might result in underestimating the importance of them.

For further validation the Lean Change Canvas model can be applied to the case organizations as mentioned in appendix 3.

6.3 Recommendations for future research

In this research the main question was “How can we design a model for requirements prioritization in agile software development?”. For this purpose six different organizations participated (in total ten different cases) and in most cases only one person from each organization (or business unit). Thus there is a need for further research with more organizations and especially for interviews with more than one person per case. This will provide a more clear view on the process and will help to better understand by taking into account different opinions and points of view. It is also highly recommended to participate in one of the requirements prioritization meetings in order to have a personal view of how the process works. This will help to draw more clear results and also identify areas of improvement that they have not found out yet.

Moreover, more business sectors should be included in a future research as different business sectors have different needs, thus they require different requirements prioritization models.

Finally this research was focused mainly on the metrics that are needed for requirements prioritization but there is the need for a research in the overall process.

6.4 Recommendations for practice

The proposed framework for requirements prioritization can bring some challenges in practice. There are also some challenges that derived from the interviews as mentioned in section 4.1.2, summarized in table 6.4 and recommendations on how to overcome them are proposed.

Challenges in practice	Ways to overcome
Missing trust: created most of the times due to lack of clarity and not well defined processes. It can lead to conflicts and inefficient prioritization.	In order to establish a mutual trust among people involved in the process there should be clearly defined methods and processes. Alignment between members should happen before establishing any methodology.
Missing information, crucial for prioritization. Such information can be long term strategy, visibility within or out of the team, etc. As a result the process will become useless while it is based on such information.	High level management should define and clarify all elements that should be provided by them. Also as working in agile environments, alignment meetings should be established, including all interested stakeholders.
Resistance to change: people are not so keen on changing their way of work, especially those that are under the impression that the current state works fine.	Again high level management should be involved and communicate the benefits of such a change and the clear transmission steps.
Evaluation of metrics: some metrics might not be relevant for some organizations and others that are not defined here might be more important.	One of the steps defined in section 5.4.4 is to examine the metrics and decide whether they should be used and how. This is highly important step as the metrics are a core element of this model.

Table 6.4: Challenges and proposed solutions

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Appendix 1 – Interview questions

Introduction

Personal Introduction: Eleni Stavrou, Master student currently working on my thesis while doing my internship in company X

Research interest: want to learn how the requirements prioritization is being done in Portfolio level (features), what is the process followed and what are the concrete steps of prioritization

Research Background: A model for requirements prioritization and the role of business value

I would like to ask you if I can record our conversation in order to use this information for my Thesis research, always by keeping you anonymous. None of the statements will be linked to you and if I need to quote your words, you will be first asked.

Time: 60 mins

Interviewee background

1. What is your educational background?
2. What is your working experience so far? Have you worked in an agile environment before?
3. How long have you been working here and what is your current position?

General questions

4. What business is your organization?
5. What are the goals of the organization? Are they clearly defined and communicated?

Structure

6. What is the role and objectives of Portfolio Management?
7. Who is the “leader” in each level (portfolio, program, team)?
8. What are the key roles within the organization?
9. How is the organization structured regarding actors, roles and responsibilities (functional, divisional, matrix, roles, responsibilities etc.)?
 - i. (Provide empty sheet of paper, show example of actor network) Could you please draw out a network of participants in your organizations across teams as detailed as you remember?
 - ii. Do you have documentation (illustration or text) of your process that I could take with me?

Requirements prioritization

Process

10. Who is involved in requirements prioritization and how often there is a meeting about that?
11. How do you prioritize requirements?
12. Which process does your organization follow to prioritize requirements?
 - i. (Provide empty sheet of paper) Could you please write down a step-by-step description of the requirements prioritization process as detailed as you remember?
 - ii. Do you have documentation (illustration or text) of your process that I could take with me?

Criteria for requirements prioritization

13. What are the criteria that you use as input for prioritization (profit, cost)?
14. What is the number 1 factor you take into account when you prioritize requirements?
15. How highly do you rank customer's needs compared to organization's needs (customer over cost/time)?
16. Could you rank the importance of the following criteria that can be used for requirements prioritization: business value, cost of implementation, cost of delay, profit, risk, time, dependences, competitive advantage.
17. How do you prioritize requirements across different markets (Netherlands, Us, China)?

People

18. Are there conflicts in perceptions on the importance of requirements across the actors (of what needs to be implemented and how)??
19. Between which roles most conflicts occur?
20. How these conflicts are resolved?
21. Who is the person/role/team that affects more requirements prioritization (managers, production, customers)?
22. What are the main characteristics that a prioritization method should have according to you?
23. Are you satisfied with 'how' the process is or just things work at this moment? What works well, what can be improved?
24. How do you measure the value and effectiveness of the process, are there any KPIs?
25. Are you aware of existing methods (give some examples to the interviewee.)?
 - i. If yes, what do you know about it?
 - ii. If not, explain some and ask if any of them can feed to the organization.

Questions about Business Value

- 26. How do you define customer's business value?
- 27. How do you measure business value (metrics used)?
- 28. Who is responsible for business value assessment?

Appendix 2 - Lean Change Canvas method

Execution and evaluation of the proposed changes will be done based on this analysis. The Lean Change canvas method is the way to plan changes and present them in a single picture with certainty, simplicity, ease of use and enhance modification. It is a way to communicate the changes that are going to take place. The Lean Change Canvas framework comprises of several key aspects of the change plan: urgency, change participants, vision, target options, action, commitments, benefits, success criteria and communication. A sense of urgency should be established regarding the changes and communicated to the change participants (one or more). Vision and target options provide the suggested methods, behaviors and other aspects of the environment related to the change. In addition, based on target options a set of actions regarding the change are going to be established and commitments from the involved stakeholders is required. The benefits of the change should be made clear to the stakeholders, by defining measurable success criteria. Finally, the whole process should be communicated to any interested parties (Anderson, 2003).

The Lean Change Canvas model is going to be used to drive and validate the whole research process. Key aspects that need to be clear before, during and after the research are:

- Why this research is needed
- What is the problem that this research is going to address/deal with
- How the problem can be resolved, what are the needed actions
- Who has to participate in the change process to have the expected results

Having these aspects in mind and using the Lean Change Canvas model the results are summarized in table 3.3.1.

Target options: as the current researches do not offer a full picture of how prioritization needs to be organized, especially in agile software development environments, the target is to define the whole process of requirements prioritization. The goal is to create a framework for requirements prioritization defining the steps, processes, people and expected outcome.

Vision: To propose and implement a requirements prioritization model which can cover all company's needs and optimize the process of requirements prioritization in order to achieve the maximum of business value delivered.

Urgency: it has been observed from literature as well as from practice that the way that requirements prioritization is implemented has some inefficiencies, though it can be optimized. In most cases that have been examined, requirements prioritization is an abstract term and process. However, requirements prioritization is an essential process as it defines what and when is going to be delivered to customers. Each manager has to make sure that the right priorities have been set, so a well-defined process needs to be in place. If not, the danger is to deliver an increment that is not of value for the customer, does not increase customer satisfaction and as a result does not increase revenue. Thus, people involved in requirements prioritization need to have a process that helps them identify the top priorities in a timely and efficient manner.

Success criteria: the expected benefits of this framework are defined by the measurable success criteria. The framework needs to be precise, with clearly defined processes and steps. This will result in speeding-up the process which means faster time to market with more accurate deliverables. Also, it needs to address one of the most important aspects in prioritization which is the business value. Business value is impact variable in prioritization, thus it needs to be measurable and well defined. Last but not least it is important that the process ensures that the company applying the framework is still innovative and not only follows market needs but also introduce requirements that are ahead of the current market needs.

Communication: as every change within an organization, it is essential to communicate the changes before they are implemented. All parties should know what the change is about, why it is needed and what the expected results are. Furthermore, people that are going to be impacted should be involved in the whole process of refinement and adjustments that will happen. People need to feel the urgency themselves in order to contribute to the change and adopt it. It is also important to inform and involve them in order to avoid denial and dissatisfaction.

Change participants: key people that have to be informed and involved in the change process are so those that are going to use the framework as well as those that are going to be impacted by changes in the process. These people, as resulted from the interviews are product managers that are the main drivers of requirements prioritization, product owners that are important contributors, the teams that give their input and of course all related stakeholders, depending on the company. The later can be people from legal/sales/customer care department or direct customers. All parties need to be identified and make sure that no one is excluded.

Action: the process that was followed in order to define the appropriate prioritization framework started with analyzing the organizational context. This gave an essential insight of what is

processed in different levels in order to be able to define all aspects that are related to requirements prioritization. After the analysis of organizations' structure the interviews were analyzed in depth in order to see where companies stand in terms of prioritization. The next step is to propose the appropriate framework that covers aspects applicable to more than one organization and then validate its contribution and value.

Commitment: the purpose of this research is to help organizations in applying a precise and valid requirements prioritization model, thus it is needed to present a valid set of results after an extensive research in different organizations. Of course the results of this research will have no value if the interested parties resist to change. So together with the presentation of the results each organization should ensure that the changes are communicated and their importance is clearly defined. This will also help in adopting the changes and applying them in a short period of time.

Benefits: the benefits of applying this framework if first of all to increase reliability of the applied process for requirements prioritization. By making the process more precise and clear, requirements will be prioritized in a more efficient manner, resulting in increasing business value, time to market and revenue.

Urgency  - Inefficiency in requirements prioritization process - Wrong prioritization - Time waste - Not a clear and well defined process	Target Options  A requirements prioritization framework for Agile Software environments	Vision  To propose and implement requirements prioritization model which can cover all company's needs and optimize the process of requirements prioritization in order to achieve the maximum of business value delivered.	Communication  - The change should be communicated beforehand - All interested parties should be involved in defining the process	Change Participants  - Product managers - Product owners - Agile teams - Different stakeholders
	Success Criteria  - A precise prioritization model - Faster process of requirements prioritization - Prioritize based on business value - Faster time to market - Leave space for innovation		Action  - Analyze the organizational context - Define critical aspects about requirements prioritization - Propose and implement the new model - Validation	
Commitment  - Present valid results after an extensive business research - Participants should not resist to change - All stakeholders should participate and commit to the whole change process - The change should be implement in a short period			Wins/Benefits  - Reliability - Maximization of business value = increased revenue - Time efficiency - Time to market	

Table 3.3.1: Lean Change Canvas Method (Anderson, 2003)

Furthermore, in order to evaluate the proposed research framework, a series of interviews are going to be done to understand the background, structure and the way that company X is doing business. The aim is to define how business value of a product can be determined within an organization and how requirements prioritization should be done.

Appendix 3 – Codes as derived from interviews

There were found approximately 90 codes that fall under 5 main categories: People interviewed, structure, process of prioritization, markets and prioritization models. In the below table codes are presented with a short explanation.

Code	Explanation	Code	Explanation
Org_Structure	Refers to the organizational structure	Improvements	These are codes for the proposed improvements on the current prioritization process in each company. Related codes: align_with_goals, align_with_dependencies, clarity, mathematical_method, etc.
Goals	Is about the goals of the departments and whether they are clearly communicated or not	Markets	These codes identify the answers related to prioritization across different markets. Related codes: standardization, customization
Agile_contribution	Defines whether agile practices affect prioritization or not. Associated codes are agile_dir and agile_inder	Model	Refers to existing models for prioritization and whether they are known/adopted. Related codes: no_model, no_model_is_known, use_of_model
Interviewee	Mainly refers to interviewee's background. Related codes: background, experience, roles, agile_exp	Challenges	Refers to the challenges that the companies face when it comes to prioritization. Related codes: long_term_strategy, PPM_involvement, time, visibility, etc.
Process	Refers to the process that each company follows for prioritization and derives from the methods that companies use	Frequency	Refers to the frequency in which prioritization happens. Related codes: weekly, monthly
Steps	The steps are about the process and what steps the company follows to prioritize. Related codes are: structured_method, unstructured_method that further refer to metrics and methodology	Metrics	Metrics are referring to the metrics that are used for prioritization. Related codes: BV, ROI, revenue, feature clarity, feature completeness, cost of delay, etc.
People_involved	Is about the people that take part in the process of prioritization. Related codes: internal internal_people, external_people		

Table: Codes and explanations

High level code diagram

