

**Quest for a Silver Bullet: Creating Software Product  
Value through Requirements Selection**

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## **Abstract**

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The value of a software product is based on the requirements included in a specific release of that product. This paper provides an overview of how software product value is both understood and created through release planning for three software products in Australia and Germany. This paper examines how IT professionals perceived value creation through requirements engineering and how the release planning process was conducted to create software product value. It then looks at the relative importance of different criteria applied in deciding whether to include a requirement in a specific release of software and the degree to which the major stakeholders' perspectives were represented in the decision making process.

The external client/market base of the software product was the most influential group in the decision to implement specific requirements; this is reflected both in the processes followed and the decision-making criteria applied.

The paper concluded that the creation of software product value is dependant on the context in which the software product exists, including issues such as the market or age of the product. But value creation through requirements selection needs to be better understood in order for the process to be more effectively managed.





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# 1 Introduction

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## 1.1 Preliminary

Value-based requirements engineering (VBRE) aims to maximise the value of a release of software through the selection of the optimal subset and prioritisation of requirements (Wohlin & Aurum, 2005a). While most release planning literature covers prioritisation and dependencies between requirements (Karlsson et al., 1997, Carlshamre et al., 2001; Carlshamre, 2002; Dahlstedt & Persson, A. 2003; Ruhe & Greer 2003), there has been little research into the criteria used in this decision-making process (Wohlin & Aurum, 2005a).

Market driven incremental software development is increasingly becoming commonplace (Carlshamre 2002; Ruhe & Greer 2003). Software in this category is developed and released to meet the requirements of a particular market, but will continue to evolve with future releases. Each iteration aims to deliver a new set of features or requirements. For example, this may be to meet the needs of new markets or to meet the changed needs of the existing clients.

The requirements for software are often so many that not all can be included in the next release (Wohlin & Aurum, 2005a). This makes it necessary to select a set of requirements to implement for the next release, and postpone the implementation of the other requirements. This process is called release planning.

## 1.2 Rationale

Value-based software engineering (VBSE) is becoming an area of increasing interest to researchers. After the dot-com bubble burst there has been incredible pressure on software companies to achieve and sustain competitive advantage. To achieve this in a global market place it is important to focus on the value of different customers and markets when developing a product. (Aurum & Wohlin, 2005a)

Since different customers have different needs that change over time, the selection and prioritisation of requirements to implement for each release of software becomes a powerful way of creating and controlling the product's value.

Little work has been done to understand what criteria influence the selection and prioritisation of requirements for a software release. However, a clear understanding of how product value is created will allow it to be more effectively managed. To the best of the researchers knowledge no such study has been completed in either Australia or Germany.

### **1.3 Research objectives**

The main purpose of this study is to understand how software product value is created through the requirements engineering process in industry. This objective was broken up into four more specific objectives.

The first research objective seeks to understand how professionals within the IT industry perceive VBRE. While it is a new area of academic study, the problem of creating software product value by selecting a set of requirements to implement for a release is a problem that is faced by the software industry today. Companies have been forced to change their development practices due to current market forces, but there is little theory providing alternative approaches that provide value to all stakeholders (Gordjin & Akkerman, 2003). The first research question is therefore:

**Research Question 1:** How is value-based requirements engineering perceived by the software development industry?

The second research objective focuses on describing the processes followed in industry today to manage software product value through release planning for market driven incremental software development. This question seeks to understand how requirements engineering and release planning are conducted to decide which requirements are implemented in a specific release. It is critical to look at the stakeholders involved and the roles they play in the decision making processes as the success of these processes is determined by the success-critical stakeholders (Boehm & Jain, 2005). Thus, the second research question for this study is:

**Research Question 2:** How does the software industry conduct release planning in order to create product value?

The third research objective is concerned with the value system applied to selecting and prioritising requirements for inclusion in a software development release. When selecting the subset of requirements to implement for a release of software, decision-makers apply a set of values to decide which requirements will make the release. This research objective seeks to quantitatively evaluate the relative importance of different decision-making criteria when determining whether or not to include a requirement in a specific release. Hence the third research question is:

**Research Question 3:** What values are applied to the decision making process to select and prioritise requirements for a software project or release? How does this differ to industries perception of the optimal application of the criteria?

After determining the values that influence release planning, this study aims to quantitatively understand the degree to which the major stakeholder perspectives are represented by the value system used in the requirements selection process. There are three major stakeholders involved in the development of software; the software development company management, development and maintenance personnel, and the external market or clients; each with their own agenda. Consequently the fourth research question is:

**Research Question 4:** To what degree to the do the perspectives of the major stakeholders influence the requirements selection and prioritisation process? How does this differ to industry's perception of the optimal application of the criteria?

## **1.4 Research Contribution**

This article presents the results of an empirical study, based on data collected from three software; two from an Australian company and one from German company. The main objective of this paper is to provide insight into the release planning processes used in industry to create software product value from both the perspectives of the processed followed and the criteria used in the decision making process. This research will highlight different stakeholders' roles and influence in the process. To the best of the researcher's knowledge, there are no other field studies that examine VBRE practices in Australian companies or the value system applied to requirements selection in German companies. The contribution of this paper is fourfold; a) investigates how VBRE is perceived by practitioners, b) examines how industry conducts release planning, c)

studies the values applied in prioritisation of requirements, and d) examines to what degree the stakeholders' perspective influences the prioritisation of requirements.

## **1.5 Organization of Thesis**

This thesis is organised in six chapters. These are outlined below.

**Chapter 1 – Introduction:** Introduces the problem domain, rationale for the research, research objectives and major contributions of the research to the body of knowledge.

**Chapter 2 – Literature Review:** Presents a review of the literature relevant to this study. The areas covered include requirements engineering, release planning, value-based software engineering, and value concepts from software engineering, management, economics and marketing.

**Chapter 3 – Research methods:** Details the research objectives and questions, the research methodology employed to gather the data needed in this research study, the modifications to the research instruments, pilot studies, description of the case studies, data sampling, ethical considerations and data analysis techniques.

**Chapter 4 – Results and Discussion of Results:** Presents the results and discussion of each research objective, answering the research questions posed. This chapter also details the threats to the validity of the research.

**Chapter 5 – Discussion of the Results:** This chapter discusses the contribution of the research.

**Chapter 6 – Conclusions:** Presents a summary of the research findings and opportunities for further study.

## **1.6 Chapter Summary**

This chapter provided an introduction to the problem domain of value-based software engineering and has detailed the rationale, research objectives and contribution of this study.

## 2 Literature Review

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### 2.1 Introduction

This chapter presents a review of the literature relevant to this research study. The concept of value and value-based requirements engineering (VBRE) is defined to establish a common understanding of the problem domain. Literature is drawn from requirements engineering, release planning, value-based software engineering, and value concepts from software engineering, management, economics and marketing.

### 2.2 Requirements Engineering

The purpose of requirements engineering is to help define, formulate and assess the requirements of a software product. These requirements are a starting point for system design and implementation (Gordjin & Akkerman, 2005).

Loucopoulos & Karakostas (1995) define requirements engineering as “the process of development of requirements through an iterative cooperative process of analysing the problem, documenting the resulting observations in a variety of representations formats, and checking the accuracy of the understanding gained.”

Traditionally requirements engineering has five main stages:

1. **Elicitation:** Where knowledge is gained about the problem space through interviews, goal analysis, scenario analysis, etc ...
2. **Analysis:** The elicited requirements must be analysed for consistency and to ensure that they are clear in their meaning.
3. **Negotiation:** Where a conflict exists between two or more requirements a common understanding of what is required must be found.
4. **Specification:** This serves as an agreement between the stakeholders about the problem to be solved and acts as a blueprint for the design, implementation and final stage of:
5. **Verification and Validation:** to check that the requirements specification complies with the stakeholders’ intentions.

Most requirements engineering literature is devoted to managing requirements at the project level, however, requirements can also be managed at the product and organisational levels (Aurum & Wohlin, 2005). The management of requirements at the product and organisational level is a continuous process, whereas requirements engineering has a fixed life for a given project.

### **2.3 Value**

Software engineering is largely researched and practiced in a value neutral setting, in which every requirement, use case, test case, defect and object is considered equally important (Boehm, 2005a). Traditionally there is a separation of concerns – software developers are confined to turning requirements into verified code. Yet Bullock (2000) found that eighty percent of business value comes from only twenty percent of the software components.

Most studies of the critical success factors in successful and failed projects find that the primary critical success factors lie in the value domain, that is most projects fail due to a lack of user input, incomplete requirements, lack of resources, unrealistic expectations, unclear objectives and/or unclear timeframes (Boehm, 2005a; Standish 1995, 2001).

Today software has a major effect on the cost, value and schedule of a project (Boehm, 2005a). However, an organization's success in profitability or market capitalisation does not correlate with their level of investment in IT (Thorp, 1998). For benefits to be realised other non-IT development activities need to take place. Technical changes take place within a business context, and that environment needs to adapt to the technical change.

Software projects are tracked using *earned value systems*, monitoring project cost and schedule (Boehm, 2005a). This does not take into consideration stakeholder or business value. A project can be very successful in its cost oriented earned value, but fail to provide any business value. This can be due to the earned value system not effectively tracking a project if the plan changes rapidly, there are flaws in user acceptability, operationally the system is not cost-effective or timely market entry is required (Boehm, 2005a).

Value in a business market is the worth in monetary terms of the technical, economic, service and social benefits a customer company receives in exchange for the price it pays for goods and/or services (Anderson & Narus, 1998). Benefits refer to net benefits, in which all costs other than that paid for the product are taken into account, otherwise this definition separates the price paid for a product from the value it provides. Thus changing the price of a product does not change its value, but alters the customers' incentive to purchase it.

The value software provides to clients depends on the clients' preferences and the alternatives. Client value has two aspects (Browning, 2003); absolute value – how well a product meets a customer's needs, and relative value – the value of a product relative to the alternative solutions available.

Marketing literature describes value as the relationship between the needs of a customer and the benefits a product offers that satisfy those needs (Alwis et al., 2003). But they also recognise the need to consider value from the perspective of all stakeholders.

Nunamaker et al. (2001) take a more general view describing value as anything that one might consider useful, convenient or essential. Under this definition value can only be defined from a particular perspective. As each stakeholder has their own needs, wants and desires organizations create value along many dimensions, including economic, physical, emotional, social, cognitive and political dimensions.

The definition of software product value provided by Keller (1995) is closest to that of Nunamaker et al. (2001). Keller (1995) explains that software is different to most other products in that each stakeholder has their own definition of what value means to them, software is not tangible and the value of software is perceived very differently to other products.

There are many stakeholders involved in software product development. Stakeholders include users, developers, project sponsors, project managers and maintainers.

Each stakeholder's perception of value is different in the software development process (Keller, 1995; Boehm, 2005b). For example a project sponsor defines value in terms of the cost of the software and the benefits it provides, a software company measures value in profit, while a user looks at how well the software meets their needs.

These ideas are often not compatible, and must be reconciled (Boehm, 2005b). For example:

- Users of the software want many features, while the project sponsor wants to limit cost by minimising the development effort;
- Developers want stable requirements, but users want to be able to change the requirements; and
- The system maintainers want their job to be made easier, but the developers and project sponsors want control over the solution provided.

Additionally stakeholders are not always aware of their own value propositions, which can often only be elicited through experience in the problem domain (Anderson & Narus, 1998).

Additionally few suppliers in business markets are able to define or measure value from their customers' perspectives despite this having "never been more important" (Anderson & Narus, 1998). Persuading customers to focus on total costs rather than simply acquisition cost price a supplier must have an accurate understanding of what customers value and would value.

## ***2.4 Release Planning for Market-Driven Incremental Development***

Market-driven incremental product development, as opposed to projects for a single customer and delivery, is increasingly becoming commonplace in the software industry (Carlshamre, 2002; Ruhe & Greer, 2003). Maurice et al. (2005) stated the plan is to deliver an optimal subset of requirements in a certain release, that is:

- What a release should contain;
- When it should be released; and
- At what cost this should be achieved.

Release planning can only be conducted after a product's requirements have been elicited, analysed and specified (Aurum & Wohlin, 2005a).

If release planning is done badly it creates risk (Maurice et al., 2005). For example, leaving critical features or difficult tasks to last or ignoring dependencies and interdependencies can result in time and budget overruns and a loss of market share.

Karlsson et al. (1998) suggested that release planning be approached through the prioritisation of requirements. Carlshamre et al. (2001) and Dahlstedt & Persson (2003) furthered prioritisation by recognising and accommodating the dependencies that exist between requirements.

Ruhe and Greer (2003) designed an algorithmic approach to plan different releases.

The values that a market places on different requirements change over time (Maurice et al., 2005), but it is not understood how they will change (Aurum & Wohlin, 2005a). The critical success factor for software vendors is to respond to the changing requirements quickly while maintaining a focus on their value proposition, which may be a quicker return on investment for example.

Maurice et al. (2005) recognised that while iterative development facilitates early customer feedback, allowing faster delivery and a more interactive process; it also creates difficulties with resolving conflicting stakeholder perspectives.

Aurum & Wohlin (2005a) recognised that a systematic approach to release planning is required.

## ***2.5 Value-Based Requirements Engineering***

There is an incredible pressure for software companies to achieve and sustain competitive advantage. Value-based software engineering aims to examine software engineering from the perspective of stakeholder value propositions (Berry & Aurum, 2005) in order to produce more valuable software. Requirement selection and prioritisation is a powerful way of creating and controlling the value of a software product to all stakeholders (Wohlin & Aurum, 2005a)

Value-based product development in general is addressed by various economic disciplines, especially marketing. But there is little theory providing an approach for the development of IT intensive commerce ideas that are valuable to all stakeholders (Gordjin & Akkerman, 2003).

Formal theories in the engineering and sciences attempt to abstract human factors, however, a software systems success is reliant on computer science theory, managerial aspects of software engineering, and the personal, cultural and economic values involved in developing and evaluating software systems (Boehm & Jain, 2005). Value-based software engineering needs to address all of these issues in order to create products that are useful to people (Boehm, 2005a).

Traditionally requirements engineering neglects the value concept in the development of an information system (Gordjin & Akkerman, 2003). Value-based requirements engineering exploits the concept of economic value during the requirements engineering process (Gordjin & Akkerman, 2005). Boehm (2005a) states that in order to achieve this, value-based requirements engineering must include practices and principles for:

1. Identifying a system's success-critical stakeholders;
2. Eliciting their value propositions with respect to the system; and finally
3. Reconciling these value propositions into a set of mutually agreed objectives for the system.

## ***2.6 Methodologies for Value-Based Requirements Engineering***

There is a need for decision support in release planning due to the inability of human to cope well with complex decisions dealing with competing and conflicting goals and the absence of a single 'best' solution (Maurice et al., 2005). A couple of methodologies exist to support requirements engineering and VBRE.

Instead of using earned value systems to track projects Boehm (2005b) suggests using the business case to monitor the business value that will be provided by the project. This involves continually updating the business case to reflect the changes to the business models, assumptions, market conditions, organization priorities and project progress.

There are numerous methodologies to resolve conflicts between stakeholders' value propositions (Berander and Andrews, 2005; Boehm, 2005b, Lehtola et al, 2005):

- **Expectations management:** If stakeholders are aware of other stakeholders value propositions they are often more willing to relax their less-critical desires.

This helps stakeholders understand feasibility with respect to budget, schedule and technological constraints.

- **Visualisation and trade-off analysis techniques:** Prototypes, scenarios, estimation models, etc ... allow stakeholders to obtain a better mutual understanding of which aspects of an application are most important and achievable.
- **Prioritisation:** Having stakeholders rank or group their relative priorities will help determine which combination of requirements best satisfies the stakeholders' most critical needs.
- **Groupware:** There is software to support prioritisation, brainstorming, discussion and win-win negotiation of conflict situations.
- **Business case analysis:** Determining which capabilities provide the best return on investment can help stakeholders prioritise and reconcile their value propositions. This can be complex with one option having a faster return on investment, while another has a slower but greater return on investment. Additionally assumptions can have an impact, for example, it may be believed that a faster entry to the market will result in a bigger market share
- **Roadmapping:** A technique to support and communicate long-range product and release planning. Roadmapping is effective for communicating ideas to stakeholders, and strengthens the link between business and requirements engineering.

There are other more formal methodologies like 'Evolve' and 'F-Evolve', which rank requirements according to the relative value provided to the customer, the cost-benefit of implementation, urgency of individual requirements, budget, effort, minimum marketable features and other financial analysis techniques (Maurice et al., 2005).

Methodologies for creating and understanding product value also exist outside the software development industry. Anderson and Narus (1998) propose a model whereby:

1. A comprehensive list of value elements is generated; this is anything that affects the cost and benefit of the offering;

2. Each of these value elements should be valued in monetary terms, this will involve gathering data through interviews, observation, etc ...
3. Validate the model, the resultant model should be checked against other customers and organizations allowing the estimates to be refined;
4. Create a sales tool using the data collected to tailor solutions and/or sales information to individual client circumstances.

This value model can demonstrate the value that can be provided by the market offering even when it is priced higher than the alternatives; and can be used to determine what improvements are worthwhile and which ones have the highest priority.

## ***2.7 Adding Value to Release Planning***

For value to be managed it must be measurable (Berry & Aurum, 2005). Decision making for release planning must be based on information, and value-based software engineering aims to improve the information on which decisions are made. In order to make a product valuable to all success-critical stakeholder, its value needs to be measured not through personal value constructs but through a group value construct by a process of elicitation, discussion and consensus (Berry & Aurum, 2005).

Business process and IT design specification have rigorous representation techniques, but do not consider value from all stakeholders' perspectives (Gordjin & Akkerman, 1995). There are many tools that can be used to examine aspects of value, such as value chains, value maps and the use of economic and financial models; but many of these are not well understood or used by the software development industry (Wohlin & Aurum, 2005a). For example cost-benefit analysis fails consider competitive advantage in a business context.

Decisions are traditionally made in a client neutral setting as it is easier to assume that all clients have the same or similar expectations in the solution a product will supply (Berry & Aurum, 2005). This does not result in the best solution for all stakeholders.

Additionally software developers are increasingly trying to expand the target market for software products (Wohlin & Aurum, 2005a). Requirements come from a diverse set of

stakeholders are not fed into a specific project, but are managed at a product level. Product managers initiate development projects based on a selected set of requirements.

Software developers need to make product development decisions with a full understanding of the economic impact on product value (Deaton & Muellbauer, 1980; Urban & Hauser, 1993; Park, 1998; Faulk et al., 2000; Browning et al., 2002; Harmon et al., 2003). They need to consider customers' requirements, business requirements and technologic opportunities when making decisions. These areas need to be aligned to the software developers' business drivers for cost, time and quality (Aurum & Wohlin, 2005b).

Recognising that not all requirements are of equal value Bullock (2000) proposed that testing of should focused towards the requirements that create the greatest business value, giving a higher return on investment for a given testing effort.

Understanding the effect of a decision both economically and on a product's value is complicated by changes in market values and different characteristics becoming dominant business drivers over the software product's lifecycle (Aurum & Wohlin, 2005a). Due to this problem Nunamaker (2001) recognised a need to create value along dimensions such as economical, physical, emotional, social, cognitive and political dimensions.

Aligning and reconciling the value propositions of all the success-critical stakeholders is seen as paramount in successfully developing a software system (Faulk et al., 2000; Aurum & Wohlin, 2005a; Boehm, 2005a). There is a growing body of research highlighting the importance of knowing the business goals to which an information system should contribute (Gordjin & Akkerman, 2005) and reconciling this against the strategic business objectives of the software development organization (Faulk et al., 2000). Few requirements engineers are aware how the cost of IT relates to the profit and revenue of an enterprise (Gordjin & Akkerman, 2005). All this emphasises the importance of effective communication between the technical and business stakeholders to ensure the business goals are understood, the strategic needs of success-critical stakeholders are met and the success-critical stakeholders expectations are adequately managed in a way that aligns with the businesses' objectives.

Businesses exist in a marketplace that impacts on their opportunities and influences their objectives (Boehm, 2005a); and hence decisions. For example, there are advantages in being the first company to offer a solution to a problem, effectively being granted temporary monopoly to that market. However, if other companies are working on similar solutions short-cuts may need to be made to be first to market. In which case analysis needs to be done to assess the impact of being first and releasing a less rich product, which will be followed by a competitors potentially richer product; or not being first to market but being able to release a satisfactorily rich solution.

## **2.8 Criteria used in decision making**

Aurum & Wohlin (2005a) found that to that point no study has looked at the criteria used in decision making when deciding to include a specific requirement into a software project or release. They identified 13 criteria, presented in Table 2.1, which influence the selection and/or prioritisation of a requirement covering the main stakeholders.

**Table 2.1 Criteria that influence requirements selection (Wohlin & Aurum, 2005a)**

<b>Criteria</b>	<b>Explanation and Motivation</b>
<b>1. Competitors</b>	The status of competitors with respect to the requirement – it is taken into account whether a competitor has the implied functionality. We may feel forced to include a requirement if our competitors have the functionality, or we may want to implement something that is considered to be leading edge functionality (functionality competitors do not have).
<b>2. Requirement's issuer</b>	The party responsible for issuing the requirement is taken into account - which stakeholder (internal or external) generated the requirement. We may judge some issuers more important than others, for example an important client or representative of a key market.
<b>3. Stakeholder priority of requirement</b>	The priority of the requirement is taken into account. We may want to prioritise the requirements that our customers or markets think are of particular importance.
<b>4. Volatility</b>	This criterion is related to whether the requirement is likely to change or not. We may want to handle highly volatile requirements differently.
<b>5. Support/ Education/ Training</b>	The ability and possibility to provide technical support, education, and training to customers, markets and so forth with respect to the requirement. We may not want to implement functionality unless we could provide the appropriate technical support, education and training in relation to the requirement.
<b>6. Development cost-benefit</b>	The actual cost-benefit for implementing the requirement. We may not want to include a requirement if the implementation cost is judged to be high in relation to the expected benefit.
<b>7. Resources/ competencies</b>	The availability of resources with the right competencies to implement the requirement.

	We may not want to implement a requirement unless we are sure that we have the right people available for the job.
<b>8. Delivery date/ Calendar time</b>	The ability to meet the project deadline. We may not want to introduce a requirement that may affect the deadline of the project negatively.
<b>9. System impact</b>	The impact of the requirement on the existing system. We may not want to implement a requirement if we judge that the actual impact in terms of changes to the existing system is too great.
<b>10. Complexity</b>	The estimated complexity of the requirement and the associated challenges in implementing it. We may not want to include a requirement that is judged to be very complex to implement and as a consequence the risk of failure as too high.
<b>11. Requirements dependencies</b>	The dependencies between a specific requirement and other requirements, either already implemented or other posed requirements. The dependency to other requirements (already implemented, scheduled to be implemented, or deferred to later release) may affect our decision regarding the current requirement.
<b>12. Evolution</b>	The impact on the future evolution of the system. We may not want to implement a requirement if it is believed to make long-term evolution of the system more complicated.
<b>13. Maintenance</b>	The impact on the maintenance of the current system. We may not want to implement a requirement if it is believed that the requirement may cause many problems in terms of maintenance.

While their survey results identified five additional criteria, only one was substantially different to the others:

### **Function is promised/sold**

**Explanation:** The expectation of stakeholders to see the requirement met is taken into account.

**Motivation:** We may want to include requirements that were promised or sold to meet stakeholder expectations.

Aurum & Wohlin (2005a) conducted an industrial survey to determine the relative importance of the criteria used to select and prioritise requirements both as they are used today and how they would be used in an ideal situation. The survey results were based on two Swedish companies that develop real-time applications for international markets. Both companies in the survey valued the criteria similarly. The most important criteria when selecting and prioritising requirements for both companies were:

1. Development cost-benefit

2. Stakeholder priority of a requirement
3. Delivery Date

Analysis of these criteria by stakeholder group showed the external customer and company management issues were the most important in selecting requirements, but respondents felt that the input of developers and maintainers was being undervalued (Aurum & Wohlin, 2005b).

## **2.9 Chapter Summary**

This chapter details existing literature in the problem domain of value-based requirements engineering. The relationship between requirements engineering, release planning and creating software product value were highlighted.

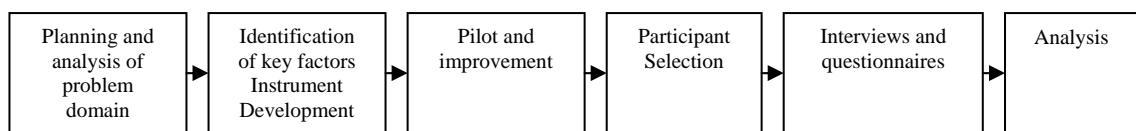
## 3 Research Methods

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### 3.1 Introduction

This section offers a systematic discussion of the design of this research study, dedicated to understanding value-based requirements engineering (VBRE). The process used to develop the methodology used for this research study is outlined in

Figure 3.1. The first stage involved defining the research objectives and questions (Section 3.2). A research model is proposed based on the literature, which is then linked to the research questions (Section 3.3) The research instruments were then created to address the research objectives, a pilot study conducted, and subsequent improvements to the instrument were made (Section 3.4). Two organizations and products within the organizations were selected so that case studies could be carried out (Section 3.5). Ethics approval was sort and gained to conduct the research (Section 3.6). Interviews were then organised and conducted and the questionnaire distributed and collected (Section 3.7). The data collected was analysed, with close reference to the research



objectives (Section 3.8).

**Figure 3.1 Research Process**

### 3.2 Research Objectives

#### 3.2.1 Research Objective 1

The first research objective is to determine how value-based requirements engineering is perceived the software development industry. To the best of the researcher's knowledge no such study has been conducted in Australia. Value-based software engineering is a very young area of academic study, however, the problem of creating product value through requirements selection and prioritisation is real to the development of software products in today's competitive environment. Companies have been forced to change their practices due to current market forces, but there is little theory providing an approach for development of IT intensive solutions that are

valuable to all stakeholders (Gordjin & Akkerman, 2003). It is therefore of interest to understand how this area of study is understood by the industry. The first research questions is therefore:

**Research Question 1:** How is value-based requirements engineering perceived by the software development industry?

### **3.2.2 Research Objective 2**

This research objective focuses on qualitatively describing the processes used in industry to manage software product value through release planning for market driven incremental software development. The primary aim of this objective is to determine what processes are followed in the requirements engineering and release planning processes resulting in decisions being made as to which requirements are implemented in the next release or project for a software product. In answering this question it is critical to ask who is involved and what roles do they play in the decision making processes as the success of these processes is determined by the success-critical stakeholders (Boehm & Jain, 2005). Thus, the second research question for this study is:

**Research Question 2:** How does the software industry conduct release planning in order to create product value?

### **3.2.3 Research Objective 3**

The third research objective is concerned with the value system applied to selecting and prioritising requirements for inclusion in a software development project/release. In market driven incremental product development an optimal subset of requirements is selected for inclusion in each project or release (Aurum & Wohlin, 2005). This research objective seeks to quantitatively evaluate the relative importance different decision making criteria when determining whether or not to include a requirement in a specific project or release. Hence the third research question is:

**Research Question 3:** What values are applied to the decision making process to select and prioritise requirements for a software project or release? How does this differ to industries perception of the optimal application of the criteria?

### 3.2.4 Research Objective 4

After determining the values that influence release planning, this study aims to quantitatively understand the degree to which the major perspectives are represented by the value system used in the decision-making process. There are three major stakeholders involved in the development of software; the software development company management, development and maintenance personnel, and the external market or customers; each with their own agenda. Consequently the fourth research question is:

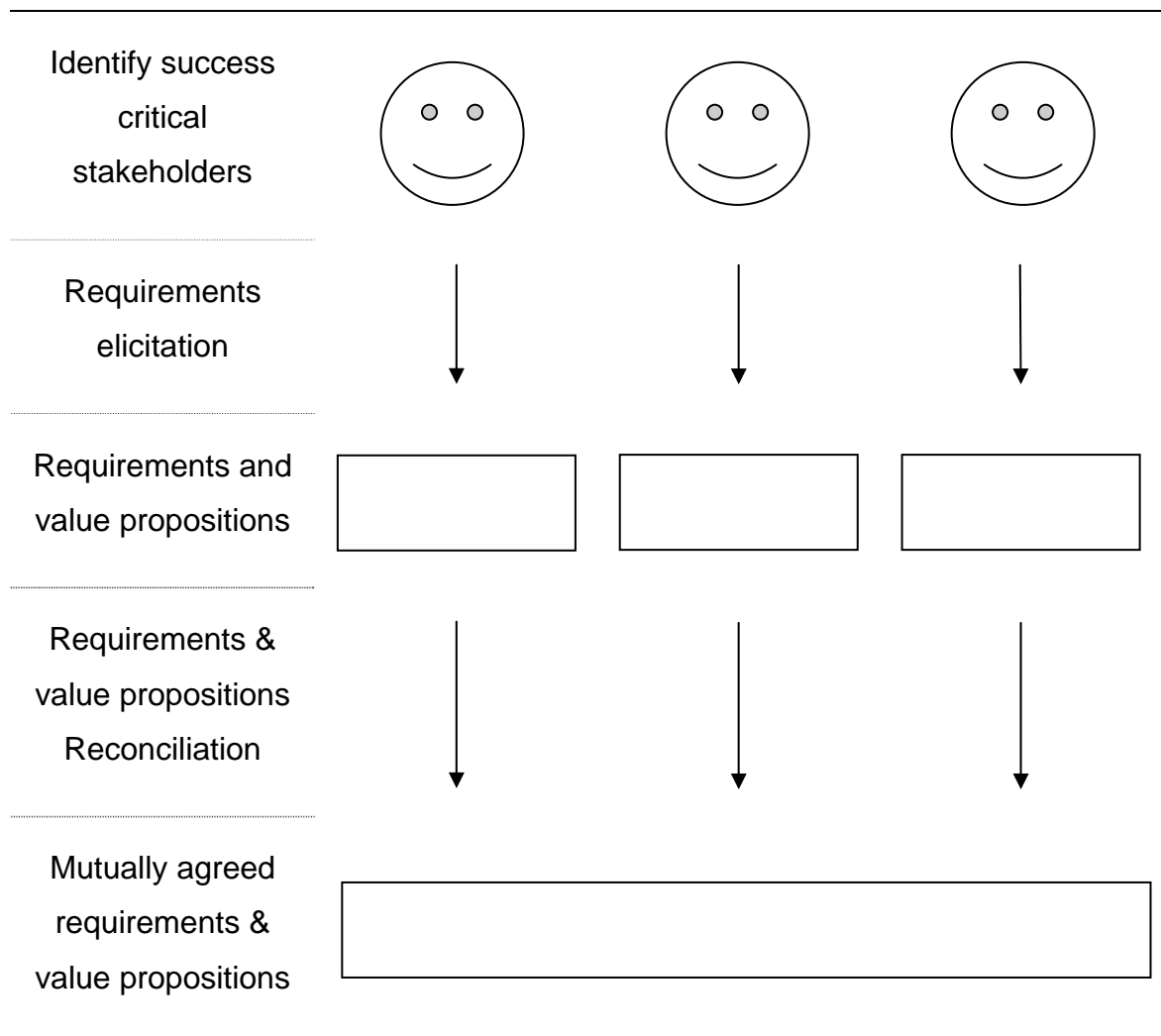
**Research Question 4:** To what degree do the perspectives of the major stakeholders influence the requirements selection and prioritisation process? How does this differ to industry's perception of the optimal application of the criteria?

### 3.3 Research Model

Boehm (2005a) proposed a process for VBRE where by the success-critical stakeholders must be identified, their value propositions and requirements elicited, then these need to be reconciled into a mutually agreed set; this process is represented in Table 3.1.

Research questions 1 and 2 are concerned with describing the VBRE process as it is understood and applied in industry today. The third research question is concerned with the set of values applied in the *requirements and value proposition reconciliation* in order to come up with a set of mutually agreed requirements. The fourth research question is concerned with the degree of influence each of the success-critical stakeholders have in the reconciliation of requirements and value propositions.

**Table 3.1 Practices and Principles for Value-Based Requirements Engineering (Adapted from Boehm, 2005a)**



### **3.4 Research Method**

The researcher in this study used a mixed research methodology to conduct case studies; each case study was conducted in three stages, semi-structured interviews, questionnaires and an unstructured discussion. Interviews were conducted to answer research questions one and two; to gain an understanding of industries' perspective of value-based requirements engineering, and the processes used in requirements engineering and release planning to create product value. Questionnaires were conducted to answer research questions three and four, to understand the value-system applied to the decision making process in release planning to create product value. The results for the interviews and questionnaires were then presented to one of the participants for confirmation and comment.

Value-based requirements engineering is a new area of study and to the best of the researcher's knowledge no research in Australia or Germany has sought to understand how industry was approaching this problem. A decision to conduct a collective case study was made by the researcher as case studies are "especially suitable for learning more about a little known or poorly understood situation" (Leedy & Ormrod, 2005).

A mixed methodology was used; with semi-structured interviews, questionnaires and unstructured discussions; as VBRE is a new area of study still in the theory building stage, and a mixed methodology allows a richer and more reliable understanding of a topic to be gained by exploiting the strengths of different methods (Mingers, 2000). Mingers (2000) emphasises the usefulness of conducting multi-method research in stages, as was done in this study, because it allowing the strengths of different methods to be mapped to each stage.

### **3.4.1 Interview**

The first stage of this research aims to answer research questions one and two; to gain an understanding of industries' perspective of value-based requirements engineering, and the processes used in requirements engineering and release planning to create product value.

Research objectives one and two "seeks to answer questions about the complex nature of phenomena" and are best suited to qualitative research as it "from the participants' point of view" (Leedy & Ormrod, 2005). Due to the potential richness

s and diversity of data that could be collected, the researcher believed a semi-structured interview would best meet the objectives. A semi-structured interview collects standard information, but allows the interviewer to probe deeper where required.

The researcher created interview questions based on the key activities in the requirements engineering and release planning processes and value-based requirements engineering. The interview examined five key areas:

- Company background details,
- Product background details,

- Personal background details,
- Requirements engineering process, and
- Perceptions of how to create software product value.

A copy of the interview schedule can be found in Appendix B. Additionally a copy of the *Participant information statement and consent form* provided to the candidates before the interview can be found in Appendix A.

#### **3.4.1.1 Interview Pilot Study**

In order to test the reliability and validity of the research instrument a pilot study was conducted. The pilot study consisted of three stages; firstly an informed pre-subject phase, then an uninformed pre-subject phase, and finally academic review.

#### **3.4.1.2 Informed Pre-Subject Phase**

The informed pre-subject phase involved providing copies of the interview schedule to individuals aware of its purpose. Two participants were involved in this stage of the pilot study; a recent graduate of an information systems degree and a student currently studying information systems.

##### **3.4.1.2.1 Modifications and Improvements**

Both respondents to the interview schedule had trouble understanding the meaning of “feedback mechanism” in questions:

*4.2. Are there any formal feedback mechanisms for eliciting requirements?*

*4.3. Are there any informal feedback mechanisms for eliciting requirements?*

The wording of these questions was clarified and subsequently changed to:

*4.2. Are there any formal methods for eliciting requirements?*

*4.3. In addition to the formal requirements elicitation process, do requirements come from other sources? If so, whom? And how are they managed?*

In the introduction to the section six, Requirement prioritisation and selection, one respondent felt that the word release needed to be defined for the interviewee. In addition to the existing introduction a definition was given by way of example:

*Software is increasingly being released incrementally – for example, Microsoft Windows has had a number of major releases, such as 95, 98, and XP. Each release implements a set of requirements.*

One of the respondents found two questions on the methodologies used for requirement selection and prioritisation ambiguous in their meaning:

*6.3. Which methodologies are formally used in this process, if any?*

*6.5. Which methodologies are informally used in this process, if any?*

These questions were more explicitly stated, being changed to:

*6.3. Which methodologies are formally used to select and prioritise requirements?*

*6.5. Which methodologies are informally used to select and prioritise requirements?*

### **3.4.1.3 Uninformed Pre-Subject Phase**

A pilot of the interview was conducted after the researcher incorporated the changes to the research instrument from the informed pre-subject phase. An IT professional was interviewed by phone using the interview schedule and asked to provide feedback.

The respondent in the pilot study had been working in a software development role for a period of five years and was involved in requirements engineering and release planning for several software projects at the organization he was employed.

#### **3.4.1.3.1 Modifications and Improvements**

The respondent confirmed that the interview could be understood, and did not recommend any changes.

However, the respondent felt that only an approximate metric could be provided for the question:

*2.3. How big is the product in either man months or lines of code?*

This question was modified to:

*2.3. Can you give me an idea of how big the product is in either man months or lines of code?*

At several stages in the interview the respondent asked for clarification of some terms by example. While some questions included examples, it was decided that examples should be included for more questions. These were:

*2.2. What are their [the employees working on the product's] backgrounds? For example business analysts, computer scientists, engineers, technical support.*

*3.6. Is there a role defined for a requirements engineer? What is their title? For example, they might be called a system analyst.*

*4.2. Are there any formal methods for eliciting requirements? For example market surveys, business process reengineering, scenarios and/or prototyping.*

*6.2. Are there any processes used to help prioritise and select requirements for a release? For example, negotiation, workshops or prioritisation.*

*6.8. What are the biggest constraints faced in selecting and prioritising requirements? For example time, budget and resources.*

#### **3.4.1.4 Academic Review**

A meeting was arranged with an academic from the School of Information Systems Technology and Management (SISTM), at The University of New South Wales (UNSW). The academic was asked to inspect the structure and clarity of the interview schedule and determine whether sufficient data could be obtained to address the first two objectives.

#### **3.4.1.4.1 Modifications and Improvements**

The academic suggested including a more detailed introduction. It was felt that the introduction should describe the research and cover the ethical considerations. A copy of the interview schedule, including the detailed introduction, can be found in Appendix B.

#### **3.4.2 Questionnaire**

The questionnaire in this study aimed to answer research questions three and four, to understand the value-system applied to the decision making process in release planning to create product value. Due to the number of perspectives that influence the release planning process these questions were best suited to a quantitative approach, as questionnaires can be sent to a large number of people (Leedy and Ormrod, 2005). Questionnaires also have the advantage of being able to be completed by people “who live thousands of miles away” (Ormrod & Leedy, 2005) at a time that is convenient to the participant.

Wohlin and Aurum (2005a, 2005b) conducted a survey of two Swedish software development companies

*... to quantify the importance of different decision-making criteria when deciding whether to include a requirement in a project or release.*

A copy of the questionnaire used in the Wohlin and Aurum (2005a, 2005b) studies was made available to the research to use and modify in this study.

A copy of the questionnaire as provided to the research participants can be found in Appendix C.

##### **3.4.2.1 Questionnaire Pilot Study**

The researcher adapted the questionnaire used in the Aurum and Wohlin survey and refined it for this study over a three-stage pilot study. The researcher used an introspective approach to analyse and assess the questionnaire. The researchers academic supervisor reviewed the questionnaire. Finally the questionnaire was then given to an IT professional to complete as part of an uninformed pre-subject phase.

### 3.4.2.2 Introspective Approach

The researcher first reviewed and answered the questionnaire to find obvious issues and make improvements. This task was undertaken shortly after first receiving the questionnaire to avoid over familiarity with the research instrument. The researcher was able to answer the questionnaire from employment experience in private sector organizations.

#### 3.4.2.2.1 Modifications and Improvements

The researcher identified an additional value criterion from the literature that was not included in the original questionnaire, whether or not the function is promised or sold. This was included in both in the questionnaire and the glossary of terms that accompanied the questionnaire as the fourth criterion. This was:

##### *Function is promised/sold*

*Explanation: The expectation of stakeholders to see the requirement met is taken into account.*

*Motivation: We may want to include requirements that were promised or sold to meet stakeholder expectations.*

Additionally some minor changes were made to the wording of the questions and in the glossary for clarity and flow:

The explanation of the first criterion, *Competitors*, contained a subordinate clause without a main clause:

*The status of the competitors with respect to the requirement. In other words, it is taken into account whether a competitor has the implied functionality implemented or not.*

The explanation was changed to:

*The status of competitors with respect to the requirement – it is taken into account whether a competitor has the implied functionality.*

The explanation of the second criterion, *Requirements' Issuer*, was considered confusing:

*The actual issuer of the requirement is taken into account, i.e. which stakeholder (internal or external) generated the requirement.*

This explanation was changed to:

*The party responsible for issuing the requirement is taken into account - which stakeholder (internal or external) generated the requirement.*

The researcher felt the motivation for the tenth criterion, *Systems Impact*, could be better expressed:

*We may not want to implement a requirement if we judge that the actual impact in terms of changes to the existing system is too large.*

The description of the motivation was changed to:

*We may not want to implement a requirement if we judge that the actual impact in terms of changes to the existing system is too great.*

### **3.4.2.3 Academic Review**

A meeting was arranged with an academic from the School of Information Systems Technology and Management (SISTM), at The University of New South Wales (UNSW). The academic was asked to inspect the structure and clarity of the questionnaire and determine whether sufficient data could be obtained to address the last three objectives.

#### **3.4.2.3.1 Modifications and Improvements**

The academic suggested collecting further demographic information about the respondents work experience and the product they had in mind while responding to the survey. Three additional demographic criteria were added to the questionnaire. The first asks for the number of years work experience of the respondent, the second the amount of time working at their present company, and finally the product they had in mind while responding to this questionnaire.

While this extra information was not required to answer the research questions, it was felt that it could prove useful in future analysis.

#### **3.4.2.4 Uninformed Pre-Subject Phase**

A pilot of the questionnaire was run after the researcher made his changes to the research instrument. A copy of the question was provided to an IT professional to complete and provide feedback.

The respondent in the pilot study had been working in a software development role for a period of five years and was involved in requirements engineering and release planning for several software projects at the organization he was employed.

The respondent confirmed that the questionnaire could be understood, and did not recommend any changes.

#### **3.4.3 Unstructured Discussion**

The third stage of this research aimed to confirm the findings from the first two stages, and gain greater insight into the results obtained. The analysed results for the interviews and questionnaires were sent via email to the person identified as most influential in the decision to include a requirement in a given release for each product. The email asked the recipient to confirm these results and consider why they were obtained. A meeting was arranged to for the research participants to comment on the results. The results were presented to in the same form of Chapter 4 of this thesis; however, each participant was only shown the results for the product or products for which they were involved.

### **3.5 Case Studies**

The researcher conducted three case studies as part of this research; the first at a German company and the second at an Australian company. Three products were studied at the Australian company, while one product was studied at the German company.

Any cultural issues are outside the scope of this study. The researcher does not perceive cultural issues as a factor in this research as both companies are Western companies,

with the German company having a multicultural workforce. Two of the contacts at the German company are Australian.

### **3.5.1 Company A Case Study**

Company A primarily operates across Europe, developing, manufacturing and supporting value-added services for fixed-line and mobile telecommunications networks. The client base includes major telecommunication service providers, major mobile phone service providers, alternative mobile phone carriers, internet service providers and prepaid telephone card operators.

The solutions offered by the company involve both hardware and software components, and must be integrated into their clients' telecommunications infrastructure.

Company A employs approximately 100 staff across six offices around Europe. While the company does not have an IT department per se, most staff have a technical background.

The company is based in Germany, with the other European offices housing sales and technical support teams. The development teams are located together in the head office in Germany.

The researcher has a number of personal contacts within Company A and was aware of the product range it offered. He felt that the company and products aligned with the purpose of this study.

Through one of the researchers contacts, the researcher gained the approval of the Chief Technical Officer to conduct this study. The researcher's contact acted as an intermediary in conducting the research selecting interviewees, organising interview times and distributing questionnaires.

#### **3.5.1.1 Product A**

Product A is a real-time service for mobile telecommunications networks, developed, manufactured and supported by Company A. Once implemented this product allows mobile subscribers to decide what each caller hears before the subscriber answers his/her phone call, replacing the traditional the ring back tone.

The product has been undergoing iterative development for over two years. It has been implemented for over ten mobile telecommunications carriers, and continues to be highly popular with new clients of Company A.

Product A needs to be set-up for each mobile telecommunications carrier by Company A. While implementations of this product have a common core, it needs to interface with a number of proprietary systems of the mobile telecommunications carrier. These include the mobile telecommunications network and account management system. Interfaces to these systems, and integration of the service into the existing infrastructure need to be developed and customised.

The product has a highly customisable front end for user interaction with the system, the core product software in a middle layer, with a database and special telephony switches at the backend.

Product A was originally built for a specific client contract, but was designed to allow it to be implemented in other environments.

### **3.5.2 Company B Case Study**

Company B operates primarily in Australia, and provides outsourced services in business communication and data processing. It provides a range of standard customisable solutions, as well as developing customer specific solutions. The company's client base represents a diverse range of industries including telecommunications, finance, government and retail.

The company employs approximately 1000 permanent staff in seven offices nationwide, of which about 200 are in IT or IT related roles. Both Company Management and IT Research and Development (R&D) are based at the head office in Sydney. While the R&D Team is based at the head office, the team members work throughout the branch network.

The researcher has worked at Company B as an IT Consultant in client implementations since starting this research. From his knowledge of the company and its products, he felt that some of solutions provided by the company aligned with the purpose of this study.

The researcher made direct contact with the Chief Information Officer to gain approval to conduct his research. He worked with a senior consultant within R&D to select interviewees and participants for the questionnaire. The researcher made direct contact with the research participants to organise interview times and distribute questionnaires.

#### **3.5.2.1 Product B1**

Product B1 is a large-scale document and data repository developed and supported by Company B. Once implemented this product is an enterprise document retrieval and management system.

Product B1 is an indexed and searchable content repository developed and supported by Company B. It allows users of the system to store, retrieve and view documents of various types. It can be customised in many ways for clients' needs, including data formats, user permissions, access options, reporting templates and security levels.

The product has been undergoing iterative development for over ten years. It is in its third major release, with the fourth release due later this year. In addition to the major releases the product has a number of minor update releases between major versions being released.

#### **3.5.2.2 Product B2**

Product B2 provides a solution for managing the collection, analysis and processing of paper requests and responses such as election polls, surveys, exams, insurance claims, remittances and general inbound mail. It is developed, hosted and supported by Company B.

The solution is responsible for converting paper documents into an electronic form, classifying documents, capturing the data on the documents, and processing the captured data. While these processes are automated, it is possible to have manual intervention at different stages of the workflow. Each document, its status, data captured and information processed is stored in a database. Management tools allow documents to be manually moved throughout the workflow and support reporting requirements.

The product has been undergoing iterative development over two years. At the time of the study Company B was preparing for the first major release of this product since it

was first released. In addition to the major release the product has a number of minor update releases since the first major release.

This product was implemented to replace the existing solutions within the organization that no longer met the requirements of the business.

### **3.6 Ethics**

Ethics approval to conduct this study was sort and gained from The University of New South Wales Faculty of Commerce and Economics and AGSM Human Research Ethics Advisory Panel on 6 June 2005. The ethics approval reference number for this application is 56027.

### **3.7 Data Collection**

#### **3.7.1 Interview**

The company contact in each company selected the participants appropriate to be interviewed. The researcher was able to explain the aims of the research and who would make the best participants – those people involved in the requirements engineering and release planning process for the product. All people suggested by the company contacts were interviewed.

The researcher conducted each and every interview with only one participant in attendance. The interviews were held at times suitable for both the researcher and participant. Each participant was read an introduction giving an overview the research, and detailing the participant's rights and responsibilities. Then each participant was asked a series of questions, with the researcher and participant seeking clarification or more information where required. The proceedings of each interview were recorded verbatim electronically.

##### **3.7.1.1 Product A**

The company contact at Company A arranged the interview times on behalf of the researcher at Company A.

Three interviews were conducted at Company A; one with the development team lead, and two with implementation project managers. Two of the respondents were

Australian, with English as their first language. The third participant did not have English as his first language, but is required to speak English in order to fulfil his job function.

Each interview went for a duration ranging between 25 and 40 minutes. The researcher felt that the variance in time is best attributed to each participants comfort with the English language.

The interviews were conducted over the phone. The researcher was in a private meeting room with a speakerphone. Each respondent chose to partake in the interview from his or her desk in his or her shared office space.

### **3.7.1.2 Product B1**

As the researcher was employed at Company B, he made direct contact with the employees selected for interview. An appropriate time to conduct the interview was arranged with each individually. Four potential interview participants were approached to be interviewed and all accepted.

All interviews for Product B1 were conducted onsite at Company B; one with each of the Product Manager, Research and Development Manager, an IT Consultant in the implementation team, and the Systems and Programming Team Manager.

Each interview went for a duration ranging between 25 and 35 minutes, except one, which went for seventeen minutes. The researcher felt that the variance in time is best attributed to each participant's knowledge and involvement in the processes.

The interviews were conducted in private meeting rooms at the premises of Company B. This helped ensure a quiet environment, minimising possible interruptions during the interview.

### **3.7.1.3 Product B2**

The researcher made direct contact with two potential participants selected to interview for Product B2. Both accepted and an appropriate time to conduct the interview was arranged with each.

Two interviews were conducted for Product B2; one with each of the Product Manager and the Research and Development Manager. The interview went for 35 and 25 minutes respectively.

The interviews were conducted in private meeting rooms at the premises of Company B. This helped ensure a quiet environment, minimising possible interruptions during the interview.

### **3.7.2 Questionnaire**

The questionnaire was targeted at employees who are in a decision-making capacity for the selection of requirements for the product studied. The company contact at each company selected participants they regarded as appropriate to participate in the questionnaire. The researcher was able to explain the aims of the research and who would make the best participants – those people involved in the requirements engineering and release planning process for the product. The researcher was also able suggest participants based on data collected during the interview process.

#### **3.7.2.1 Product A**

The contact at Company A chose to liaise with the employees at Company A directly. The contact was provided with an electronic copy of the questionnaire to distribute. The company contact offered to send each employee's response to the researcher; however, the researcher's contact details were provided in the questionnaire should any participant wish to contact the researcher directly.

In total nine responses were received from Company A for Product A out of a total of 16 questionnaires sent out.

#### **3.7.2.2 Product B1**

A list of suggested participants was provided by the contact at Company B. The researcher saw each of these participants individually to give them a copy of the questionnaire and briefly explain the purpose of the study. Participants were asked to return their responses to the researcher, who was working at the company at the time, during the proceeding fortnight.

All participants selected to partake in this stage of the study returned a complete questionnaire. In total seven responses were received from Company B for Product B1.

### **3.7.2.3 Product B2**

A list of suggested participants was provided by the contact at Company B. The researcher saw each of these participants individually, except where they either worked interstate or worked from home. Where possible the researcher saw each participant in the office to give them a copy of the questionnaire and briefly explain the purpose of the study. Where this was not possible the employee was contacted via internal email. Participants were asked to return their responses to the researcher, who was working at the company at the time, during the proceeding fortnight.

In total five responses were received from Company B for Product B2 out of a total of seven questionnaires sent out.

### **3.7.3 Unstructured Discussion**

The results from the interviews and questionnaires were sent to the most influential participant in release planning. For Product A this was the development team lead and an implementation project manager; for Product B the person selected was the product manager; the selected person for Product B2 was also the product manager. One person fulfils the role of Product Manager for both Product B1 and Product B2. The researcher partook in a conference call with the development team lead for Product A. The implementation project manager for Product A was unable to provide feedback due to other commitments. A face-to-face discussion was conducted with the Product Manager for Product B1 and Product B2. For all discussions both the researcher and the research participant had a copy of the results in front of them.

## **3.8 Data Analysis**

### **3.8.1 Interview**

Each interview was transcribed verbatim from the recording. These transcriptions were sent to the respondent for confirmation of their content.

A set of categories were identified “to help cluster the data into meaningful groups” (Ormrod & Leedy, 2005), these groups were:

- Perception of how to create software product value,
- Stakeholder involvement,
- Product Manager,
- Role of a requirements engineer,
- Client communication,
- Constraints,
- Requirements elicitation,
- Requirements interpretation,
- Requirements verification and validation,
- Requirements selection and prioritisation, and
- Release Planning.

The participants’ responses were then coded against these categories. The categories were tabulated in a column. Each participant’s response was summarised with quotes conveying their meaning selected and placed into a new column in the table.

The tabulated results allowed easy comparison of the participants’ responses for each section.

### **3.8.2 Questionnaire**

The results for the questionnaire will be analysed for each product and/or company individually and again as an aggregated values for both companies.

The importance of each criterion, both at present and in the future, were analysed by summing all the points for each criterion and normalising the result for each criterion to a percentage.

To analyse the importance of different stakeholder perspectives each criterion will be placed into one of three groups – external market/customer, company management, and development/maintenance dependant on which perspective it represents. The points awarded to each criterion in that group will be summed and normalised as a percentage.

### **3.8.3 Unstructured Discussion**

The results of the unstructured discussion were included in the discussion of the results in Chapter 5 of this thesis.

## **3.9 Chapter Summary**

This chapter details the research methodology that underpins this study. Details were provided about the software products and development companies for each of the three case studies and the process used to conduct the interview and questionnaire. This chapter highlighted enhancements made to the interview questions and questionnaire as a result of a pilot study. The methods used for data analysis were also discussed.

## 4 Results

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### 4.1 Introduction

Three case studies at two organizations were completed in this research study. A total of nine semi-structured interviews were conducted; three for Product A, four for Product B1 and two for Product B2. Additionally a total of 21 questionnaires were analysed; 9 for Product A, 7 for Product B1 and 5 for Product B2. This chapter presents the data collected, addressing the research objectives outlined at the beginning of the study.

The first objective was to understand how IT professionals understand value-based requirements engineering. The second research objective was to gain insight into the requirements engineering process used in industry. The third research objective was to identify the relative importance of different values on the selection and prioritisation of requirements. The fourth research objective was to evaluate the influence of different groups on the selection of requirements for a release.

### 4.2 Research Objective 1

The problem of creating product value through requirements selection and prioritisation is real to the development of software products in today's competitive environment. This problem has been addressed in value-based requirements engineering literature, but as this is a new area of study little is known of industries perceptions of creating product value through requirements engineering and release planning. The first research objective is to determine how value-based requirements engineering is understood the software development industry:

**Research Question 1:** How is value-based requirements engineering perceived by the software development industry?

#### 4.2.1 Results for Product A

None of the three interview participants from Company A had heard the term *value-based requirements engineering* before taking part in this research.

*Value-based requirements engineering* did “not [mean] very much” to two of the research participants. However, one participant saw merit in value-based requirements engineering:

*I would think you would be coming up with some sort of premiss or way you should do this to make it more structured, but I don't know what that road would be.*

#### **4.2.2 Results for Product B1**

Only one of the four interview participants for Product B1 had heard the term *value-based requirements software development* before taking part in the study. The participant who had heard the term, the second participant, acknowledged that they “haven't ... gone into it.”

Three of the participants, the first second and fourth, articulated what *value-based requirements engineering* meant to them. A number of common concepts were raised in their response; developing to client requirements, recognising constraints and making a solution that meets the needs of Company B.

The first key to creating software product value is to align the software product with the goals of their target market. In discussing the problems software systems in general faced in the past, the first participant thought:

*If any organization wants to succeed today they need really to look at their market and who they want to service and align the products with their goals.*

In developing a software product value companies need to consider value from the perspective of the consumer, not just from the development company's own perspective. The fourth participant stated:

*You look at the value of the requests and how that compares to the amount of effort that you develop and what value it adds not only to the product, but to the actual consumer itself.*

However, the most effective way to align a software product with the goals of the target market is to work directly with customers to understand the problems they face. These

problems can then be addressed as business goals in developing the software solution. The first participant asserted:

*By listening to our customers, and listening to their challenges that they have and interpret that into a business goal, and into code and into a deliverable down to the end. It's working with your clients to build something that is very important.*

It is critical to recognise the context in which development takes place. Constraints and non-functional requirements need to be met for a software product to be successful. For example a system might need to be operational by a certain date to meet legal requirements. The second participant observed:

*You have to be very careful in any software development that you are supplying the need to the market place, but you have to do that within other criteria – cost of development, length of development – and you have to be fairly strict.*

Failure to recognise the context in which development takes place can result in the failure of the software product, regardless of how well the functional requirements are met. The second participant thought:

*... With anything you could spend 10 years developing the ideal product, but by the time you have developed it, then it is probably out of date anyway.*

Value should be considered from more than just the markets perspective, with the second participant asserting:

*It's not purely what a client is going to get out of that piece of software.*

The software company needs to consider its own requirements; according to the first participant at Company B software solutions need to be generic and customisable enough to meet the needs of clients from a diverse range of industries:

*It's very hard to service a lot of industries, but if you keep your code and your software to be customised very simply at the front end then you can do that, and that where I think we are ahead, we want to take a bigger share out of the industry sectors we are targeting and let them focus on their core business, so that's where our product work will actually come from.*

### 4.2.3 Results for Product B2

The two interview participants for Product B2 were interviewed for Product B1. The interviews for Product B2 were held after the interviews for Product B1, so the participants had been exposed to a discussion of value-based software engineering prior to this interview.

The first participant felt that the direction being followed for Product B2 aligned with value-based requirements engineering, despite having not heard this term before interviewed for Product B1:

*It is something that [Company B] does.*

The second participant did not admit to hearing the term in either the interview for Product B1 or Product B2. However, he felt the term was related to the funding of development effort:

*All of this new terminology is just another way to describe where people put their money in the development effort. ... It's more about how you should invest it [the money].*

The first participant saw working with clients to achieve their goals as key to value-based requirements engineering:

*Basically you give the customers a greater feel of comfort to ... create something for their specific needs.*

The first participant sees the key to achieving client goals as making the clients business processes more efficient, without requiring business process reengineering. Business processes are intellectual property that can help achieve competitive advantage. Product B2, according to the first participant, needs to support clients' existing processes in order to operate effectively:

*[Clients] operate differently. And that is actually their competitive advantage. And that is their own intellectual property. ... [What] we basically try and do is not go in and say you now need to operate like this. We say this is how you want to operate, we will help you operate like that.*

## **4.3 Research Objective 2**

### **4.3.1 Introduction to Research Objective 2**

Researchers have proposed numerous methods to create software product value through requirements engineering and release planning, such as Evolve and trade-off analysis techniques. While it is recognised that there is a disparity between formal methods and the processes used in industry, little research has been conducted into the process companies in the software industry use to create software product value. Hence we have the second research question:

**Research Question 2:** How does the software industry conduct release planning in order to create product value?

### **4.3.2 Results for Product A**

Product A is a real-time service for mobile telecommunications networks, developed, manufactured and supported by Company A. Once implemented this product allows mobile subscribers to decide what each caller hears before the subscriber answers his/her phone call, replacing the traditional the ring back tone.

#### **4.3.2.1 Stakeholder groups**

The major stakeholders identified by the first participant were customers and project managers. However, it is felt that the newly appointed Product Manager will start playing a bigger roll, as expressed by the first participant:

*Product management will start to play a bigger role now.*

#### **4.3.2.2 Product Manager**

Company A has recently created a role for a Product Manager for Product A. The role of the Product Manager is not clearly defined, but the third participant postulated that the Product Manager would help define a direction for the product that better integrated the requirements from different implementation projects:

*One of the most important parts of product management would be to ... integrate all the requirements coming from different projects into a common release plan.*

Company A has been having problems with their competitors improving products faster than them. This resulted in a loss of business, according to the first participant, where other companies offered features that were not requested, but which won them the contract:

*We were having problems in the market place with competitors improving their product and we were tracking what improvements the competitors made so we were sometimes behind. There were things that weren't necessarily in the requirements or request for quotation that competitors could offer, but weren't necessarily asked for explicitly, but were still causing us to loose business.*

The first participant suggests that the Product manager may look at developing minor enhancements without a market in order to stay competitive:

*We may look at developing minor enhancements without a specific customer.*

Product manager will also help sales understand the state of the market so that the sales material reflects what is going on and ECT can react in sales bids, according to the first participant:

*Their [The product manger's] role is also to help the sales team [understand] the state of the market so that our sales material reflects the state in the market place and so that we can react to that kind of thing in negotiations with our customer when we are making our bid.*

#### **4.3.2.3 Requirements Engineer**

The role of requirements engineer is not clearly defined for Product A with multiple people fulfilling this role. According to the second participant the implementation project managers are responsible for eliciting requirements, while the development team will be involved in the analysis of the requirements:

*We [the implementation project managers] would go and work out what the requirements are and then have a meeting with [name removed: the*

*development team lead] and look at if we can or cannot implement it and any other points of interest.*

The development team lead, the first participant, involves his team in this process:

*The project managers in collaboration with myself and the other programmers fulfil that [the requirements engineering] role.*

However, the third research participant identified only the implementation project managers as fulfilling the role of a requirements engineer:

*Yes, it will be the [implementation] project manager for us [Company A].*

#### **4.3.2.4 Constraints**

The biggest constraint facing product development identified by both the second and third participants was the availability of resources:

*Lack of develop [time], lack of somebody to actually implement it.*

#### **4.3.2.5 Product Change Management**

Changes to the product are managed according to their size. The first participant identified small changes being rolled out in bug fixes, while bigger changes have a more formal project:

*It depends on the size of the change. If it is a minor bug fix then we may not go through a longer process, but if it is a larger change request then yeah [they undergo a project specification].*

#### **4.3.2.6 Requirements Gathering**

Company A had problems selling products developed without a client. The first participant stated that clients know what they require better than Company A and for these reasons customers and not marketing is not involved in the development of product requirements:

*We build it to their requirements because we believe they know their business better than we do.*

The requirements of a solution are developed from the information provided in a request for quotations (RFQs) to implement Product A:

*Usually we develop the requirements specification from their [a potential client's] request for quotation.*

At this stage there has been no market research conducted for this product. According to the second participant the client base is responsible for the elicitation of new features:

*At this stage, with the particular product we have just been waiting for requirements to come to us, at this stage. We have a large customer basis and they are coming up with new things.*

If company A wins a contract that an implementation project manager will additionally conduct a client workshop to elicit requirements. The purpose of this workshop is to determine how the system will be integrated into its planned environment and determine additional requirements. According to the second participant:

*We go and have a workshop with customers ... We have the power of knowledge having implemented it [Product A] at other companies and what their requirements were, so we kind-of go there and say this is how the system works and then we come to the one where we need to work out what their requirements are, depending on who is at the meeting they have done enough thinking to be able to tell you what their requirements are.*

The workshop works aims to work through business requirements and integration requirements to get clients thinking about issues they had not previously considered. The third research participant explained his approach:

*It starts with a very detailed presentation of how the product currently works and then we try to fit this in to the customer's environment.*

*At this first common meeting with business people and technical people, we can see the business requirements behind the technical requirements.*

*So the ideas is to start the discussion within the customers organization itself and raise questions they haven't thought about before.*

*The way I do it is that I present them our architecture and this raises questions because at some point it doesn't fit with what the customer wants to do or has to do.*

The third participant also acknowledged that complexity influences the amount of time required to elicit requirements:

*Depending on the complexity that [the workshop] can take anywhere between half a day and a week.*

#### **4.3.2.7 Requirements Interpretation**

The implementation project managers are responsible for interpreting the requirements that are elicited. The first participant stated:

*The project manager will analyse it [the requirements] and decide what they think about how well we [Company A] can meet the customer's requirements.*

However, the first participant recognised the development team support this process and act as technical advisors:

*Also the developers will go through [the requirements], if the customer wants to double check we can do what they want.*

The implementation project managers use their knowledge of past implementation projects to assist in the interpretation of requirements, as stated by the second participant:

*We just use our knowledge of the product.*

The implementation project managers knowledge is considered sufficient, with the second research participant acknowledging, “no we don't” use any specified processes to assist in completing this task.

As part of this process the implementation project managers need to consider the affect of requirements on the software system. The third participant stated that:

*Of course our goal must to formulate the requirements in a way that it fits best into our own existing architecture.*

#### **4.3.2.8 Requirements Verification and Validation**

The requirements are documented using standard templates in a word processing tool and a diagramming tool. The third participant stated that the core product documentation is a template for documenting customer requirements from a workshop:

*We start with the documents, which describe our core product, what is actually presented in the workshop. And then we adapt this core documentation to customer specific versions by adding the modified requirements from the workshop. The template is the document for the core product.*

The second participant established the documentation totals several hundred pages:

*We've broken up into separate documents for each interface, but it is about a couple of hundred pages.*

The requirements are verified and validated jointly by both Company A and the client for whom the requirements are being implemented. The second participant stated that once the requirements are documented for a specific client, the requirements document passes back and fourth between Company A and their client until the client's requirements finalised:

*...then we would create a document based on that, it goes back and fourth a couple of times with changes on both sides. Both sides are supposed to read the document and come back with any questions or changes. At one point there is a finalisation of that document and then the requirements are really finalised.*

#### **4.3.2.9 Requirements Selection and Prioritisation**

Company A will not implement a requirement unless a client has requested it. In regard to developing requirements that have not been requested by a client the first participant said:

*We will not develop them without an explicit market.*

To make a feature rich product the second participant recognised that Company A would like to implement as much as possible in the core system shared by all customers:

*Everything that we can put in the core product we will, because that results in a feature rich product, but sometimes the implementation doesn't allow that to happen.*

The priority of a requirement is influenced by how easy it is to implement and how important the customer is who requested it. The second participant stated that:

*For little customers we won't make a lot of customisations. If they have some weird, wacky requirements we will say no, sorry that's not how it works and force them down a track that is easier for our developers to do.*

The second participant identified the development team lead as responsible for deciding what requirements go into the core product, and what requirements will go into a customer specific branch of the software:

*That's a decision between the feature and the head developer really.*

The development team lead, the first participant, bases his decision to implement a feature as a core feature on the requirements of upcoming customers:

*It is dependant on the requirements of the next customer.*

Where it is not possible to implement the requirements of the current implementation projects in a timely manner, the project managers must decide which implementation has priority with the third participant noting:

*So if there is a conflict then we discuss it between us.*

No formal methods are used in prioritising and selecting requirements, but as the third participant acknowledged different factors will be considered that influence the decision making process:

*A number of different factors come in – one justification might be that one is a very very very big customer and the other is a very very very small customer and the decision is easy. Another thing might be just contractual issues, if one contract has high penalties if you do not meet the deadline. The end decision we deliver late for the customer who will be the less heavy.*

The importance of a clients relationship with Company the impact that non-delivery will bring are critical to deciding which customers requirements will be implemented first.

#### **4.3.2.10 Release planning**

Company A has a roadmap to plan future releases of software. The second participant identified that where features that have not been implemented but are repeatedly seen they will be suggested for inclusion into the product roadmap:

*You keep them in mind and in reading a couple of RFQs you go 'oh, they've asked for it again' and a couple of those features go on our roadmap.*

The second participant states features are suggested by the implementation project managers, who analyse the requests for quotation, and sales is responsible for assigning these features to the future releases:

*Normally we [the implementation project management team] just provide a list of features, and sales make it up as to what should be in each quarter.*

The second participant stated that direction of the roadmap is a commercial decision based on strengthening customer relationships and improving the products:

*Probably more commercial in that the company has a strategy for who they want to impress and keep as a customer. At the top they will either say 'they have requested these features before' or 'we think these are good new features' and then you would come up with a list you want to implement and you speak to the developers to find out what of those is actually feasible to implement.*

She felt that the CIO and sales team used their knowledge of the market to assist them in this decision making process:

*I think it is just their knowledge of the market place.*

The latest development roadmap seen by the second participant plans releases approximately six months into the future:

*... from a time plan, we have Q2-2005, Q3-2005.*

However, the development of Product A is project based and does not follow the roadmap. The third participant felt:

*This roadmap changes all the time depending on what projects come in. The roadmap will just be ignored completely.*

The third participant suggested that there is no release planning for the product outside a specific implementation project:

*There is not real release planning, except in the [implementation] project planning.*

Customer specific versions of the software have been created that are hard to merge back into a common version of Product A. The third participant suggested that with an implementation focus:

*You will end up as we do at the moment with a bunch of customer specific release and it is a lot of work after that to merge them into a standard product again.*

### **4.3.3 Results for Product B1**

Product B1 is a large-scale document and data repository developed and supported by Company B. Once implemented this product is an enterprise document retrieval and management system.

#### **4.3.3.1 Stakeholder groups**

Clients of Company B, and their clients, were identified by the fourth participant as the most crucial stakeholder group:

*First of all we have our customers, their customers ...Understanding our consumers' issues and market place, issues and problems is one of the important things.*

However, sales, implementation, operations and development were also seen as important and influential in release planning, as identified by the first participant:

*So that would be the key things, sales, implementation, operations and R&D.*

#### **4.3.3.2 Product Management**

In the past at Company B the sales team dealt directly with the Research and development team to create customer specific versions of Product B1. This created unnecessary rework so the role of Product Manager was created to rolling these changes into a core product with a strategy to take it into the market place. The first participant described the situation as:

*We were just building a lot of one off things for clients. This way now we start rolling things up and releasing them as products and modules and not just saying thank god it's done, but also having a strategy to take it out to the market place.*

Additionally both development and sales are biased in their approach to development. The development team is technology focused, the sales team is revenue focused and operations just need to get the job done. The first participant describes how a Product Manager agnostically has a view of all areas and can make a balanced judgement:

*From an R&D perspective, they're basically technology focussed, so sales people have a revenue focus and the operations people just want to get it done. I'm pretty much in between all areas, I have a long term, because I'm in marketing I have an unbiased view, so I can see this is what we need to release.*

#### **4.3.3.3 Ad Hoc Process**

Company B has a defined direction for Product B1, but that new and existing customers defining new requirements heavily influence this direction. In addition to the formal requirements engineering and release-planning project the product evolves with customer specific versions being developed between major releases. The first participant acknowledged:

*We [Company B] have an idea of where we're taking the product in terms of where we want to go. But we are heavily driven by what our clients want.*

If there are features that need to be implemented to win a contract, then they will be made available in either the next release or a customer specific version, in which case

they will be rolled back into the core product at a later date according to the fourth participant:

*If there are specific features or specific things that a customer requires in order for us to win the contract ... then that gets included as part of the next release. Or we will develop a special version that includes those features and then release it to the rest of the branches, thereafter.*

Any requirements that are perceived to have a sufficient market are rolled back into the core product. The first participant acknowledged:

*A lot of things are developed client specific, which are then rolled back into [the core product].*

The product managers preferred method is to get all of the stakeholders into a meeting discuss and analyse the business requirements. These requirements are then documented in a development brief and passed to the development team to be turned into technical requirements, and a quote prepared for the client. This process was described by the first participant, the Product Manager:

*So we'll sit down and put together a development brief and answer all of the requirements of what we're developing, how long is it going to take, are we going to build for it, how much are we going to sell it for, who else can use it – so all these other questions will form that brief, we'll submit that to R&D and they'll take a look at it and say yep, it'll take two hours, it will cost this much, cost that much, they'll do the building, all the testing that they need to do and sort-of roll it out for that client and then later on roll it out in a major release.*

#### **4.3.3.4 Requirements Engineer**

The role of a requirements engineer is being filled by two people for Product B1; the Product Manager is responsible for business requirements, while the Development Manager is responsible for technical requirements. The first participant described this relationship:

*I [The Product Manger] put together the business requirements ... In the R&D team there is actually an architect to actually map out technically how we need to achieve those goals.*

#### **4.3.3.5 Constraints**

Both the first and fourth participants identified the resources in the Research and Development department as the biggest constraints to development. The third participant identified time and money as the constraints facing development.

#### **4.3.3.6 Change Management**

Changes to the product are managed according to their size. The third participant identified small changes being rolled out in bug fixes, while bigger changes have a more formal project:

*A new version of the product will be a whole new project by itself ... but once version four is release if there are any bugs or slight modifications they will be managed by change control.*

#### **4.3.3.7 Requirements Gathering**

Company A holds annual meets bringing together the sales teams, production team and other vested parties to develop a business strategy for the upcoming year. The fourth participant stated that the people in the meeting:

*... give us feedback on what are the things that are going to be driving the business that year.*

The key products to fulfilling the business strategy will be brought into focus, as stated by the fourth participant:

*Depending on the feedback we will put particular products into focus.*

When a product is brought into focus, it undergoes a requirements elicitation phase involving sales, developers and support teams as asserted by the fourth participant:

*When we look at a particular product we have feedback sessions ... and capture what the [sales] branches say. ... And then we have sessions with the technical people, we also have sessions with the sales and account support people.*

The first participant mentioned that sales represent general markets requirements and identify product development opportunities:

*With our sales guys they will look for opportunities and different sales people will make opportunities.*

Additionally the first participant identified trade shows and conferences as ways to keep their product aligned with their competitors, with the marketing and development teams:

*Basically go to world trade shows and national trade shows and just look at technology and look at what the industry is doing and just try and align our development.*

The requirements elicited from these processes are documented at feature level, with the fourth participant asserting:

*At the moment it's just feature level. ... When we decide to go into those particular features we define them in more depth.*

#### **4.3.3.8 Requirements Interpretation, Verification and Validation**

Once business level requirements are defined a workshop is held with the Product Manager, development team and support team to determine what the requirement elicited means to Product B1. They look at what must be delivered, what can be delivered and in what timeframe it should be delivered. This process is described by the fourth participant:

*We then have a workshop with the product manager, team members and some of the support people to try and work out where things are at, and try and put a value on or associated with what must be delivered, what can be delivered and try and work out if we can deliver on the time plan that has been requested.*

This workshop is used to develop an understanding of what the requirement's issuer needs implemented to meet their objective. Feature descriptions can often be vague, the fourth participant noted that different concepts will be tested to develop an understanding of what is required:

*Because although most people will say 'we want this particular feature' nobody can give you a clear definition of what this feature is going to be, or how it is going to look, or its form. They all have their own interpretations. So we have been testing different concepts out.*

The fourth participant noted the requirement's issuer is responsible for verifying that the requirement has been understood:

*We have a review with the business managers or if it's a feature being delivered for a specific solution the customer will sign it off.*

#### **4.3.3.9 Requirements Selection and Prioritisation**

Traditionally requirements selection and prioritisation has been the role of the Research and Development Team. The position of Product Manager for Product A, the first participant, was created earlier this year, and now the Product Manager has taken on this role:

*Traditionally at HPA it has been the R&D guys who actually do that; but now my [the Product Manager's] role has actually been created as a new role within HPA and I work with the R&D guys to help them do that.*

Requirements selection and prioritisation is a part of the workshop mentioned in the Requirements Interpretation, Verification and Validation stage of the requirements engineering process.

The first stage in requirements selection and prioritisation is to ask if the requirements can be implemented. The third participant described the process:

*Then we did sit down with R&D and go through the changes and say okay, 'Can they be done? Yes or no.' If yes, start prioritising them.*

Revenue, product differentiation and sales are the key aims in selecting and prioritising requirements according to the Product Manager, the first participant:

*Cause what we want to do is get things out in a market that differentiate us and generate revenue, immediate revenue and also help the sales people sell. So they are the key factors I'm looking at.*

The value of requirements from the perspective of Company A and their clients forms part of the requirements selection and prioritisation process. The fourth participant listed key questions asked as part of this process:

*What is the value to HPA? Is it something that is strategic? Is it eye candy? Is it limited to one particular market place? So we don't only look at the amount of effort required by HPA, but what it delivers to our customers.*

The second participant acknowledged if a client requests a requirement be implemented, but this requirement not seen as marketable to other clients, then it may not be rolled into the core product, but a client specific version will be created:

*If something is particularly custom to a particular client, and it's not seen as a potential marketing point, then we may go outside the scope of the product and put and add on.*

While the input of the workshop plays an important role, the final decision as the selection and prioritisation of requirements lays with the Product Manager working closely with the Development Manager, the fourth participant:

*I [The Development Manager] will make some recommendations based on the team feedback, but the product manager will say that's the ultimate feature we must have.*

Once agreed the resultant list of requirements is usually made available, the second participant noted:

*We may be provided with a list of items and how they are prioritised.*

#### **4.3.3.10 Release Planning**

Citing resource limitations, the fourth participant stated that Company B plans to a major release of Product B1 every 18 to 24 months:

*We have 10-12 people and 4-5 product lines we look at doing a major revision every 18-24 months.*

Company A will try and include of the features selected for inclusion, with the first participant acknowledging that the release may be delayed to get everything implemented:

*If we have to delay the release of 4 we will do that. ... So you want to get as much major functionality into your releases and avoid those smaller and litter ones.*

However, the third participant also recognised that if a release needs to be out by a certain date Company A make a major release and follow it with a minor release:

*The way we doing things here is if a release has to be out by a certain date and there is a requirement that is going to take us more time to do that then we release version four and then say three or four weeks later release version 4.1.*

#### **4.3.4 Results for Product B2**

Product B2 provides a solution for managing the collection, analysis and processing of paper requests and responses such as election polls, surveys, exams, insurance claims, remittances and general inbound mail. It is developed, hosted and supported by Company B.

##### **4.3.4.1 Stakeholder groups**

Both interviewees identified the clients as the most important stakeholder group in determining what requirements were implemented for a release of software because they represent the revenue stream. This was expressed by the first participant:

*The clients are number one ... because they are in effect paying the bill and that's where the revenue [comes from], and we look after that stream very well.*

The high importance of protecting revenue within Company B was expressed by the second participant:

*Everything that is billable goes this year, so the priority is there.*

However the participants disagreed on the order of importance for the other key stakeholder groups in requirements selection for a release. The first participant identified operations as the second most influential group followed by research and development. The second participant felt that marketing was the second most influential group, followed by. The first participant also noted the role of product management, marketing, sales and project managers.

Operations plays an important role for this product as there is a ongoing labour intensive component involved as part of the solution provided by Product B2. A team of people are employed to scan document and facilitate their movement through the appropriate workflow. Optimising the product to reduce labour costs increases revenue, as described by the first participant:

*We want to gain maximum efficiencies ... reduce our labour costs, reduce our risks ... because if we sell at a price and increase our efficiency we also get revenue.*

#### **4.3.4.2 Product Management**

Product B2 has had a product manager from within marketing at Company B for its two and a half year life.

#### **4.3.4.3 Requirements Engineer**

The role of a requirements engineering is not clearly defined for this product. The second participant, who is in the role of the development manager, identified the product manager as the business level requirements engineer:

*The product manager takes care of the business requirements.*

However, first participant as the product manager, described the implementation consultants and clients as together responsible for defining what is required of Product B2:

*[The role of a requirements engineer is] pretty much from the client perspective and project management team. They will basically say the client has a need and we will actually develop the system to meet that need.*

The second participant stated that the research and development team handles technical requirements directly:

*The technical requirements come to us [research and development] and we determine those sort of things.*

#### **4.3.4.4 Constraints**

The biggest development constraint for Product B2 identified by both participants was to do with development resources. The developers who work on Product B2 are not dedicated to core product development, but are involved in developing and supporting other software systems for clients that will generate immediate revenue. These often take priority over Product B2, as expressed by the second participant:

*Projects. Projects. Customer projects. Projects taking time away from IWS. That's my major thing. Helping the branches implement ... [and] support applications. ... Everything that is billable goes this year, so the priority is there.*

#### **4.3.4.5 Change Management**

Company B uses two methods when dealing with changes to Product B2 according to the second participant. Controlled software product releases contain new functionality and bug fixes to be rolled out as an update to the core product. Individual client requests may be handled on a single client basis. There is “a change control system for both of those.”

#### **4.3.4.6 Requirements Gathering**

For most Product B2 implementation projects the developers do not have direct contact with the clients. The product manager is responsible for initiation changes to Product B2 from the perspective of the developers. The product manager is responsible for the elicitation of what is required.

*We usually have a product manager who does most of the communications. On occasions our team leaders, in this case Mark, will visit clients to get some feedback.*

An IT implementation consultant from Company B works with a client to determine their requirements. This results in a functional specification of the client's requirements being written by the consultant. The first participant described this process:

*We have like a business analyst who will actually review the customers specific situation and say this is what their business processes are, this is what they are currently doing, this is what we can do with toolkits from [Company B].*

The first interview participant identified industry forums, expos, conferences and seminars as ways to keep abreast of changes in the marketplace.

*We actually attend industry forums and usually go to expos, conferences or seminars and either present at these functions, interact with the market themselves and just gauge what is happening within the industry.*

Indirect industry contact is constructive when moving the product to support new markets or identify gaps in existing markets. The second research participant noted that industry contact through the forums above is:

*... especially in specific fields of markets to address and identify gaps.*

#### **4.3.4.7 Requirements Interpretation, Verification and Validation**

The functional specification is analysed by the product manager and development team to ensure it is both understood and fits into the existing system architecture. For a major piece of work a workshop will be set-up to analyse the requirements from a technical perspective, however, for a small discussions are more informal over phone and email. This process was described by the second participant:

*Usually when we have a major piece of work we [work] with the product manager or some of the business people and our team. Then we workshop all of the requirements to have a clear understand of the requirements for a major piece.*

*For a minor piece they would email around the requirements and discuss it over the phone. If things aren't clear they will then bring the business people in.*

As a result of these discussions the development team determines the system architecture and who will be responsible for what task. The second participant described how this is documented and added to the functional specification:

*What comes out of there is a general architecture plan, some general action items or who's going to be taking responsibility. Also some decisions about how we are going to be approaching the task at hand. ... Normally we write it online, and that document gets expanded and added to the functional requirements.*

The first participant described how the development team supplies additional information required for development, such as costs and time frame:

*R&D will supply a development time frame for what they need to do, hours, responsibilities, costs, any additional software. That will be incorporated into the project plan as well from the implementations person.*

Once the functional specification is complete, the client is responsible for verifying and validating that the system specified meets their requirements, as described by the first participant:

*When we develop something specific for a client they will need to sign off on the functional specification. The functional specification is what they are going to get at the end.*

#### **4.3.4.8 Requirements Selection and Prioritisation**

The selection and prioritisation of requirements is the responsibility of the Product Manager and Development Manager. The requirements issuer will be involved as to when the requirement is required. The second interviewee stated:

*It's basically the responsibility of the product manager, myself [the development manager] and the requester. If someone has requested a particular feature it is our responsibility to agree on timelines.*

Revenue is a key driver in the selection and prioritisation of requirements. A return on investment (ROI) analysis is conducted for development effort. The first participant described:

*Whatever you spend you have to show an ROI, and that's what it comes down to.*

However, the impact of a requirement on Product B2 was identified by the second participant as a key consideration:

*If there is a request, what is the impact on the existing product? That's a big one.*

As this product is relatively new, a large part of the development effort is rolling customer specific features that have been developed back into the core product as generic components. The product manager and development manager start by looking at what should be rolled back into the core product. The second participant described how:

*The features are based on a branch of the original product, which then get merged.*

The first participant said that the Product Manager and Development Manager then consider the opportunities identified by the sales teams:

*Then things we see based on the sales people and what we want to release.*

In order to facilitate an open working environment, the Product Manger writes a monthly report that details all work being done by the Research and Development team. The first participant describes how this report is then used to request changes to existing priorities:

*Someone will say I want this, this is more important. They will come to me [the Product Manager] and I can filter that information through to the technical people.*

#### **4.3.4.9 Release Planning**

Company B normally works on a two-year cycle for major releases of its software products. However, the second participant describe that as Product B2 is relatively young, it is currently undergoing six monthly releases:

*Major pieces of work we plan to do in two-year cycles. ... What we usually find, where things are growing or reaching maturity there is a significant update every six months.*

The second participant described how as Company B gets closer to a release date they renegotiate what will be in the release:

*As we get closer, we will view that critical time line and what can be delivered and renegotiate.*

If it is decided that certain features cannot make the desired release date, an additional release with the postponed functionality will be planned to follow. The first participant described how this approach:

*... gives us more credibility if we release the product soon, it gives it more functionality, better saleable product.*

### **4.4 Research Objective 3**

The third research objective is concerned with the value system applied to selecting and prioritising requirements for inclusion in a software development project/release. In market driven incremental product development an optimal subset of requirements is selected for inclusion in each project or release (Aurum & Wohlin, 2005). This research objective seeks to quantitatively evaluate the relative importance different decision making criteria when determining whether or not to include a requirement in a specific project or release. Hence the third research question is:

**Research Question 3:** What values are applied to the decision making process to select and prioritise requirements for a software project or release? How does this differ to industries perception of the optimal application of the criteria?

## **4.4.1 Results for Company A**

### **4.4.1.1 Results for Product A**

Nine of the sixteen participants selected to take part in this study for Product A completed and returned the questionnaire. When assigning points for how the criteria are applied today two participants assignments did not add to 1000, instead adding to 900 and 1100. The contact for Company A confirmed that these participants were satisfied with their values being scaled to 1000, and did not wish to submit a new results.

#### **4.4.1.1.1 Additional Criteria**

No additional decision making criteria in release planning for Product A were identified by any of the participants.

#### **4.4.1.1.2 Relevant Criteria**

Four of the nine participants felt that all of the criteria were relevant, but there was little consistency between the other participants as to which criteria were relevant. Of the five participants that felt not all of the criteria were relevant, three of them only described one or two as not being relevant. Two participants, however, described six and seven of the fourteen criteria as not being relevant.

Only two criteria were identified as relevant by all of the participants; these were (3) the market's priority of the requirement, and (14) the impact of a requirement on system maintenance of the system.

Most of the criteria were seen as relevant by relevant by all participants, with only one participant disagreeing; these were: (1) the status of competitors with respect to the requirement, (2) the stakeholder responsible for issuing the requirement, (4) if the function has been promised or sold, (7) the development cost-benefit of the requirement, (8) the available resources and their competencies, (9) the impact the requirement has on delivery date, (10) the impact on the system, (11) the complexity of the requirement, and (12) any requirement dependencies.

The impact of a requirement on the future evolution of the system (13) was not seen as relevant by two of the participants.

The least relevant criteria were (5) a requirement's volatility, and (6) the ability to provide technical support, education and training for the requirement; with three of the nine participants seeing these as not relevant.

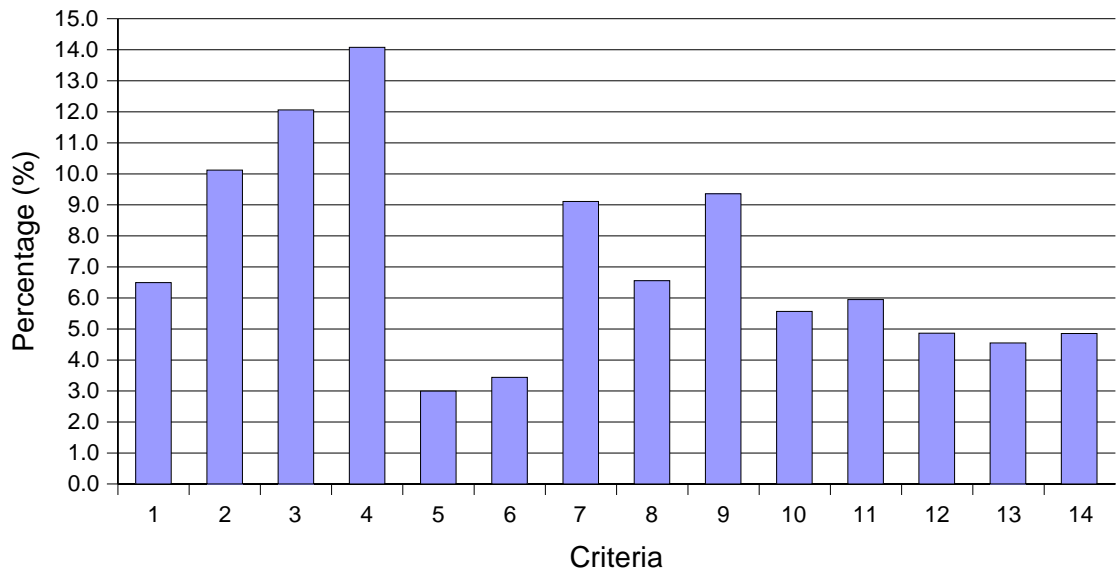
#### 4.4.1.1.3 Importance of Criteria Today

The results for Product A clearly indicate that some criteria are more important than others in the selection and prioritisation of requirements for a release. It is worth noting that three of the criteria have percentage values above 10% and five have values below 5% for Product A. The order and relative importance of the different criteria can be seen in Table 4.1 and graphically in Figure 4.1.

**Table 4.1. Relative importance of different criteria for Product A today**

	<b>Criteria</b>	<b>%</b>
4.	Function is Promised/Sold	14.1
3.	Stakeholder Priority of Requirement	12.1
2.	Requirement's Issuer	10.1
9.	Delivery Date/Calendar Time	9.4
7.	Development Cost-Benefit	9.1
8.	Resources/Competencies	6.6
1.	Competitors	6.5
11.	Complexity	5.9
10.	System Impact	5.6
12.	Requirements Dependencies	4.9
14.	Maintenance	4.9
13.	Evolution	4.6
6.	Support/Education/Training	3.4
5.	Volatility	3.0

## Criteria Today: Product A



**Figure 4.1** Relative importance of different criteria for Product A today

The market and clients of Product A have the most significant influence on the selection and prioritisation of requirements for inclusion in the software. The three most important criteria all represent the clients or market of Product A; in order these are (4) if the function has been promised or sold, (3) the market's priority of the requirement, and (2) the stakeholder responsible for issuing the requirement, Requirement's Issuer.

Some management issues were considered much more important than others. Both (7) the development cost-benefit of the requirement and (9) the impact the requirement has on delivery date had percentage values above 9%, while (5) a requirement's volatility and (6) the ability to provide technical support, education and training for the requirement were below 3.5% in their importance.

Development and maintenance issues were considered of fairly equal importance, with all criteria representing these groups clustered together in the results between 5.9% and 4.6%.

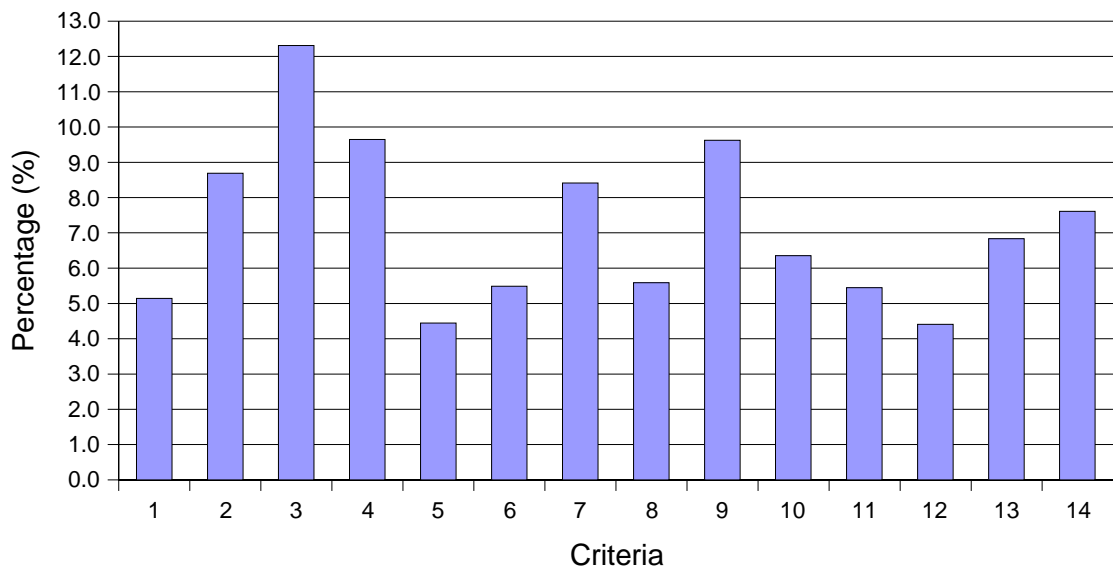
### 4.4.1.1.4 Importance of the Criteria in the Future

The results for how the value criteria should be optimally applied in requirements selection and prioritisation for Product A indicate that some change would be perceived beneficial. The results can be seen in Table 4.2 and graphically in Figure 4.2.

**Table 4.2. Optimal relative importance of decision making criteria for Product A**

Criteria		%	Movement
3.	Stakeholder Priority of Requirement	12.3	+ 1
4.	Function is Promised/Sold	9.6	- 1
9.	Delivery Date/Calendar Time	9.6	+ 1
2.	Requirement's Issuer	8.7	- 1
7.	Development Cost-Benefit	8.4	-
14.	Maintenance	7.6	+ 5
13.	Evolution	6.8	+ 5
10.	System Impact	6.4	+ 1
8.	Resources/Competencies	5.6	- 3
6.	Support/Education/Training	5.5	+ 3
11.	Complexity	5.4	- 3
1.	Competitors	5.1	- 5
5.	Volatility	4.4	+ 1
12.	Requirements Dependencies	4.4	- 4

**Optimal Criteria: Product A**



**Figure 4.2 Optimal relative importance of different criteria for Product A**

The participants from Company A optimally saw a tighter distribution of the criteria. In describing the current situation the criteria were distributed over 11.1 percentage points, compared with an optimal distribution over 7.9 percentage points.

The optimal application of the criteria remained customer focused, however, the focus within this area has changed. The first two criteria swapped place, with Company A preferring to see (3) the stakeholder's priority of the requirement as the most important criteria over (4) whether the function has been promised or sold.

The optimal application of the criteria also saw the management issue of (9) the impact the requirement has on delivery date overtake the importance of (2) the stakeholder responsible for issuing the requirement. It is also of interest to note that (6) the ability to provide technical support, education and training for the requirement rose three places, while (8) the available resources and their competencies fell three places in the ranking.

The criteria representing the developers and maintainers became more distributed when applied optimally. Instead of being distributed over 1.3 percentage points, they were distributed over 3.2 percentage points, despite the general reduction in range. The effect of a requirement on both (14) maintenance and (13) system evolution jumped five places in the ranking of the criteria, while considerations of (12) requirement dependencies fell four places in the ranking.

## **4.4.2 Results for Company B**

### **4.4.2.1 Results for Product B1**

In total seven responses were received from Company B about Product B1, this represented all of the questionnaires sent out. The results of one participant's survey did not sum to the required for either the criteria as applied today nor an optimal application of the criteria, adding to 1020 and 1080 respectively. The researcher contacted the participant in question, who confirmed that the results could be scaled to 1000.

#### **4.4.2.1.1 Additional Criteria**

Three additional criteria were identified in this study as being important in the decision making process in release planning for Product B1. The three criteria were identified by two of these participants, both of whom described themselves as technical product managers within the organization, although not for this product.

The first additional criteria identified by one participant was:

*Creation of competitive advantage.*

The remaining two criteria identified were identified by the same participant. These were:

*Preferred operating architecture.*

And:

*Adherence to corporate software design parameters.*

#### **4.4.2.1.2 Relevant Criteria**

Four of the seven participants described all of the 14 criteria as relevant.

All seven participants considered all of the criteria that represented the perspective of the client or market relevant.

The criteria of most contention represented the management perspective. Two of the seven participants regarded each of (5) a requirement's volatility, (6) the ability to provide technical support, education and training for the requirement, and (8) the available resources and their competencies as not relevant to the selection and prioritisation of requirements. One participant did not feel that (7) the development cost-benefit of the requirement was a factor.

The criteria representing the developers and maintainers were all considered relevant by the participants, except one who disagreed on two of the criteria; the impact of a requirement on (13) the future evolution of the system and (14) system maintenance.

#### **4.4.2.1.3 Importance of Criteria Today**

The results for Product B1 clearly indicate that some criteria are more important than others in the selection and prioritisation of requirements for a release. It is worth noting that two of the criteria have percentage values above 10% and five have values below 5% for Product B1. The order and relative importance of the different criteria can be seen in Table 4.3 and graphically in Figure 4.3.

**Table 4.3 Relative importance of different criteria for Product B1 today**

Criteria		%
3.	Stakeholder Priority of Requirement	11.5
2.	Requirement's Issuer	11.5
4.	Function is Promised/Sold	9.0
11.	Complexity	8.9
1.	Competitors	8.8
10.	System Impact	7.8
12.	Requirements Dependencies	7.6
7.	Development Cost-Benefit	7.3
9.	Delivery Date/Calendar Time	7.3
8.	Resources/Competencies	4.9
14.	Maintenance	4.8
13.	Evolution	4.5
6.	Support/Education/Training	3.4
5.	Volatility	2.7



**Figure 4.3 Relative importance of different criteria for Product B1 today**

As with Product A, the market and clients of Product B1 have the most significant influence on the selection and prioritisation of requirements for inclusion in the software. When the criteria were ranked in order of influence, all four criteria representing the clients and market of Product B1 appear in the first five places.

Some management issues were considered much more important than others. Both (7) the development cost-benefit of the requirement and (9) the impact the requirement has on delivery date had percentage values above 9%, while (5) a requirement's volatility and (6) the ability to provide technical support, education and training for the requirement were below 3.5% in their importance.

Three development and maintenance issues were considered of higher importance with values above 7.5%, the other two criteria had values below 4.9%. In order the criteria of higher importance today are (11) the complexity of the requirement, (10) the impact on the system, and (12) any requirement dependencies. While the criteria treated as less important related to the impact of a requirement on (13) the future evolution of the system and (14) system maintenance.

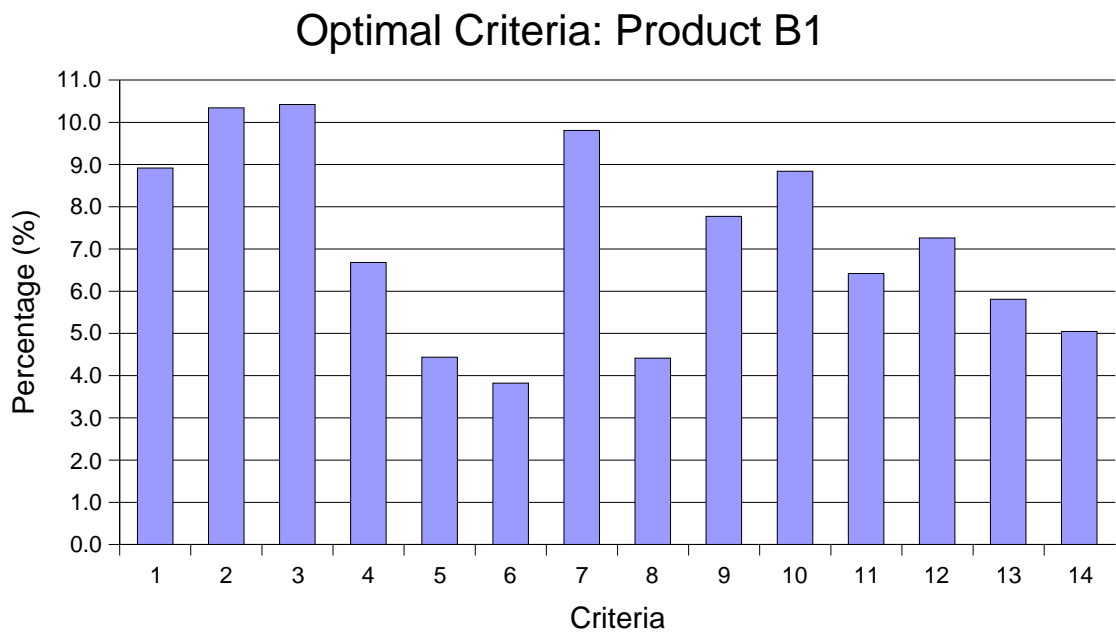
#### 4.4.2.1.4 Importance of the Criteria in the Future

The results for how the value criteria should be optimally applied in requirements selection and prioritisation for Product B1 indicate that some change would be perceived beneficial. The results can be seen in Table 4.4 and graphically in Figure 4.4.

**Table 4.4 Optimal relative importance of decision making criteria for Product B1**

	<b>Criteria</b>	<b>%</b>	<b>Movement</b>
3.	Stakeholder Priority of Requirement	10.4	-
2.	Requirement's Issuer	10.3	-
7.	Development Cost-Benefit	9.8	+ 5
1.	Competitors	8.9	+ 1
10.	System Impact	8.8	+ 1
9.	Delivery Date/Calendar Time	7.8	+ 3
12.	Requirements Dependencies	7.3	-
4.	Function is Promised/Sold	6.7	- 5
11.	Complexity	6.4	- 5

13.	Evolution	5.8	+ 2
14.	Maintenance	5.1	-
5.	Volatility	4.4	+ 2
8.	Resources/Competencies	4.4	- 3
6.	Support/Education/Training	3.8	-1



**Figure 4.4 Optimal relative importance of different criteria for Product B1**

The participants for Product B1 optimally saw a tighter distribution of the criteria. In describing the situation today the criteria were distributed over 8.8 percentage points, compared with an optimal distribution over 6.6 percentage points.

The optimal application of the criteria remained customer focused, however, this area still reported a significant change. The importance of the criteria (4) if the function has been promised or sold fell five places in the ranking of criteria, while (3) the market's priority of the requirement and (2) the stakeholder responsible for issuing the requirement remained unchanged in the first two positions.

The issue seen as most undervalued at the time the questionnaire was conducted was (7) the development cost-benefit of the requirement. This criterion rose five places when the criteria were ranked how the participants would like to see them applied.

The most significant change in the criteria representing the developers and maintainers was a decrease in the importance of (11) the complexity of the requirement. This criterion fell five places when ranked against how the participants would like to see them applied.

#### **4.4.2.2 Results for Product B2**

Five responses were received from Company B about Product B2, out of a total of seven that were sent out. The responses for two of the participants required scaling as the sum of the points awarded by them did not total 1000. One participant's score summed 1120 for today and 1230 in an optimal situation, while the other participants score summed 985 for the criteria today. Both participants confirmed they were happy to have their results scaled and did not wish to submit a new questionnaire.

##### **4.4.2.2.1 Additional Criteria**

Two additional criteria were identified as influencing the release planning process. Both were identified by one of the participants. These were:

*Non custom application (Resell a solution, save costs)*

And

*Future financial worth/new business applications*

##### **4.4.2.2.2 Relevant Criteria**

Three of the five participants saw all of the criteria as relevant to the release planning decision making for Product B2.

As with Product B1, all criteria related to the client or market perspective were seen as relevant.

The only criterion that was not seen as relevant by both of the participants who claimed not all criteria were relevant was (13) the impact of a requirement on the future evolution of the system. It should be noted that both of these people worked in development roles for Product B2.

The criteria seen as not relevant by one of the participants were, (5) a requirement's volatility; (6) the ability to provide technical support, education and training for the requirement; (10) the impact on the system; and (12) any requirement dependencies.

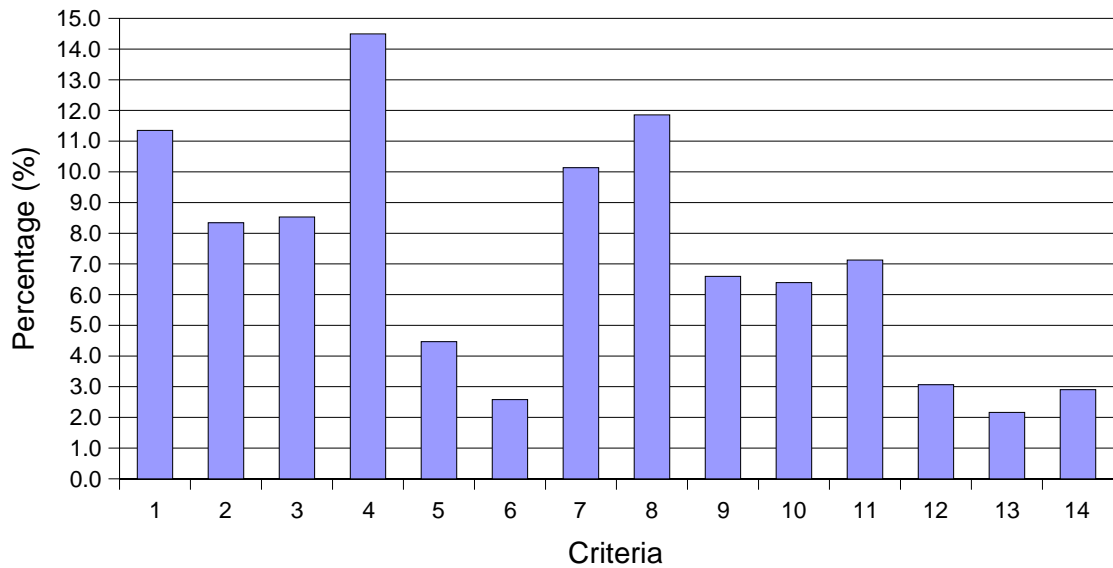
#### 4.4.2.2.3 Importance of Criteria Today

The results for Product B2 clearly indicate that some criteria are more important than others in the selection and prioritisation of requirements for a release. It is worth noting that four of the criteria have percentage values above 10% and five have values below 5% for Product B1. The order and relative importance of the different criteria can be seen in Table 4.5 and graphically in Figure 4.5.

**Table 4.5 Relative importance of different criteria for Product B2 today**

	<b>Criteria</b>	<b>%</b>
4.	Function is Promised/Sold	14.5
8.	Resources/Competencies	11.9
1.	Competitors	11.3
7.	Development Cost-Benefit	10.1
3.	Stakeholder Priority of Requirement	8.5
2.	Requirement's Issuer	8.3
11.	Complexity	7.1
9.	Delivery Date/Calendar Time	6.6
10.	System Impact	6.4
5.	Volatility	4.5
12.	Requirements Dependencies	3.1
14.	Maintenance	2.9
6.	Support/Education/Training	2.6
13.	Evolution	2.2

## Criteria Today: Product B2



**Figure 4.5 Relative importance of different criteria for Product B2 today**

As with Product A, the market and clients of Product B1 have the most significant influence on the selection and prioritisation of requirements for inclusion in the software. When the criteria were ranked in order of influence, all four criteria representing the clients and market of Product B1 appear in the first five places.

Unlike Product A and Product B1, the most important criteria for Product B2 represent both the client/market and management issues topped the list of criteria when ranked by importance in release planning. In order these were (4) whether the function has been promised or sold, (8) the available resources and their competencies, (1) the status of competitors with respect to the requirement, and (7) the development cost-benefit of the requirement. These criteria were directly followed by the two remaining criteria representing the market place.

Product B2 also differed from the others in the key management criteria. The most important issue from the management perspective was (8) the available resources and their competencies. The only other notable difference in this area is that the least two important management criteria have swapped place with (5) a requirement's volatility being more important than (6) the ability to provide technical support, education and training for the requirement.

Two development and maintenance issues were considered of higher importance with values above 6.3%, the other three criteria had values below 3.2%. In order the criteria of higher importance today are (10) the impact on the system, and (11) the complexity of the requirement. While the criteria treated as less important related to (12) any requirement dependencies, (13) the impact of a requirement on the future evolution of the system and (14) the impact of a requirement on system maintenance.

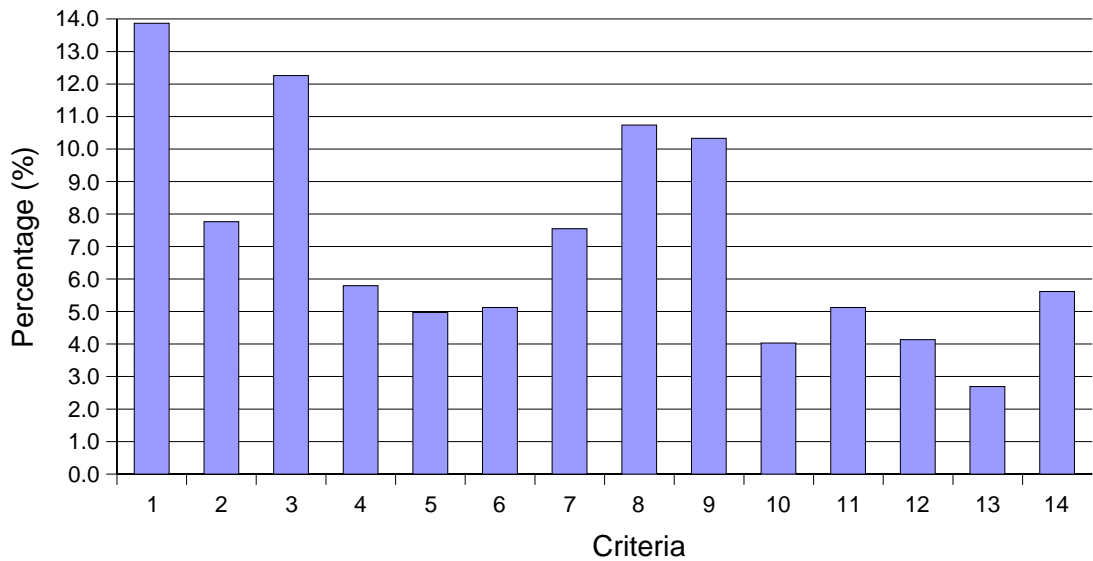
#### 4.4.2.2.4 Importance of the Criteria in the Future

The results for how the value criteria should be optimally applied in requirements selection and prioritisation for Product B2 indicate that some change would be perceived beneficial. The results can be seen in Table 4.6 and graphically in Figure 4.6.

**Table 4.6 Optimal relative importance of decision making criteria for Product B2**

	<b>Criteria</b>	<b>%</b>	<b>Movement</b>
1.	Competitors	13.9	+ 2
3.	Stakeholder Priority of Requirement	12.3	+ 3
8.	Resources/Competencies	10.7	- 1
9.	Delivery Date/Calendar Time	10.3	+ 4
2.	Requirement's Issuer	7.8	+ 1
7.	Development Cost-Benefit	7.5	- 2
4.	Function is Promised/Sold	5.8	- 6
14.	Maintenance	5.6	+ 4
11.	Complexity	5.1	- 2
6.	Support/Education/Training	5.1	+ 3
5.	Volatility	5.0	- 1
12.	Requirements Dependencies	4.1	- 1
10.	System Impact	4.0	- 4
13.	Evolution	2.7	-

## Optimal Criteria: Product B2



**Figure 4.6 Optimal relative importance of different criteria for Product B2**

The optimal application of the criteria remained customer focused, however, this area reported a significant change in its makeup. The importance of the criteria (4) if the function has been promised or sold fell six places in the ranking of criteria going from the most important to the least important customer/market criterion. The order of the customer/market criteria was otherwise unchanged, with (1) the status of competitors with respect to the requirement and (3) the market's priority of the requirement being the most significant in first and second place of all criteria respectively.

The management issue seen as most undervalued at the time the questionnaire was conducted was (9) the impact the requirement has on delivery date. This criterion rose four places when the criteria were ranked how the participants would like to see them applied.

The participants from Company A optimally saw a tighter distribution of the development criteria. In describing the current situation the criteria were distributed over 4.7 percentage points, compared with an optimal distribution over 1.4 percentage points.

### 4.4.2.3 Combined Results for Company B: Product B1 and Product B2

#### 4.4.2.3.1 Additional Criteria

The additional criteria identified for Product B1 and Product B2 were all different. The researcher did not note any overlap or repeated additional criteria.

#### 4.4.2.3.2 Relevant Criteria

All of the participants identified all of the criteria representing clients and the market as relevant. The only other criteria recognised as relevant by all of the stakeholders were the (9) impact the requirement has on delivery date, and (11) complexity of the requirement.

The criteria identified as least relevant by three of the twelve participants were (5) a requirement's volatility, (6) the ability to provide technical support, education and training for the requirement, and (13) the impact of a requirement on the future evolution of the system. Two of the participants did not see (8) the available resources and their competencies as relevant.

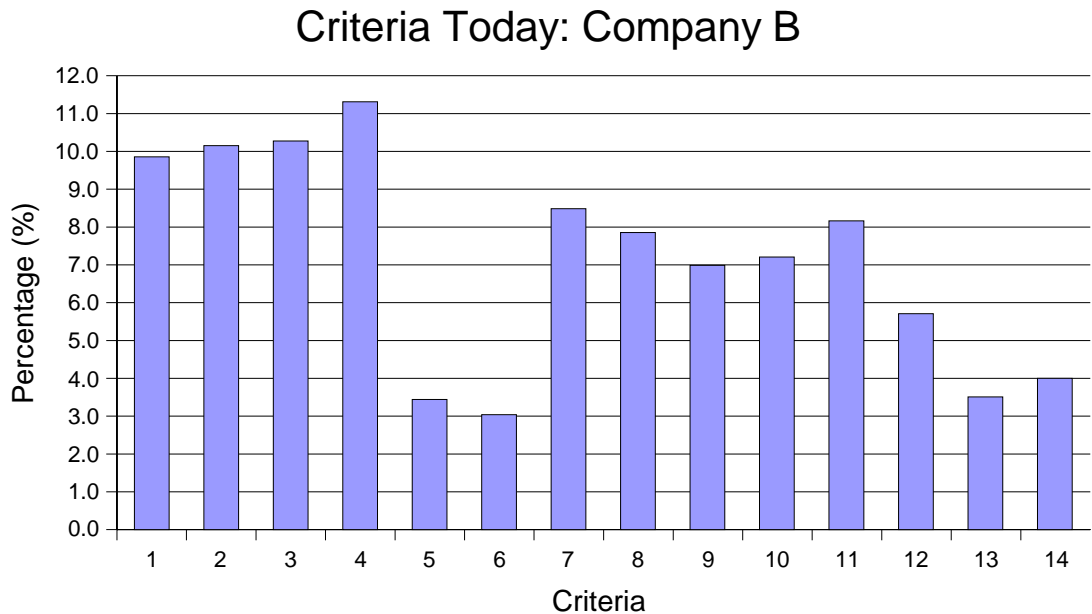
#### 4.4.2.3.3 Importance of Criteria Today

The combined results for Company B clearly indicate that some criteria are more important than others in the selection and prioritisation of requirements for a release. It is worth noting that three of the criteria have percentage values above 10% and four have values below 5%. The order and relative importance of the different criteria can be seen in Table 4.7 and graphically in Figure 4.7.

**Table 4.7 Relative importance of different criteria for Company B today**

	<b>Criteria</b>	<b>%</b>
4.	Function is Promised/Sold	11.3
3.	Stakeholder Priority of Requirement	10.3
2.	Requirement's Issuer	10.2
1.	Competitors	9.9
7.	Development Cost-Benefit	8.5
11.	Complexity	8.2

8.	Resources/Competencies	7.9
10.	System Impact	7.2
9.	Delivery Date/Calendar Time	7.0
12.	Requirements Dependencies	5.7
14.	Maintenance	4.0
13.	Evolution	3.5
5.	Volatility	3.4
6.	Support/Education/Training	3.0



**Figure 4.7 Relative importance of different criteria for Company B today**

Just as with Product B1 and Product B2 the combined results show a strong customer focus with all four of the client/market focused criteria filling the first four places when all the criteria are ranked. Although close, (4) if the function has been promised or sold, leads the decision-making criteria in importance when planning a release of software.

The results are clearly split into two groups when looking at management issues. Three of the criteria are rated with 7.0% or higher, in order these are (7) the development cost-benefit of the requirement, (8) the available resources and their competencies, and (9) the impact the requirement has on delivery date. Two management criteria were seen of little importance for both Product B1 and B2, these were (5) a requirement's volatility,

and (6) the ability to provide technical support, education and training for the requirement.

Two development/maintenance criteria were seen as important for both products; these were (10) the impact on the system, and (11) the complexity of the requirement. The two criteria seen as least important were the impact of a requirement on (13) the future evolution of the system and (14) maintenance of the system. The other criterion, (12) impact of requirement dependencies, was important for Product B1, but not Product B2.

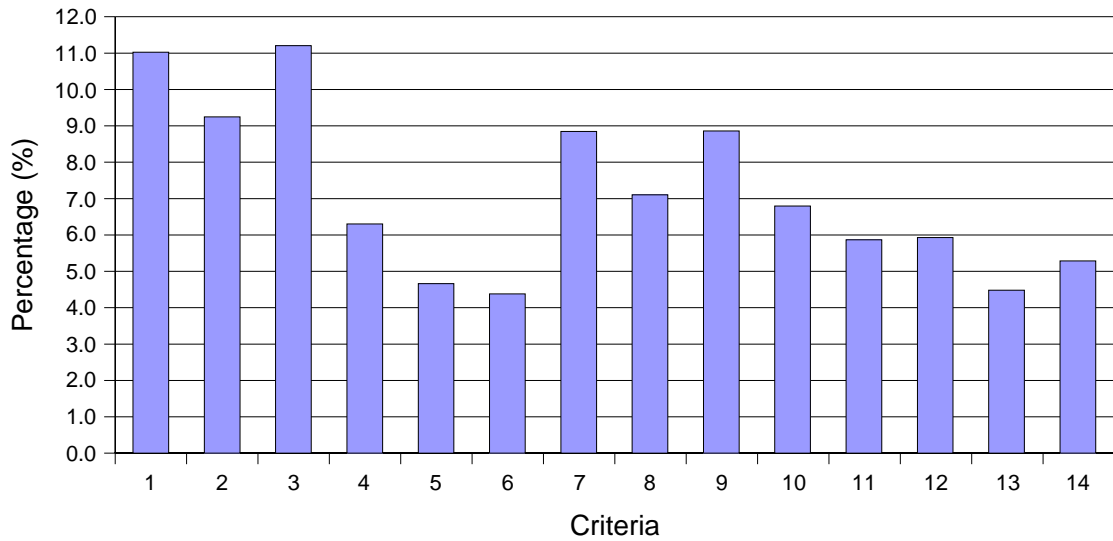
#### 4.4.2.3.4 Importance of the Criteria in the Future

The results for how the value criteria should be optimally applied in requirements selection and prioritisation for Product B1 and Product B2 indicate that some change would be perceived beneficial. The results can be seen in Table 4.8 and graphically in Figure 4.8.

**Table 4.8 Optimal relative importance of decision making criteria for Company B**

<b>Criteria</b>		<b>%</b>	<b>Movement</b>
3	Stakeholder Priority of Requirement	11.2	+ 1
1	Competitors	11.0	+ 2
2	Requirement's Issuer	9.2	-
9	Delivery Date/Calendar Time	8.9	+ 5
7	Development Cost-Benefit	8.8	-
8	Resources/Competencies	7.1	+ 1
10	System Impact	6.8	+ 1
4	Function is Promised/Sold	6.3	- 7
12	Requirements Dependencies	5.9	+ 1
11	Complexity	5.9	- 4
14	Maintenance	5.3	-
5	Volatility	4.7	+ 1
13	Evolution	4.5	- 1
6	Support/Education/Training	4.4	-

## Optimal Criteria: Company B



**Figure 4.8 Optimal relative importance of different criteria for Company B**

The optimal application of the criteria remained customer focused, however, this area reported a significant change in its makeup. The importance of the criteria (4) if the function has been promised or sold fell seven places in the ranking of criteria going from the most important to the least important customer/market criterion. The first three criteria are related to the customer/market with (3) the market's priority of the requirement becoming the most important criteria when selecting and prioritising requirements. The (1) status of competitors with respect to the requirement overtook (2) the stakeholder responsible for issuing the requirement in importance.

Each management issue was seen of similar importance for an optimal application of the criteria in release planning, except that (8) the available resources and their competencies was seen as a bigger issue facing Product B2 in the future. Of high importance to both products were (7) the development cost-benefit of the requirement and (9) the impact the requirement has on delivery date; while (5) a requirement's volatility and (6) the ability to provide technical support, education and training for the requirement were considered less important issues.

The most significant change in the criteria representing the developers and maintainers was a increase in the importance of (14) the impact of a requirement on system maintenance of the system, rising four places. The participants would also like to see a

reduction in the importance of (10) the impact of a requirement on the system, with this criterion losing four places when ranked.

#### **4.4.2.4 Combined Results for All Products**

##### **4.4.2.4.1 Additional Criteria**

As no additional criteria were identified for Product A. The additional criteria identified for Product B1 and Product B2 were all different. The researcher did not note any overlap or repeated additional criteria.

##### **4.4.2.4.2 Relevant Criteria**

The combined results for relevant criteria reflected the results for all products; Product A, Product B1 and Product B2.

The criteria relating to clients and markets were seen as most relevant with each being marked relevant by all or all but one participant in the study.

The two criteria seen as least relevant with were (5) a requirement's volatility, and (6) the ability to provide technical support, education and training for the requirement, with six participants marking them as not relevant. Five participants felt that (13) the impact of a requirement on the future evolution of the system was not relevant.

The remaining criteria were seen relevant by:

- 20 participant: (9) the impact the requirement has on delivery date, (11) the complexity of the requirement, and (14) the impact of a requirement on system maintenance of the system;
- 19 participants: (7) the development cost-benefit of the requirement, (10) the impact on the system, and (12) any requirement dependencies.
- 18 participants: (8) the available resources and their competencies

##### **4.4.2.4.3 Importance of Criteria Today**

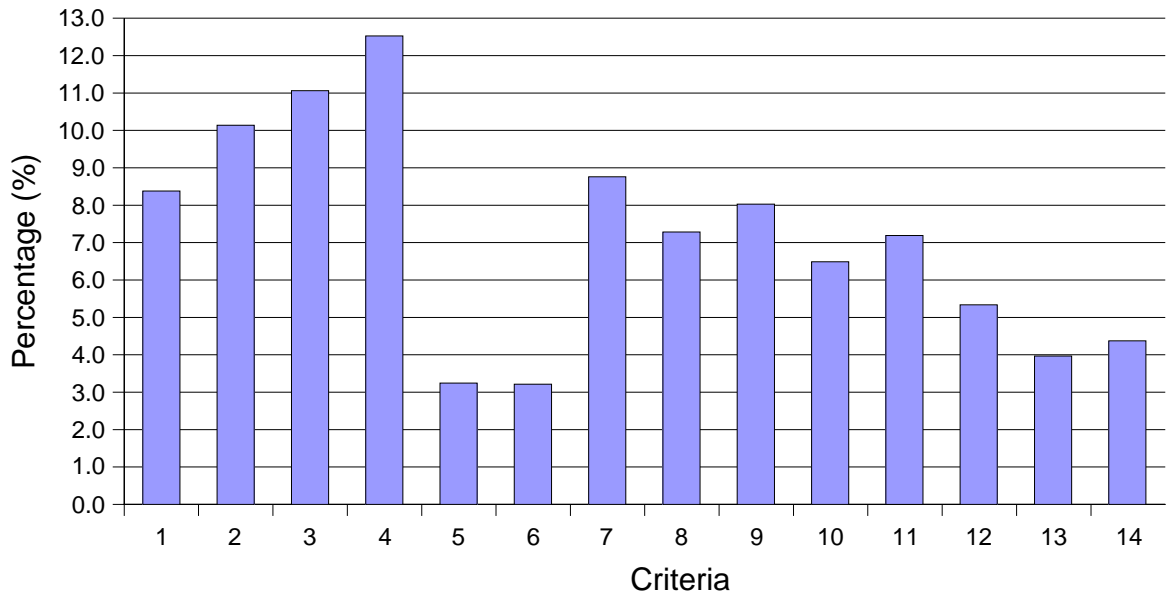
The combined results for all products clearly indicate that some criteria are more important than others in the selection and prioritisation of requirements for a release. It

is worth noting that three of the criteria have percentage values above 10% and four have values below 5%. The order and relative importance of the different criteria can be seen in Table 4.9 and graphically in Figure 4.9.

**Table 4.9 Relative importance of different criteria for Company A and Company B today**

<b>Criteria</b>		<b>%</b>
4.	Function is Promised/Sold	12.5
3.	Stakeholder Priority of Requirement	11.1
2.	Requirement's Issuer	10.1
7.	Development Cost-Benefit	8.8
1.	Competitors	8.4
9.	Delivery Date/Calendar Time	8.0
8.	Resources/Competencies	7.3
11.	Complexity	7.2
10.	System Impact	6.5
12.	Requirements Dependencies	5.3
14.	Maintenance	4.4
13.	Evolution	4.0
5.	Volatility	3.2
6.	Support/Education/Training	3.2

## Criteria Today: All Products



**Figure 4.9 Relative importance of different criteria for Company A and Company B today**

Across all products there is a strong customer focus. The combined results for all products show all four of the customer/market related criteria presented in the first five places when all criteria are ranked. The most important criterion representing the customer/market perspective is (4) whether the function has been promised or sold; while the least important issue is (1) the status of competitors with respect to the requirement.

Three of the management criteria are of relatively high value, while two are consistently considered unimportant. The management criteria that are seen as most relevant in release planning are, in order, (7) the development cost-benefit of the requirement, (9) the impact the requirement has on delivery date, and (8) the available resources and their competencies. For all products (5) a requirement's volatility, and (6) the ability to provide technical support, education and training for the requirement are of relatively small importance.

### **4.4.2.4.4 Importance of the Criteria in the Future**

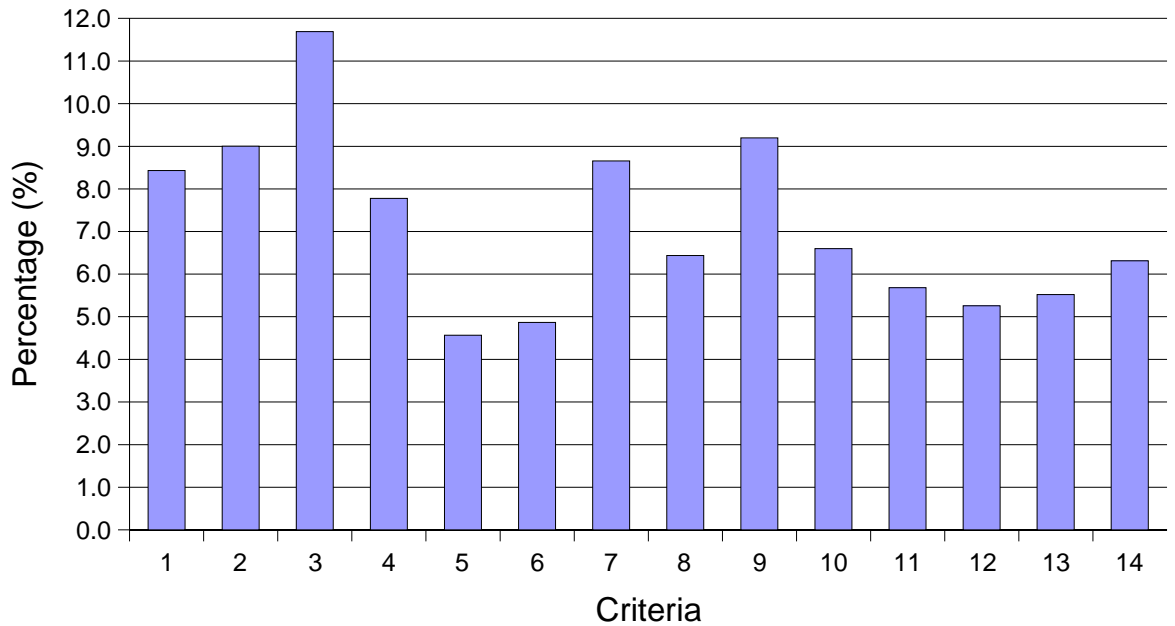
The results for how the value criteria should be optimally applied in requirements selection and prioritisation for all products indicate that some change would be

perceived beneficial. The results can be seen in Table 4.10 and graphically in Figure 4.10.

**Table 4.10 Optimal relative importance of decision making criteria for Company A and Company B**

	<b>Criteria</b>	<b>%</b>	<b>Movement</b>
3	Stakeholder Priority of Requirement	11.7	+1
9	Delivery Date/Calendar Time	9.2	+ 4
2	Requirement's Issuer	9.0	-
7	Development Cost-Benefit	8.7	-
1	Competitors	8.4	-
4	Function is Promised/Sold	7.8	- 5
10	System Impact	6.6	+ 2
8	Resources/Competencies	6.4	- 1
14	Maintenance	6.3	+ 2
11	Complexity	5.7	- 2
13	Evolution	5.5	+1
12	Requirements Dependencies	5.3	- 2
6	Support/Education/Training	4.9	+ 1
5	Volatility	4.6	- 1

## Optimal Criteria: All Products



**Figure 4.10 Optimal relative importance of different criteria for Company A and Company B**

The participants optimally saw a tighter distribution of the criteria. In describing the situation today the criteria were distributed over 9.3 percentage points, compared with an optimal distribution over 7.1 percentage points.

The optimal application of the criteria remained customer focused with the four criteria representing a client/market perspective appearing in the first six places of the ranked criteria. The most significant change in this set of criteria was the fourth criteria (4) if the function has been promised or sold, dropping five places in the ranking, going from the most important customer/market criteria to the least.

However, some management issues became as important as client/market issues with (9) the impact the requirement has on delivery date, and (7) the development cost-benefit of the requirement appearing at places two and four respectively. The ninth criteria rose four places in ranking. The two least important criteria in release planning for all product individually and combined are (5) a requirement's volatility, and (6) the ability to provide technical support, education and training for the requirement.

The importance of criteria relating to development and maintenance vary for Product A, Product B1 and Product B2 with no pattern discernable by the researcher. It should be noted that all of the development criteria are tightly packed over 1.3 percentage points.

## 4.5 Research Objective 4

This study seeks to understand the degree to which the major perspectives are represented by the value system used in the release planning decision-making process. The fourteen criteria in the questionnaire were divided into three groups; the software development company management, development and maintenance personnel, and the external market or customers. It is also of interest to see how the situation differs between the situation today and how the participants believe that it ought to be in the future. Consequently the fourth research question is:

**Research Question 4:** To what degree to the do the perspectives of the major stakeholders influence the requirements selection and prioritisation process? How does this differ to industries perception of the optimal application of the criteria?

### 4.5.1 Results for Company A

#### 4.5.1.1 Results for Product A

The results for Product A when grouped by stakeholder group clearly indicate that some stakeholder groups are more important than others in the selection and prioritisation of requirements for a release. The results for how the value criteria should be optimally applied in requirements selection and prioritisation for all products indicate that some change would be perceived beneficial. The results can be seen in Table 4.11.

**Table 4.11 Relative influence of stakeholders on Product A requirements selection**

	<b>Today (%)</b>	<b>Optimal (%)</b>
<b>External Market/ Customer</b>	46	40
<b>Company Management</b>	28	29
<b>Development/Maintenance</b>	26	31

Company A has a strong customer/market focus for Product A with this group being the major influence in release planning for the product. The management perspective is second most important in selecting and prioritising requirements, while development and maintenance issues are least important.

While the participants in the study felt that optimally the ranking of these groups would remain the same, it was felt that the opinions of the groups should be valued more equally. Where the perspectives today are distributed over 20 percentage points (today: difference between 26 and 46), the participants felt optimally this distribution would be over 11 percentage points (optimal: difference between 40 and 29).

## 4.5.2 Results for Company B

### 4.5.2.1 Results for Product B1

The results for Product B1 when grouped by stakeholder group clearly indicate that some stakeholder groups are more important than others in the selection and prioritisation of requirements for a release. The results for how the value criteria should be optimally applied in requirements selection and prioritisation for all products indicate that some change would be perceived beneficial.

As three additional criteria that influence release planning were identified for Product B1, these have been applied to stakeholder groups decided by the researcher. Both the *preferred operating architecture* and *adherence to corporate software design parameters* were assigned to the management perspective. The *creation of competitive advantage* was applied to the external market/customer perspective. The results, both including and not including the additional criteria, can be seen in Table 4.12.

**Table 4.12 Relative influence of stakeholders on Product B1 requirements selection**

	14 Criteria		Including Additional	
	Today (%)	Optimal (%)	Today (%)	Optimal (%)
<b>External Market/ Customer</b>	43	41	45	42
<b>Company Management</b>	23	26	23	27
<b>Development/Maintenance</b>	34	33	32	31

Product B1 has a strong customer/market focus with this group being the major influence in release planning for the product. The development perspective is second most important in selecting and prioritising requirements, while management issues are least important.

While the participants in the study felt that optimally the ranking of these groups would remain the same, it was felt that the opinions of the groups should be valued more

equally. Where the perspectives today are distributed over 22 percentage points (today: difference between 45 and 23), the participants felt optimally this distribution would be over 15 percentage points (optimal: difference between 42 and 27).

#### 4.5.2.2 Results for Product B2

The results for Product B2 when grouped by stakeholder group clearly indicate that some stakeholder groups are more important than others in the selection and prioritisation of requirements for a release. The results for how the value criteria should be optimally applied in requirements selection and prioritisation for all products indicate that some change would be perceived beneficial.

As two additional criteria that influence release planning were identified for Product B2, these have been applied to stakeholder groups decided by the researcher. Both *making a resellable [sic] solution* and *future financial worth/new business applications* were assigned to the management perspective. The results, both including and not including the additional criteria, can be seen in Table 4.13.

**Table 4.13 Relative influence of stakeholders on Product B2 requirements selection**

	14 Criteria		Including Additional	
	Today (%)	Optimal (%)	Today (%)	Optimal (%)
<b>External Market/ Customer</b>	47	42	46	40
<b>Company Management</b>	31	36	33	37
<b>Development/Maintenance</b>	22	23	21	22

Product B2 has a strong customer/market focus with this group being the major influence in release planning for the product. The management perspective is second most important in selecting and prioritising requirements, while development and maintenance issues are least important.

The participants in the study saw the release planning being conducted more effectively with a small decrease in the influence of the external market/customer and an increase in the influence of the company management.

#### 4.5.2.3 Combined Results for Company B

The results for Company B when grouped by stakeholder group clearly indicate that some stakeholder groups are more important than others in the selection and prioritisation of requirements for a release. The results for how the value criteria should be optimally applied in requirements selection and prioritisation for all products indicate that some change would be perceived beneficial.

Any additional criteria were applied as for they were for the originating product. The results, both including and not including the additional criteria, can be seen in Table 4.14.

**Table 4.14 Relative influence of stakeholders at Company B on requirements selection**

	14 Criteria		Including Additional	
	Today (%)	Optimal (%)	Today (%)	Optimal (%)
<b>External Market/ Customer</b>	45	42	45	42
<b>Company Management</b>	36	29	27	31
<b>Development/Maintenance</b>	29	28	27	27

Company B has a strong customer/market focus with this group being the major influence in release planning for the product. The development perspective is second most important in selecting and prioritising requirements, while management issues are least important.

The participants in the study saw the release planning being conducted more effectively with a small decrease in the influence of the external market/customer and an increase in the influence of the company management.

#### 4.5.2.4 Combined Results for All Product

The results for all products when grouped by stakeholder group clearly indicate that some stakeholder groups are more important than others in the selection and prioritisation of requirements for a release. The results for how the value criteria should be optimally applied in requirements selection and prioritisation for all products indicate that some change would be perceived beneficial.

Any additional criteria were applied as for they were for the originating product. The results, both including and not including the additional criteria, can be seen in Table 4.14.

**Table 4.15 Relative influence of stakeholders for Company A and Company B on requirements selection**

	14 Criteria		Including Additional	
	Today (%)	Optimal (%)	Today (%)	Optimal (%)
<b>External Market/ Customer</b>	44	41	45	41
<b>Company Management</b>	30	29	27	30
<b>Development/Maintenance</b>	26	29	27	29

Company A and Company B has a strong customer/market focus with this group being the major influence in release planning for the product. The management perspective is second most important in selecting and prioritising requirements, while development and maintenance issues are least important.

The participants at both companies in the study saw the release planning being conducted more effectively with a decrease in the influence of the external market/customer. When the results were combined an increase in the influence of both the company management and development and maintenance perspective was perceived as beneficial.

## **4.6 Validity Threats**

This research has low external validity, as it only looks at three software products from two companies. This is not a representative sample of the software development industry, and the results must be interpreted with caution when moving away from the characteristics of the products studied.

Two of the participants were involved in both the interview and questionnaire for both Product B1 and Product B2 affecting the internal validity of the results. Each of the products has the same Product Manager and Development Manager. It is possible that these participants applied the same values to product development in general. However, comparing the responses the Product Manager’s responses for the two products showed that more than half of the points were awarded differently both for the criteria today and

the optimal application of the criteria, 54% and 59% respectively. The differences for the Development Manager were not as high with 27% and 30% of the points being awarded differently respectively.

The small number of people involved in the decision making process for the inclusion of a requirement in a software system limited the number of possible responses for each product.

Another potential threat to internal validity is related to the questionnaire. It is always difficult to know whether the respondents have understood the questions as intended and in a similar fashion to one another. This threat was partially address by the third stage of this study where the results were presented to the product manager for confirmation and discussion with the researcher.

It is easier for the participants to agree with the set of criteria identified by the researchers than disagree. This is partially taken care of by allowing the participants to assign a relative importance of zero or propose new criteria where they see fit. This threatens the ability to draw conclusions about the set of values that influence the selection and prioritisation of requirements. Future work should include improving the set of criteria based on the feedback from this and similar studies.

These threats highlight the need to replicate this study.

## ***4.7 Chapter Summary***

This chapter presented the results and a discussion of the research objectives of this study. The first research objective was to understand IT professionals perception of value-based requirements engineering. Creating software product value through the selection of requirements is an intrinsic process that is not very well understood. The second research objective was to understand the requirements engineering and release planning processes used in industry. The results highlighted the importance of building to clients actual requirements and using the clients knowledge in this process. The third research objective was to identify the relative importance of different values on the selection and prioritisation of requirements. The results for this section showed that some criteria are more important that others in selecting a requirement for a release, however, the importance of meeting client needs was always key. The forth research

objective was to evaluate the influence of different groups on the selection of requirements for a release. The results for this section again highlighted the strong influence of the external market and clients in creating software product value. Finally threats to the validity of the research were discussed.

## **5 Discussion of Results**

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### ***5.1 Introduction***

This chapter presents a discussion of important issues relevant to this research study. The chapter is broken up into a discussion of the results for each of the research objectives; perceptions of value-based requirements engineering (Section 5.2), how industry creates software product value through release planning (Section 5.3), the value system applied to selecting requirements for a release (Section 5.4) and the influence of the major perspectives in requirement selection for a release (Section 5.5).

### ***5.2 Research Objective 1***

#### **5.2.1 Perceptions of Value-Based Requirements Engineering**

There was no silver bullet for creating software product value through RE identified by the interview participants. While between them they raised the perspectives of each of the major stakeholder groups, it appeared that the value propositions that influence their decision making process are more intrinsic than part of an explicitly planned process.

#### **5.2.2 Discussion of Results for Product A**

None of the interviewees for Product A were able to describe how software product value should be created through requirements engineering. However, during the interview each described processes and approaches for creating product value for Product A. Actions such as product release planning rather than implementation project release planning, working directly with clients to meet their requirements and prioritising requirements based on the importance of the requester were some of the methods identified to manage the software product's value through requirements engineering. This highlights the intrinsic nature of value-based software engineering as a knowledge area.

#### **5.2.3 Discussion of Results for Product B1**

The interview participants for Product B1 identified the importance of aligning the objectives of release planning to both those of the client and the development company

within a certain set of constraints in order to create software product value. However, the participants did not identify any approaches that could be used to reconcile these perspectives. This further highlights the intrinsic nature of value-based software engineering as a knowledge area.

#### **5.2.4 Discussion of Results for Product B2**

One participant for Product B2 identified value-based requirements engineering as how the development money should be invested, but was unable to describe how this should be done in order to create software product value. The other felt that key to creating software product value for Product B2 was to align the product to meet the needs of the client, rather than the client changing their processes to meet the needs of the product. But neither described a process that would guarantee software product value to all stakeholders. Again these approaches do not detail how different value propositions can be reconciled.

### **5.3 Research Objective 2**

#### **5.3.1 Release Planning in Industry**

Company A and Company B in the past developed products for the market without the support of a specific client. This approach was unsuccessful for both clients with the products not meeting the needs of the market and not selling.

In order to create software product value Company A and Company B have shifted the focus from fulfilling the perceived value propositions of the market to the much safer known value propositions of clients in a relationship with the company. This “real” client base is a more a more secure source of revenue for the software development company there is a relationship between the two organizations and the software development company is creating software to meet the actual needs of the client.

Both companies moved to a development strategy that requires a client to request a product or feature before it will be developed. This approach created a situation where new features were only made available in customer specific implementations. This approach created two main problems; new features developed for a customer-specific implementation could not be made available to other clients easily, and when changes

were made to the core product many customer-specific implementations need to be released involving a large human effort.

Company A and Company B both created positions for product managers. While the role of the Product Manager for Product A is yet to be clearly defined, the Product Manager for Product B1& B2 saw his primary role as facilitating the rolling up of customer specific functionality into the core product so that it could be released to the market. An interview participant for Product A expressed a hope that the product manager for Product A would do likewise. A role of the product manager at both companies is to monitor similar products so that the company can react more competitively in bids and marketing material without the need to have functionality implemented. Both companies felt that with a better understanding of the market place sales bids would be more successful.

Even after creating a role for a product manager both companies expressed a need to remain implementation driven – only implementing requirements when requested by a client. As one interviewee from Company A expressed:

*We build it to their requirements because we believe they know their business better than we do.*

The elicitation of new requirements for a client for all products involves the client and a project manager and/or business analyst from Company A or Company B. Where the requirements are technically complex key developers, and in the case of Company B the Product Manager, will also get involved to ensure a common understand is reached between all of the stakeholders in the requirements.

It should be noted that whenever new functionality is to be implemented for Product A, Product B1 or Product B2 the client requesting the functionality is used to validate that it is correctly understood and when implemented that it functions work as required. This ensures that the functionality is meeting the real market need, and not what Company A or Company B perceives as the markets' need.

When a software product has a small client base it is easier to keep the product in line with individual clients' requirements. The client base of Product A and Product B2 are both measured in the tens, while the client base of Product B1 is a few hundred. It is

much more feasible to create client specific versions of Product A and Product B2 with the intention to roll this functionality back into the core product at a later date as the number of customer specific version so the software can be kept relatively low. This is reflected through the approaches to product development for the three products; requirements engineering for Product A and Product B2 follows an implementation project lifecycle, whereas Product B2 follow a product release plan except where a client has specific needs that must be met in the short term.

Developing a software product to individual clients' requirements is beneficial in the early stages as it facilitates the products growth in line with the needs of the client base and the general market. All features that are developed are requirements of the clients, and nothing is developed that is not a requirement of a client. This practice minimises the time to market with a fully featured product, bringing forward revenue generation. The product manager of Product Manager for Product B1 and B2 noted:

*It gives us more credibility if we release the product soon; it gives it more functionality, better saleable product.*

However, when a company only develops functionality requested, they risk losing competitive advantage where other marketing offerings contain features that have not been requested, but are sufficient to win a contract.

## **5.4 Research Objective 3**

### **5.4.1 Discussion of Results for Product A**

When the results were presented to selected interviewees for comment during the third stage of the research, the development team lead reinforced his opinion that Company A is a "customer centred organization." The three most influential criteria in the release planning process relating to the requirements of specific clients of Company A. The remaining two criteria that represent the external client and market perspective were different to these three in that one represented (1) the needs of the general market and the other represented (5) the volatility of a requirement for a specific client.

The most influential criterion at the time of the study was (4) a function is promised or sold because the organization is contractually obligated to provide this functionality.

Failure to provide functionality promised or sold will result in short term penalties and potentially impact the company's credibility.

The relative lower importance of (1) the status of competitors with respect to the requirement is a function of the drivers of new functionality. Functionality in this category drives how the clients of Company A compete with other operators in their market. Company A does not want to anticipate where their clients wish to achieve competitive advantage, allowing the competitor to request the features that they desire to compete in their market. Functionality that is (1) developed to compete with other market offerings will be driven by, (2) a stakeholder issuing this functionality as a requirement, (3) a clients priority of having this functionality, or (4) the function being promised or sold.

The (5) volatility of a requirement is of little influence as when requirements get to the development they are usually quite stable. Changes to a requirements and handled contractually. If there are changes to requirements they will be negotiated with changes to the delivery date as necessary.

However, there is currently a focus on maximising short-term revenue at the expense of longer-term benefits. The low influence of (6) support, education and training in deciding whether to include a requirement in a release today is because it is "perceived as an extra cost" according to the development team lead, noting "it would take pressure of development if it would be more important."

The development and maintenance issues were undervalued for Product A with Company A focusing on short term objectives. Both the importance of (14) maintainability and (13) system evolution were considered much more important when the criteria were applied optimally. Short term aims to please individual clients and maximise revenue by minimising development effort allow these issues to be pushed back. The development team lead noted that Company A "ends up suffering in the long run" by taking this approach.

The reduction in relative importance of (1) the status of competitors with respect to a requirement may be related the newly created position of Product Manager for Product A. One of the Product Manager's roles is to keep abreast of the market; currently other people in the organization fulfil this role. Once the Product Manager takes on this role

these people will be less concerned with representing this perspective, placing a lower importance on it in the future.

#### **5.4.2 Discussion of Results for Product B1 and Product B2**

The maturity of the product has a big influence on the importance of the criteria applied in release planning. Product A1 has been evolving over the past 10 years, whereas Product A2 is much newer at two years.

In the external market/client space Product A1 is established, however, Product A2 was still trying to gain credibility within the market place. This can be seen through the most important criteria representing this stakeholder group, for Product A1 these are (3) the stakeholders priority of the requirement and (2) the party responsible for issuing the requirement, while for Product A2 these are (4) whether the function has been promised or sold and (1) the status of competitors with respect to the requirement.

Similarly, (8) the resources and competencies of development personnel were more important for Product A2 than Product A1. As Product A1 is more mature, expertise exists within the company to support this product. However, Product A2 is taking the company through “unknown waters”.

Development cost-benefit (7) is also a bigger issue for Product A2 as a lot of money has been spent in its early development and management is more cautious about seeing revenue, where Product A1 has become highly profitable for Company A.

Looking at the optimal application of criteria, the Product Manager felt that the development cost-benefit (7) for Product A1 was perceived as undervalued was due to the time and resources being put into other projects. There is a perception within the organization that the highly profitable Product A1 will lose competitive advantage while resources are focused elsewhere. However, he also conceded that currently there is a greater desire to build functionality with less concern over the revenue it will generate.

The increase in the importance of (9) the impact a criterion has on the delivery date for both Product A1 and Product A2 was explained as it helps to create a positive market perception when the company is first to bring new functionality to the market place.

The massive decrease in the importance of (4) the functionality being promised or sold was explained as Company A would like to start taking a more structured approach to bring new functionality out into the market place. Rather than developing client specific versions of the software, the company would like to see more controlled release planning, which implements functionality and releases it to the general market.

## **5.5 Research Objective 4**

### **5.5.1 Stakeholder Influence in Requirements Selection**

The results for the fourth research question only further highlighted the results of the other research questions – the clients are the most critical group in creating software product value. Clients are and should be the key driving force behind creating software product value.

However, while clients are and should remain the key stakeholder in creating software product value, for each product their influence is perceived as being too dominant. The perspective of client is stifling management, development and maintenance issues that in turn have a negative affect on the value of the software products. This is most evident the results for Product A, where the four most influential external client/market criteria were all perceived as being relatively too influential, while two of the development/maintenance issues were optimally perceived as being ranked five places higher.

### **5.5.2 Discussion of Results for Company A**

#### **5.5.2.1 Discussion of Results for Product A**

At the time of this study short-term objectives of meeting client requirements to create market credibility and maximise revenue were key in selection of requirements for a release of Product A. However, the strong client focus existed at the detriment to the long-term system evolution and maintenance issues. Remaining client focused is an important way to create product value, but a balance needs to be achieved where both the client and developers needs can issues can be best met in the longer-term.

Issues that are more influential in the longer term such as (14) system maintenance, (13) system evolution and even the management issue of (6) support, education and training

can all be deferred in preference to creating client specific functionality, bringing forward the delivery date and not sufficiently considering the long-term consequences of design decisions. The developers and maintainers were not given the time or resources to work on these issues to a level perceived as adequate as these issues are “perceived as an extra cost,” as expressed by the development team lead. For example the decision to create customer specific versions of Product A has created problems when releasing bug fixes where rather than releasing a single product update, numerous customer specific version of the software need to be re-released.

### **5.5.3 Discussion of Results for Company B**

The Product Manager for both Product B1 and Product B2 regarded the influence of the client/market stakeholder group correct and appropriate both as they are applied today and would be applied optimally.

#### **5.5.3.1 Discussion of Results for Product B1**

While Product development is perceived best focused towards the needs of the external client and market, the features of Product B1 need to be more effectively managed to maximise the software product’s value. Development and technical personnel managed product B1 until recently when a position was created for a Product Manager. Prior to creating a role of Product Manager development was very customer focused with a lot of functionality built for individual client implementations of Product B1, but this functionality was not rolled back into the core product. The main role of the Product Manager is to facilitate the rolling of client specific functionality back into the core product in the most effective manner, this process had recently started at the time of the interviews.

#### **5.5.3.2 Discussion of Results for Product B2**

Development and maintenance issues are less influential in the selection and prioritisation of requirements for Product B2 as more standard tools are used in its development and the product is more modular in its design compared to Product A and Product B1. The Product Manager identified the use of more common development tools as making it easier to find resources to develop for this product. The methods for using these tools are better understood, making the management of development and

maintenance issues more intrinsic than explicitly planned. The more modular design allows individual components to be updated and changed without impacting the whole system, making development and maintenance issues relatively less important.

## **5.6 Chapter Summary**

This chapter presents issues of significance to this research study. The major contribution of this study to value-based requirements engineering were also communicated.

## **6 Conclusion**

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### ***6.1 Introduction***

This research aimed to discover how value-based requirements engineering (VBRE) is perceived and practiced in industry. Three case studies were conducted of software products developed using market driven incremental development at two companies. This study has articulated how IT professions perceive the creation of software product value through requirements engineering, and examined the current processes used for requirements engineering for each of the three case studies. Additionally the values that influence the selection and prioritisation of requirements for a release of software were studied as to their relative importance and the influence of each of they key stakeholder groups were analysed.

### ***6.2 Research Objective 1***

The first research objective of this study was to understand how professionals within the IT industry perceived VBRE. To the best of the researcher's knowledge no such study has been conducted in Australia with little literature providing an approach for development of IT intensive solutions that are valuable to all stakeholders. However, the problem of creating software product value through requirements selection is real to industry with companies being forced to change their development practices due to current market forces.

The results of this study show that VBRE is still in a theory building stage and it not yet very well understood. Most participants were unable to describe how software product value was created through requirements engineering with intrinsic knowledge heavily guiding this process in industry today. There are not yet any silver bullets for creating software product value through requirements engineering.

It is well understood that meeting the goals of individual clients is critical to creating software product value. However, these goals need to be reconciled with the goals of the software development company and consider any constraints that may exist within the development environment. What is least clearly explicitly understood by IT

professionals is how these different perspectives are best reconciled to maximise software product value to all stakeholders.

### **6.3 Research Objective 2**

This research objective seeks to qualitatively describe the processes used in industry to manage software product value through release planning. The primary aim of this objective is to ascertain what processes are followed in the requirements engineering and release planning processes that result in decisions being made to implement a certain set of requirements.

The requirements of the market are best understood and represented by clients within the market. Aligning development to these needs ensures that market requirements are met. However, the development company needs to ensure that its needs are also met.

Company A and Company B have both failed in developing product to meet the perceived needs of a given target market in the past. This problem has prompted a development strategy at both companies where functionality is not built unless it is requested by a client. This ensures that the product meets the real needs of the client and development effort has not been spent on implementing unnecessary functionality.

The requirements of individual clients are a close proxy to the requirements of other companies. Companies in an industry face similar problems; building functionality to meet the needs of one company provides greater opportunities to meet the needs of other companies within the same industry. Thus implementing client specific requirements broadens to potential target market for a software product.

The strategy by which new functionality is implemented into a product is a function of a product's maturity and market size. Both Product A and Product B2 follow client implementation development lifecycles, bringing in new functionality for new clients as it is requested. This strategy has a faster time to market for new functionality, making a more feature rich product available sooner. However the support and maintenance issues of this strategy become onerous with a larger client base. Product B1 undergoes a product development lifecycle, rolling functionality for many clients into a single release. A client specific version of Product will only be released for complex functionality specific to an individual clients needs.

There was a process for all three products studied that involved external clients, management and developers/maintainers when implementing new complex functionality to come to an agreement and understanding about what could and would be delivered. For Product A this process is more ad-hoc than for the other two products. A meeting or technical review of complex requirements would only take place when it was considered necessary by the implementation project manager, with the form of this negotiation varying. The preferred method of negotiation for Product B1 and Product B2 was to get the client, product manager and development leads into a face-to-face meeting to that a common understanding could be reached between all stakeholders.

### **6.4 Research Objective 3**

The third research objective is concerned with the value system applied to selecting the optimal subset of requirements for a software project or release of software. Each participant was asked to assess the relative importance of different decision-making criteria when determining whether or not to include a requirement in a specific project or release both as they are applied today and how they should be applied optimally.

This study has shown that some criteria are more important than others in the selection of requirements to include in a specific project or release. While the exact focus changes slightly for each case study, criteria representing the market and specific clients' requirements are the most influential in release planning decision-making, that is meeting the objectives of the external client/market are critical in creating software product value. Developments cost-benefit and the deliver date are more critical for less mature products as costs are recuperated and product credibility is gained.

The participants can perceive benefits in applying the criteria to the selection of requirements for a release slightly differently. Much of this change pertains to taking a more structured approach to release planning and considering longer-term development and maintenance issues rather than catering too heavily towards the client.

### **6.5 Research Objective 4**

The fourth research objective was to understand the degree to which the major perspectives are represented by the value system used in the decision-making process. There are three major stakeholders involved in the development of software; the

software development company management, development and maintenance personnel, and the external market or customers; each with their own agenda. The results for the third research objective were aggregated according to the perspective they represented.

The results for this research question again highlighted that the client and market perspective is more influential and important than the business and technical perspectives in creating software product value. While client perspective is perceived as currently slightly too influential for all products to the detriment of the other two perspectives, there was a need seen to remain strongly client and market focused.

Where standard development tools and techniques are used the development and maintenance perspective is less influential. The use of standard development tools makes it easier to find resources and development approaches are more widely understood.

Optimally the influence of the major stakeholder groups would be considered slightly more equal. The key client/market perspective would become less influential while the management and/or development/maintenance perspective would become more influential. Currently software development is highly client focused at the expense of other issues.

## **6.6 Further Research**

These conclusions have some implications. First, as the creation of software product value through requirements selection is not very well understood it cannot be managed in the most effective way. Greater insight into how value is created through release planning would allow this process to be more effectively managed.

Secondly the management of software product value is dependant on the context in which the product exists. Factors such as: the maturity of the product, the marketplace in which it exists and the development tools and methods influence the criteria that decide whether a requirement is included in a specific project or release. A young product will have a greater need to recoup initial development costs, a more competitive marketplace requires more adaptive development, and standard software tools and techniques speed development and reduce development resource issues. However,

further research is required to determine what aspects of a software product's context influence the decision-making criteria.

These issues pose great challenges when it comes to creating software product value through requirements selection. Meeting business requirements creates software product value, but the software developers deliver the value.

## **6.7 Chapter summary**

The major findings from this research study were summarised in this chapter. In addition possible areas for future research were raised.

# Appendices

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## ***Appendix A: Interview Consent form***

### **Participant information statement and consent form**

Ethics approval: 05602

You are invited to participate in a study on value-based requirements engineering. We hope to learn how organizations select and prioritise requirements for a project or release of software. You were selected as a possible participant in this study because your company identified you as being in a decision-making capacity for what to include and what not to include in specific software projects/releases.

If you decide to participate Sebastian Barney will conduct a one-on-one semi-structured interview about the requirements engineering practices at your organization. This interview will take 20-30 minutes.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential, except if disclosure is required by law. If you give us your permission by signing this document, we plan to publish the results and provide copies to each company participating in the study and the University of New South Wales. In any publication, information will be provided in such a way that neither you nor your company can be identified.

Complaints may be directed to *The Ethics Secretariat* on one of:

The University of New South Wales  
UNSW Sydney 2052  
Australia

Phone: +61 2 9385 4234

Fax: +61 2 9385 6648

Email: [ethics.sec@unsw.edu.au](mailto:ethics.sec@unsw.edu.au)

Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

Your decision whether or not to participate will not prejudice your future relations with The University of New South Wales. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without prejudice.

Your decision to partake, not partake or revoke your consent to partake in this study will not be discussed with your company.

If you have any questions now or at a later stage, please feel free to ask Sebastian Barney on +61 431 967710.

You will be given a copy of this form to keep.

### **Background Information**

Ethics approval: 05602

Market-driven incremental software development is increasingly becoming commonplace. Software that fits into this category usually accounts for all the software on one's home and work computers. Examples of market-driven incremental software development include Windows, Word and Norton Anti-Virus.

It is developed and released to meet the requirements of a particular market, but will continue to evolve with future releases. Hence we see Windows 95, 98 and XP. Each iteration aims to deliver a new set of features or requirements.

Requirements for software are often so many that not all can be included in the next release. This makes it necessary to select a set of requirements to implement for the next release, and postpone the implementation of the other requirements.

Value-based requirements engineering aims to maximise the value of a release of software through the selection and prioritisation of requirements. Value can be thought of as anything that one might consider useful, convenient or essential.

**Participant information statement and consent form**

Ethics approval: 05602

You are making a decision whether or not to participate. Your signature indicates that, having read the Participant Information Statement, and that you have decided to take part in the study.

_____	_____
Signature of participant	Signature of witness
_____	_____
Please print name	Please print name
_____	_____
Signature of investigator	Nature of witness
_____	_____
Please print name	Date

**Revocation of consent**

Ethics approval: 05602

I hereby wish to WITHDRAW my consent to participate in the research proposal described above and understand that such withdrawal WILL NOT jeopardise any treatment or my relationship with The University of New South Wales.

_____	_____
Signature	Date
_____	

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Please print name

The section for Revocation of Consent should be forwarded to Sebastian Barney, International House, UNSW Sydney NSW 2052, Australia.

## ***Appendix B: Interview Questions***

### **Introduction**

I am in my final year of a business information technology degree at the University of New South Wales. This year I am completing my honours thesis on the creation of software product value through the selection and prioritisation of requirements.

Market-driven incremental software development is increasingly becoming commonplace. It is developed and released to meet the requirements of a particular market, but continues to evolve with further releases of the software. Most of the software on your computer at home and work fits into this category, hence we have Windows 95, 98, XP and Word 6, 97, 2000 and XP.

Requirements are often so many that not all can be included in the next release of the software product. This makes it necessary to select a set of requirements to implement for the next release, and postpone the implementation of the other requirements.

Value-based software engineering aims to maximise the value of a release of software through the selection and prioritisation of requirements. Value can be thought of as anything that one might consider useful, convenient or essential.

This interview aims to understand the requirements engineering process of Product A/B/C and your perception of value-based requirements engineering. In the next few weeks I will carry out a questionnaire to determine the relative importance of different value in deciding which requirements to include in a release of software.

Anything you say in this interview will be anonymous when published. I would like to record this interview for the ease of note taking. The recording will be deleted after the interview transcript has been written up. Nobody will hear the recording except me.

Do you have any questions?

I'm going to start by asking you a couple of questions about your company, then I ask you some general questions about Product A/B/C before getting into the requirements engineering process. Finally we will look at your perception of value-based requirements engineering.

1. Company background details:

1.1. How many people are employed at your company?

1.2. And how many of these are in IT?

2. Product background details:

I would now talk about the Product A/B/C. I understand that Company A/B tailors this product for individual clients, but where possible I'd like to focus on the core of that product that goes out to all new customers.

2.1. How many employees are working on the product(s)?

2.2. What are their backgrounds? For example; business analyst, computer scientists, engineer, tech support.

2.3. Can you give me an idea of how big the product is in either man months or lines of code?

3. Requirements engineering process:

3.1. Is requirements engineering explicitly planned?

3.2. How is this defined? (How is it documented? / How much detail?)

3.3. Is it tailored specifically for the project/product?

3.4. How closely is this process followed? Is adherence to the requirements engineering process verified?

3.5. As the product undergoes iterative development, after the first release (1) are changes handled by change management procedures; (2) is there a new

requirements elicitation process at the beginning of each iteration; or (3) do you manage changes to the system by some other procedure? (If 3, Could you please define that for me?)

3.6. Is there a role defined for a requirements engineer? What is their title? For example, they might be called a system analyst.

#### 4. Requirements elicitation process

Now we will discuss how your company elicits requirements for the product that you have chosen.

4.1. Does the project team communicate with the customer through (1) direct contact, (2) indirect contact, marketing represents the anonymous customer, (4) are any other methods used, (if not) is there no communication between the project team and the market?

4.2. Are there any formal methods for eliciting requirements? Who is involved in this process? For example market surveys, business process reengineering, scenarios and/or prototyping.

4.3. In addition to formal requirements elicitation processes, do requirements come from other sources? If so, whom? And how is this information managed? Is there any informal feedback from sales/marketing

4.4. How are changes to the requirements managed?

4.5. Are any documents or software packages used to store and/or manage requirements that have been identified? Which software packages? Who uses them?

#### 5. Requirements interpretation, structuring, verification and validation

Can you tell me how the elicited requirements are interpreted and structured? So:

5.1. Who is responsible for interpreting the requirements that have been identified?

5.2. What processes are used? For example use cases, modelling techniques or document templates.

- 5.3. What documents are produced as part of this process?
- 5.4. What software supports this process?
- 5.5. Can you tell me how the requirements are now verified and validated? For example, Inspection, prototyping or simulation.

## 6. Requirement prioritisation and selection

Software is increasingly being released incrementally – for example, Microsoft Windows has had a number of major releases, such as 95, 98 and XP. Each release implements a set of requirements. I'd now like to discuss how requirements are selected for inclusion in a release at your company.

- 6.1. Who is responsible for prioritising requirements and who is responsible for selecting which requirements go into a release of software or project?
- 6.2. Are any processes used to help prioritise and select requirements for a release? For example, negotiation, workshops or prioritisation.
- 6.3. Which methodologies are formally used to select and prioritise requirements? For example cost-benefit analysis. How rigorously are these used?
- 6.4. Are any software tools used to help prioritise and select requirements for a release?
- 6.5. Which methodologies are informally used to select and prioritise requirements, if any?
- 6.6. Can you identify the major stakeholder groups and prioritise them according to the impact they have on the requirements included in a specific release of software?
- 6.7. How far ahead do you plan software releases?
- 6.8. What are the biggest constraints you face in selecting and prioritising requirements? For example time, resources or budget.
- 6.9. What other issues do you consider?

## 7. Value-Based Software Engineering

Value-based software engineering in a new area of study. It looks at computer science theory; managerial aspects of software engineering; and personal, cultural and economic considerations involved in developing and evaluation software systems.

7.1. Have you heard the term value-based software engineering before?

7.2. From what you know and what we have discussed what does it mean to you?

## 8. Personal background details

And finally, if I could just get some personal information about you:

8.1. (What company do you work for? – This question was answered by the researcher.)

8.2. What is your position in the company?

8.3. How many years of work experience do you have?

8.4. How many years have you been at the company?

8.5. And how long has that been in your current role?

## ***Appendix C: Questionnaire***

### **Participant information statement and consent form**

Ethics approval: 05602

You are invited to participate in a study on value-based requirements engineering. We hope to learn how organizations select and prioritise requirements for a project or release of software. You were selected as a possible participant in this study because your company identified you as being in a decision-making capacity for what to include and what not to include in specific software projects/releases.

If you decide to participate you will be requested to complete this questionnaire about the requirements engineering practices at your organization. This questionnaire should take approximately 20 minutes to complete.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential, except if disclosure is required by law. If you give us your permission by returning the questionnaire, we plan to publish the results and provide copies to each company participating in the study and the University of New South Wales. In any publication, information will be provided in such a way that neither you nor your company can be identified.

Should you wish to revoke your consent after completing and returning the questionnaire complete and send the *revocation of consent* form in this booklet.

Your decision to partake, not partake or revoke your consent to partake in this study will not be discussed with your company.

Complaints may be directed to *The Ethics Secretariat* on one of:

The University of New South Wales  
UNSW Sydney 2052  
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Phone: +61 2 9385 4234

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Email: [ethics.sec@unsw.edu.au](mailto:ethics.sec@unsw.edu.au)

Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

Your decision whether or not to participate will not prejudice your future relations with The University of New South Wales. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without prejudice.

If you have any questions now or at a later stage, please feel free to contact Sebastian Barney on the details provided below.

Before starting the questionnaire, please become familiar with the criteria identified and described on the following two pages. After completing both sides of the questionnaire please return it to Sebastian Barney at the address below. You may keep this information booklet, which includes the revocation of consent form.

International House  
UNSW Sydney 2052  
Australia

Phone: +61 2 93150619  
Mobile: +61 431 967710  
Email: sebastian.barney@student.unsw.edu.au

## **Information and Instructions**

Ethics approval: 05602

Background Information:

Market-driven incremental software development is increasingly becoming commonplace. Software that fits into this category usually accounts for all the software on one's home and work computers. Examples of market-driven incremental software development include Windows, Word and Norton Anti-Virus.

It is developed and released to meet the requirements of a particular market, but will continue to evolve with future releases. Hence we see Windows 95, 98 and XP. Each iteration aims to deliver a new set of features or requirements.

Requirements for software are often so many that not all can be included in the next release. This makes it necessary to select a set of requirements to implement for the next release, and postpone the implementation of the other requirements.

Value-based requirements engineering aims to maximise the value of a release of software through the selection and prioritisation of requirements. Value can be thought of as anything that one might consider useful, convenient or essential.

Instructions

The purpose of this questionnaire is to understand what criteria you use to select and prioritise requirements so that they can be assigned to a release of software. A list of criteria with explanations has been included. If you think this list is incomplete you can list additional criteria in the questionnaire. You are also able to mark the listed criteria as not relevant.

This survey has been divided into two sections:

Characterisation: This is used to determine the context for your answers.

Prioritisation of criteria: This part captures the different criteria involved in the decision process and their relative importance in affecting the inclusion of a specific requirement in the forthcoming project/release.

Please complete both sides of the survey and return to Sebastian Barney at International House, UNSW Sydney NSW 2052, Australia. Return of the questionnaire will be taken as consent to partake in the study. Should you wish to revoke your consent at a later date please complete and return the revocation of consent form.

Please direct any questions to Sebastian Barney on:

Phone: +61 431 967710

E-mail: [sebastian.barney@student.unsw.edu.au](mailto:sebastian.barney@student.unsw.edu.au)

## **Identified criteria**

The following criteria for inclusion of a requirement have been identified:

### **1. Competitors**

Explanation: The status of competitors with respect to the requirement – it is taken into account whether a competitor has the implied functionality.

Motivation: We may feel forced to include a requirement if our competitors have the functionality, or we may want to implement something that is considered to be leading edge functionality (functionality competitors do not have).

### **2. Requirement's issuer**

Explanation: The party responsible for issuing the requirement is taken into account - which stakeholder (internal or external) generated the requirement.

Motivation: We may judge some issuers more important than others, for example an important client or representative of a key market.

### 3. Stakeholder priority of requirement

Explanation: The priority of the requirement is taken into account.

Motivation: We may want to prioritize the requirements that our customers or markets think are of particular importance.

### 4. Function is promised/sold

Explanation: The expectation of stakeholders to see the requirement met is taken into account.

Motivation: We may want to include requirements that were promised or sold to meet stakeholder expectations.

### 5. Volatility

Explanation: This criterion is related to whether the requirement is likely to change or not.

Motivation: We may want to handle highly volatile requirements differently.

### 6. Support/Education/Training

Explanation: The ability and possibility to provide technical support, education, and training to customers, markets and so forth with respect to the requirement.

Motivation: We may not want to implement functionality unless we could provide the appropriate technical support, education and training in relation to the requirement.

### 7. Development cost-benefit

Explanation: The actual cost-benefit for implementing the requirement.

Motivation: We may not want to include a requirement if the implementation cost is judged to be high in relation to the expected benefit.

## 8. Resources/competencies

Explanation: The availability of resources with the right competencies to implement the requirement.

Motivation: We may not want to implement a requirement unless we are sure that we have the right people available for the job.

## 9. Delivery date/Calendar time

Explanation: The ability to meet the project deadline.

Motivation: We may not want to introduce a requirement that may affect the deadline of the project negatively.

## 10. System impact

Explanation: The impact of the requirement on the existing system.

Motivation: We may not want to implement a requirement if we judge that the actual impact in terms of changes to the existing system is too great.

## 11. Complexity

Explanation: The estimated complexity of the requirement and the associated challenges in implementing it.

Motivation: We may not want to include a requirement that is judged to be very complex to implement and as a consequence the risk of failure as too high.

## 12. Requirements dependencies

Explanation: The dependencies between a specific requirement and other requirements, either already implemented or other posed requirements.

Motivation: The dependency to other requirements (already implemented, scheduled to be implemented, or deferred to later release) may affect our decision regarding the current requirement.

## 13. Evolution

Explanation: The impact on the future evolution of the system.

Motivation: We may not want to implement a requirement if it is believed to make long-term evolution of the system more complicated.

#### 14. Maintenance

Explanation: The impact on the maintenance of the current system.

Motivation: We may not want to implement a requirement if it is believed that the requirement may cause many problems in terms of maintenance.

### **Revocation of consent**

Ethics approval: 05602

I hereby wish to WITHDRAW my consent to participate in the research proposal described above and understand that such withdrawal WILL NOT jeopardise any treatment or my relationship with The University of New South Wales.

---

Signature

---

Date

---

Please print name

The section for Revocation of Consent should be forwarded to Sebastian Barney, International House, UNSW Sydney NSW 2052, Australia.

## Questionnaire – Characterisation

Name:

Email:

Company:

Organizational unit:

eg. development, testing, marketing, sales

Number of years work experience:

Number of years at this company:

Type of application:

eg. telecommunications, finance, services

Product market:

eg. contracted development for one customer/company, several different customers/companies, consumer product

Product in mind when answering this questionnaire:

If your answer is based on your overall experience, write no specific product.

Your role in the organization:

eg. product manager, project manager, developer

## Questionnaire – Prioritisation of Criteria

Please fill in the table below as follows:

First, if you think any important decision criteria are missing, please add them in to the rows numbered 15-18.

Then answer yes or no depending on whether you think the criterion in the row is *relevant* to consider when deciding if a specific requirement should be included or not.

In the columns *Today* and *Optimal*, rate the relative importance of the different criteria in terms of a value between 0 and 1000. For example, if one criterion is twice as important as another one, the value should be twice as large. However, the sum of all values in the column should be 1000.

The *today* column represents the situation today. In other words, how you value things in practice today.

The *optimal* column represents how it ought to be or how you would like to see it in the future.

	<b>Criteria</b>	<b>Relevant</b>	<b>Today</b>	<b>Optimal</b>
1.	Competitors			
2.	Requirement's issuer			
3.	Customer/market priority of requirement			
4.	Function is promised/sold			
5.	Changeability			
6.	Support/Education/training			
7.	Development cost			
8.	Resources/competencies			
9.	Delivery date/Calendar time			
10.	System impact			
11.	Complexity			
12.	Requirements dependencies			
13.	Evolution			
14.	Maintenance			
15.				
16.				
17.				
18.				
		<b>SUM</b>	<b>1000</b>	<b>1000</b>

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