

Strengthening the link between business decisions and RE: Long-term product planning in software product companies

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Abstract

Long-term product planning (i.e. roadmapping) is an approach that companies operating in the software product business have used to bridge the gap between business planning and product development. A strong link between strategy and product development is important, since companies developing software products need to select requirements for forthcoming releases based on the business decisions of the company. However, in practice, connecting requirements engineering decisions and business management is far from trivial. This paper reports lessons learned from four software product companies that recognize the need for more business-oriented long-term product planning. The study was conducted using the action research approach. We identified four practices that seem to strengthen the link between business decisions and requirements engineering. These are: 1) explicating the planning levels and time horizons needed in product planning, 2) separating the planning of business goals relating to products from R&D resource allocation, 3) conducting open-ended planning by pre-defined rhythm and 4) emphasizing whole-product thinking.

1. Introduction

For a software company, product development is an investment that should provide maximal added value [3]. Providing value for different customer and end-user segments by means of the product is a lifeline for the sales of the product and, via that, to the business of the company. This means that a company needs the ability to implement the most valuable requirements to the software product in each product release. Especially in the software product business, the role of a successful selection of the feature enhancements (i.e. requirements) for the product releases is recognized as extremely important [19] [8].

However, market-driven requirements engineering seems to entail special challenges [11]. Selection and prioritization of requirements in particular has been recognized as a challenging activity [12] [5] [23]. Many of the

challenges involved in the selection and prioritization of requirements are related to an inability of those involved to understand the business value of individual requirements and the business consequences of the available opportunities [14] [23].

The need to make business-based product development decisions means that a company needs the ability to connect business management and software development [21]. Only by integrating upstream (that is, long-term planning) and downstream (that is, software development) processes, value-based decisions concerning the future features of the products can be made [7] [13]. Unfortunately, in research on requirements engineering, the viewpoint has mostly been that of bespoke software development [11], while requirements engineering before projects (e.g. long-term product planning) has not had that much emphasis placed upon it.

Long-term product planning (typically called roadmapping [10] [17]) is one way that companies have used to bridge the gap between business planning and product development. Roadmapping as a technique is widely used in manufacturing industry [18]. However, application of the approach in the software engineering field is rather new and less investigated. Also, the practical implications of long-term product planning in software product companies in terms of the state of practice or good practices are not widely known.

In this paper, we investigated the current state of long-term product planning in four Finnish software product companies that operate in international markets. As a result, we provide lessons learned from how the companies are linking business decisions to requirements engineering (RE) by long-term product planning. The research is an on-going part of a long-term action-research-type research relationship with the case companies. Section 2 presents related work. Section 3 presents the research design. Sections 4 and 5 present the results, while Section 6 concludes the paper with a discussion and suggested directions for further research.

2. Related work

2.1. Market-Driven Requirements Engineering

Software companies can be roughly divided into two: companies operating in the software project business (other terms used are ‘bespoke software’ and ‘software services’) or in the software product business (also called ‘market-driven software development’) [6] [9] [15].

Market-driven requirements engineering refers to requirements engineering in companies operating in the software product business. According to Nambisan [15], software companies moving towards the software product business from custom-made solutions face new managerial product development challenges. The differences between the business models seem to be reflected in requirements engineering as well. For example, Karlsson et al. [11] reported that requirements engineering for commercial off-the-shelf software packages entails special challenges, such as a gap between marketing staff and development and requirements overload.

One of the key effects that the movement to a product business has had on requirements engineering is the increasing importance of requirements prioritization and selection [25]. Market-driven development companies have to deal with a steady stream of new requirements as well as select an optimal part of these requirements to implement in the next version [4]. This implies that, in market-driven situations, requirements engineering is not just a within-project activity.

2.2. Value-Based Requirements Prioritization

Wiegiers [27] defines a requirement as a property that a product must have to provide value to a stakeholder. The challenge (in product development) is to select the ‘right’ requirements out of a given superset of candidate requirements so that all the different key interests, technical constraints, and preferences of the critical stakeholders are fulfilled and the overall business value of the product is maximized [24]. Unfortunately, much current software engineering practice and research is conducted in a value-neutral setting, in which every requirement is treated as equally important [3].

In companies operating in the product business, understanding the value of requirements is not just a within-the-project activity in software product development [7]. In a market-driven situation, the traditional, monolithic requirements specification is of limited value when managing a steady stream of incoming requirements of varying quality [11]. In order to provide value with their products, companies need to place an emphasis on the selection and prioritization of requirements before projects that are additional to within-project activities [7]. Also, Wiegiers [27] suggests that priorities should be evaluated and adjusted periodically throughout the period of development

as customer needs, market conditions, and business goals evolve [27].

However, usually, the viewpoint in the requirements engineering literature has been that of bespoke software development [11]. As a whole, requirements engineering before projects seems to be not that much discussed in the literature. According to Ebert [7], this might be because of its complexity (e.g. overlapping ownerships) and the historical division between product management and requirements engineering, which was perceived as an internal engineering discipline.

2.3. Long-Term Product planning

Earlier studies indicate that requirements documents for short projects are not sufficient to ensure the kind of wide understanding in the organization that developing software products for wide markets requires [11] [13]. Long-term product planning is one route that software product companies follow to explicate the needed link between business decisions and requirements engineering [13].

Typically, long-term product planning is called roadmapping in software product companies. In general, roadmapping can be defined as a flexible technique that is used to support strategic and long-range planning [10]. The basic purpose of roadmapping is to explore and communicate the dynamic linkages between markets, products, and technologies over time [10]. The output of the roadmapping process is called a roadmap. A generic roadmap is a time-based chart that typically includes both commercial and technological perspectives [10]. In the context of software development, roadmapping can be defined as a popular metaphor for planning and portraying artefacts, resource usage, and their relationships over a period of time [22].

Rautiainen and Lassenius [22] report the three main values that long-term product planning provides for software product companies. These are: 1) Help in coordinating a complex set of activities, 2) Explication of the direction of intent, and 3) Help in making short-term decisions and trade-offs. Also, Vähäniitty et al. [28] report an experience where a small software company used product roadmapping for keeping long-term goals clear and maintaining its focus on the right issues. However, the current state of long-term product planning in software product companies has not been widely investigated.

3. Research design

This research has been conducted as a part of two research projects (Core and Reflex) at the Software Business and Engineering Institute at Helsinki University of Technology between 2003 and 2006. The high-level research goals of the projects were to investigate how or-

ganizations can cost-efficiently develop products that provide value for both customers and users.

3.1. Research goals and questions

The high-level objective of this study was to investigate the practices that software product companies have for long-term product planning. The detailed research questions were as follows:

1. What are the characteristics of long-term product planning in software product companies?
2. What practices support linking business decisions to requirements engineering?

3.2. Research approach

The need for a deep understanding of long-term product planning practices, problems, and needs in software product companies calls for a qualitative research approach and, more precisely, an action research method [1] [26]. According to Avison et al. [1], the particular strength of qualitative methods is their value in explaining what goes on in organizations; also, action research can address complex real-life problems and immediate concerns. In addition, qualitative methods permit the evaluator to study selected issues in depth and detail [16].

Also, Potts [20] suggests an “industry-as-laboratory” research approach, where researchers identify problems through close involvement with industrial projects, and create and evaluate solutions in an almost indivisible research activity. This lets researchers emphasize what people actually do or can do in practice, rather than what is possible in principle. Formal research operates at a distance from the everyday lives of practitioners, and, although it provides interesting theoretical perspectives about the nature and complexities of social life, it largely fails to penetrate the experienced reality of their day-to-day work [26]. Action research instead seeks to engage “subjects” as equal and full participants in the research process [26].

According to Avison et al. [1], action research is an iterative process involving researchers and practitioners acting together in a particular cycle of activities, including problem diagnosis, action intervention, and reflective learning.

3.3. Data collection

The experience drawn on in this research comes from work with the industrial partners of the research projects. The research work was carried out in four Finnish software product development companies. All the participating companies are companies developing software products for international markets. The case companies are introduced in more detail in Table 1.

Table 1. Case companies

Company	Number of employees	Application domain
A	500	Information management systems for building, public infrastructure, and energy distribution designers
B	300	Computer security systems for companies and consumers
C	100	Computer security systems for companies and consumers
D	300	Systems for financial processes and buyer-supplier-related transactions

The findings of this study are based on the data collected through formal semi-structured interviews, observations, informal conversations, and analysis of both long-term product planning process documentation and roadmaps.

In practice, the research consisted of interviews of primary stakeholders in all four companies. In addition, the interviews of secondary stakeholders were held in the two main companies (A and B). Furthermore, the researchers were involved in process improvement work in these two companies, which allowed them to attain a deeper understanding of the existing processes and practices, improvement needs and viewpoints of different stakeholders. We also organized, in total, three experience-exchange seminars for the practitioners from the case companies during the years of our research. In these meetings, the practitioners were able to learn from each other and gain new understanding and insights. The researchers, on the other hand, had an opportunity to follow the current trends and learning curve in the companies. In total, researchers worked over 100 hours with the two main companies during the research period of two years. The research activities in different case companies are summarized in Table 2.

Table 2. Research activities

	A	B	C	D
Interviews (of primary stakeholders)	x	x	x	x
Interviews (of secondary stakeholders)	x	x		
Informal conversation	x	x	x	x
Observation	x	x		
Document analysis	x	x	x	x
Experience exchange seminars	x	x	x	x
Process improvement work	x	x		

An overview of the primary informants can be found from Table 3 and of the secondary informants from Table 4. All of the informants were interviewed as well.

Table 3. Primary informants

Company	Roles of the interviewees	Amount
A	Product manager Product management director	3
B	Product manager	3
C	Director of product development	1
D	Product manager	1

Table 4. Secondary informants

Company	Roles of the Interviewees	Amount
A	Business area leader Director of a segment Service manager Marketing planner Documentation specialist	5
B	VP of R&D VP of Customer Advocacy Manager of Services Quality manager	4

3.4. Data analysis

All of the interviews were transcribed on the basis of the recordings. Soon after the interviews, the most significant findings from each interview were moved to mind maps for further processing. The mind maps were completed on the basis of the transcriptions, and the opinions of the interviewees were compared to each other in order to find similarities and discrepancies. In addition to comparing all the interviewees at the same time, we made role-based comparisons to understand the role-specific characteristics in the experiences and challenges involved.

During the improvement work in the two case companies, the researcher kept a research diary in which she kept her field notes. Case write-ups were written after every meeting. The field notes were mostly descriptions of about half a page long of what happened in each meeting and, typically, a few sentences of analysis of observations concerning, for example, conflicts between participants or the motivation of participants. The field notes can be seen both as notes from the meetings and as a type of preliminary analysis.

Results of the study consist of the two main areas: description of the practice in the case companies and practices that seem to link business to RE. The practice description is formed based on commonalities between the companies. The practices that link business to RE are selected based on the researchers' analysis of the bottle-

necks in the companies encountered by the research process and on how they were solved.

3.5. Threats to validity

In this study, internal validity denotes the property of an empirical study where the result is consistent within its local context [2]. External validity, on the other hand, denotes the property of an empirical study where the result is generalizable to other contexts [30].

The threats to internal validity in this study included the question of whether we were able to gain a representative and true image from the current practices and practical challenges in the case companies. To increase the internal validity of the study, we used several tactics, especially in the data-collection phase. First, we triangulated data sources by selecting more than one interviewee from two of four case companies. Second, we used the triangulation of data collection techniques to improve the internal validity of findings within the organizations. In addition, we developed practices cooperatively with the practitioners from the companies in order to get deeper information about their current practices. Thus we were able to relate the information gathered from the interviews to these observations. Third, the study was carried on in the case organizations over a long period, which improved the ability of researchers to understand the existing practices and practical challenges in more detail.

The threats to external validity include the possibility, on the basis of the situation in the case companies, drawing conclusions that concern software companies operating in the product business in general. To improve the external validity of the research results, this study involved seven separate case organizations of different sizes. In addition, the companies represented different types of products, customers, and business environments in order to avoid a sampling bias.

4. State of the practice in the case companies

In this chapter, we summarize the main reasons why the companies deemed long-term product planning important and needed. In addition, we describe the characteristics of existing practices in the area.

4.1. Rationale for long-term product planning

The need to gain and share a holistic long-term view of the future with different stakeholders. Sharing a common and holistic long-term view of the future development steps of the software products within the organization was recognized as important in the case companies. All the case companies had found that requirements documents for short projects were not sufficient to ensure the necessary kind of wide understanding in the organization. Both the internal and external communication of the products' future development steps and their

rationales were critical issues that the companies had had problems with. By ‘holistic’, we mean that an important need for many of the case companies was that they wanted to inform and involve more stakeholders (R&D, marketing and sales, and management) within the company earlier in the development cycle. The companies wanted to start the development by setting the high-level targets co-operatively beforehand so that the marketing and sales functions were able to prepare their activities at the same time as when the product development activities were taking place.

The need to trace business decisions to product development. The practitioners in the case companies felt that they needed some articulated decisions, not only concerning the future features for the following releases, but also as to what the customer segments are, and which geographical areas they were to satisfy most with the different releases. This was seen as necessary for preparing for the future and for understanding the priorities of the potential features better.

The need to explicate the links between the development needs of different products. In all of the case companies, the product managers were fighting for the same product development resources. This means that the practitioners needed to be able to communicate their future ideas and resource needs to other product managers in a way that is understandable to the others. This communication was also needed to find and realize potential synergies that may exist between different products and their future development directions.

In addition, the management in most of the case companies faced the challenge of comparing different projects and feature ideas with each other. This is why, in many of the case companies, the management had compelled practitioners to prepare the roadmaps in such a way that the management can see all the planned releases in the same format and thus be able to compare them with each other in order to make trade-offs.

4.2. Characteristics of existing practices

Focus is usually on features of one product. Typically, the roadmaps depicted a high-level view of the most important features of the forthcoming releases. In two of the case companies, the roadmap templates also covered issues such as marketing arguments or product positioning in the markets. However, practitioners saw that kind of information as quite static, and therefore the dynamic planning of these items via roadmaps had not worked properly.

Most case companies saw, for example, announcements of forthcoming language versions and dropped features (compared to earlier versions) as important information that should be covered in the roadmaps. However, integrating these issues into roadmaps was not yet so systematic in the case companies. In addition, roadmapping

was usually performed for individual products, while possible links to other products and synergies were not explicitly recognized.

Link from business decisions to requirement engineering decisions not explicit. All of the case companies felt that the feature-level roadmapping was not enough, but a more business-oriented view of the future was needed. Furthermore, explicit linking between different planning levels was needed to understand which business targets are affected if certain features are not implemented, or which products are affected by different business targets. However, the relationships between business goals and decisions regarding features seemed to be quite difficult to identify in practice.

Typical planning horizon is a few releases ahead. The most typical planning horizon in the case companies was from one to two releases ahead. The time horizon for planning was usually open-ended so that the near future was planned in more detail. The more remote future was also outlined, but in less detail.

Preparation of roadmaps is mostly the product managers’ responsibility. The persons responsible for preparing the roadmaps were usually product managers. This is quite natural since the decisions concerning the future of the products were their responsibility. The most important stakeholder groups to which the contents of roadmaps were communicated and with whom the product managers should negotiate were management, sales and channel partners, and customers. However, the viewpoint of the developer was usually less emphasized in the case companies than that of other stakeholders.

5. Practices that link business view to RE

In this chapter, the practices that seem to strengthen the link between business decisions and requirements engineering are presented. The corresponding practices are summarized in the bullet points below:

- Explicate needed product planning levels and time horizons
- Separate planning of product’s business goals from R&D resource allocation
- Plan open-endedly by pre-defined rhythm
- Emphasize whole-product thinking

5.1. Explicate planning levels and time-horizons

It seems that one of the first things to do for a company developing or improving its product planning practices is to explicate the needed *planning levels* and *time horizons*. The term ‘planning level’ refers to items that are planned, while the term ‘time horizon’ refers to the length of the time period for the plans and should be made explicit for each planning level. In practice, this means that companies should discuss: “What, in our case, needs to be

planned and for how long forward?” For example, do we make plans concerning the features of a single product for its next release? Do we need separate plans for the future development of a product line?

Both of the main case companies (A and B) lacked a clear understanding of their currently employed planning levels and time-horizons. Furthermore, in both of the companies, it was unclear which roles were responsible for planning what, since the current organizational structure did not support the planning levels that they currently had. For example, in company B, the technical product managers were responsible for making decisions concerning the future features of individual software products. However, the software products were not sold alone, but as parts of customer solutions that were combinations of several software products. From the business viewpoint, the solutions were entities, but no one in the company planned for the solutions’ future as a whole; no one was responsible for taking care of where the solutions as a whole were going.

The relationships between different planning levels and the corresponding responsibilities modified from the situation in case company B are illustrated in Figure 1. This picture was first drawn by the first author. After seeing the picture, the practitioners in company B felt that they were better able to understand their current situation and challenges. A similar picture was also introduced to the other case companies during an experience exchange seminar. The participants from the other case companies also agreed that they could clearly benefit from depicting their own situation in a similar way.

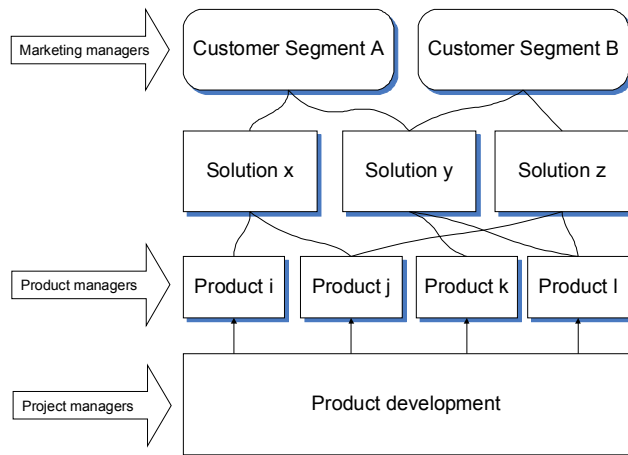


Figure 1. Visualization of planning levels and roles

Another possible visualization for analyzing the planning levels and time horizons currently employed by a company and for finding potential gaps in the long-term planning practices is shown in Figure 2. In the matrix shown above, the darker cell shading indicates that the

issue is planned in detail, while the lighter indicates that there is at least some planning (but less than needed) for that time horizon. This visualization was recognized as interesting by the practitioners, but it has not yet been tested in practice.

There is no simple answer to the question of how many different levels of abstraction for planning a company should have. For example, company size and its organizational structure obviously play a role. Based on our experiences from the case companies, the gap between company strategy and the requirements for a single release is not bridged by a single level of planning (for example, having a product roadmap only).

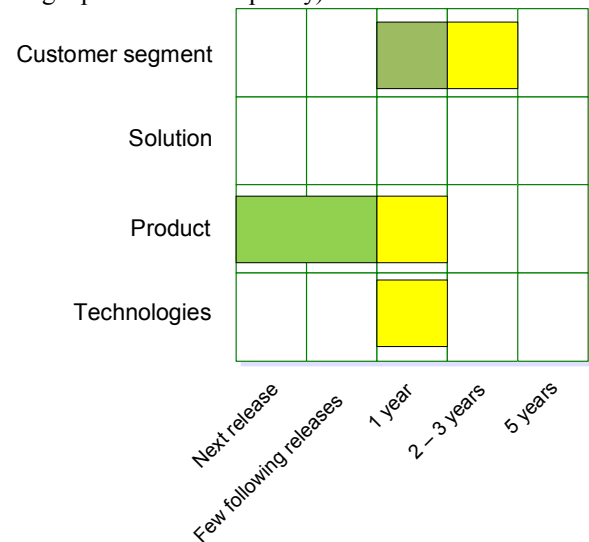


Figure 2. Visualization of planning levels and horizons

5.2. Separate the planning of product’s business goals from R&D resource allocation

According to our findings, it seems that business goals for the products should be discussed separately from R&D resource allocation. Practitioners from all of the four case companies complained that they had problems in seeing the ‘big picture’. By this they meant that it was difficult for them to see what the goals of further releases were, and how well the decisions made concerning features were matching the needs of different customer segments.

In these companies, roadmaps were mainly used for planning what features will be implemented by which teams in the following releases. The business goals for the products and how they changed over time were not discussed in separate sessions, and planning for them was in danger of being overrun by tiny product features and the above mentioned detailed allocation of R&D resources. Furthermore, neither of the companies had a view that would show the entire product portfolio.

During the study, two of the four case companies came to the conclusion to separate business opportunity sketching and goal setting (i.e. strategic level) from software production planning (i.e. operative level). Based on our observations in these case companies, it seems that at least two distinct levels in long-term planning could be beneficial. *Market oriented or commercial roadmaps* would form an overall view of the offering and give an understanding of how well different customer segments will be served in the future. On this level, the roadmap(s) might depict issues such as the needs of target customer segments, positioning of the products, and different market trends for the next few years. In addition, it might be important to communicate possible changes in the sales channels and marketing arguments. These roadmaps would serve as a basis for more detailed planning. On the other hand, lower level *release or software roadmaps* are needed from the perspective of managing software development. Each technical product could have its own roadmap to provide information about the features to be implemented in the upcoming releases. These roadmaps are needed for allocating product development resources to different products and for giving product developers additional importance.

5.3. Plan open-endedly by pre-defined rhythm

All of the four case companies performed open-ended planning by pre-defined rhythm. *Open-ended planning* means that the time horizon for future planning is not fixed. The steps for the near future (e.g. next release) are planned in more detail, but the remote future is also outlined to some degree. By *pre-defined* we mean that planning should be undertaken at regular intervals. Figure 3 illustrates this kind of planning and how the content of the following releases sharpens in each planning round.

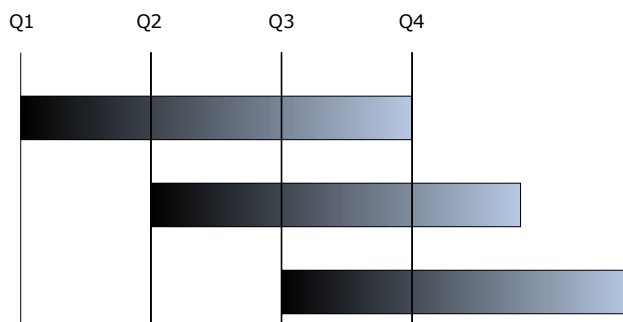


Figure 3. Open-ended planning by pre-defined rhythm

The practitioners in the companies felt that this kind of planning suits market-driven planning where the decisions are typically trade-offs between ‘now’ and ‘later’ rather than clear-cut ‘no’s. The actual implementation of open-ended planning varied in the case companies. In company

B, for example, the next 12 months for a product was discussed every month. This implied that, in practice, the content of one one-month project was iterated 12 times. In the other case company, open-ended planning was performed via a tool by allocating features to following releases.

5.4. Emphasize whole-product thinking

It seems important to widen the planning scope from the features of individual products to whole-product planning. Launching a software product release needs cross-functional effort and outputs from functions other than R&D as well. For example, marketing material, product documentation, and sales campaigns need to be planned and implemented before a product can be launched as a whole product. This requires cross-functional effort already in the early planning phase.

In the early days, the case companies saw product planning as product management’s internal discussion about forthcoming features of the software. The functions other than product management (such as marketing, sales or documentation) were not seen as that important to stakeholders when talking about the future plans. However, the customer and user needs that the company should meet are not related only to the software. For example, the customer requires good enough information about the product, a place where to buy it, and maybe some additional services.

The software centralized planning seemed to complicate and delay release launches and cause resource challenges to functions other than R&D. Firstly, other functions (e.g. documentation, marketing and sales) had continuous resource problems, since their resource needs were not planned early enough. Furthermore, their limitations were not taken in to account, since only R&D resources were thought of when deciding what should and can be done during the following months. Secondly, the functions other than R&D were continuously able to start their work too late. This was because they did not get enough information about forthcoming features of the products early enough to allow them to start their work when the software development was still ongoing. Thirdly, the value that the product provides for the customers was more or less implicitly seen as something that comes only via new product features. The product managers alone did not come out with ideas for, for example, improving services instead of new features for certain customer segments.

During the study, the two main case companies concluded that they needed a cross-functional project team for planning the main product release launches from the early phases of the development. The other case company had already started this practice and found it to be a good experience. The project group consisted of members from marketing, product management, documentation and ser-

vice. The group gathered once a week during the whole product development project. During this time they made preparations towards launching the release. The practice improved their ability to synchronize other functions with R&D and also to prepare outputs other than software earlier than before.

Case organization A even changed their organizational structure from functional to more market-segment based. This means that every market segment has its own segment team that includes representatives from many internal functions (product management, sales, marketing and service). The team is co-operatively responsible for integrating segment development plans into the product development plans once these begin to form. The practitioners feel that this type of organization has brought experts from different functions nearer each other and improved their communication. In addition, the shared responsibility has forced the practitioners themselves to truly cooperate with each other.

6. Conclusions

This work aims to clarify how to strengthen the link between business decisions and requirements engineering in software product development companies. The focus of the study is on long-term product planning, since it has earlier been recognized as an important intermediate level between strategy and product development. Our results deepen the understanding concerning the rationales for long-term planning in software product companies, and characterize existing industrial practices. Furthermore, we propose practices that seem to strengthen the link between business decisions and requirements engineering.

Our study indicates that the need for long-term product planning originates from the need for transparent and business-driven decision-making and rational utilization of R&D resources over time. It seems that adding intermediate planning levels between business decisions and requirements engineering helps to link them together. For example, marketing arguments are easier to tie to high-level features than to individual, small-scale requirements. In addition, gaining and sharing a holistic long-term view of the future with different stakeholders is important for rational utilization and co-ordination of resources over time, not just in R&D, but in other functions as well. For example, sales and marketing need early information concerning future developments. Furthermore, explicit links between the development needs of different products are needed, since the product development resources are usually shared. Similarly, Karlsson et al. [11] found that the co-operation between different stakeholders in market-driven companies requires ways other than communication via low-level requirements.

According to our findings, the current product planning practices in the case companies remain at quite a

low-level by focusing mostly on features of individual products. For example, we found that the case companies did not have business-oriented views that depict the future of their offerings as a product family. Furthermore, real long-term product planning seems to be more of a dream than reality, since the planning horizon is typically a few releases ahead. In addition, the preparation of plans seems to be mostly restricted to product managers who often have a technical background. This may narrow the perspectives that are taken into account in planning.

However, we were able to identify practices that seem to strengthen the link between business decisions and requirements engineering. First, explicating needed product planning levels and time horizons helps to clarify the typically fuzzy field of different kinds of plans and planning between strategy and software development. Second, by separating the planning of the business goals relating to a product from R&D resource allocation and detailed feature-level planning, it is easier to see the big picture from the business viewpoint and avoid getting entangled in details. Similarly, Vähäniitty and Rautiainen [29] discuss separating different-level planning items from each other. Third, open-ended planning by pre-defined rhythm seemed to suit market-driven planning, where the decisions are typically trade-offs between ‘now’ and ‘later’ rather than clear-cut ‘no’s. Finally, by emphasizing whole-product thinking in the organization, organizational functions other than R&D (such as marketing and services) get better integrated into product planning from the early phases and, for example, a commercial launch of a new release may become easier. The study conducted by Ebert [7] revealed a somewhat similar finding, since he found that installing a core team for each release has an effect on the success of the product.

Our study suggests directions for further investigations. One of the research challenges in the future is to investigate how the links between the development needs of different products could be better explicated at the portfolio management level. In addition, it would be important to investigate how explicit linking between different planning levels could be achieved in practice.

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References

[1] Avison, D, Lau, F, Myers, M, and P. Nielsen, “Action Research”, *Communications of the ACM*, Vol. 42, No. 1, pp. 94-97.

- [2] Bernder, P. and C. Wohlin, C. "Identification of Key Factors in Software Process Management – A Case Study", *Proceedings of the 2003 International Symposium on Empirical Software Engineering (ISESE'03)*, IEEE Computer Society, pp. 316-325.
- [3] Boehm, B. (2003), "Value-Based Software Engineering", *ACM Software Engineering Notes*, Vol. 28, No. 2, 2003.
- [4] Carlshamre, P. *Usability Perspective on Requirements Engineering - From Methodology to Product Development*, Ph D Dissertation No. 726, Department of Computer and Information Science, Linköping University, Sweden, 2001.
- [5] Carlshamre, P. "Release Planning in Market-driven Software Product Development - Provoking an Understanding", *Requirements Engineering Journal*, Vol. 7, No. 3, 2002, pp. 139-151.
- [6] Carmel, E. and S. Sawyer, "Packaged Software Development Teams: What Makes Them Different?", *Information Technology & People*, Vol. 11, No. 1, 1998, pp. 7-19.
- [7] Ebert, C. "Requirements BEFORE the Requirements: Understanding the Upstream Impacts", *Proceedings of 13th IEEE International Conference on Requirements Engineering*, IEEE Computer Society Press, 2005, pp. 117- 124.
- [8] Gorchels, L. *The Product Manager's Handbook – The Complete Product Management Resource*, second edition. NTC business books, Illinois, USA, 2000.
- [9] Hoch, D., Roeding, C., Purkert, G., Lindner, S. and R. Muller, R. *Secrets of Software Success: Management Insights from 100 Software Firms Around the World*. Harvard Business School Press, Boston, 1999.
- [10] T. Kappel, "Perspectives on Roadmaps: How Organizations Talk about the Future", *The Journal of Product Innovation Management*, Vol. 18, 2001, pp. 39-50.
- [11] L. Karlsson, Å. Dahlstedt, J. Natt och Dag, B. Regnell, and A. Persson, "Challenges in Market-Driven Requirements Engineering - an Industrial Interview Study", *Proceedings of the Eighth International Workshop on Requirements Engineering: Foundations for Software Quality (REFSQ'2002)*, Essen, Germany, September 2002, pp. 37-49.
- [12] Lehtola, L., Kauppinen, M., and S. Kujala, "Requirements Prioritization Challenges in Practice", *Proceedings of 5th International Conference on Product Focused Software Process Improvement (PROFESS 2004)*, April 5 - 8, Kansai Science City, Japan, pp. 497-508.
- [13] Lehtola, L., Kauppinen, M. and S. Kujala, "Linking Business View to Requirements Engineering: Long-Term Product Planning by Roadmapping", *Proceedings of 13th IEEE International Conference on Requirements Engineering*, IEEE Computer Society Press, 2005, pp. 439-446.
- [14] Lehtola, L. and M. Kauppinen, "Suitability of Requirements Prioritization Methods for Market-Driven Software Product Development", *Software Process Improvement and Practice (SPIP)*, Vol. 11, No. 1, 2006, pp. 7-19.
- [15] S. Nambisan, "Why Service Businesses are not Product Businesses", *MIT Sloan Management Review*, Vol. 42, No. 4, Massachusetts Institute of Technology, Summer 2001, pp. 72–80.
- [16] Patton, M. Q. *Qualitative Evaluation and Research Methods*, second edition. Sage Publications, Newbury Park, CA, 1990.
- [17] R. Phaal, C. Farruk, R. Mitchell, and D. Probert, "Starting-up Roadmapping Fast", *Research Technology Management*, Vol. 46, No. 2, pp. 52-58.
- [18] Phaal, R., Farrukh, C.J.P. and D. Probert, "Characterisation of technology roadmaps: purpose and format", *Proceedings of the Portland International Conference on Management of Engineering and Technology (PICMET '01)*, Portland, 29th July - 2nd August, pp. 367-374.
- [19] Penny, D.A. "An Estimation-Based Management Framework for Enhance Maintenance in Commercial Software Products", *Proceedings of the IEEE International Conference on Software Maintenance (ICSM'02)*, 2002, pp. 122-130.
- [20] Potts, C. "Software-Engineering Research Revisited", *IEEE Software*, Vol. 10, No. 5, pp. 19-28.
- [21] Rautiainen, K., L. Vuornos, and C. Lassenius, "An Experience in Integrating Strategic Product Planning and Agile Software Development Practices", Rome: 2003 ACM-IEEE International Symposium on Empirical Software Engineering (ISESE 2003), 2003.
- [22] Rautiainen, K., and C. Lassenius (eds.) *Pacing Software Product Development: A Framework and Practical Implementation Guidelines*. Helsinki University of Technology Software Business and Engineering Institute Technical Reports 3, Helsinki, 2004.
- [23] Regnell, B., Beremark, P., and O. Ekhlund, "A Market-Driven Requirements Engineering Process: Results from an Industrial Process Improvement Programme", *Requirements Engineering*, Vol. 3, No. 2, 1998, pp. 121–129.
- [24] Ruhe, G., Eberlein, A., and D. Pfahl, "Quantitative WinWin - A New Method for Decision Support in Requirements Negotiation", *Proceedings of the 14th International Conference on Software Engineering and Knowledge Engineering (SEKE'02)*, pp. 159-166.
- [25] P. Sawyer, "Packaged Software: Challenges for RE", *Proceedings of the sixth Int. workshop on Requirements Engineering: Foundation of Software Quality (REFSQ'00)*, pp. 137-142.
- [26] Stringer, E. T. *Action Research*, second edition, Sage Publications, Thousand Oaks, CA, 1999.
- [27] Wiegers, K. *Software Requirements*, second edition. Microsoft Press, Redmond, WA, 2003.

[28] J. Vähäniitty, C. Lassenius, and K. Rautiainen, "An Approach to Product Roadmapping in Small Software Product Businesses", Conference Notes of Quality Connection - 7th European Conference on Software Quality, Helsinki, Finland, July 2002, pp. 12-13.

[29] Vähäniitty, J. "A Tentative Framework for Connecting Long-Term Business and Product Planning with Iterative & Incremental Software Product Development". In proceedings of

the 7th International Workshop on Economic-Driven Software Engineering Research (EDSER-7) at ICSE 2005, St. Louis, USA, 2005

[30] Yin, R. K. (1994) *Case Study Research – Design and Methods*, second edition, Sage Publications, Thousand Oaks, CA, 1994.