

Product Portfolio Management in Small Software Product Businesses – a Tentative Research Agenda

Jarno Vähäniitty
*Software Business and Engineering Institute,
Helsinki University of Technology
Jarno.Vahaniitty@soberit.hut.fi*

Abstract

Product portfolio management is crucial to product-oriented software companies' long-term success but is mostly overlooked by current software engineering research. This paper presents preliminary results from a multiple case study on the state-of-the-practice and improvement of product portfolio management processes in three small product-oriented software companies. Our findings suggest that implementing portfolio management as explained in the literature is based on assumptions about the product development process that do not hold in the context of small software product businesses. Based on the limitations of existing research this paper presents a number of questions to guide further work.

1. Introduction

Success in the software product business demands more than just succeeding in individual development projects. Building products at the right time with the right features and keeping an eye on the big picture are at least as important [19]. Indeed, effective product portfolio management, that is, the continuous process for defining, evaluating and prioritising the set of current and planned product development activities [7], is reported as crucial to product-oriented software companies' long-term success [11,12,18].

Software engineering (SE) research has traditionally been primarily technical and tends to adhere to the viewpoint of individual development projects as far as management is concerned [14], thus neglecting the portfolio perspective. To make up for this, SE has recently started looking for answers from the field of new product development (NPD) [6,15,20] where product portfolio management has been studied for more than two decades. However, adopting these lessons to the SE context is still at its beginning. Also, from the perspective of small software product

businesses, the differences in resourcing and organisation size make the applicability of existing literature subject to question [1].

The majority of software companies are small [13] (under 50 people, according to the European Union standard). These companies play a crucial role in the industry because of their innovativeness, popularisation of new technologies, keeping established firms on their toes, job creation and promotion of growth [21]. However, up to one half of small companies founded in any one year are not in business five years later – and inadequate management is considered a major factor here [21]. Also, there is a clear need for supporting deliberate and systematic product development decision-making in small product-oriented software companies [2,10,19].

This paper examines how product portfolio management as explained in new product development literature applies to the context of small software product companies operating in turbulent environment. Section 2 presents the specific questions posed and the methods used in seeking answers to them. Section 3 presents the results, and section 4 concludes the paper with discussion and directions for further research.

2. Research questions and methodology

This paper aims to provide preliminary answers to the following questions:

- 1) What is the state-of-the-practice of product portfolio management in small, product-oriented software companies, and what are the problems and challenges as perceived by the practitioners and the author?
- 2) To what extent is state-of-the-art literature helpful in solving the problems and challenges found, and what are the main gaps between existing literature and practitioners' needs?

Answering these questions involves a literature review and investigating portfolio management within

its real-world context. For the latter, the author has taken up action research in the form of multiple qualitative case studies. This is also deemed as a suitable approach by Yin [22]. The selection of the three case companies was opportunistic and based on accessibility, i.e., the companies' participation in the research projects of our institute. The representativeness of the sample has not yet been evaluated, making the results at this point indicative of the situation rather than conclusive.

Question #1 was addressed through observing how the case companies' product development portfolios and long-term product development plans are managed, and what the problems and challenges involved are. For this, I conducted monthly interviews of 1-2 hours in length at the case companies for a period of five months. The interviewed persons were responsible for managing product development. In addition to these interviews, I was able to observe real-time portfolio management decision-making through participating in meetings that dealt with planning future products and product releases in one of the case companies. I attended meetings that ranged from 2 to 3 hours each and recorded the discussions. I also took notes and asked for necessary clarifications and discussed possible insights with the head of product development (who also attended the sessions) after each meeting. This helped me understand the nature of portfolio management in its real-life context and find the right focus and the important questions to ask in those case companies where direct observation of portfolio-level decision-making was not possible.

Parallel to conducting the mentioned monthly interviews and observation, I approached question #2 by conducting a review of literature and regularly discussing the proposed solutions with the case companies. This was done as I participated along with my colleagues in creating and improving the product development processes of the case companies.

3. Results

This section summarises the state-of-the-practice of portfolio management in the case companies and the respective problems and challenges as perceived by the case companies and the author. The principles of product portfolio management as explained in the literature are presented, and the limitations of applying existing literature in the studied context are discussed.

3.1. State-of-the-practice in the case companies

None of the case companies managed their development efforts as an explicit portfolio at the start of the co-operation, and all had experiences of what

can be termed as inadequate portfolio management. Important product development decisions were often made based on the opinions of key personnel and without explicit discussion or justification. Because of unclear and shifting priorities, overbooking of resources was common, while some important activities such as long term product and release planning did not receive enough attention. Although important portfolio decisions did get made, they were not necessarily taken deliberately, but rather inadvertently, or even through inaction. Likewise, the key personnel were not always aware of the gamut of important decisions they faced in managing their new product development efforts. All of the companies agreed that their processes regarding these issues needed improvement.

3.2. Product portfolio management in the literature

According to Cooper, Edgett and Kleinschmidt, product portfolio management encompasses product strategy formulation and enactment, making go/kill/hold decisions for individual activities on an ongoing basis and conducting periodic reviews of all activities as a whole. Successful portfolio management achieves a balance between the four potentially conflicting goals of 1) *maximising the financial value* of the portfolio, 2) *linking the portfolio to strategy*, 3) *balancing* it on relevant dimensions, and 4) ensuring that the *total number of ongoing activities is feasible*. While portfolio management is essentially about resource allocation, the inherent complexity of the issues involved keeps it far from being a mechanistic exercise. [9]

There are two different approaches to implementing portfolio management. The first approach, called *gates dominate*, is bottom-up, emphasising decision-making through in-depth reviews for each ongoing project. The second approach, *portfolio reviews dominate* is top-down, with decisions based on looking at the portfolio as a whole. In principle, the *gates dominate* approach is better suited for larger firms in mature businesses with fairly static portfolios and dedicated resources. Also, the *portfolio reviews dominate* approach is more appropriate for fast-paced companies in fluid markets because it promotes dynamic resource allocation. [9]

Both approaches to implementing product management build around and depend on having a Stage-Gate –based model for governing the life cycle of development efforts in place [9]. The Stage-Gate organises the new product development process, beginning with ideation and ending with product

launch and maintenance, into a sequential set of phases with different themes (the stages) and corresponding milestones (the gates). The gates represent business and prioritisation decision points, and development is conducted during the stages, along with gathering the information needed to pass the next gate. [8]

There are two common misconceptions regarding the appropriateness of Stage-Gate –based product development models for software development that have recently been addressed by SE literature. First, the Stage-Gate *is reminiscent* of the waterfall life cycle for software development. However, it does not prescribe the life cycle model used for software development, thus in principle allowing for iterative and incremental software development processes [15,20]. Second, the Stage-Gate [7] *seems* more descriptive of the life cycle of a completely new product of than that of a single release of an existing product – especially regarding the front-end phases of ideation, preliminary investigation and business case building. As explained in [15], this can be accounted for by correctly emphasising different stages for different kinds of releases.

3.3. Limitations of existing literature

We found that advances in managing new product development from large companies and other industries can be of use for small software companies: as the result of our joint process improvement efforts, the case companies have succeeded in implementing aspects of product portfolio management and are satisfied with the initiatives taken. However, it seems that our contribution, especially in helping to interpret the lessons from existing literature to the context, was significant. The interviewed product development managers felt that despite the improvements' importance, it was unlikely that the companies would have fared as well or even undertaken such work by themselves. A quote from one of the managers suggests an explanation of why these issues might be overlooked in small companies: *"Many of the problems we face seem to have already been solved, but the solutions masquerade as something that looks fit for companies very different from ourselves."*

Besides the problems in perception demonstrated by the quote, theoretical mismatches exist as well. I see the main problems in applying existing literature as 1) *the incompatibility of event paced approaches to portfolio management with time paced software development life-cycle models* and 2) *the approaches' design to large company context*. These are further explained in sections 3.3.1 – 3.3.2 below.

3.3.1. Differences due to pacing. In the software product business, there is typically major pressure on time-to-market, and release cycles have shortened from years to several months or even weeks [5]. Many modern approaches to software product development respond to these demands by being iterative, incremental and time paced in nature [17]. Time pacing means that actions at different levels – ranging from entering new markets, creating new products, making new releases, and introducing new services to conducting development in time-boxes of certain length – are done according to a pre-determined rhythm, with scope adjusted as necessary. Time pacing is considered a success factor especially when developing products for turbulent markets. In contrast, event pacing drives evolution according to occurrences, such as moves by the competitors, changes in technology, customer demands, or the completion of a specific set of features. [4] While not all of the case companies had time paced, iterative and incremental development processes in place, all saw the potential benefits from having such a process and actively aspired towards this.

Of the two Stage-Gate –based implementations of portfolio management (gates dominate vs. portfolio reviews dominate), emphasising portfolio reviews over gates is a better match for both time pacing and the software product business [9]. However, according to Cooper, Edgett and Kleinschmidt [9], even portfolio reviews are triggered by a certain development project reaching a gate. This, in turn requires having a prescribed set of deliverables ready for examination, making Stage-Gate –based portfolio management implementations *fundamentally event paced* regardless of whether gates or portfolio reviews serve as the dominant decision-making mechanism. Thus, of the software engineering triangle of time, scope and cost [3], Stage-Gate –based implementations of portfolio management emphasise (in order of relative importance) meeting scope, cost and time, whereas for time paced development life cycle models, this is reversed. This mismatch complicates process design, especially regarding resource allocation.

3.3.2. Differences due to size. In large companies, portfolio management means deciding on a multitude of development project opportunities concerning different product lines and their extensions, possibly across several business units [1]. In contrast, portfolio management in small product-oriented software companies emphasises the contents of upcoming releases for relatively few products. However, because portfolio management in the latter context also involves resourcing of different kinds of development-

like or even non-development effort requiring attention from the developers, it is not clear whether portfolio management is actually any less complex. In our case companies, the developers' attention was divided between developing new product releases, doing customer-specific development, customer deliveries, and often performing other services as well. Also, these activities were not necessarily explicitly managed as projects or even recognised as part of the product development portfolio. This complicated resource planning, often to the degree that it was more or less omitted because of its perceived futility. Thus, resource planning and allocation are more volatile in small organisations because on the average there are more responsibilities per person. The issue of technical resources having multiple and potentially conflicting roles and responsibilities is also noted but not further discussed by Cooper, Edgett and Kleinschmidt [9]. The author assumes this is due to its lesser severity in the context of larger companies.

In small companies, resources are also more limited in the absolute sense. This difference is illustrated by a quote from [8], which describes a course of action less likely to work in small companies (or software development [3]): *"Further, deadlines must be regarded as sacred [when time-to-market is essential]. ... Delays are dealt with via extra input of effort and resources, not [deadline] postponement."* Time paced development suggests adjusting scope as the alternative to postponing deadlines or putting extra resources on the job [17]. While this requires careful prioritisation and examination of dependencies, it seems a more feasible approach in the context of limited resources.

In small companies senior management participates more in the hands-on work [16]. From the perspective of portfolio management, this suggests that added value from holding in-depth gate reviews is lower because the managers tend to be more aware of what is going on at the floor level. On the other hand, explicit decision points are still needed – otherwise managers may end up making portfolio level decisions inadvertently [19].

4. Discussion and further work

I see the main contributions of this paper as twofold. First, a topic important to managing software engineering, product portfolio management, is identified. Product portfolio management is largely overlooked by current SE research but complements existing work in a way that holds potential benefits for the field. Second, the applicability of portfolio management is examined in a context not discussed by

literature, namely, that of small companies. While my findings are at this point indicative of the situation rather than conclusive, they suggest that in a large majority of product-oriented software companies, managing product development as an explicit portfolio is rare, resulting in a number of problems. While it seems that these kinds of companies would gain from managing their development efforts as an explicit portfolio, existing guidance to implementing portfolio management is based on assumptions that do not hold for modern software development processes or small companies.

In section 3.3, the main differences between the homeground of portfolio management literature and the context of this study were identified. The key question that cannot be answered based on existing literature is stated as follows:

How should product portfolio management be implemented in small software product businesses that employ time paced, iterative and incremental product development processes?

More specifically,

- 1) What would the pros and cons of a time paced portfolio management process (PMP) be compared to an event paced one, and what would it require from the development process?
- 2) Can 3rd generation Stage-Gate constructs [8] be used for implementing a time paced PMP? If not, to what degree can they be used in alleviating the problems due to the mismatch in pacing?
- 3) How does the involvement of senior management in hands-on work affect how PMP should be implemented?
- 4) How should the volatility in resourcing due to multiple & conflicting roles and responsibilities be accounted for in the PMP?
- 5) How should the "absoluteness" of resource constraints be accounted for in the PMP?
- 6) How can the different types of tasks requiring the developers' attention be accounted for in the PMP?

Further, of interest are whether these questions can be answered in a practical and theoretically sound manner, and if so, can the lessons learned be generalised across cases as an approach to implementing product portfolio management in the context of small software product businesses?

To provide answers, I am constructing and validating a generic and tailorable approach to implementing product portfolio management featuring time paced portfolio reviews and synchronised gates. The approach is designed to be suitable for managing a mixture of time and event paced activities in the

context of small software product businesses operating in a turbulent environment.

5. References

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