

Title:

Small software organizations need explicit project portfolio management

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Abstract:

The concept of managing new product development projects as an explicit portfolio originates from the context of large organizations. However, it has rarely been discussed whether explicit portfolio management is relevant for small organizations as well. We conducted a qualitative multiple case study of six small organizations (15-40 people) which developed software and provided related services. Five of the organizations did not practice explicit portfolio management. They also seemed to suffer from problems that in the literature are considered symptomatic of inadequate portfolio management, such as having too many simultaneous projects, overcommitment in terms of workload and ineffective executive decision-making. In one of the studied organizations, management had recognized the need for explicit portfolio management and introduced portfolio management practices, such as regular reviews of the project portfolio, appointing specific people for resolving cross-project conflicts, and limiting the number of concurrent projects a person can be assigned to. The personnel we interviewed perceived clear improvements in the related problem areas since the introduction of these practices. Our study suggests that explicit portfolio management is relevant for small software organizations, at least when the development personnel possess multiple roles and responsibilities and are concurrently performing many different types of activities.

INTRODUCTION

The majority of software companies offer both software products and professional services for the purposes of sharing risk, supporting innovation and balancing their cash flow [1-5]. The processes, competencies and resources needed for running software service and software product businesses, however, are intrinsically different [1,5-9], and an improper balance in resource allocation has been noted “an easy way to ruin an otherwise good business” [1].

The process for achieving balanced resource allocation in terms of value maximization, strategic alignment, risk level and the number of ongoing projects, is in literature on managing new product development known as *portfolio management of new product development projects* [10], or portfolio management for short. Portfolio management deals with 1) managing a set of (possibly different types) of activities that 2) use the same resource pool in order to 3) meet objectives without violating specified constraints, for example, the availability of resources or desired risk level [10-13]. In portfolio management, projects are evaluated, selected, prioritized, launched and canceled [14].

Also, business strategy is adapted as needed according to information gained during the projects' realization [15].

The concept of portfolio management originates from the context of large organizations, where activities are primarily organized as projects, there is an explicit strategy, and dedicated portfolio management personnel exist [16]. The relevance of portfolio management in the context of small organizations – software, product development, or otherwise – has not been discussed [16-18]. It is plausible that in small organizations, resource allocation would be managed by a small group in a timely response to client demands, with the decisions being shared, communicated and understood without the aid of more formal approaches or tools [18]. On the other hand, in small organizations the same people are responsible for managing a number of “portfolios” in addition to the portfolio of development projects. These other portfolios involve ongoing sales, deliveries and other services as well as relationships with customers and partners [19].

Modern approaches to managing software development [20] have also up to until quite recently [21-24] neglected the portfolio perspective and instead focused on managing individual development projects [25]. Overall, little help is currently available for the manager of a small software company or organization with several concurrent projects and a wide range of responsibilities [26]. Thus, it is reasonable to inquire whether explicit portfolio management might be relevant for small software organizations as well.

In this study we look into the topic by comparing the problems experienced by six small software organizations with problems that in the literature are associated with inadequate portfolio management. We also present the portfolio management practices employed by one of the organizations to tackle their problems.

RESEARCH PROBLEM AND METHODOLOGY

This section presents our research problem, research questions, and the methodology we used to answer the research questions.

Research problem

Our research problem is set as follows: *Do small software organizations suffer from the lack of explicit portfolio management?*

Portfolio management decisions always get made – sometimes consciously, but also inadvertently, through inaction, or by accident. Thus, the lack of an explicit portfolio management process does not necessarily cause problems: the mix of ongoing activities in a small organization may be simple enough to be managed project-wise, or even without formal project management. For example, if the ongoing activities have no resource or deliverable dependencies, explicit portfolio management may not be needed. To assess whether an organization is actually suffering from the lack of explicit portfolio management, we need to know what symptoms occur in conjunction with inadequate portfolio management. If an organization exhibits many or most of such symptoms, but

does not consciously practice portfolio management, it is reasonable to propose that explicit portfolio management could be beneficial.

In accordance with the above reasoning, the research problem is further broken down into four research questions:

- 1) What symptoms are associated with inadequate portfolio management?
- 2) Do small software organizations practice portfolio management?
- 3) What kinds of problems do small software organizations experience in managing their development activities?
- 4) Are the problems similar to those are considered symptomatic of inadequate portfolio management?

Research question 1) is answered on the basis of a review of literature on symptoms associated with inadequate portfolio management. To answer research questions 2) and 3), we present an overview of how five small software organizations practiced – or rather, did not practice – portfolio management and the problems they experienced in managing their development activities. We contrast this with one small software organization that did practice portfolio management and the problems they experienced. To answer research question 4), we compare the symptoms associated with inadequate portfolio management as described in the literature with the problems experienced by the case organizations. The research problem itself is, after discussing the limitations of the study, answered in the conclusions of this paper.

Literature review

We conducted a literature review in two steps. First, we searched through 19 books on managing new product development and/or software development to 1) provide a preliminary outline of what missing or poor portfolio management and the resulting symptoms look like, and 2) to identify keywords for database searches. The books were selected informally, based on their accessibility and perceived relevance. We then continued with a systematic review [27] through the ScienceDirect™ portal, thus covering the journals relevant for portfolio management [28] as defined in this study.

The terminology used in the literature is diverse [28], and using many different keywords seemed necessary for finding the relevant research papers. As keywords for the database searches we used the terms that had surfaced during the book review as essentially synonymous or very closely related to the concept of portfolio management as defined in the introduction. These were *pipeline management*, e.g. [29-31], *NPD portfolio and pipeline management*, e.g. [32], *portfolio selection and management*, e.g. [33], *new product development decision-making*, e.g. [34], *R&D project selection*, e.g. [35], *R&D resource allocation*, e.g. [36,37], *project prioritization*, e.g. [38], *aggregate project planning*, e.g. [39], *multi- or multiple project management*, e.g. [40-42] and *program management*, e.g. [43]. We tested for keyword validity by conducting further searches using combinations of the most common new keywords from those articles that were found relevant in our database searches, as well as those articles that explicitly discussed

related keywords [28,44]. Details of the database search protocol such as criteria for stopping the search and including and excluding articles are described in [45].

With the database searches we discovered a total of 34 research papers that contained material describing inadequate portfolio management and/or the typical problems that occur in conjunction with it. The papers focused on a specific problem area, for example resource allocation [37,46,47], and/or provided generic problem lists of their own, e.g. [48-50]. The overlap of these problem lists was limited, warranting the creation of a synthesis.

Case study design

The selection of the case organizations was purposeful [51], as they were participating in our research projects on software process improvement at the Helsinki University of Technology. Possible implications of the selection on the results are discussed in limitations.

The case organizations, here referred to as *Achilles*, *Hector*, *Odysseus*, *Ajax*, *Proteus* and *Theseus* are all small, with 7-30 developers and 15-40 personnel in total. Theseus is an independent business unit of a 100 person company, while the other case organizations are small companies.

The state of practice in the case organizations as described in this study is based upon interviewing 5-10 people at each organization, depending on the case. At Achilles, Hector and Odysseus, we first conducted a semi-structured in-depth interview with the companies' product development managers, and then informal, conversation-like interviews with other product development personnel for triangulation. The interviews were not aimed at examining the state of portfolio management in the companies, but to gain an overview of their work practices and perceived problems and challenges. Based on the results of these interviews, we started to suspect that many of the perceived problems the companies faced could stem from inadequate portfolio management. Thus, we revised our interview questions to include topics that directly addressed whether portfolio management was being conducted, implicitly or explicitly, and whether the personnel experienced symptoms that in the literature are associated with inadequate portfolio management. At Ajax, Proteus and Theseus, all of the interviews were semi-structured, and the revised interview questions were used.

LITERATURE REVIEW

In order to answer research question 1) (*What symptoms are associated with inadequate portfolio management?*) we distilled the findings of the literature review into *eight problems that are symptomatic of inadequate portfolio management*: 1) *Excessive multitasking*, 2) *Fire-fighting*, 3) *Overload*, 4) *Ineffective decision-making*, 5) *Missing strategic alignment*, 6) *Slipping schedules*, 7) *Project failures and poor profitability* and 8) *Perceived need to improve project management*. These are further described below.

Excessive multitasking

Assigning the same individual to multiple parallel projects enables organizations to use their expertise on more than one project [33] and reduces the time resources are idle [52,53]. The best developers may find themselves assigned to more than four or five concurrent projects [39] or crisis management duties [36]. People assigned to too many concurrent projects start working in a “time-sharing” manner in an attempt to show progress on all projects they are working on [41]. The completion of each project is slowed down [54], and time is lost due to learning, forgetting and re-learning [46,55]. More time is needed for non value-added activities such as “update” and problem solving meetings [39,54,56]. Excessive multitasking has also been reported to result in perceiving work as disrupted and fragmented, with less opportunities for recuperation, competence development or improvement of work routines [52].

Fire-fighting

Fire-fighting refers to the reactive and unplanned allocation of resources to fix problems that are discovered late in a project or during maintenance. Fire-fighting is a self-reinforcing phenomenon and sometimes becomes the de facto process for resource allocation: activities must be proclaimed as urgent if they are to be attended to at all [37]. While management should have the flexibility to re-allocate resources [57,58], reactive resource redistribution tends to produce unanticipated negative effects on other projects in the portfolio [38].

Overload

Resource demands are commonly met with having people work overtime because of its effectiveness on the short term [50,55]. However, often too few people are simply trying to accomplish too much [48,58-60]. A typical overload is 2-3 times the actual capacity [36,39]. Overload may also occur when a significant amount (up to 50%) of development resources’ effort is spent on tasks the developers are not supposed or even known to attend to or, which are perceived to have a marginal impact in terms of resource expenditure [36,58].

Ineffective decision-making

Ineffective is used here as an umbrella term for 1) *late*, 2) *toothless*, and 3) *misguided and/or uninformed* portfolio level decision-making. First, senior management may lack the time or the commitment to participate in portfolio decision-making [60], provide the necessary guidelines [30] or give feedback to guide the projects to the right direction [39]. Thus, they deal with problems at the last moment only, if at all [39]. As a result, development decisions with strategic implications have to be made by the frustrated developers [30]. Second, ongoing projects may be very hard to kill [47]. Projects are seldom stopped [49], and when they are, they may be put in a “hold tank” – an endless list of projects recognized as inferior but which nobody wants to kill [35,47,50,57,61]. The incentives of the managers or sales people may also be tied to the projects in a dysfunctional way [47,50]. Third, a common situation is that no relevant data on which

portfolio decisions could be based has been collected [35]. Management may also be overwhelmed with all the possible ways to plot and visualize relevant information [57], and the information models used for portfolio level decision-making may imply a degree of precision far beyond the reliability of the actual data [31].

Missing strategic alignment

The ongoing mix of projects may not be strategically aligned [30] or have no apparent link to strategy or organizational goals [59,60,62]. As there is no possibility to make fire-fighting or project selection decisions in the context of strategy, divergence between individual projects and the entire organization's goals develops easily [30,36,62,63]. A portfolio consisting of many relatively small projects of low value, such as tweaks and modifications to existing systems, has also been reported to be a sign of missing strategic alignment [35,48].

Slipping schedules

Sometimes projects are late [36,58,60], time-to-market is increased [35,62], and development cycle times are poor [48] because of inadequate portfolio management. Target dates do not become commitments, because everyone knows that the priorities will shift and the dates will be revised again [39].

Project failures and poor profitability

Project failures, disappointing project outcomes and poor profitability are often associated with inadequate portfolio management [54,60]. Profitability may suffer due to compromised project scope and quality, too many low or high risk projects, or not penetrating the market. Product launches may be issued in an indifferent manner and the overall failure rate of products and/or features is high [35,62].

Perceived need to improve “project management”

Inadequate portfolio management may not be recognized as a cause of the troubles experienced. Instead, the personnel believe that better project management, e.g. more detailed planning or more precise effort estimates would help [54]. While efficient management of individual projects has been found important for efficient portfolio management, it is not sufficient to guarantee it [64].

CASE STUDIES

To answer research questions 2) (*Do small software organizations practice portfolio management?*) and 3) (*What kinds of problems do small software organizations experience in managing their development activities?*), we conducted six case studies [65]. This section provides an overview of the case organizations, their common denominators and problems, and compares the latter with the symptoms of inadequate portfolio management identified from the literature. We also present the portfolio

management practices employed by one of the case organizations to tackle its problems. Table 1 provides an overview of the case organizations.

INSERT Table 1 HERE

Common denominators

All of the case organizations offered software services as well as products that require a varying degree of integration and/or customization. They also developed new features in customer-specific projects and included the results as part of their platform or a later product release. The developers were working on many activities besides software development (for example, sales, maintenance, deliveries, customer service and consulting). In the majority of our case organizations, only some of these activities were managed as explicit projects. Some of the services offered were not related to the products offered. For example, at Hector and Achilles some developers were doing management consulting, and at Achilles, a significant percentage of its entire development staff was contracted to other companies for longer-term software development projects. The multiple roles of the employees seemed sometimes to be inherently conflicting. For example, the product manager at Odysseus acted simultaneously as the manager of a certain customer-specific development project and recognized himself as biased towards letting through requests from his own customer with a less thorough consideration for the overall direction the product should be going to. All of the case organizations were profitable, and had experienced fairly rapid growth in revenue and in personnel during the years preceding this study.

Portfolio management in the case organizations

As an answer to research question 2) (*Do small software organizations practice portfolio management?*), only one of our case organizations, Theseus, managed the developers' activities as an explicit portfolio. However, as stated earlier, it is plausible that small organizations do not have to explicitly practice portfolio management.

In the following section we examine the problems and improvement needs stated by the interviewees at the case organizations. Then, we describe the portfolio management practices used at Theseus. Finally, we compare the problems and improvement needs experienced by all of the case organizations with the symptoms of inadequate portfolio management as described in the literature.

Problems experienced by the case organizations

To answer research question 3) (*What kinds of problems do small software organizations experience in managing their development activities?*), we now review the problems experienced by the case organizations.

Excessive multitasking

At Achilles, Hector, Odysseus, Ajax and Proteus, most of the developers were working on several concurrent projects. Seeing what implications decisions in a project had on the

other projects in the portfolio was challenging due to the missing “big picture” and consequently, unknown resource interdependencies.

At Theseus, some people were still occasionally involved in too many concurrent activities. However, the situation had improved much during the last year because of a conscious effort by the management to limit the number of concurrent assignments.

Fire-fighting

At Achilles, Hector, Odysseus, Ajax and Proteus, resource planning was seen as difficult, and was often omitted entirely because of its perceived futility. Instead, resource allocation and prioritization of ongoing activities mostly “happened” through fire-fighting or personal judgment. Decisions were being made on the level of individual projects, with their effects rippling across the entire portfolio and causing a cascade of new decisions. Most of the interviewees felt that priorities were unclear, and many felt that they were shifting constantly.

At Theseus, the ongoing activities were not explicitly prioritized against each other, but most interviewees considered that in practice it was usually quite easy to come up with a marching order for the projects when the need arose. While the criteria for selecting and prioritizing development activities had not been explicated beforehand, the interviewees had, upon asking, reasonably uniform opinions on what kinds of activities were most valuable for business.

Overload

At Achilles, Hector, Odysseus, Ajax and Proteus, overbooking of especially some developers was common. Often, this was due to having other time-consuming tasks besides the actual project assignments. Also, new projects were sold without properly considering the projects’ impact on the already overloaded development staff. And, with the big picture missing, the developers’ efforts could not be systematically re-scoped or re-prioritized. As a result, some important activities, for example, testing, did not receive enough attention, causing surprises later on.

At Theseus, while the uneven demand of customer-specific development projects posed challenges in terms of overload, prioritization decisions were said to be made consciously when the need arose. Also, some people were still missing overload indicators (see next section).

Inefficient decision-making

At Achilles, Hector, Odysseus, Ajax and Proteus, the personnel seemed generally less aware of the gamut of decisions they were making as part of their daily work. Important product development decisions were made based on the opinions of the key personnel without explicit discussion or justification, and often it was up to the developers to decide what tasks to do and what to drop. While we cannot directly comment on the quality of these decisions, we found out that at least some of the interviewees in each company considered that the dialogue between the business (in other words, top management and

sales) and the development people (later, just Business and Development) was in need of improvement (see *missing strategic alignment* below).

At Theseus, the roles and their responsibilities, i.e. who should decide what for different types of development activities and in different situations seemed quite clear for the interviewees.

Missing strategic alignment

At Achilles, Hector, Odysseus, Ajax and Proteus, most of the interviewees (except for the top managers) complained that the strategy of the company had not been updated or at least communicated for some time now. Dialogue between Business and Development was considered scarce, and combined with a lack of long-term plans for the products, product development efforts seemed to have little explicit consideration for business case. Most of the ideas for new features or products had originated from Development and were technical in nature. At Hector and Odysseus there was an active dialogue between Business and Development, with the downside being shifting priorities and the impulsiveness in setting up new projects – which often resulted in not getting old assignments finished as they were overridden by new ones. For example, product development efforts that had at one point been deemed important were constantly postponed or otherwise compromised because of pressures from customer-specific projects. No long-term plans or explicit visions for the products existed, except possibly in the minds of the CEOs, and the ‘idea generator’ sales manager at Hector.

At Theseus, there was an explicit strategy set by the management (see the section on *explicit practices for portfolio management* below for details).

Slipping schedules

At Achilles, Hector, Odysseus, Ajax and Proteus, the internal schedules planned for the projects rarely held. However, with respect to the external deadlines agreed with the customers, the interviewees considered that their performance was no worse than that of their peers. As put by one of our interviewees, slipping schedules were seen as “business as usual in the industry”.

At Theseus, keeping to the agreed schedules was also seen as challenging, although less so than in the past.

Project failures and poor profitability

All of the case organizations, including Theseus, were to some degree suffering from compromised project profitability due to project overruns, not being able to start planned new projects in time, and a long project finalization phase because of too little or too late testing.

The interviewees at Theseus considered that they were past the worst period, while the struggles at the other case organizations had only recently begun. Still, all of the case organizations were profitable. A possible explanation for this is survivor bias [3], that is, our sampling did not reach less successful organizations.

Perceived need to improve “project management”

At Achilles, Hector, Odysseus, Ajax and Proteus, the personnel considered that their project management practices were seriously in need of improvement. However, most of the interviewees were not at the time conceptually aware of the distinction between portfolio and project management. When inquired further, the majority of the interviewees came to the conclusion that the topmost improvement need was actually to gain an understanding of the big picture, that is, a common view of what projects and other activities were underway that required attention from the development people, how resources were allocated to these activities, what the activities’ relative priorities were – and why so.

At Theseus, the personnel considered that processes for project management were in reasonably good shape. Roughly half of the interviewees considered that the emphasis of improvement was currently in making the process and practices for portfolio management more explicit. Although portfolio management decisions were being made by those who “should” make them, added communication of the decisions made was perceived to help in explicating, communicating and refining the long-term plans and strategy. While we noticed that adoption of the newly defined development process was still in progress, the overall satisfaction of the interviewees with their current ways of working seemed better than at the other case organizations.

Explicit practices for portfolio management at Theseus

Below we go through the specific practices (*in italic*) that Theseus had employed to alleviate the respective problem areas.

Developers were consciously assigned to *no more than two projects at any one time*. The *big picture of who was assigned to what was kept up-to-date using a toolset* developed internally during the past couple of years. Decisions that could affect other projects were *escalated to a specific forum, where those involved resolved possible conflicts*, facilitated by the head of the business unit.

The *developers’ workloads were tracked* using the internally developed support toolset. The *decision-making responsibilities of the various roles had been explicated*: developers were free to make choices that did not affect the goal setting or content of project iterations; project managers could make choices that did not affect the goal setting or schedules for the entire project; and the head of the business unit was responsible for project prioritization in case of conflict or when a project had run into trouble that could jeopardize its external schedule or goals.

There were *regular meetings for both reviewing the ongoing development activities* (for example, to change resource allocation as necessary) as well as *the status of the possible leads* (what projects may begin or should be sought for in the immediate future). Theseus’ management expressed strategy via *ambitions* (for example “We are growing profitably”), *goals* (for example “Ten new customers this year” or “profitability should be 10%”), *means* (for example “developers should spend 75% of their effort in billable

activities” or “three new leads per salesperson per month”) and *key performance indicators* (for example “cash flow from new customers per total cash flow” or “average billing per person hour” – portfolio management related indicators were still missing, though). The *types of activities the developers’ efforts should be spent on* were product development, customer-specific development projects, competence development outside of customer projects, and internal projects. Theseus had also defined *how much (in relative terms) should different roles in an ideal situation spend* in each category.

Deviations from the schedule were easier to spot in advance due to *systematic progress reporting* using the tool support in place. Projects’ profitability was tracked via *logging all project related effort, regardless of whether it was directly billable or not*. Also, the *incentive systems for sales people accounted for the projects’ realized billing* (including the warranty repair period) instead of just the sales achieved.

Summary

Table 2 summarizes the symptoms of inadequate portfolio management as identified from the literature, and compares these with the problems experienced at all of the case organizations.

INSERT Table 2 HERE

As can be seen from Table 2, the problems experienced at Achilles, Hector, Odysseus, Ajax and Proteus – who did not practice explicit portfolio management – seem to match the symptoms of inadequate portfolio management. However, Theseus, with explicit portfolio management practices in place, was better off in all of the areas. Interestingly, the top management at Achilles, Hector, Odysseus, Ajax and Proteus seemed less critical of their practices for managing the development efforts than the other interviewed roles. In contrast, the interviewed developers and project managers at Theseus seemed more satisfied with the current practices than the top management. This can be considered to be in line with the notions that challenges with portfolio management often disguise themselves as project management problems [54], and that the top management plays a crucial role in adopting and implementing portfolio management [62].

To answer research question 4) (*Are the problems similar to those are considered symptomatic of inadequate portfolio management?*), the problems experienced by the case organizations seem similar to the symptoms associated with inadequate portfolio management.

LIMITATIONS

The discussion below is organized according to the research methods used. The answers to the research questions are summarized in the conclusions (see Table 3).

Literature study

The literature study on problems associated with inadequate portfolio management was conducted after the data at Achilles, Hector and Odysseus had been collected. This is because we realised that many of the problems could stem from the lack of explicit portfolio management only after the initial interviews had been completed.

The bias of looking for evidence in support of the hypothesis is difficult to avoid [51]. In this case, the fieldwork may have affected the literature study. To limit potential bias, we tried to conduct our literature review in a systematic and reproducible manner, using a defined protocol to e.g. include and exclude material. However, we did not systematically go through the reference lists of the articles produced by the database search. Still, the end results seem adequate for the intended comparison. Using a defined protocol in the literature review can also be considered an improvement compared to the majority of contemporary software engineering research [66].

Case studies

Currently, we do not have evidence of how typical our cases are of the population of small software organizations. Our co-operative relationship with the organizations creates a potential for sampling bias. It can also be questioned whether organizations who – like our cases – experience pressures in managing their portfolio are an actual majority in the population of small software organizations. The representativeness of our sample should in the future be further examined by the means of, for example, surveys.

Because the data for Achilles, Hector and Odysseus was originally gathered to study the companies' work practices in developing software and not portfolio management per se, our analysis had to rely on less detailed data for these cases. To alleviate bias, the comparison was made for those problems that were experienced by all of the case organizations.

The categorization of the symptoms of inadequate portfolio management can also affect the results of the comparison. To assess whether we had unconsciously formulated our list of symptoms so that it matches with the case organizations' problems, we matched the discovered problems against the symptom lists found in the literature [49,58]. Also based on this comparison, our case companies do seem to suffer from the lack of explicit portfolio management.

Finally, we acknowledge that the symptoms may have many root causes besides inadequate portfolio management. However, the perceived improvements at the single organization who had taken strides towards explicit portfolio management are encouraging. While the underlying set of problems can be complex, explicit portfolio management may still be a reasonably effective remedy.

CONCLUSIONS

We conclude the article by answering the research problem in the light of the study's limitations. We then outline managerial implications and present directions for future research.

Answering the research problem

Table 3 below summarizes the answers to the research questions along with the related limitations.

INSERT Table 3 HERE

Based on the answers to the research questions and the limitations of the study, we answer the research problem as follows: *explicit portfolio management seems relevant for small software organizations, at least when the development personnel possess multiple roles and responsibilities and are concurrently performing many different types of activities.*

Contribution and managerial implications

In this study we summarized problems associated with inadequate portfolio management from existing literature and presented six small software organizations who suffered from similar problems. We also presented practices employed by one of the organizations that seemed to alleviate the problems.

Explicit portfolio management seems to be relevant in the context of small software organizations, and the management has a crucial role in making it happen. Based on the Theseus case, it seems that finding out what the development resources are actually spending their time on, distinguishing between different types of activities, and extending the boundary of the "project portfolio" to these, could be the starting point for improvement efforts. Defining who gets to make what kinds of decisions, conducting regular reviews of the portfolio of ongoing activities and active leads, limiting the number of concurrent projects per person, having a forum for solving cross-project conflicts and tracking individuals' workloads seemed to be effective portfolio management practices at Theseus.

Our case organizations had four common denominators we suspect may predispose similar organizations without explicit portfolio management to problems. These were 1) *leveraging customer-specific projects for product development*; 2) *dealing with a portfolio of different kinds of activities* instead of a clear-cut product, project or product development portfolio; 3) the developers' *multiple and sometimes conflicting roles and responsibilities*; and 4) *recent growth*. Even though the total number of products and services offered may not be high, these factors seemed to make the complexity of portfolio management comparable with larger organizations. It also seems reasonable to ask, whether portfolio management could in the context of small organizations be even more complex, as a single developer may have to deal with not only multiple and important, but inherently conflicting roles that involve very different kinds of decisions.

Directions for future research

This study suggests that at least organizations similar to our cases should not wait to perfect their single-project management practices until setting up explicit portfolio management. Quite the contrary, establishing the rudiments of portfolio management may in similar cases be a pre-requisite for effective single-project management. However, implementing portfolio management has been referred to as a “notable challenge for even the most progressive company” [32]. Further research is warranted, and it should aim at tailoring the existing solutions, principles, guidelines and tools to the small organization context; we propose three focus areas.

First, while our findings support the notion that all activities that require the attention of the development people should be included in portfolio management [10], the burden of “projectifying” and listing every single activity has been denoted impractical [58]. Thus, guidelines on what kinds of development activities should be included in the explicitly managed portfolio – and to what degree – are needed.

Second, top management’s and developers’ differing perspectives of the state of current practices and improvement needs may detain the right course of action from taking place. Thus, a systematic approach for assessing – or better yet, self-assessing [67] – the state of portfolio management and its adequateness could prove useful.

Third, despite the small organization context, tool support may play an important role in deploying portfolio management practices. Having proper project management information systems in place has been reported to directly impact projects’ success [68] and eases the necessary understanding of the “big picture” of ongoing activities [69]. However, only 20% of organizations have information systems in place that support multi-project and portfolio management [70]. Further, even those organizations that are otherwise satisfied with their project management tools recognize the need for support in this area [71]. While we did not assess the tool support in place at Theseus in detail, we suspect that having light-weight but adequate tool support may be a key success factor in implementing portfolio management in small software organizations. Because of the danger of going overboard with the planning and scheduling capabilities of project management information systems [69], future work should focus on understanding the degree of necessary tool support. This includes investigating the applicability and value of various techniques that claim to help in maintaining the big picture while concentrating on the tasks at hand, e.g. [72].

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Figures and tables:

Case	Type of business	# of employees
Achilles	Mobile enterprise solutions and professional services	19
Hector	Solutions and services for relationship and customer information management	21
Odysseus	Solutions for securing electronic transactions	15
Ajax	Solutions and services for automating safety-critical logistics	15
Proteus	Systems for optimizing the operation of transport vehicles	20
Theseus	Solutions and services for industrial business integration	40

Table 1: Overview of the case companies

Symptom	Situation at Achilles, Hector, Odysseus, Ajax and Proteus	Situation at Theseus
Excessive multitasking	Developers assigned to several concurrent projects	Some people still assigned to too many concurrent activities
Fire-fighting	Decisions made on the level of individual projects, effects ripple across the portfolio	Ongoing activities' priorities not explicit outside of conflict resolution
Overload	<ul style="list-style-type: none"> - Overbooking of the resources common, partly due to having other major duties besides projects - New projects launched without consideration for resource implications 	<ul style="list-style-type: none"> - Some people still missing overload indicators - Uneven demand recognized as the reason for challenges in scheduling
Inefficient decision-making	<ul style="list-style-type: none"> - Developers forced to decide which tasks to skip - Personnel not aware of the distinction between project and portfolio management 	Portfolio level performance indicators missing
Missing strategic alignment	<ul style="list-style-type: none"> - No long-term plans for product development - Relative priorities of the ongoing projects unclear for most developers - Setting up new projects frequent and impulsive 	"Ambitions, goals & means" explicitly defined; project types defined and target spending levels set
Slipping schedules	Schedules rarely held	Keeping to the agreed schedules seen as challenging
Project failures and poor profitability	Compromised project profitability due to project overruns and long finalization phases	Basic problem similar, but perceived less severe than in the past
Perceived improvement needs	<ul style="list-style-type: none"> - Interviewees generally felt that better project management and planning were necessary - Developers more critical of the current situation than top management 	Overall satisfaction with current practices better than at the other case companies; Top management more critical of the current mgmt practices than developers

Table 2: Symptoms of inadequate portfolio management vs. the situation at the case companies

Research question	Answer	Limitations
1) What symptoms are associated with inadequate portfolio management?	Excessive multitasking, Fire-fighting, Overload, Ineffective decision-making, Slipping schedules, Missing strategic alignment, Project failures and poor profitability, Perceived need to improve portfolio management	Review protocol did not systematically go through the reference lists of the articles found relevant
2) Do small software organizations practice portfolio management?	Only one out of six case companies had made strides towards explicit portfolio management	No evidence of how well the case organizations represent the population
3) What kinds of problems do small software organizations experience in managing their development activities?	See the answer to research question 1), except for poor profitability	Survivor bias; Also, the problems may have been not around long enough to affect business performance adversely
4) Are the problems similar to those are considered symptomatic of inadequate portfolio management?	Yes – except for the company that had explicit portfolio management practices in place	The symptoms may have many root causes besides inadequate portfolio management. See also the limitation regarding research question 2)

Table 3: Answering the research questions