

# Small software organizations need explicit project portfolio management

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*The concept of managing new product development projects as an explicit portfolio originates from the context of large organizations. However, the question as to whether explicit portfolio management is relevant for small organizations is rarely discussed. We conducted a qualitative multiple-case study of six small organizations (with 15–40 people) that 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, the management personnel 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 to which a person can be assigned. The personnel we interviewed perceived clear improvements with respect to various challenges since the introduction of these practices. Our preliminary study suggests that explicit portfolio management is relevant for small software organizations, at least in cases in which the development personnel possess multiple roles and responsibilities and are concurrently performing many different types of activities.*

## Introduction

Most 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 a software service and software product businesses, however, are intrinsically different [1, 5–9], and an improper balance in resource allocation has been noted as “an easy way to ruin an otherwise good business” [1].

The process for achieving balanced resource allocation in terms of value maximization, strategic alignment, the risk level, and the number of ongoing projects is discussed in the literature on managing new product development and is

referred to as *portfolio management of new product development projects* [10], or portfolio management for short. Portfolio management deals with managing a set of (possibly different types of) activities that use the same resource pool in order to meet objectives without violating specified constraints, for example, the availability of resources or the desired risk level [10–13]. In portfolio management, projects are evaluated, selected, prioritized, launched (i.e., introduced to the public or to a market), and canceled [14]. Furthermore, the business strategy is adapted as needed according to the information gained during the realization of projects [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

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organizations—such as those involving software or product development—has rarely 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 different kinds 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 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.

In this study, we examine the topic by comparing the challenges 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 address their problems.

## Research problem and methodology

In this section, we present our research problem, research questions, and the methodology we used to answer various research questions.

### Research problem

Our research problem can be stated as follows: *Do small software organizations suffer from the lack of explicit portfolio management?* Note that portfolio management decisions are always 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 sufficiently simple to be managed for each project or even without formal project management. For example, if the ongoing activities have no resource or deliverable dependence, 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 intentionally or explicitly practice portfolio management, it is reasonable to propose that explicit portfolio management could be beneficial.

In accordance with the above reasoning, the research problem may be subdivided 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 these problems similar to those that 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 the extent to which five small software organizations practiced 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-study organizations. After discussing the limitations of the study, the research problem is answered in the conclusion 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 in order to provide a preliminary outline of the characteristics of missing or poor portfolio management and the resulting symptoms, and we identified keywords for database searches. The books were informally selected, based on their accessibility and perceived relevance. We then continued with a systematic review [27] through the ScienceDirect\*\* portal, thus examining 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 we had discovered during the book review as essentially synonymous or very closely related to the concept of portfolio management as defined in the introduction. These terms 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], *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 from those articles that explicitly discussed the related keywords [28, 44]. The details of the database search protocol such as the 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 inadequate portfolio management. 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., see [48–50]. The overlap of these problem lists was limited, warranting the creation of a synthesis of lists.

### **Case-study design**

We selected several organizations for case studies, which we refer to as *case organizations* [51]. These organizations had been participating in our research projects on software process improvement at the Helsinki University of Technology. Possible implications of the selection on our results are discussed in the “Limitations” section of this paper.

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 smaller companies.

We determined the state of practice in the case organizations described in this study by interviewing five to ten people at each organization, depending on the case. At Achilles, Hector, and Odysseus, we first conducted semistructured in-depth interviews with the product development managers of the companies, followed by informal conversation-like interviews with other product development personnel for an additional perspective. 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 semistructured, and the revised interview questions were used. As a representative example of the kind of individuals we interviewed, the eight interviewees at Theseus were a business analyst, a business developer, a business unit head, a process manager, a system architect, a system developer, and two project managers. Furthermore, as a representative example, the types of work performed by the development personnel at Theseus involved various internal projects, customer-specific development projects, systems platform development, maintenance, customer support, sales, consulting, and customer training.

## **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 problem areas that are symptomatic of inadequate portfolio management: 1) excessive multitasking; 2) firefighting; 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 problem areas are further described below.

### **Excessive multitasking**

Assigning the same individual to multiple parallel projects enables organizations to use the person’s expertise for more than one project [33] and reduces the time that 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 on which they are working [41]. The completion of each project is slowed [54], and time is lost due to learning, forgetting, and relearning [46, 55]. More time is needed for activities with low inherent value such as “update” meetings 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].

### **Firefighting**

*Firefighting* refers to the reactive and unplanned allocation of resources to solve and fix problems that are discovered late in a project or during maintenance. Firefighting is a self-reinforcing phenomenon and sometimes becomes the *de facto* process for resource allocation: activities must be claimed to be urgent if they are to be attended to at all [37]. While the management personnel should have the flexibility to reallocate 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 by having people work overtime because of the effectiveness of this approach in the short term [50, 55]. However, often, too few people are simply trying to accomplish too much [48, 58–60]. A typical overload may be two to three times the actual capacity of the workers [36, 39]. Overload may also occur when a significant amount (up to 50%) of development resource effort is spent on tasks that the developers are not supposed to attend to or that are perceived to have a marginal impact in terms of resource expenditure [36, 58].

### ***Ineffective decision making***

The term *ineffective* is used here as an umbrella term for: 1) late; 2) toothless (e.g., lacking clout); and 3) misguided and/or uninformed portfolio-level decision making. First, the 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 in 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 terminate [47]. Projects are seldom stopped [49], and when they are, they may be put in a “holding tank”—an endless list of projects recognized as inferior but which nobody wants to terminate [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 have 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 firefighting or project selection decisions in the context of strategy, divergence between individual projects and the goals of the entire organization easily develops [30, 36, 62, 63]. A portfolio consisting of many relatively small projects of low value, such as small adjustments and modifications to existing systems, has also been reported to be a sign of missing strategic alignment [35, 48].

### ***Slipping schedules***

We use the term *slipping* to refer to a falling behind in terms of a schedule such as a scheduled production rate or delivery date. 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 company workers know 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 insufficient penetration of 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 may 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 to be important for efficient portfolio management, it is not sufficient to guarantee such efficiency [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 and 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 address its problems.

**Table 1** provides an overview of the case organizations.

### ***Common denominators***

All of the case organizations offered software services and 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 performing 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 sometimes seemed to be inherently conflicting. For example, the product manager at Odysseus simultaneously acted as the manager of a certain customer-specific development project and recognized himself as biased toward accepting requests from his own customer with a less thorough consideration for the overall direction to which the product should head. During the years preceding this study, all of the case organizations were profitable and had experienced a fairly rapid growth in revenue and personnel.

### ***Portfolio management in the case organizations***

As an answer to research question 2 (*Do small software organizations practice portfolio management?*), only one of

**Table 1** Overview of the case companies.

<i>Case</i>	<i>Type of business</i>	<i>Number of employees</i>
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

our case organizations, i.e., Theseus, managed the activities of the developers as an explicit portfolio. However, as stated earlier, it is plausible that small organizations do not need to explicitly practice portfolio management.

In the following section, we examine the problems and needs for improvement stated by the interviewees at the case organizations. Next, 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. It was a challenge to observe what implications decisions in a project had on the other projects in the portfolio—due to the missing “big picture” (i.e., overall view and perspective) and, consequently, unknown resource interdependence.

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

#### **Firefighting**

At Achilles, Hector, Odysseus, Ajax, and Proteus, resource planning was seen as difficult and was often entirely omitted because of its perceived futility. Instead, resource allocation and prioritization of ongoing activities mostly “happened” through firefighting 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 the priorities were unclear, and many felt that they were constantly shifting.

At Theseus, the ongoing activities were not explicitly prioritized with respect to each other, but most interviewees considered that, in practice, it was usually quite easy to establish explicit directions or directives 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 the business.

#### **Overload**

At Achilles, Hector, Odysseus, Ajax, and Proteus, overbooking (in terms of workload), particularly of some developers, was common. Often, this was due to having other time-consuming tasks aside from the actual project assignments. Furthermore, new projects were sold without properly considering the impact of projects on the already-overloaded development staff. Additionally, with the “big picture” missing, the developers’ efforts could not be systematically rescheduled or reprioritized. As a result, some important activities such as testing did not receive sufficient attention, causing surprises in the future.

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

#### **Inefficient decision making**

At Achilles, Hector, Odysseus, Ajax, and Proteus, the personnel seemed generally less aware than at Theseus 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, the developers seemed to be the responsible parties that decided what tasks to perform and what to discard. While we cannot directly comment on the quality of these decisions, we discovered that at least some of the interviewees in each company considered the dialogue between the business personnel (i.e., top management and sales people) and the development personnel (later, business and development personnel) to need improvement (see the next section).

At Theseus, interviewees were quite clear about personnel roles and responsibilities, i.e., which personnel had decision-making capabilities for different types of development activities and in different situations.

### ***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 areas was considered rare, and combined with a lack of long-term plans for the products, product development efforts seemed to be performed with little explicit consideration for a business case. Most of the ideas for new features or products had originated from the development area and were technical in nature. At Hector and Odysseus, there was an active dialogue between the business and development areas, with the downside being shifting priorities and the impulsiveness in establishing new projects, which often resulted in unfinished assignments 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 chief executive officers and the “idea generator” sales manager at Hector.

At Theseus, the management personnel set an explicit strategy (see the section “Explicit Practices for Portfolio Management at Theseus” below for details).

### ***Slipping schedules***

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

At Theseus, keeping to the agreed upon 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 cost and schedule overruns, the inability to start planned new projects in time, and a long project finalization phase due to 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. Nevertheless, all of the case organizations were profitable. A possible explanation for this is the 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 we 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 relative priorities of the activities were, and why such priorities and related consideration existed.

At Theseus, the personnel considered that processes for project management were reasonably effective. Roughly half of the interviewees considered that the emphasis on improvement was currently directed toward making the process and practices for portfolio management more explicit. Although portfolio management decisions were being made by those who “should” make them, additional 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***

In the following paragraphs, we discuss 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 were assigned to particular projects was kept up to date using a*

toolset developed within the company during the past few years. When useful, 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 *workloads of developers were tracked* using the internally developed support toolset. The *decision-making responsibilities of the various roles had been explicated*, and 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. The head of the business unit was responsible for project prioritization in case of conflict or when a project had encountered trouble that could jeopardize its external schedule or goals.

*Regular meetings were held for both reviewing the ongoing development activities* (e.g., to change resource allocation as necessary) and reviewing *the status of the possible leads* (i.e., projects may begin or should be sought in the immediate future). The Theseus management personnel expressed a strategy via *ambitions* (e.g., “We are growing profitably”), *goals* (e.g., “Ten new customers this year” or “profitability should be 10%”), *means* (e.g., “developers should spend 75% of their effort in billable activities” or “three new leads per salesperson per month”), and *key performance indicators* (e.g., “cash flow from new customers per total cash flow” or “average billing per person hour”). However, portfolio-management-related indicators were still missing. The *types of activities on which the efforts of developers should be spent* were product development, customer-specific development projects, competence development outside of customer projects, and internal projects. Theseus had also defined *how much time (in relative terms) personnel in different roles in an ideal situation should spend* in each category.

Deviations from the schedule were easier to identify in advance due to *systematic progress reporting* using the tool supports in place. The profitability of projects was tracked by *logging all project-related effort, regardless of whether it was directly billable or not*. Furthermore, the *incentive systems for sales people accounted for the realized billing of projects* (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. As can be seen from Table 2, the problems experienced at Achilles, Hector, Odysseus, Ajax, and Proteus—companies that 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 personnel at Achilles, Hector, Odysseus, Ajax, and Proteus seemed less critical of their practices for managing the development efforts than the personnel in 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 consistent with the notions that challenges with portfolio management are often disguised as project management problems [54] and that the top management plays a crucial role in adopting and implementing portfolio management [62].

In answer to research question 4 (*Are these problems similar to those that are considered symptomatic of inadequate portfolio management?*), it indeed appears that the problems experienced by the case organizations are similar to the symptoms associated with inadequate portfolio management.

## Limitations

In this section, we mention the various limitations of our study, and we believe that the preliminary observations, caveats, and ideas in this paper will provide useful guidance for future work. The discussion in this section is organized according to the research methods used. The answers to the research questions are summarized in the conclusions (see **Table 3**). Additionally, the limitations of our protocols and study are briefly summarized in Table 3.

## Literature study

We conducted our literature study on problems associated with inadequate portfolio management after the data at Achilles, Hector, and Odysseus had been collected. This “delay” took place because we realized 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 the potential bias, we attempted to conduct our literature review in a systematic and reproducible manner, using a defined protocol to, for example, include and exclude material. However, we did not systematically examine the reference lists of the articles produced by the database search. Nevertheless, the end results seem adequate for the intended comparison. Using a defined protocol in the literature review can also be considered an improvement when compared to a significant number of contemporary software engineering studies [66].

## Case studies

Currently, we do not have evidence of how typical our cases are of the population of small software organizations. Our cooperative relationship with the organizations creates a potential for a sampling bias. It can also be questioned

**Table 2** Symptoms of inadequate portfolio management and the situation at the case companies.

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

whether organizations that (like our cases) experience pressures in managing their portfolio are an actual majority in the population of small software organizations. In the future, for example, the representativeness of our sample should be further examined by means of surveys.

Because the data for Achilles, Hector, and Odysseus were originally gathered to study the work practices of the companies in developing software and not portfolio management per se, our analysis had to rely on less detailed data for these cases. To alleviate the 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 problems of the case organizations, we matched the discovered problems against the symptom lists found in the

literature [49, 58]. Furthermore, 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 aside from inadequate portfolio management. However, the perceived improvements at the single organization that had taken strides toward explicit portfolio management are encouraging. While the underlying set of problems can be complex, explicit portfolio management may still be a reasonably effective remedy.

## Conclusion

We conclude this paper by answering the research problem with respect to the limitations of our study. We then outline managerial implications and present directions for future research. The work presented in this paper, although in its early stages, may serve as a “launch pad” for future work in this area.



**Table 3** Answering the research questions.

<i>Research question</i>	<i>Answer</i>	<i>Limitations</i>
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, and perceived need to improve portfolio management	Our review protocol did not systematically examine the reference lists of the articles that were deemed to be relevant
2. Do small software organizations practice portfolio management?	Only one out of six case companies had made strides towards explicit portfolio management	We have 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 not have existed for a sufficiently long time to adversely affect business performance
4. Are these problems similar to those that 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 aside from inadequate portfolio management. See also the limitation regarding research question 2

### **Answering the research problem**

Table 3 summarizes the answers to the research questions along with the related limitations inherent in this work. 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 based on existing literature and presented six small software organizations that suffered from similar problems. We also presented practices employed by one of the organizations that seemed to alleviate the problems.

As mentioned, explicit portfolio management appears to be relevant in the context of small software organizations, and the management personnel play a crucial role in ensuring its success. Based on the Theseus case, we believe that determining what the development personnel are actually spending their time on, distinguishing between different types of activities, and extending the boundary of the “project portfolio” to these activities could be the starting point for

improvement efforts. Defining which personnel are enabled to make particular decisions, conducting regular reviews of the portfolio of ongoing activities and active sales leads (i.e., opportunities), limiting the number of concurrent projects per person, having a forum for solving cross-project conflicts, and tracking workloads of individuals seemed to be effective portfolio management practices at Theseus.

Our case organizations had four common denominators that we suspect may predispose similar organizations without explicit portfolio management to problems. These common traits included the following: 1) making use of customer-specific projects for product development; 2) dealing with a portfolio of different kinds of activities instead of a clearly defined product, project, or product development portfolio; 3) the multiple and, sometimes, conflicting roles and responsibilities of developers; 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 be concerned with not only multiple and important roles but also inherently conflicting roles that involve very different kinds of decisions.

### Directions for future research

This study suggests that at least organizations similar to the ones we studied should not wait to perfect their single-project management practices until setting up explicit portfolio management. On the contrary, establishing the rudiments of portfolio management may, in similar cases, be a prerequisite 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 obviously needed, and it should involve 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 listing every single activity and managing each as an explicit project has been deemed 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, differing perspectives of the top management and the developers on the state of current practices and improvement needs may inhibit the appropriate 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 should 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 project success [68] and facilitate the necessary understanding of the “big picture” (wide perspective) of ongoing activities [69]. However, only 20% of organizations have information systems in place that support multiproject and portfolio management [70]. Furthermore, 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 simple but adequate tool support may be a key success factor in implementing portfolio management in small software organizations. Because of the danger of devoting excessive effort to trying to utilize 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 are claimed to help in keeping the larger perspective while concentrating on the current daily tasks, e.g., [72].

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