



Agile portfolio management: An empirical perspective on the practice in use

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Abstract

Agile project management methods revolutionized the way how software projects are executed and organized. The question, however, on how to enable agility outside of individual projects and help larger organizations to compete with small entrepreneurial companies requires further attention. As a possible perspective, project portfolio management provides a global view on resources and their distribution across individual projects according to strategic choices. Based on 30 interviews conducted in 14 large European organizations this study contributes to the understanding of agile project management methods applied in IT project portfolios. First, we empirically identify the domains of practice. Then, guided by literature and our data we discuss the characteristics and implications of the agile portfolio management practice in our case organizations. © 2014 Elsevier Ltd. APM and IPMA. All rights reserved.

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1. Introduction

Agile project management methods caused a silent revolution in the way projects are organized and executed (Abrahamsson et al., 2009; Dybå and Dingsøyr, 2008). While originating in software projects, the methods are gaining increased attention in the general field of project management. In 2011, for example, the term “*agile project management*” for the first time surpassed “*agile software development*” on Google Trends. However, the current methods are bound to a “sweet spot” (Hoda et al., 2010) of small, co-located software projects and individual teams.

In order to break out of this comfort zone and implement the advantages of agile project management in broader organizational contexts, research calls for a view on agility outside of individual projects and teams (Kettunen and Laanti, 2008). One possible

perspective, especially prominent in project-based organizations, is that of project portfolio management (PPM). PPM links organizational strategy to the distribution of resources across projects in the portfolio (Cooper et al., 1999; Martinsuo and Lehtonen, 2007). As such portfolios provide an opportunity to make organizations more agile outside of individual projects.

While portfolio management is well established in traditional project management literature, the iterative nature of agile methods introduces new challenges to the current management practice. Agile methods show substantially different patterns of action to traditional projects (Nerur and Balijepally, 2007; Thummadi et al., 2011). They are largely based on recurring activities, so-called organizational routines (Pentland and Feldman, 2007), such as iterative delivery of intermediate results or daily standup team coordination meetings (Schwaber and Beedle, 2001; Williams, 2012). Agile software development is fast and flexible due to frequent feedback loops, iterative reviews and close customer contact. Without this direct interaction agile methods lose much of their effectiveness (Hoda et al., 2010; Stettina and

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Heijstek, 2011). This is especially challenging for larger organizations with well established routines and structures.

Leffingwell (2007, 2010), Krebs (2008), and Vähäniitty et al. (2012) propose frameworks for agile portfolio management and point out initial benefits and challenges, however, there is a lack of empirical evaluation. While most contributions originate in consulting literature only a few limited single-case studies exist on program management (Kettunen and Laanti, 2008; Laanti, 2008; Laanti et al., 2011), and a few conference publications exist on the application of agile methods within project portfolios, all in individual organizations (Kalliney, 2009; Rautiainen et al., 2011). In order to close this research gap we take the perspective of the concrete practices applied across three stakeholder teams: senior management, portfolio management and project management. We interviewed project and portfolio management staff in 14 organizations in the Netherlands, Germany and Sweden on their experiences in using agile methods in the context of IT project portfolios. The 30 interviews resulted in a total of roughly 1600 min of recorded material.

In this paper we report on this study for the first time presenting an insight on the portfolio management practice in multiple organizations applying agile methods. To the academics this paper provides an overview of the portfolio practice domains affected by agile methods, thus enabling an appropriate investigation on the necessary micro-activities to establish agile portfolio management capabilities (Salvato, 2009). To the project management professionals it provides an understanding of the potential characteristics of agile portfolios and the implications to be expected when applying agile project management methods in portfolios of projects.

2. Related work

While project portfolio management originates in project management literature (Martinsuo and Lehtonen, 2007), agile project management practices as we know them today originate in the domain of software development (Dybå and Dingsøyr, 2008). Further, the roots of agility in organizations can be traced back across multiple domains including manufacturing and logistics (Booth and Harmer, 1994). Due to different interpretations across domains the concept can be difficult to define (Laanti et al., 2013). Widely, agile organizations are regarded as those that learn fast and are effective (Booth and Harmer, 1994; Conboy, 2009). Agility as a concept to execute and organize software development projects emerged in the 1990s based on ideas found in new product development (Takeuchi and Nonaka, 1986). Agile project management methods such as Scrum (Dybå and Dingsøyr, 2008; Schwaber and Beedle, 2001) are design-oriented and enable frequent feedback loops based upon recurring project cycles (e.g. demonstration of intermediate results). Compared to traditional plan-driven project management methods they embrace project environments as uncertain and enable an iterative delivery of intermediate project results rather than assuming their predictability and a linear sequence of steps from project definition to delivery (Nerur and Baliyepally, 2007).

In project management literature the goals of project portfolio management are established as (Martinsuo and Lehtonen, 2007):

(1) maximization of the portfolio's financial values, (2) linkage of the firm's strategy to the portfolio, (3) and balancing the project within the portfolio with respect to the organization's capacities. There is a number of contributions describing how such a process is implemented in traditional project management practice, most prominently the work of Cooper et al. (1999) and the guidelines provided by the Project Management Institute (PMI, 2008). Although literature generally distinguishes portfolio management from program management in the fact that the projects are content-wise independent, there is an overlap to program management literature. Ferns (1991) distinguishes three types of programs: strategic (group of projects to implement a strategic reorganization e.g. change of an organizations mission), business-cycle (group of projects linked to a time-related business cycle such as an annual plan, this configuration is generally understood as portfolio management) and single-objective (a macroproject, so large in size that it is divided and managed as a group of smaller sub-projects).

While the standard PPM models mentioned above have their specialities the main concept remains the same, they describe mostly linear process steps to *identify, prioritize, allocate, balance* and *review* the projects within a portfolio. In that sense the iterative nature of agile methods with frequent reevaluation of project results might affect current portfolio management practice. Lycett et al. (2004) point at the contextuality of multi-project environments. They outline the fact that current frameworks assume an equally effective application of prescriptive and highly structured approaches in all contexts. Recent contributions argue that the complex societal setting of project work is not sufficiently reflected in the available frameworks, neglecting their embedment in context and the relevance of actors and their interactions constantly (re)shaping the project environment (Cicmil et al., 2006). To improve this understanding the literature proposes to conduct concrete empirical analyses of project management methods enacted in practice (Cicmil et al., 2006; Pentland and Feldman, 2007; Wenger, 1998).

Agile practices, are an integral part of agile methods such as Scrum. In Scrum many project management tasks are taken over by project teams. The practices are concrete team routines to a large extent based upon recurring micro-activities such as daily team coordination meetings, biweekly planning and review meetings with stakeholders, or post-mortem reviews (Williams, 2012). As such they make the software project management more explicit by describing team level routines and shedding light on parts of the process not considered earlier. However, these recurring activities make agile methodologies substantially different to traditional methods (see event sequencing study of Thummadi et al. (2011)). It is especially troublesome for large organizations which have to deal with co-existing sequential project management approaches and legacy systems. Here, the perspective of organizational routines (Pentland and Feldman, 2007) can be helpful in uncovering the underlying activities and their implications on existing practice.

Framework descriptions of agile methods applied in portfolio management are provided by Leffingwell (2007, 2010), Krebs (2008), and Vähäniitty et al. (2012). Leffingwell (2007, 2010) describes in his books and his framework description of the

Scaled Agile Framework (SAFe)¹ several practices to implement agile methods at enterprise scale. He divides his framework into the levels: portfolio, program and team. On portfolio level the portfolio management team maintains the portfolio vision, allocates resources to value streams through investment themes and defines and prioritizes a portfolio backlog, the highest-level mechanism and artifact holding business and technology development initiatives. On program level a product manager or comparable “chief content authority” Leffingwell (2010) constantly interacts with the portfolio management team and participates in decision-making on priorities of the program backlog. On team level about 5–10 agile teams are responsible for implementing and executing the projects following agile project management practices, such as those provided by Scrum. He further defines four core values of the frameworks as: alignment (of strategy from portfolio backlog down to the respective team backlogs), code quality (ensured by number of practices), transparency (to build trust and enable better decision making), and program execution (successful execution of the entire program).

In his book, Krebs (2008) proposes a dynamically managed portfolio based upon agile principles with flexible financial models. He divides portfolio management into project, resource (e.g. personnel) and asset (e.g. systems, applications, materialized projects) portfolio management while suggesting to use a dashboard to assess the situation as a whole and adopting progress, quality and team morale as key metrics for the individual projects. Krebs (2008) discusses challenges across these three portfolio domains as: 1) Project portfolio: too many active projects and incorrect mix of projects, 2) Resource portfolio: lack of vision, too many projects while not enough (right) resources, and lack of feedback, 3) Asset portfolio: legacy systems as roadblocks and underestimation of total cost of ownership. According to him, implementation of a project management office (PMO) and transparency of resources are key to agile project management.

The dissertation of Vähäniitty et al. (2012) discusses agile product and portfolio management in the context of small software organizations. He proposes a framework for connecting business and development decision making through three key processes (development portfolio management, product roadmapping, release planning (Vähäniitty et al., 2012, p.113) across three groups of actors (top management, strategic release management and software development management, (Vähäniitty et al., 2012, p.80). According to him the key steps in establishing agile portfolio management are: 1) establishing public prioritized list of all ongoing activities, 2) making sure incentive systems do not encourage local optimization, and 3) appointing a steering group to meet and regularly decide on priorities and resourcing.

While the most elaborated views of agile portfolio management are discussed in the references mentioned above, empirical evaluation of agile methods in portfolios and the enactment of the proposed frameworks are scattered. Initial challenges have been reported, especially those related to the alignment of business needs and strategy (Hodgkins and Hohmann, 2007; Kalliney, 2009), establishing agile IT project portfolios with prioritization,

resource allocation and governance (Rautiainen et al., 2011; Thomas and Baker, 2008) and synchronizing development dependencies (Hodgkins and Hohmann, 2007; Kalliney, 2009). Kalliney (2009) discusses issues concerning the alignment with business strategies and company vision, managing cross-team risks and synchronizing development dependencies as well as handling the knowledge and skill silos of the company. Hodgkins and Hohmann (2007) report their key challenges in the adoption of an agile program management office. They found that Scrum backlogs were insufficient in addressing business needs and introduced roadmaps as a filter to aid backlog prioritization and to communicate strategic intent and business opportunities between the product managers and the technical team. These findings indicate a need for further and more integrated research on agility in portfolio management.

While the interest on agile project management grows, there is little empirical evidence on the methods enacted in portfolio management and how the proposed frameworks relate to the characteristics across the domains of PPM practice. Based on the present state of the art we thus find it appropriate to pose the following research question: *What are the characteristics of agile portfolio management in use?*

3. Method

In this paper we aim to contribute to the understanding of management practices in a real-world context where events cannot be controlled. Thus we chose for a case study research approach as commonly proposed by the literature (Yin, 2009). Qualitative studies allow to research complex problems while developing rich and informative conclusions while engaging practitioners in a constructive dialog to create a shared understanding (Cicmil et al., 2006). As current literature on portfolios in agile software development focuses on single cases we chose to conduct a multiple-case study (Yin, 2009).

3.1. Case selection

In our case study research the unit of analysis, the single individual case, is an organization with IT project portfolios applying agile methods to manage and develop the endorsed projects. To select our case organizations we followed a replication logic strategy. This strategy, as recommended by the case study design (Yin, 2009) recommends selecting similar cases and dissimilar cases to provide similar and dissimilar results for predictable reasons. Accordingly we have chosen organizations with little experience and recent adoption of agile methods, as well as organizations with up to 10 years of experience with agile software development, as one could hypothesize a better integration of the process. Agile practices have been found especially adopted in small organizations (Hoda et al., 2010). Project portfolios however are rather to be found in bigger organizations, we thus set the scope of the study to large (more than 250 employees, at least 3 software development teams) organizations developing software projects by using agile methods. To ensure variability across the cases

¹ <http://www.scaledagileframework.com/>.

we selected organizations from different industrial domains with a variety of organizational structures.

We created an initial list of 25 organizations from references and Internet search according to the pre-defined selection criteria: large organization, active software development, agile methods adopted, presence of a project portfolio. Within the 25 contacted organizations 14 were chosen according to availability of interview partners. As some organizations use different terminology for portfolio and/or program management we use the definition of Cooper et al. (1999), following what Ferns (1991) defines as a group of projects linked to a time-related business cycle such as an annual plan. We have selected the organizations accordingly. The collected data from 14 organizations represent a rich set of fields from insurance, government to media.

3.2. Data collection: semi-structured active interviews

According to the qualitative design of our study the primary source of our data is semi-structured interviews. Those allowed us to collect rich data while keeping the flexibility necessary for an explorative study. According to Yin (2009) researchers should formulate a research question including potentially important variables, however, they should avoid linking variables and theories as much as possible. We know the importance of the software development and the portfolio management process. Based on those we created protocols for semi-structured interviews. The interviews covered the three domains: 1) portfolio management, 2) software development and 3) project handover. Example questions were: *Could you please write down a step-by-step description of your portfolio process, as detailed as you remember? What is your process of prioritizing, allocating, monitoring and reviewing of projects? Which specific agile practices were applied (e.g. iterations, standup meetings, pair programming)? Are you satisfied with your current process to manage the IT portfolio; what are your challenges?* The interviews took place between May and July 2012, were conducted face-to-face and voice recorded with the consent from the participants. The interview guide has been adopted in the course of the study to reflect on the comments of the participants.

In the course of the interviews we asked the participants to write down their activities step by step on a piece of paper as narratives (Pentland and Feldman, 2007), in their own words and as detailed as possible. This allowed us to capture their practice in natural language as well as visually and discuss it in the course of the interview. The interviewer was present during the entire interview, would ask questions and discuss the steps with the interviewee. This more active form of interviewing (Holstein and Gubrium, 1997) allowed the interviewers and interviewees to establish a deeper, commonly created understanding of the practice. When available we also asked the participants to provide documented process descriptions.

3.3. Data analysis

To analyze the data according to our study design we first created a full description of each case, then transcribed and coded the interviews and the collected process steps. This was

performed by both authors in an interleaved and iterative way. Firstly, the interviews have been transcribed and analyzed by using open, axial and selective coding. By open coding we broke down, compared and categorized the transcripts line by line assigning a code and a short summary to each. Coding was performed by both authors on consensus. An example of such a code is: *c_proc_commitment_seniormgmt: "Getting senior management committed"*. Secondly, the analysis of the process descriptions occurred in two ways: through visual mapping and through coding of narratives as emerged in the interviews. The collected narratives from the transcribed interviews, were coded by inductively deriving a set of categories by sorting the process steps across the organizations. Further, following Langley's framework for building theory from process data (Langley, 1999) we have selected the visual mapping strategy. Using graphical forms allows the presentation of large amount of information in little space and is a useful tool to develop and verify ideas in theory development (Langley, 1999). According to Langley (1999) this strategy requires at least five cases in moderate level of detail to begin pattern identification. The process descriptions as collected within the interviews have been carefully modeled according to the descriptions of each participant. All process diagrams were modeled and discussed by both authors and sent to the participants for feedback. By embracing textual narratives and visual representations we were able to capture the process, its structural dependencies and discuss them with participants.

4. Results

In this section we will describe the practice related findings in our data. Table 2 presents an overview on the organizations and their descriptive variables, such as the organizational structure, predominant project management frameworks and the roles of the interviewees. Due to privacy reasons and ethical considerations we anonymized our data and will identify the described organizations with the letters A–O. We will now begin describing our case organizations and their portfolio practices.

4.1. Case organizations

As we can see in Table 2 the majority of organizations in our data set are from the financial, governmental, and telecommunications sectors from the Netherlands, Germany and Sweden. Most organizations exhibit a functional structure. In all but organization B the adoption of agile methods begun bottom-up, originally starting with individual software development projects. In three organizations the portfolio is managed strategically with top management having an explicit role in identifying, prioritizing and authorizing the projects in the portfolio. In six organizations there is a single portfolio in the whole organization. Six out of the 14 organizations have multiple portfolios. In four organizations (D,E,F,K) the portfolios are part of a respective business unit with prioritization applied locally. The portfolios in that case are prioritized on level of the business unit.

All case organizations have a set of independent projects, thus a project portfolio (Cooper et al., 1999) or a business-cycle program (Ferns, 1991). However, although fitting this classification we observed that some participants call it “*portfolio and program management*”, pointing at the fact that there might be at times related projects in the portfolio. However, although this classification is fitting we observed that some participants call it “*portfolio and program management*”, pointing at the fact that there might also be program-like, related projects in the portfolio. Further, all organizations have different types of projects and initiatives in their portfolio, a range of supporting activities such as maintenance, replacement or upgrades or implementation of new technologies or techniques. “*Within our portfolios we have four types of projects which are continuity (IT), mandatory (Legal or branch agreements), integration (reduction of complexity) and strategic.*”, says the head of program and portfolio management (K).

Regarding the applied portfolio management methods, the first observation we made was that none of the organizations explicitly applied one of the frameworks of Leffingwell (2007, 2010), Krebs (2008), or Vähäniitty et al. (2012). Rather, the majority of our participants describe their application of PRINCE2 or an own not further specified general project management framework with own portfolio management practices. PRINCE2 (Murray et al., 2009), acronym for: PProjects IN Controlled Environments, version 2) is a process-driven traditional method similar to the guidelines provided by PMI (2008). As a general project management method PRINCE2 is widely used as a basis framework by project managers without a software development background especially among the Dutch organizations.

As represented in Table 2 the majority of our case organizations apply a mix of PRINCE2 as the general project management framework and Scrum or a derivate as the software development process. General PM methods are thus a major interface to agile techniques. “*We use a combination of PRINCE2 and agile (Scrum)*”, says a project manager (A). Responsibility for IT projects is generally divided among a project manager representing business and an IT project manager or team lead.

Scrum (Schwaber and Beedle, 2001) is the most applied software project management and development framework. The origins of Scrum lie in the “rugby” approach described by Takeuchi and Nonaka (1986). There a cross-functional team develops a product iteratively in overlapping phases instead of applying a linear process from the initial product definition to delivery. Scrum is an adaptation of the ideas to the context of software projects. It defines a set of practices (e.g. reviews, standup meetings), roles (e.g. team, product owners and team leads or coaches, so called ScrumMasters) and artifacts (e.g. work backlogs) to guide the iterative process (Schwaber and Beedle, 2001).

Regarding the specific standard agile practices in use (Williams, 2012), the majority of our case organizations apply standup meetings (daily coordination meetings of the team), development in short iterations (intermediate project results are frequently delivered and reviewed commonly reviewed by the team and project owners), and retrospectives (reflective sessions of the team on work process). What we generally observe is that in each organization a set of practices from the available frameworks is

adopted and mixed in practice: “*We use Scrum and Scrumban (Kanban with Scrum elements like Review and Retrospectives) and we make use of some XP elements (e.g. pair programming etc.)*”, says a head of project and portfolio management (N).

4.2. Identified domains of practice

During our analysis we identified 49 narratives related to the portfolio practice, we then sorted and organized all narratives into a chronological stream. An example of the sorted narratives can be found in Table 3. Considering the narratives and the visual process models created for each organization we clustered the reappearing patterns of action. After a number of iterations including the feedback of the participants we identified the practice across three groups of actors (senior management, portfolio management and project management) and grouped the activities into the four following practice domains in Fig. 1:

- *Strategize and roadmap*: This describes the actions taken to define the strategic course of the organization, generally done by the highest management (e.g. board of directors (A), governance board (F) or escalation group (K)). In our case organizations such a definition of the strategic course took place between one (A) and three years (B).
- *Identify and funnel*: This describes actions where project ideas are collected and enter the portfolio funnel of possible projects. While ideas are obviously created all across the organization, the entry point is generally provided by middle management.
- *Review, prioritize and balance*: This is the core of the portfolio management process. These actions generally occur within portfolio meetings with steering committees. “*Prioritization and allocation of resources are done by the portfolio management (vice-president level) (VP D level). Within the projects we speak of delegated commissioning; decisions about priorities and resources are always made at portfolio level.*”, says the project portfolio manager in organization O. These review meetings take place between 2 weeks (D) and 12 months (K).
- *Allocate and delegate*: Allocation of resources is generally done by a specific portfolio project manager, while delegation is done by project management. A speciality of agile methods is that teams *pull* their work items from the respective backlog. Instead of a project manager defining and delegating the tasks to the team, a backlog of all work items is created, and updated in each iteration. The team members then actively ‘pull’ their tasks from there. This generally happens in iterations of 1–4 weeks.

4.3. Perceived challenges in practice

After transcribing and coding all interviews we identified 25 exclusive thematic codes and 51 sub-codes related to the application of agile methods within the portfolios. We organized the identified themes into four categories as represented in Fig. 2:

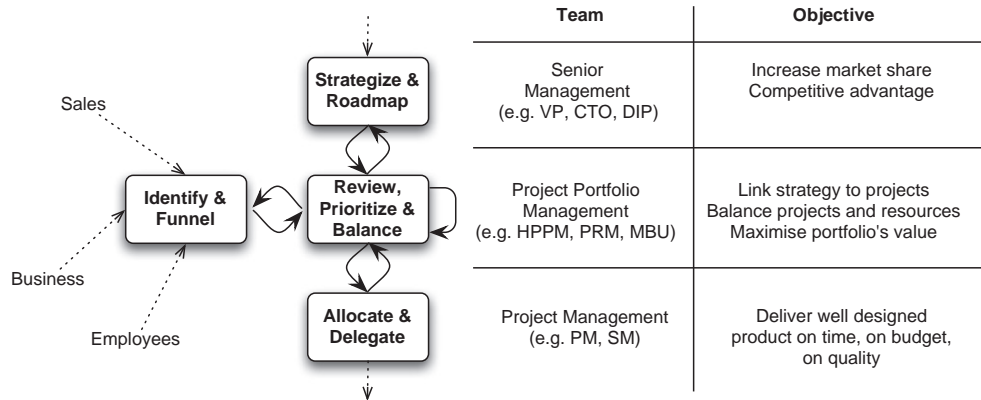


Fig. 1. Domains of portfolio practice identified in case organizations.

process, people, organization and technology. The coded themes were mentioned in the transcripts in 179 instances of which 99, 55% were related to the process, 22% were related to people, 16% to the organizations and 6% to technology. In this paper we will focus on discussing these process-related themes. The technology related challenges were mostly related to legacy systems, the people-related themes were culture and trust, and the organizational challenges related to difficulties in structure (e.g. hierarchies, bureaucracy), making an organization more agile and portfolio governance. Out of the process-related themes we found challenges related to alignment with existing processes (37 instances), commitment (23) and resource allocation (19).

- *Alignment to existing processes.* The alignment to existing project management, software production and business practices was the biggest challenge in the portfolio management process mentioned by participants.
- *Commitment.* In about a quarter of the identified process challenges the participants mentioned issues concerning the commitment of staff. Predominantly mentioned is the lacking commitment and involvement of senior management to the software development process.

- *Resource allocation.* The third most mentioned challenge is related to resource allocation, especially the allocation of teams to multiple projects simultaneously and reshuffling of teams.

4.4. Perceived benefits in practice

As our interview guide has been tuned to the collection of practice descriptions, the challenges and implications on portfolio management, the identified benefits emerged directly from the interviews. The benefits reported here have been mentioned by the interviewees and identified during the coding process alongside the challenges. Similarly to the challenges the main identified categories were: process (mentioned 18 times), people (16) and organization (6). Out of the process-related themes we found benefits related to alignment and coordination of customer needs (8), involvement of business, customers and maintenance teams (4), as well as planning (4). The distribution of themes across the categories can be found in Fig. 3.

- *Alignment and coordination.* Alignment to customer needs has been found beneficial with agile project management methods.

Challenges over cases

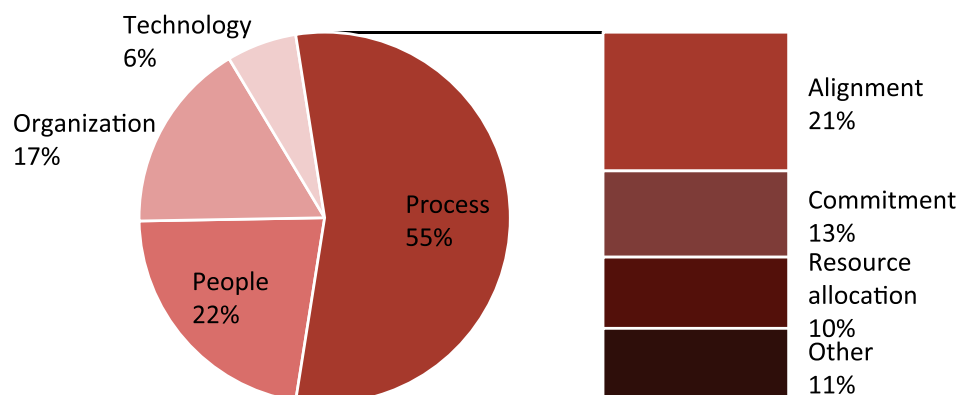


Fig. 2. Challenges reported in case organizations.

Benefits over cases

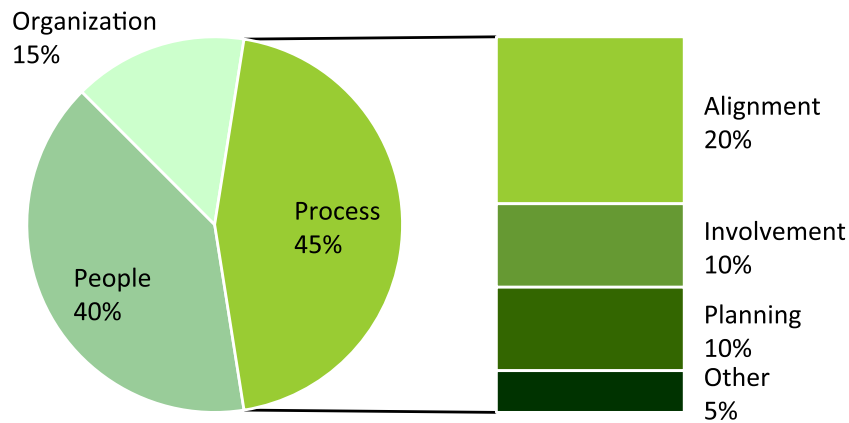


Fig. 3. Benefits reported in case organizations.

The participants report that agile methods are not always faster but more in line with wishes of a customer. Backlogs further improve coordination by providing a shared view on the work items.

- *Involvement of business, customers and maintenance teams.* Involvement of business and customers (e.g. by showing working software on preproduction environment) and IT maintenance teams (e.g. early involvement during development).
- *Planning.* Agile methods have been reported to provide more insight and transparency on actual status of projects.

5. Analysis and discussion

Based on the shared understanding of the cases and the collected narratives we will now discuss our findings. Table 2 depicts the descriptive variables and the concrete practices perceived as agile in our case organizations. A further comparison of these practices and characteristics across literature as well as the presented cases is depicted in Table 1. In order to create a better visual understanding of the interconnections across domains of practice, we depicted the involved actors and their objectives in Fig. 1.

Agile organizations are generally considered as those that learn fast and are effective (Booth and Harmer, 1994; Conboy, 2009; Laanti et al., 2013). In practice this is enabled by a set of routines stimulating interaction such as project team standup meetings, or reviews with product owners and users. We observe that in our case organizations these routines are expanded towards neighboring practice domains such as general project and portfolio management and production. This closer interaction across the domains is perceived as the biggest benefit. The alignment to existing practices and routines is perceived as the biggest challenge. “After introducing Scrum within the software development we see now that people around us start to stir (business and software management).”, says the director of product development (B).

Due to the self-managing and rather autonomous character, agile teams take over many traditional project management tasks. For example, they coordinate and plan their own work tasks, pull their work from *backlogs* co-defined and prioritized by the management (Leffingwell, 2010). Here we observe the preference to work in dedicated, stable project teams as well as a shift in culture towards collaboration based on transparency, trust and frequent interaction. “The Agile teams are self-managed, which is not yet fully accepted by team leads of the individual Agile team members. There are actually no more projects, but work that needs to be done. Higher management is used to be in control of projects and now have to trust the Agile teams that work gets done.”, says head of PPM (D).

Agile methods have been implemented bottom-up in the majority of our cases. This is reflected in the fact that characteristics perceived as agile can be mostly found on the project level and portfolio level. The characteristics in Table 2 are ordered according to their origin starting with the top management on the left to project management on the right. As presented in the table, dedicated project teams are a characteristic shared across the majority of our cases, followed by frequent portfolio reviews and embracing other activities than projects inside the portfolio to improve transparency of resources. Commitment of senior management to a more active role in the portfolio process is frequently pointed at, however, often lacking. These findings indicate that processual, routine related aspects (e.g. frequent portfolio reviews) as well as structural aspects (e.g. dedicated teams, one portfolio) are associated with and have implications on agile portfolio management.

In order to draw a richer picture on our data we will now proceed to discuss the characteristics across the three groups of actors involved: project, portfolio and senior management. As it is difficult to delineate what is “agile portfolio management” and what is not, we compare the collected narratives in context to: 1) the definitions of Laanti et al. (2013), 2) the characteristics shared in the frameworks of Leffingwell (2010, 2007), Krebs (2008), Vähäniitty et al. (2012), and 3) our interviewees’ perceptions of agility.

Table 1
Common characteristics of agile portfolio management across literature.

| | Leffingwell (2007, 2010) | Krebs (2008) | Vähäniitty et al. (2012) | Cases |
|------------------|---|--|--|--|
| | Senior Management | | | |
| Commitment | <ul style="list-style-type: none"> Executive sponsor | | <ul style="list-style-type: none"> Product portfolio management Roadmapping | <ul style="list-style-type: none"> Commitment to strategically managed portfolios |
| | Portfolio Management | | | |
| Transparency | <ul style="list-style-type: none"> Transparency to build trust and improve decision making Alignment of strategy from portfolio backlog down to team backlogs | <ul style="list-style-type: none"> Transparency of resources via ROI Project Management Office is crucial Funnel kept prioritized Incremental Return on Investment Risk-reward diagrams | <ul style="list-style-type: none"> Public prioritized list of all ongoing activities Traceability of iteration level work items to high level product and business goals Development portfolio management | <ul style="list-style-type: none"> Transparency on resources and decision making One portfolio for the entire organization Strategic backlogs |
| Collaboration | <ul style="list-style-type: none"> “Chief content authority” (e.g. product manager) participates in decision making | <ul style="list-style-type: none"> Iterative portfolio balancing | <ul style="list-style-type: none"> Release planning | <ul style="list-style-type: none"> Frequent portfolio reviews |
| | Project Management | | | |
| Team orientation | <ul style="list-style-type: none"> 5–15 agile teams | <ul style="list-style-type: none"> No project switching | | <ul style="list-style-type: none"> Dedicated project teams |

5.1. Project management

According to the literature agile project teams take over many traditional project management responsibilities such as assignment of individual tasks, estimation and planning of iterations. In our sample this is especially reflected in the fact that project teams actively pull their tasks from the portfolio. Agile teams are granted with a large degree of autonomy and self-management (Dybå and Dingsøyr, 2008; Schwaber and Beedle, 2001; Stettina and Heijstek, 2011). Our interviewees mention their preference towards working in stable teams. This is also reflected in the fact that 9 of the 14 organizations dedicate developers to one team. Furthermore, the responsibility for project success is divided among the *Product Owner* (Schwaber and Beedle, 2001), a formal project manager representing business and the team, represented by the ScumMaster. “Try to make a good tandem of project manager and Scrum Master”, says a project manager in organization A.

5.1.1. Team orientation

5.1.1.1. Dedicated software development teams. Resource allocation is recognized as a major issue in PPM (Engwall and Jerbrant, 2003). In matrix organizations team members are often allocated to different projects and teams at the same time. “Frequent switching between projects (determined by management) creates unrest. From a lean perspective this is waste. [...] Although we have scarce resources the amount of projects is too high.”, says coach (A).

Engwall and Jerbrant (2003) discuss that the two main reasons for this challenge in project portfolios are the failure of project scheduling and over commitment (to too many projects at the same time). Project organizations often try to allocate personnel to official project schedules and priorities via

complex resource planning systems. Due to project reality (e.g. frequent delays, change of plans) this resource allocation, however, often becomes obsolete and resources cannot be available at the scheduled point in time. An untransparent network of actors across multiple teams, assigned to several projects and across diverse departments creates unrest and organizational overhead. Krebs (2008) further discusses project-switching penalties taking into account the return of investment (ROI) (Krebs, 2008, p.119).

To counter this half of our case organizations prefers to have dedicated project teams. Having dedicated teams means that software developers are preferably dedicated to one (or two) project(s) at the same time. Our participants mention improvement of quality of their work and less unrest as positive consequence. “As we have steady dedicated teams, they own and maintain the code also after a project ends. [...] ...we assign work to teams and not teams to work, this is more a steady flow from the company backlog to the teams.”, says director agile project management (N).

5.2. Portfolio management

Linking strategy to budget and projects is a major goal of portfolio management (Martinsuo and Lehtonen, 2007). Enabling transparency by traceability of resources and work items is a recurring theme in literature and our cases. While six of our case organizations have one central portfolio for the entire organization, eight organizations have different project portfolios in the organization without a shared view on allocated resources across the individual portfolios. Transparency is further enhanced by the use of strategic portfolio backlogs (Leffingwell, 2010; Vähäniitty et al., 2012). Such lists of prioritized high-level work packages are further specified and divided into subsequent product and iteration backlogs in project teams. Such enable and maintain

Table 2

Case organizations and descriptive variables.

| | Organization industry | Organizational structure | Project management method | Software development method | Commitment to strategic portfolio | One portfolio | Other initiatives in portfolio | Frequent portfolio reviews | Dedicated teams | Agile experience (years) | Interviewees and their roles |
|---|-----------------------|--------------------------|---------------------------|-----------------------------|-----------------------------------|---------------|--------------------------------|----------------------------|-----------------|--------------------------|------------------------------|
| A | Insurance | Functional | PRINCE2 | Scrum/Kanban | ○ | ○ | ○ | ○ | ○ | 10 | 4 (PRM, PM,C, SM) |
| B | Investment | Functional | PRINCE2 | Scrum | ● | ● | ○ | ● | ● | 1 | 5 (DPD, PRM, MBU, 2xSM) |
| C | Telecom | Functional | (Custom) | Scrum | ● | ● | ● | ● | ● | 5 | 1 (HSD) |
| D | Auction | Matrix | (Custom) | Scrum | ○ | ○ | ○ | ● | ○ | 0.3 | 1 (HPPM) |
| E | Finance | Functional | (Custom) | Scrum | ○ | ○ | ○ | ○ | ● | 0.3 | 1 (C) |
| F | Government | Functional | PRINCE2 | RUP/Scrum | ○ | ○ | ○ | ○ | ○ | 2 | 3 (HSD,PM,SE) |
| G | Finance | Project | PRINCE2 | RUP/Scrum | ○ | ○ | ○ | ● | ● | 2.5 | 1 (CAI) |
| H | Government | Functional | (Custom) | ScrumBut | ○ | ● | ● | ○ | ○ | 0.1 | 1 (PM) |
| J | Government | Functional | (Custom) | Scrum/Kanban | ○ | ● | ● | ○ | ● | 3.5 | 1 (HSD) |
| K | Insurance | Functional | PRINCE2 | Scrum | ○ | ○ | ● | ● | ● | 3 | 3 (HPPM, DM, SS) |
| L | IT service | Functional | (Custom) | ScrumBut | ○ | ○ | ○ | ○ | ● | 4 | 2 (SRM, PM) |
| M | IT service | Matrix | PRINCE2 | Iterative RUP | ○ | ○ | ● | ○ | ○ | 1 | 4 (MBU,SM, 2xSE) |
| N | Social media | Project | (Custom) | ScrumBut | ○ | ● | ● | ● | ● | 3 | 1 (HPPM) |
| O | Media | Matrix | PRINCE2 | Scrum | ● | ● | ● | ● | ● | 1 | 2 (HPPM, DIP) |

Roles of the interviewees: Head of Project and Portfolio Management (HPPM), Director Product Development (DPD), Head of IT / Systems Development (HSD), Manager Business Unit (MBU), Director Innovation Planning (DIP), Senior Manager (SRM), Coordinator Agile Implementation (CAI), Program Manager (PRM), Project Manager (PM), Project Management Officer (PMO), Delivery Manager (DM), Coach (C), ScrumMaster/TeamLead (SM), System Specialist (SS), Software Engineer (SE).

traceability of work items throughout the domains of practice. The roles of portfolio and program managers can be affected by an agile transition due to the empowerment of teams, which collaboratively organize their tasks. Transparency can help in improving trust and collaboration.

5.2.1. Transparency

5.2.1.1. One portfolio for the entire organization. Literature does not reject having more than one portfolio within an organization (Krebs, 2008; PMI, 2008), however, having more than one portfolio might lead to an untransparent allocation of resources across the projects. Cooper et al. (1999) concluded that one of the clusters of businesses they studied used high quality rated portfolio methods which fit management well. One of these portfolio methods is treating all projects together as one portfolio

which is confirmed by Reyck et al. (2005). The participants of our study experienced difficulties having more portfolios and dependencies between projects within different portfolios. “From within IT we have limited impact on which and how many projects are started from the three ‘businesses’. Last year one of the businesses started all their projects at the beginning of the year which left little resources for other businesses.”, says a manager (F).

5.2.1.2. Other initiatives grouped within the portfolio. Project portfolio management considers the entire portfolio of projects a company is engaged in (Krebs, 2008; Reyck et al., 2005). All case organizations have different types of projects and other initiatives drawing from the same pool of resources. Examples of such initiatives can be the replacement or retirement of systems, maintenance projects or implementation of innovative systems.

Table 3
Example of narrative fragments as emerged from the interviews (sorted).

| ID | Narrative fragment |
|-------|---|
| ... | <i>Identify & funnel</i> |
| (N) | Management Board prioritizes according to strategy. |
| (P-1) | Project wishes from different staff members and innovation team enters the portfolio. |
| (P-2) | Management board selects projects as advised by portfolio team. |
| ... | <i>Review, prioritize & balance</i> |
| (A) | IT steering committee decides on budgeting and prioritization. |
| (B) | Business director Product Management comments and prioritizes on road map and backlog. |
| (C) | Strategic Product Managers keep the backlog up-to-date, prioritize and monitor projects. |
| (D) | Portfolio meeting on progress and resources is held every 2 weeks. |
| (E) | Review of projects ad-hoc |
| (F) | Steering committee of each primary process prioritizes and monitors projects according to own budget. |
| (G) | A triangle of portfolio manager, lead business change manager and enterprise architect discuss priorities and resources every 3 months. |
| (H) | Ad-hoc reviews by management, evaluation of large projects |
| (K-1) | Business unit reviews portfolio every 3 months. |
| (K-2) | Business unit management decides on projects for a year. |
| (M) | Management team of IT business unit prioritizes portfolio. |
| (N) | PMO prioritizes, facilitates reporting structure and external projects. Reviews take place in companywide meetings every 4 weeks. |
| (P) | Reviews and prioritization is done by portfolio management based on capacity (CAPEX) |
| ... | <i>Allocate & delegate</i> |
| (B) | Business Director Product Management assigns tasks to six teams (according to their field of expertise). |
| (C) | Planning Board (SPM + R&D) meets every week, discusses the detailed requirements and delegates to 12 agile teams. |
| ... | ... |

“Next to product initiatives we have other initiatives within the portfolio (infrastructure, marketing, legal) which are prioritized by product and validated by the Product Council.”, says the head of agile PPM (N).

While actually all organizations have different types of projects and initiatives, only six of the studied organizations have all initiatives within one portfolio. Blichfeldt and Eskerod (2008) point at the importance to keep all initiatives in sight as invisible projects and initiatives often drain resources originally assigned to the portfolio. The participants of the other eight organizations expressed their frustrations and worries about this situation. The head of system development department of organization F is not in control according to what projects are started when and making IT projects more visible.

5.2.1.3. Strategic backlogs. Usage of strategic product backlogs encapsulating highest strategic objectives has been mentioned among several participants as a key link to agility. Literature discusses those in the form of portfolio backlogs (Leffingwell, 2010), product content backlogs (Laanti, 2008) and roadmaps (Vähäniitty et al., 2012). These backlogs consisting of “epics” as the highest level objectives (Leffingwell, 2007, 2010; Vähäniitty et al., 2012), are broken down, further specified and linked to concrete team backlog work items as the teams move through the iterative process. *“Projects are managed by a company backlog*

approach on initiative levels, means that the PO-group is prioritizing all initiatives and teams pull the work from there.”, says the head of project portfolio management (N).

5.2.2. Collaboration

5.2.2.1. Close collaboration across the domains. Increased collaboration across the domains of practice is frequently associated with agile methods in our case organizations. Shared understanding on strategy and projects is constantly negotiated and evaluated by the involved actors. In order to establish such a shared vision the actors need to be willing to collaborate across their domains to establish and pursue a common vision.

Collaboration based on recurring patterns of action is discussed by Leffingwell (2007) across team, program and portfolio levels, and by Vähäniitty et al. (2012) across “top management”, “strategic release management” and “software development management”. Further, Hanssen and Fægri (2008) discuss the integration of agile software development and software product line engineering to support the company’s strategic and tactical goals by combining three interacting customer-centric processes: strategic (roadmapping, business cases), tactical (agile methods) and operational (day-to-day SE activities). *“I see much more communication among I&A and the Business and also among departments of I&A. While previously developers transferred their software to network- and system engineers, now they help them implement their software.”*, says team lead PPM in organization D.

Agile methods largely rely on direct communication. In organizations consisting of multiple teams documented knowledge becomes necessary and needs to be supported by appropriate artifacts and templates. Such have an influence on success and sustainability of a practice and need to be chosen carefully (Stettina et al., 2012). *“Agile goes beyond the software development department of an organization. [...] All documents (FO/TO, etc.) offer false security about the quality of a project. The result is a moving target and the world has changed during preparation.”*, says manager ICT (B).

5.2.2.2. Sufficiently frequent portfolio reviews. Agile methods stimulate collaboration on project level through recurring routines, however, they make frequent collaboration also more necessary on portfolio level. If project teams can deliver intermediate results more frequently, they neutrally need to receive more frequent feedback on what they should deliver next. *“...keep peace in the portfolio process...”*, says manager (B). How often portfolio reviews take place depends on the particular context. For example, if an organization operates in high velocity markets exposed to a big competition and project teams can deliver in intervals of 2 weeks, portfolio reviews in annual cycles will not be frequent enough to provide the teams with sufficient feedback. The majority found monthly reviews appropriate.

5.3. Senior management

Top management support is considered one of the most important factors for success of individual projects (Young and Jordan, 2008) and is frequently mentioned by our interviewees.

However, it is also one of the biggest challenges for organizations to link strategy to projects, especially when implementing the concrete actions (Aubry et al., 2007). Although the highest management should have an explicit and important role within the portfolio practice, in only three out of the 14 organizations it is the case.

5.3.1. Commitment — Management commitment to strategically managed portfolios

The participants in our study repeatedly name involvement and commitment of senior management to the practice and the integration of IT with the remaining businesses as crucial for an agile portfolio. The literature underscores the importance of having strategic management decide on project portfolios (Cooper et al., 1999; Dye and Pennypacker, 2000) and is a success factor for software projects (Chow and Cao, 2008). However, strategic management seems not aware of the possibilities this offers. While top management acknowledges the success of agile methods active participation is often missing. Almost all interviewees are not satisfied with the lacking exchange.

Getting commitment of strategic management demands a management view on agile software development. In most of our case organizations (all but B) agile methods were implemented by individual teams and then spread throughout the organizations without little or passive notice of senior management. After performing try-outs, which are often not at strategic management level, people want to continue but get stuck on management (Boehm and Turner, 2005). We have observed uncertainty about possible shifts in organizational roles, especially among managers as agile teams take over certain aspects of traditional project management such as planning and coordination. “*But there is a point at which the organization cannot be effective without executive leadership taking a role.*”, comments Leffingwell (2007, p.299). He highlights the importance of executives sponsoring the adoption, awareness and appropriate communication (Leffingwell, 2007).

5.4. Limitations

Although we employed a rigorous method and paid particular attention in selecting our case organizations and establishing a shared understanding on their practice, there are limitations to our study. The main limitation of this report lies in the limited amount of cases. Although we obtained a relatively large data set including the perceptions of 30 participants on their practice in 14 organizations, our sample might be difficult to reproduce and is not representative. To address external validity we use a replication logic strategy and compare our findings to the existing frameworks of Krebs (2008), Vähäniitty et al. (2012), and Leffingwell (2007, 2010). A further limitation is the qualitative design of our multiple-case study. Our data is based upon perceptions of the participants who might have a biased view on their work process (Pentland and Feldman, 2007). To improve construct validity and overcome intrinsic biases we applied triangulation by using multiple informants (e.g. conducting interviews on portfolio, project and development team level) and establishing a shared understanding through the application

of active interviewing. An in-depth ethnographical research (Salvato, 2009) is advisable at a further stage to explore the interaction across the routines. However, considering the explorative nature of this work, the amount of organizations and participants ensures a good foundation for further studies.

6. Conclusions

In this paper we contribute to the understanding of portfolio management in organizations applying agile project management methods. The existing literature provides either little empirical evaluation of agile portfolio management frameworks in use, or provides evidence from individual cases only (Kalliney, 2009; Laanti, 2008; Laanti et al., 2011; Rautiainen et al., 2011). In line with research on actuality of projects (Cicmil et al., 2006) we thus compare our data on the practice in use to the frameworks proposed by Leffingwell (2007, 2010), Krebs (2008) and Vähäniitty et al. (2012).

Stemming from interviews with 30 participants in 14 organizations, in total 1600 min of recorded material, our analysis indicates a common ground with shared characteristics across the frameworks proposed and our cases as presented in Table 1. In the vast majority of our case organizations agile methods have been initially adopted in individual projects not following a particular agile PPM framework. After a successful application in projects the importance to align the portfolio management practice becomes visible. Our data indicates that agility enabled on project level by recurring routines such as iteration reviews (Williams, 2012) is expanded towards neighboring domains of practice such as portfolio reviews. Our participants indicate a demand for more interaction across the domains and across strategy, tactics and operations (Hanssen and Fægri, 2008). However, with the increased frequency of interaction in projects and with the self-managing character of agile teams, current portfolio management practices might need to be adjusted to fit this enabled agility. Based on our observations above we have found implications of agile methods on three aspects of the portfolio practice:

1. *Routines: the frequent interaction based on routines in projects (e.g. reviews, standup meetings) stimulates the need for an appropriately frequent interaction in neighboring domains of practice (e.g. in PPM).*
2. *Structures: due to the self-managing nature, agile teams take over aspects of traditional project management. This has implications on the role of project and portfolio management. Further, work in stable teams is preferred in our case organizations.*
3. *Values: in order to support a closer interaction across domains of practice, a shared understanding how such a closer interaction could look like needs to be in place.*

Agile organizations are considered as those that learn fast and are effective (Booth and Harmer, 1994; Conboy, 2009). While it is difficult to delineate what is agile and what is not, we follow the advice of Laanti et al. (2013) and compare

the concrete practices applied. Based on those we observe the following characteristics shared across the existing frameworks and our cases:

1. *Transparency of resources and work items, improving trust, decision making, and resource allocation.*
2. *Collaboration, close collaboration based on routinized interaction and artifacts enabling frequent feedback-loops across the domains.*
3. *Commitment, to strategically managed portfolios.*
4. *Team orientation, removing unrest in resource allocation and building capabilities in teams.*

We conclude that agile software development evolves into agility in project management. It is a learning process which requires a consideration of routines, structure and culture. Long-term experience with agile methods in individual projects alone is not sufficient for an appropriate integration of the practice into an agile portfolio. It takes time to overcome the challenges in resource allocation and silo thinking. However, if large organizations want to learn fast, be more effective and integrate entrepreneurial spirit in their operations they might want to address these challenges and reflect upon the underlying routines in context.

7. Recommendations for research and practice

The results of this study point to a number of recommendations to practice and interesting questions for further research. To align project management and IT project management organizations often bind two respective roles: a formal project management representing business and a ScrumMaster representing the team. Commitment of senior management is one of the biggest issues when establishing an agile portfolio. As most of the adoptions of agile practices happen bottom-up, it is advisable to find a top management sponsor who supports the adoption. Awareness sessions and clarity about the implications are crucial to gain staff commitment.

The domains of practice identified enable further research on more detailed activities important to consider while implementing an agile portfolio. What is the best governance structure for an agile organization? How to enable strategic management in agile portfolios? How should a good contract look like when working in agile projects? Since legacy processes are to be found in all established organizations, what are the good strategies to adapt in existing practices in context? The micro-activities and organizational routines involved are important for the development of capabilities (Salvato, 2009). If we want to understand agility on the level of organizations we need to better understand the interplay of practices across functional roles. Further, there is an overlap of principles in agile project management and concurrent engineering. Comparing portfolio management experiences in concurrent engineering settings is likely to contribute to further understanding of multi-project management in fast learning and effective organizations.

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References

- Abrahamsson, P., Conboy, K., Wang, X., 2009. Lots done, more to do: the current state of agile systems development research.
- Aubry, M., Hobbs, B., Thuillier, D., 2007. A new framework for understanding organisational project management through the PMO. *Int. J. Proj. Manag.* 25, 328–336.
- Blichfeldt, B.S., Eskerod, P., 2008. Project portfolio management—there's more to it than what management enacts. *Int. J. Proj. Manag.* 26, 357–365.
- Boehm, B., Turner, R., 2005. Management challenges to implementing agile processes in traditional development organizations. *Software, IEEE*, 22, pp. 30–39.
- Booth, C., Harmer, M., 1994. Agile manufacturing concepts and opportunities in ceramics. *Ceram. Trans.* 50, 67–76.
- Chow, T., Cao, D.B., 2008. A survey study of critical success factors in agile software projects. *J. Syst. Softw.* 81, 961–971.
- Cicmil, S., Williams, T., Thomas, J., Hodgson, D., 2006. Rethinking project management: researching the actuality of projects. *Int. J. Proj. Manag.* 24, 675–686.
- Conboy, K., 2009. Agility from first principles: reconstructing the concept of agility in information systems development. *Info. Sys. Res.* 20, 329–354.
- Cooper, R.G., Edgett, S.J., Kleinschmidt, E.J., 1999. New product portfolio management: practices and performance. *J. Prod. Innov. Manag.* 16, 333–351.
- Dybå, T., Dingsøyr, T., 2008. Empirical studies of agile software development: a systematic review. *Inf. Softw. Technol.* 50, 833–859.
- Dye, L., Pennypacker, J., 2000. Project portfolio managing and managing multiple projects: two sides of the same coin? *Proceedings of the 2000 PMI Seminars & Symposium*. PMI.
- Engwall, M., Jerbrant, A., 2003. The resource allocation syndrome: the prime challenge of multi-project management? *Int. J. Proj. Manag.* 21, 403–409.
- Ferns, D., 1991. Developments in programme management. *Int. J. Proj. Manag.* 9, 148–156.
- Hanssen, G., Fægri, T., 2008. Process fusion: an industrial case study on agile software product line engineering. *J. Syst. Softw.* 81, 843–854.
- Hoda, R., Kruchten, P., Noble, J., Marshall, S., 2010. Agility in context. *Proceedings of the ACM International Conference on Object Oriented Programming Systems Languages and Applications*. ACM, NY, USA, pp. 74–88.
- Hodgkins, P., Hohmann, L., 2007. Agile program management: lessons learned from the VeriSign managed security services team. *Proceedings of the AGILE 2007*, IEEE, Washington, DC, USA, pp. 194–199.
- Holstein, J.A., Gubrium, J.F., 1997. *Active Interviewing*. Sage Publications.
- Kalliney, M., 2009. Transitioning from agile development to enterprise product management agility. *Proceedings of the 2009 Agile Conference*, IEEE Computer Society, Washington, DC, USA, , pp. 209–213.
- Kettunen, P., Laanti, M., 2008. Combining agile software projects and large-scale organizational agility. *Softw. Process* 13, 183–193.
- Krebs, J., 2008. *Agile Portfolio Management*. Microsoft Press.
- Laanti, M., 2008. Implementing program model with agile principles in a large software development organization. *IEEE Computer Society, Washington, DC, USA* 1383–1391.

- Laanti, M., Salo, O., Abrahamsson, P., 2011. Agile methods rapidly replacing traditional methods at Nokia: a survey of opinions on agile transformation. *Inf. Softw. Technol.* 53, 276–290.
- Laanti, M., Similä, J., Abrahamsson, P., 2013. Definitions of agile software development and agility. *Systems, Software and Services Process Improvement* Springer 247–258.
- Langley, A., 1999. Strategies for theorizing from process data. *Acad. Manag. Rev.* 24, 691–710.
- Leffingwell, D., 2007. *Scaling Software Agility: Best Practices for Large Enterprises*. Addison-Wesley Professional.
- Leffingwell, D., 2010. *Agile Software Requirements: Lean Requirements Practices for Teams, Programs, and the Enterprise*. Addison-Wesley Professional.
- Lycett, M., Rassau, A., Danson, J., 2004. Programme management: a critical review. *Int. J. Proj. Manag.* 22, 289–299.
- Martinsuo, M., Lehtonen, P., 2007. Role of single-project management in achieving portfolio management efficiency. *Int. J. Proj. Manag.* 25, 56–65.
- Murray, A., et al., 2009. Managing successful projects with PRINCE2.
- Nerur, S., Balijepally, V., 2007. Theoretical reflections on agile development methodologies. *Commun. ACM* 50, 79–83.
- Pentland, B.T., Feldman, M.S., 2007. Narrative networks: patterns of technology and organization. *Organ. Sci.* 18, 781–795.
- PMI, 2008. *The standard for portfolio management*. Global Standard Project Management Institute.
- Rautiainen, K., von Schantz, J., Vahaniitty, J., 2011. *Supporting Scaling Agile with Portfolio Management: Case paf.com*. IEEE Computer Society, Washington, DC, USA 1–10.
- Reyck, B., Grushka-Cockayne, Y., Lockett, M., Calderini, S., Moura, M., Sloper, A., 2005. The impact of project portfolio management on information technology projects. *Int. J. Proj. Manag.* 23, 524–537.
- Salvato, C., 2009. Capabilities unveiled: the role of ordinary activities in the evolution of product development processes. *Org. Sci.* 20, 384–409.
- Schwaber, K., Beedle, M., 2001. *Agile Software Development with Scrum*, 1st ed. Prentice Hall PTR, Upper Saddle River, NJ, USA.
- Stettina, C.J., Heijstek, W., 2011. Five agile factors: helping self-management to self-reflect. *Proceedings of European Software Process Improvement Conference (EuroSPI 2011)*, Roskilde, Denmark.
- Stettina, C.J., Heijstek, W., Fægri, T.E., 2012. Documentation work in agile teams: the role of documentation formalism in achieving a sustainable practice. *IEEE, Washington, DC, USA* 31–40.
- Takeuchi, H., Nonaka, I., 1986. The new new product development game. *Harv. Bus. Rev.* 64 (1), 137–146.
- Thomas, J.C., Baker, S.W., 2008. Establishing an agile portfolio to align IT investments with business needs. *Proceedings of the Agile 2008*. IEEE Computer Society, Washington, DC, USA, pp. 252–258.
- Thummadi, B.V., Shiv, O., Lyytinen, K., 2011. *Enacted Routines in Agile and Waterfall Processes*. AGILE, IEEE Computer Society 67–76.
- Vähäniitty, J., et al., 2012. *Towards agile product and portfolio management*.
- Wenger, E., 1998. *Communities of practice: learning, meaning, and identity*. Cambridge University Press.
- Williams, L., 2012. What agile teams think of agile principles. *Commun. ACM* 55, 71–76.
- Yin, R.K., 2009. *Case Study Research: Design and Methods (Applied Social Research Methods)*, Fourth edition. Sage Publications.
- Young, R., Jordan, E., 2008. Top management support: mantra or necessity? *Int. J. Proj. Manag.* 26, 713–725.