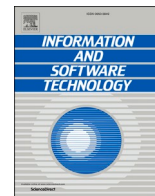




Social capital in large-scale agile software product management: A multi-case study

Title	Social capital in large-scale agile software product management: A multi-case study
Author(s)	Barbala, Astri;Berntzen, Marthe;Moe, Nils Brede
Publication Date	2025-08-06
Publisher	Elsevier
Repository DOI	https://doi.org/10.1016/j.infsof.2025.107841



Social capital in large-scale agile software product management: A multi-case study

Astri Barbala^{a,*} , Marthe Berntzen^{b,c} , Nils Brede Moe^d 

^a University of Galway, University Road, Galway, H91 TK33, Ireland

^b University of Oslo, 0373 Oslo, Norway

^c Knowit Solutions AS, Universitetsgata 1, 0164 Oslo, Norway

^d SINTEF, Strindvegen 4, 7034 Trondheim, Norway

ARTICLE INFO

Keywords:

Social capital
Human values in software engineering
Soft skills
Fintech
Software product management
Large-scale agile
Case study

ABSTRACT

Context: Large fintech organizations are increasingly adopting agile methodologies to enhance product development capabilities. However, implementing agile at scale presents unique challenges, particularly related to collaboration essential for successful software product management (SPM). Social capital, comprising structural, cognitive, and relational dimensions, may play a crucial role in facilitating the collaboration needed to overcome these challenges.

Objectives: We examine the role of social capital in large-scale agile SPM, focusing on how it facilitates coordination, collaboration, and, ultimately, success, in complex, product-focused environments.

Methods: We employ a multi-case study approach, comprising 33 interviews, observations, and document analysis, analyzing two Scandinavian fintech companies that have adopted large-scale agile practices organized around product areas.

Results: Our findings, viewed through the lens of social capital theory, show that its three dimensions help explain how large-scale organizations adopting SPM manage dependencies and enable product-focused coordination. Specifically, the structural dimension helps illuminate how networks are formed; the cognitive dimension clarifies how shared understanding of product visions and development practices emerges; and the relational dimension highlights how trust is cultivated among product development actors across multiple operational levels (i.e., product team, product area, organizational, and external levels). Together, these dimensions offer insight into how agile practices are effectively implemented at scale.

Conclusion: Our study finds that social capital is a critical enabler of effective SPM in large-scale agile contexts. Its three dimensions support the collaboration and relational networks necessary for agility at scale. These insights suggest that fostering social capital should be prioritized in agile transformations to address the sociotechnical complexities inherent in large-scale SPM.

1. Introduction

The financial technology (fintech) sector is undergoing rapid transformation. Large fintech enterprises face increasing pressure to innovate while at the same time managing complex legacy systems, regulatory requirements, and evolving customer expectations [1]. These organizations operate in a highly competitive landscape, where both global competitors and disruptive start-ups continuously challenge traditional business models. To remain competitive, fintech firms must balance regulatory compliance with agility and product innovation when handling complex customer journeys.

To navigate these complexities, many large fintech organizations have turned to agile methodologies as a means to enhance adaptability and accelerate product development [2,3]. Agile development principles, such as iterative design and development, continuous customer involvement, and adaptive planning [4], are particularly well-suited for fintech firms, as agile enables them to respond swiftly to regulatory shifts, technological advancements, and dynamic customer needs.

However, implementing agile at scale remains a challenge. While some advocate for large-scale agile frameworks like SAFe and LeSS to standardize roles, processes and artifacts, others argue for a more context-driven approach tailored to an organization's unique

* Corresponding author.

E-mail addresses: astri.barbala@universityofgalway.ie (A. Barbala), marthenb@ifi.uio.no (M. Berntzen), nils.b.moe@sintef.no (N.B. Moe).

<https://doi.org/10.1016/j.infsof.2025.107841>

Received 6 November 2024; Received in revised form 3 July 2025; Accepted 15 July 2025

Available online 23 July 2025

0950-5849/© 2025 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

coordination challenges [5,6]. Additionally, companies like Spotify exemplify a model where autonomous teams drive agility by taking end-to-end responsibility for their work and aligning their actions through cross-team collaboration [7]. More recently, there has been a growing emphasis on structuring teams in ways that align with software architecture to minimize cognitive load and enhance efficiency [8].

Amidst these varied approaches, large fintech organizations must ensure that product development efforts remain strategically aligned. Software Product Management (SPM) plays a vital role in this regard, ensuring that product decisions are effectively prioritized and balanced across competing demands [3]. Defined as the set of processes governing the entire product lifecycle, from ideation to retirement, SPM provides a structured approach to managing software products while remaining compatible with agile methodologies [9]. It encompasses activities such as market analysis, product visioning, and cross-functional coordination to ensure successful product development and long-term viability [10].

While SPM aligns well with agile principles by prioritizing customer needs and rapid iterations, it also introduces challenges in large-scale settings. Fintech firms must manage dependencies across diverse product lines, balance innovation with long-term product maintenance, and bridge the gap between business strategy and software development execution [11]. This complexity underscores the importance of effective collaboration networks—both within and across teams, leadership structures, and business units.

To understand how fintech organizations can navigate the complex social networks that shape collaboration and decision-making in large-scale SPM, we apply the theoretical lens of social capital [12,13]. Defined as "the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit" [12], social capital may represent a key factor in large-scale agile environments. For example, prior research suggests that strong social capital facilitates knowledge sharing, enhances collaboration, and mitigates complexity in software development [14–16].

Despite its relevance, the role of social capital in large-scale SPM remains underexplored in the software engineering (SE) literature, and there remains a research gap in terms of understanding the role of social dynamics in a large-scale setting. This study seeks to address this gap by examining how social capital influences SPM in large fintech organizations. Specifically, we investigate how the *structural*, *cognitive*, and *relational* dimensions of social capital, as defined by Nahapiet and Ghoshal [12] (p. 243), impact collaboration and networking in large-scale agile environments. To this end, we conducted a multi-case study of two Scandinavian fintech companies, ScanBank and NorBank (pseudonyms), to explore the following research question:

What is the role of social capital in large-scale agile SPM?

To provide a nuanced understanding, the study examines how social capital shapes SPM practices. Specifically, it identifies both challenges and enablers, aiming to clarify how the three dimensions of social capital help address inefficiencies and foster organizational advantage [12].

In the present study, social capital serves both as an analytical framework and an object of study. As a framework, it helps us examine collaboration and knowledge-sharing, and what both are enablers and challenges in large-scale SPM. At the same time, it is also an object of study because its presence—or absence—shapes how fintech organizations navigate complexity and structure their SPM efforts. By adopting this dual perspective, we gain a deeper understanding of how social capital influences large-scale software development and product innovation.

The empirical cases described in this article have been previously reported at the XP2024 conference. The NorBank case was described in [17], focusing on coordination mechanisms within the product area. Additionally, the NorBank case was described in a Master's thesis [18]. The ScanBank case was described in [19], focusing on product management challenges and configurations, and [20] where social capital

was used as a framework. For the present study, we used the challenges reported in [19] as the basis for a mapping of challenges across the two cases. Moreover, we conducted a completely new analysis using social capital theory as the analytical lens, specifically for the study reported here.

In the following sections, we review existing literature, discuss emerging trends, and examine the role of social capital for SPM in large-scale agile environments. Next, we outline our multi-case study methodology and present key findings on how social capital influences SPM at scale. Finally, we discuss the implications of our findings, acknowledge study limitations, and propose directions for future research on agile SPM practices.

2. Related work

2.1. Software product management in large-scale agile environments

Large-scale agile software development presents significant challenges for software product management (SPM) due to the complexity and scale of operations. As organizations grow, it becomes increasingly difficult to maintain a comprehensive understanding of all aspects of a system's development and evolution, in addition to roles and responsibilities. When product development involves several departments, each unit might act independently and focus on its own work instead of the whole product [21]. Further, when product teams have too many diverse tasks with urgent priority, individual goals become more important, joint goals become blurry, and the team's performance suffers [7]. In such complex arrangements, networking serves as the primary mechanism for managing tasks [22,23].

Understanding the roles involved in SPM has attracted attention in studies of large-scale agile settings [24,25,10]. Smite et al. [22] described a complex arrangement at Ericsson, where a Telecom product was developed by 17 self-managing cross-functional feature teams, located in Sweden, China, and Korea. These teams were supported by technical experts, line managers, Product Owners (POs), system managers, configuration managers, testing framework experts, continuous integration specialists, agile coaches, and integration leaders. Ebert and Brinkkemper [26] underscore the risks of operating without a dedicated Product Manager (PM), citing issues like diluted leadership, suboptimal performance, and delays, which emphasize the need for focused PMs to handle the complexities of large-scale software development. When dependencies between products are unclear, PMs and their teams struggle with prioritization, seeing the long-term picture, and being able to achieve outcomes. Networking is, therefore, a key activity for PMs [23]. Studies have identified various coordination mechanisms that POs and PMs must employ, such as architectural coordination, risk assessment, and adherence to corporate guidelines [23,27,28]. Paasivaara et al. [29] highlight the challenge of defining the PO role. Scaling the PO role is a standard SPM practice, though it often requires additional roles and structures. For instance, some setups include a team of POs [27,30] or PMs who lead the products, balancing responsibilities in software development, team management, and organizational politics [26].

Implementing and succeeding with SPM in a large-scale context is often time-consuming due to the many challenges involved [26]. Springer et al. [10] organized 15 focus groups with 47 software PMs to understand their challenges, which included:

- Determining the true value of the product the customer needs. PMs must work iteratively with teams to understand customer needs and scaling opportunities of the product.
- Strategy and priorities are changing frequently, which makes PMs and their teams struggle with prioritization.
- Technical debt slows down the product development process.
- Working in silos. Initiatives that run across different departments require aligning teams around common goals and synchronizing them.

- Balancing reactive and proactive work. Mature products struggle to prioritize innovation and new customer value against bug fixing and maintenance work.

Agile methods might mitigate many of these problems. However, another core challenge found by Springer et al. [9] was that many SPM teams were in reality not agile, but rather just followed rules and did not sufficiently use experimentation and learning, which the authors argue is essential for succeeding with SPM.

In light of these challenges reported from the literature, we consider three emerging trends that shape SPM practices in large-scale agile organizations.

The first trend is *new ways to structure teams and work processes*. Large organizations have introduced product areas, where the teams within an area are designed to focus on a specific aspect. These teams often rely on DevOps and fast feedback loops [11]. When teams are responsible for development and operations, the feedback cycle with customers is shortened. DevOps has been found to help PMs handle dependencies in large-scale agile [31]. When product teams are organized into product areas, they work together on a common product or sub-product. For example, Berntzen et al. [30] studied a public transportation program, which involved 13 teams and nine POs. In this case, seven POs managed one team each, while two POs managed three teams each. Further, Skelton and Pais [8] recommend forming teams based on function and coordination needs, emphasizing clear team boundaries, to minimize overhead and reduce dependencies. Specifically, recent trends include forming vertical product teams in product areas that focus on developing and implementing specific products, and horizontal teams, often known as platform teams, that provide resource support to the product development teams [8,28]. In line with this first trend, one of the studies the current study builds on argued for the product area as a distinct operational level between the team level and organizational level [17].

The second trend, which relates to the organizational level, is *expanding SPM beyond the software development department*, especially in fintech organizations [2,3]. Mikalsen et al. [3] found that agile product teams within a bank needed to negotiate with other teams, business units, and key management stakeholders to ensure that digital offerings met both user needs and company revenue goals. As a result, SPM must extend beyond the software department, linking to other functions such as marketing, sales, and operations. This is challenging if the other functions are not agile [32]. The bank created agile BizDev [11] teams consisting of representatives from business development and IT developers, testers, and user experience (UX) designers from IT development to achieve a continuous process of planning and execution.

The third trend is *the adoption of new technical solutions, like data-driven product development, to build better products*. Olsson and Bosch [33] argue that data-driven ways of working, artificial intelligence (AI), and the emergence of digital ecosystems challenge and change product management practices. Data can come from both within the organization, but often also from customers and users beyond the organization, linking this trend to the external level. By using data as part of the prioritization and decision processes, they argue that product management can increase its effectiveness as well as the effectiveness of SPM efforts significantly. DevOps and short feedback loops are, however, required to use and benefit from data effectively [33].

At the same time, the adoption of new technical solutions introduces challenges for organizing and coordinating activities across the organization. Ensuring alignment between teams, integrating new tools into existing workflows, and managing cross-functional collaboration become critical aspects of SPM. A stronger focus on data and data-driven product development can also create hurdles; for instance, a recent study by Barbala et al. [34] from a large public sector organization shows that the different uses and conceptualizations of data as a product can result in misunderstandings and misalignments across the organization.

2.2. Social capital and software development

Beyond technical and managerial challenges, social dynamics play a crucial role in facilitating effective product management [10,20,24]. Software development in large-scale product organizations thus requires the involvement of numerous individuals and teams who need to communicate and coordinate effectively to deliver a high-quality product [35]. Pierre Bourdieu introduced the concept of social capital to describe the resources and benefits individuals gain through their social networks, which can enhance their social position and give access to opportunities [13]. Central to Bourdieu's theory is the idea that social capital can grant access to other forms of assets, such as economic or intellectual capital.

Although Bourdieu primarily viewed social capital as an individual asset, organization studies researchers have applied the concept to examine interaction processes within organizational contexts. For example, a widely cited study by Jane Dutton and Belle Ragins [36] identified how mechanisms underpinning social capital, including motivation, opportunity structures, and effective communication channels, benefit both individuals and organizations. Moreover, they emphasize the importance of focusing both on *how social capital is created* and the *objectives it serves*, both central aspects of the present study.

Our understanding of social capital mainly builds on Nahapiet and Ghoshal's [12] conceptualization. They divide the different aspects into three different dimensions that identify how gaining value from social networks requires components of different natures to be in place:

- 1) **The Structural Dimension** focuses on the overall pattern of connections among individuals within a network, network ties and configurations, referring to the social structures that allow or restrict access to individuals and resources. In a large-scale SPM setting, this could be, e.g., expert networks and leadership teams, Communities of Practice (CoP), and ultimately knowing *who knows what* and *who knows who*.
- 2) **The Cognitive Dimension** refers to shared language, values and goals, codes, and narratives. This dimension enables *common understandings*, making knowledge exchange more straightforward. In large-scale SPM, this may relate to, e.g., a common understanding of product goals, as well as a shared language for agile roles and agile practices within SPM.
- 3) **The Relational Dimension** emphasizes the quality of relationships within the network and includes elements such as trust, norms, obligations, and identification among individuals. For actors involved in large-scale SPM, this dimension may, e.g., relate to the importance of establishing and nurturing bonds within teams, areas, and the wider organization, as well as with various external stakeholders.

As Nahapiet and Ghoshal point out, the three dimensions are intertwined and often overlap, especially in complex organizational setups, which constitutes an area for future research [33].

Although not utilized yet, to our knowledge, to study SPM in large-scale agile settings, the concept of social capital has found relevance in software development research. For example, Moe et al. [37] used the theory to study the knowledge resources embedded in the networks of developer teams, where an individual's connections directly affect their access to knowledge. Similarly, Wohlin et al. [16] explored the importance of social capital both within a team and in interactions between the team and external collaborators, highlighting how social capital fosters trust and collaboration across different organizational units. In studying software teams and their knowledge networks in large-scale software development, Smite et al. [22] explored the impact of social capital and knowledge networks on large-scale software development in companies like Ericsson and ABB, showing that effective knowledge sharing depends on both formal roles, like technical experts, and practices such as CoPs and shared communication platforms.

A recent study by Stol et al. [38] uses the social capital framework to study how inner-source participation, i.e., the practice of applying open-source development principles within an organization, affects software developers' job satisfaction. They found that developers involved in inner source projects accumulate social capital as these projects foster both increased and more intensive interactions with developers across the organization, extending beyond their immediate team or unit. Stol et al. posit that the structural and cognitive dimensions of social capital are preconditions for the possibility of building relational social capital. This perspective is consistent with our understanding, which we will elaborate on in the following sections.

Social capital has also been widely used in Information Systems research. Randolph et al. [39] draw from social capital theory to argue that network legitimacy, trust, and resilience embody the cognitive, relational, and structural dimensions of network social capital in what they label «technology-enabled cooperative networks», namely, collaboration among competitors using digital technology to achieve common goals. In using the concept to study teams, Lee et al. [14] argue that social ties, trust, and shared vision are critical for successful project outcomes in complex, knowledge-intensive environments.

3. Research method

The study was designed as an exploratory multi-case study [40] involving two Nordic fintech organizations, ScanBank and NorBank, led by the following research question: *What is the role of social capital in large-scale agile SPM?* Although the study was not originally designed to illustrate social capital theory, we use it as an analytical framework to explore challenges and enablers in large-scale agile SPM. This approach allows us to systematically interpret the relational dynamics that shape SPM outcomes.

The case study approach was chosen for its ability to provide in-depth, detailed knowledge, particularly in areas with limited existing research [41]. Our cases were selected based on convenience sampling and for their similarities and differences. Both companies had been using agile methods for over a decade without adhering to a specific scaling framework, allowing the product teams flexibility in selecting agile practices, such as sprints, stand-ups, and retrospectives. Both had focused on SPM for the last few years but had different focuses because of different strategies and different obstacles. ScanBank was interested in understanding barriers and enablers of SPM across the whole company, including key SPM skills and competencies, and how to establish SPM roles, while NorBank was interested in understanding barriers and enablers of SPM in their first product area that had been designed one year previously.

3.1. Case descriptions

In the following, we provide details of the two case organizations, which were both large-scale fintech product organizations working with agile methodologies. The data collection context for ScanBank was located at the organizational level of operation, spanning across specific product areas. At NorBank, a smaller bank, on the other hand, the focus is more on the product area and product team levels (see Table 1).

3.1.1. The ScanBank case

ScanBank, a large fintech organization with 10,000 employees, had a complex product management structure and a history of significant structural and technological changes. Over 130 individuals held key SPM roles, including product manager (PM), product owner (PO), and product lead (PL), many with extensive agile experience. Since introducing the PO role in 2017, ScanBank had not adhered to a specific agile scaling framework. Instead, product teams had chosen agile practices to fit their specific needs. Some teams engaged directly with customers, while others supported indirectly; for instance, one team managed authentication services without overseeing its customer-facing aspects.

Table 1

Data sources.

ScanBank		
Interviews	Roles interviewed	#
	Product managers	9
	Product owner	5
	Other product management roles	5
Meetings	Type of meeting	5
	Feedback meetings on results from interviews	2
	Workshops on defining roles and responsibility	2
	Product management all hands meeting	1
Documentation	Strategic documents, product management survey, reports	3
NorBank		
Interviews	Roles interviewed	
	Product area manager (twice)	1
	Team leader (group interview)	2
	Tech lead	1
	Developers	6
	Testers	1
	Designers	2
Meetings	Type of meeting	
	Team status meetings	5
	Product area all hands meeting	1
Documentation	Strategic documents	5

At ScanBank, a "product" was defined as anything that delivers value by meeting customer needs, achieving business objectives, and enabling technology. This broad definition encompassed a wide range of offerings, from advisory services to bank accounts. A 2022 internal survey found that all product managers felt responsible for products with clear business value.

Due to its size and complexity in terms of business areas, the bank had a range of SPM configurations with a set-up of product roles and teams depending on the nature and lifecycle of the product. However, all products had a PM, a PO, or both roles, and/or a PL [19]. At ScanBank, the PM was described as "the CEO of the product" and was responsible for the product's vision and strategy, roadmap, high-level priorities, and business outcomes throughout the product lifecycle. A PO focused more on hands-on work with engineers and designers, translating the high-level product vision into epics, managing the product backlog, and enabling agile ways of working. Additionally, the PL role was also utilized when there was a need to facilitate alignment across multiple product teams or product areas, where one PM is insufficient.

3.1.2. The NorBank case

The second case, **NorBank**, owned by an alliance of Norwegian banks, is a smaller but similarly structured organization, consisting of 25 agile teams. NorBank adopted agile software development in 2012 and had for several years worked on scaling the software development capacity. The teams work on digital product development, including security, operation, and administration, for the web and mobile banking domains.

Teams had considerable freedom to decide how they worked, and most used a Kanban variant with elements of Scrum and coordination practices, such as backlog meetings, team meetings, and daily stand-ups. They adopted objectives and key results (OKRs) to guide their work as well as "Monday commitments" and "Friday wins" to strengthen teamwork [42]. They also regularly performed team health checks with follow-ups in one-on-one conversations between team leads and individual team members. They used retrospectives to improve work practices and structured problem-solving for continuous improvement.

For some years, NorBank had worked towards moving away from its legacy monolithic technical architecture, which is typical for banks, toward microservice architecture. The modular architecture, tools, and automation were imperative for teams to have end-to-end responsibility and decision-making authority for their products, avoid handovers

between teams, and be able to continuously develop software using DevOps [11]. Furthermore, all code needed to be checked by another developer to meet national standards for the financial sector. The formal software inspection process had been replaced by pull request (PR), which was used within and across teams. In this approach, a contributor creates a PR after making code changes. Next, a reviewer inspects the suggested changes to see whether they can be merged into the base branch.

The 25 agile teams were organized into six product areas [17]. Of these, the product area we studied was considered the most mature. This area focused on personal banking and consisted of nine teams with approximately 60 employees. A product was defined as “a repeatable solution that can be offered to a market that solves a want or need” [Strategic document]. Moreover, the product area had an overall goal related to customer satisfaction and product area revenue.

The product teams were cross-functionally organized and consisted of developers, testers, User Experience (UX) designers, a product owner, and a team leader, depending on the focus of the team. Some teams did, for instance, not need testers, as the product quality was a shared responsibility, and automated tests were integrated into continuous integration (CI) pipelines, allowing for frequent and fast feedback on code quality. Five vertical teams worked with products such as establishing accounts and keeping an overview of personal finances, and three horizontal teams worked with features that were shared by some or all of the vertical products, such as bank accounts, payment solutions, credit cards, and the mobile bank app.

In terms of product area team roles, the product manager role at NorBank referred to domain experts responsible for product deliveries. Similarly to the PMs at ScanBank, they were engaged in high-level strategic work, but they also performed typical PO tasks such as being the links between the development teams and the internal customers. Additionally, all product teams had a *team leader*, an administrative and coordinating role, who made sure that team members knew what other teams were working on and what was happening at the product area level. Team leaders were also responsible for shielding team members from external noise. Finally, all teams had a tech lead, who was a senior developer involved with product area coordination by managing technical dependencies across teams. The product managers, team leaders, and one tech lead from one of the teams, together with representatives from technology and design, were part of a product area management team that worked with overall themes related to goals, principles and vision, strategic and economic focus, product compliance, as well as team typologies in the product area. This team was responsible for providing the teams with strategic context and making sure they had what they needed to reach their goals.

3.2. Data collection

The data (Table 1) was collected in 2023, from January to March (NorBank) and October to November (ScanBank). All interviews were conducted by two researchers, where one led the interview and asked follow-up questions to the answers, and the other researcher took notes and made sure all central questions from the interview guide were covered. All interviews were recorded and transcribed. We used open-ended questions to explore the phenomenon and aimed to understand the link between social capital and SPM. The data was collected in two rounds, with slightly different focus areas [6,21,31] and with some months in between each round. When conducting the data collection for ScanBank, we focused more on the organizational level, and our participants were PMs and POs rather than core development team roles. The ScanBank interview guide, therefore, had less focus on internal team dynamics than in the NorBank case. During the analyses, we focused primarily on interview questions that were similar across the two interview guides and mainly related to product management at the inter-team and organizational level. For the interview guides, see <https://osf.io/tgyjb>.

At ScanBank, 19 interviews were conducted via Microsoft Teams, with the sessions lasting between 46 and 70 min. Data collection involved interviews with participants across five business areas, supplemented by meetings with additional managers to gain further context about the organization’s history and structure.

At NorBank, we interviewed 14 participants from four teams within the product area, which included a mix of vertical and horizontal teams. Interviews were primarily conducted on-site, with one session and a group interview with two team leaders, held digitally. These interviews averaged 50 min. Observations of six meetings, supplemented by meetings with managers and the product area team, provided additional insights. Strategic documents were also analyzed to better understand the organizational structure and the rationale behind recent team reorganization efforts.

3.3. Data analysis

Data were analyzed using thematic analysis (TA), which allows for both inductive and deductive exploration of the data. TA is useful within empirical SE studies due to its assistance in developing theories that are relevant to SE practice and research [43]. Hence, TA can improve the utility and generalizability of primary research findings in SE by combining data from multiple sources to build a more comprehensive understanding.

TA consists of several phases [44]. In the initial analysis phase, open coding was used to generate preliminary codes and identify themes, with iterative discussions among the authors to reach a consensus on emerging categories and themes.

During initial analyses, we focused on understanding the challenges related to SPM in the two organizations. Specifically, the challenges originally identified in ScanBank [19] were re-analyzed, including material from NorBank. At ScanBank, we explored the challenges reported by PMs, POs, and other product management roles from the whole organization. In the NorBank case, we additionally interviewed team leads, developers, UX, and testers. Consequently, there was a stronger focus on the product area level and the team level in NorBank. The resulting set of challenges is presented in Table 2.

Our initial analyses suggested that the majority of the themes related to the identified challenges were connected to social capital. Accordingly, during the later stages of the analysis, the themes were refined by revisiting the material to understand how the social capital perspective clarified complex aspects. Collaborative discussions among the authors facilitated triangulation, enhancing the credibility and reliability of the findings.

Since the social aspects of product management roles were dominant among our informants, Nahapiet and Ghoshal’s [12] three-dimensional social capital model was fitting for analyzing our results. Drawing from Dutton and Ragins [36], we focused both on how social capital is created and the objectives it serves in large-scale SPM, as well as what we saw as challenges for social capital in the contexts studied. From this theoretical perspective, we coded each interview again, considering how interview statements were potentially related to the dimensions of social capital. For each dimension, we coded sub-themes related to the sub-categories outlined by Nahapiet and Ghoshal [33]. Examples of the coding sheet can be found here: <https://osf.io/gqxw6>.

4. Results

We now turn to presenting our findings. As can be seen in Table 2, many challenges were shared by both cases. For example, both banks struggled with unclear roles and responsibilities (C1), prioritization (C2), and challenges with an overview of the SPM environment (C12), either from the team perspective (NorBank) or across the organizational units (ScanBank). Other challenges were more unique for each case. For example, ScanBank’s challenges included alignment between organizational units (C4) and finding the optimal level of upper management

Table 2
Challenges related to Software Product Management in the two cases.

Challenge (C)	SB	NB	Description
1 Unclear roles and responsibilities	x	x	Having to do the tasks of other SPM roles and unclear division of responsibilities between roles, or the lack of a clear understanding of own responsibilities result in too much time spent on coordination and meetings.
2 Prioritization challenges	x	x	Prioritizations and needs come from many different parts of the organization, which often are conflicting, and many are unclear as there may lack a common SPM language. Also, within the borders of a product area, teams have different prioritizations at the expense of shared prioritizations.
3 Utilizing data	x	x	Lack of access to personnel working with data and data insights (ScanBank), or access to data itself (NorBank). Decisions related to SPM are thus not data-driven.
4 Alignment between organizational units	x		The different ways of working between the business units, and use of different SPM terminology across units caused challenges with aligning SPM-related activities.
5 Lack of customer focus	x		Goals from business rather than customer value, not sufficiently collecting or using customer feedback, then difficult to placing customer wants and needs first.
6 Lack of freedom to act	x		Challenges with freedom to act due to dependencies between products and shortage of resources, both human and technical resources and dependencies.
7 Upper management involvement	x		Upper management making prioritizations and decisions on SPM but lacks knowledge and a shared understanding about SPM. Lacking good contact with the product teams.
8 Unclear goals or lack of shared goals	x	x	A lack of a unified way of working with goals across the company, such as the use of KPIs, OKRs, or others, and difficulties with having clear common SPM goals.
9 Defining the borders of a product area		x	Not all teams share the same sense of identity and belonging within the product area due to for example other goals or other purposes within the organization, beyond the borders of the product area.
10 Knowledge sharing across teams or units	x	x	Difficulties finding optimal ways of sharing knowledge easy and effortlessly, either physically or digitally.
11 Stakeholder management	x		Not knowing who to involve and when. Lacking an efficient internal network and spending too much time on stakeholder management.
12 Overview of the SPM environment	x	x	Difficulties seeing the whole picture.
13 Collaboration across teams		x	Each team spends time on local optimization related to their own scope and area of responsibility, at the expense of shared SPM goals. Hard to avoid silo-working despite organizing into a product area with shared goals.
14 Too many ongoing tasks and initiatives	x	x	Starting too many tasks and initiatives at the expense of finishing other tasks, which can slow down speed and progress.

Notes. SB = ScanBank, NB = NorBank.

involvement (C7). NorBank, on the other hand, faced challenges within the boundaries of the product area (C9).

With these challenges as context, the remainder of this section presents the findings from our further analysis of the two cases, led by the research question: *What is the role of social capital in large-scale agile SPM?*

4.1. Social capital in software product management

Fig. 1 shows the three dimensions of social capital (presented in Section 2), as well as the themes we identified in the data corresponding to the different dimensions, connecting social capital to large-scale SPM. The overlap between circles illustrates that although these three dimensions are analytically distinct, they are highly interrelated. Where themes overlap, we have coded them as belonging to the dimension that best aligns with Nahapiet and Ghoshal's framework. For example, as can be seen in the figure, "autonomy" covers all dimensions. The identified elements connected to these overarching themes are discussed in the following sections.

4.2. Structural dimension of social capital

This dimension of social capital refers to network configuration and ties, which precede the other two dimensions and enable individuals to develop shared experiences (cognitive dimension) and build and maintain high-quality relationships (relational dimension). We first describe the themes from ScanBank and then from NorBank.

4.2.1. Structural dimension: ScanBank

In ScanBank, the four main themes coded under the structural dimension were 1) *organizational structure*, 2) *roles*, 3) *autonomy*, and 4) *ways of working*.

Concerning the first theme, organizational structure, ScanBank's large size and geographical and administrative distribution were frequently cited by our informants as defining features of the company. Maneuvering these structures, then, was central to the smooth functioning of SPM. One PM noted: *"There are lots of experts and good people everywhere. You just have to know where to ask"* [SB08]. A PO highlighted the importance of understanding the company structure: *"My biggest badge is the fact that I know how the organization is built. I know who to go to, and who not to go to. And ScanBank is complex in that regard"* [SB15].

Similarly, and relating to roles, the second theme, some also pointed to how maneuvering structures and knowing who to talk to in ScanBank very much depended on one's role. One major challenge connected to this was that there was a lack of clear role definitions for SPM. Confusion over the roles and responsibilities of, particularly, POs and PMs, was common. SB11 (PM) expressed their concerns as such: *"The roles are more flexible, encouraging people to take initiative and do what they think is best. But this leads to... people working in completely different ways."* Unclear roles, then, appeared both as enabling and challenging the structural dimension of social capital.

Both agile roles and SPM roles seemed central to establishing social capital in ScanBank. One person pinpointed the pivotal role of agile coaches for SPM. A PO, SB15, said: *"We've already used them four times in two months. They come in, do workshops, understand how the team works, and build a new structure, a way of working. And they've been extremely helpful."* However, others did not see agile roles as compatible with SPM roles. SB12 said: *"We probably have fewer Scrum Master tasks than we should. It's not that we don't try — we just don't fully follow the methodology [...] And then 'agile' becomes more of a buzzword, implying we're working in an agile way, but that's not what we're actually doing."* This points to that there were different ways of understanding and applying agile roles.

Finding the right balance in terms of role flexibility was connected to creating *autonomy*, the third theme identified. A PM saw clear parallels between SPM roles and agile methods in terms of fostering this: *"A part of the goal is to create autonomy. [...] This means that you have to place great responsibility and ownership of these products on product-holder roles to*

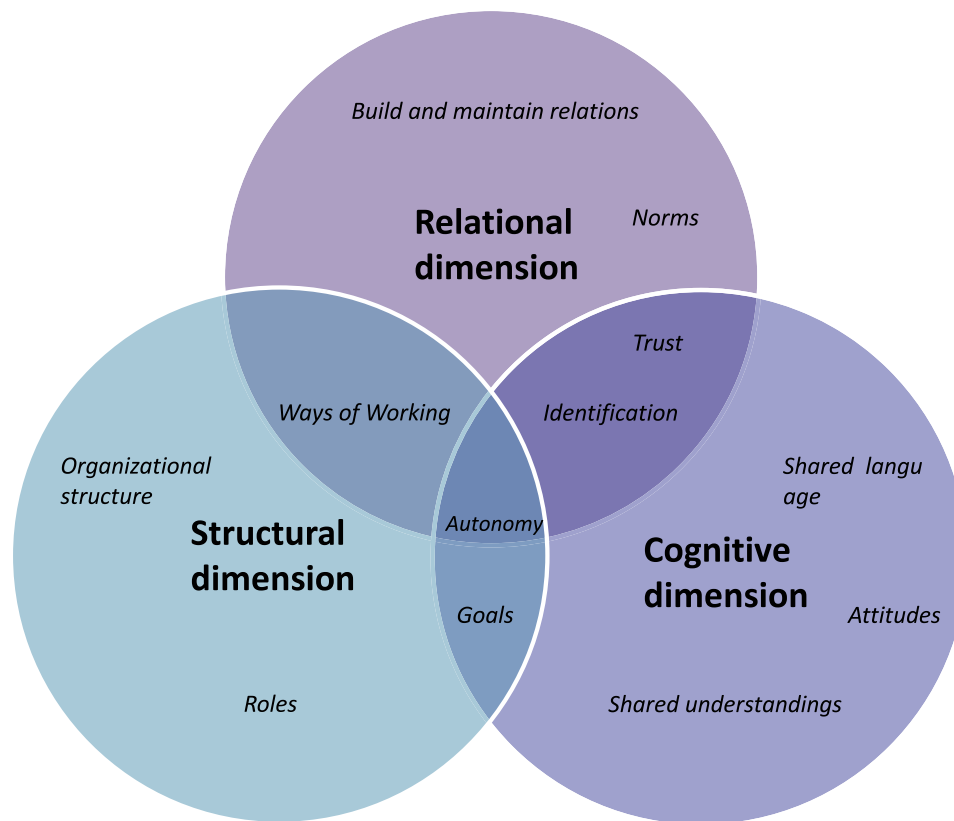


Fig. 1. The main factors influencing the social capital dimensions in large-scale SPM per our results.

ensure things move faster. Agility is perhaps the key word. That's what we have achieved with product ownership" [SB14].

Concerning the fourth theme found regarding the structural dimension in ScanBank, most of the interviewees had strong opinions regarding ways of working. Work mode, i.e., remote, hybrid, or onsite work, was a central part of this: Not being able to meet face-to-face could be a hurdle for SPM in ScanBank, especially for developers. SB10, a PM, was concerned about the developers' lack of engagement due to this: "To feel ownership and advocate for their products, they need more connection. Right now, they're just delivering code without really knowing how it's received. And sitting together, co-location, is an easy way to make that happen."

But not all agreed with this statement. Some pointed to how they were using communication tools in creative ways, claiming these abolished communicative issues. SB16, a PO, said, "I thought it would be a big disadvantage not to be physically in the same place, but I think with the tools we have today, it's not a problem." This was echoed by another PO, SB17, whose team was avid Slack users: "We have stand-ups, but it is being done in Slack. We have a bot set up where we can have a message triggered at 9:30 AM on Wednesdays and Fridays, and the team will share their inputs in the Slack thread, and I will respond to them." This thus points to how finding the right tools for supporting ways of working was a central enabler for achieving a high level of social capital.

4.2.2. Structural dimension: NorBank

For NorBank, we identified the following four main themes: 1) organizational structure, 2) roles, 3) ways of working, and 4) goals.

Regarding the first theme, organizational structure, NorBank had traditionally consisted of 25 development teams across business areas that resembled a classical departmental structure. In this large-scale setting, diverse focus areas and priorities made it challenging to deliver customer value at the desired pace and hindered effective alignment to address shared development needs. This formed a

motivation for reorganizing into product areas with product teams: "We realized that those who worked with payment cards and those who worked with online payment had nothing in common. Although they both conceptually work with payment, they have no shared goals; their code is dissimilar... They work with completely different products." [NB04, Product Area (PA) Manager].

The teams in NorBank were organized in vertical and horizontal structures, which enabled the nine teams to better support each other and align towards shared goals. One person described their experience as such: "The way I see it, the product area is an attempt to gather teams that are related to each other. First and foremost, by having some level of shared goals that are connected to our customers' everyday finances [...] But it's also about how we want to be structured and how [different roles] collaborate" [NB02, Developer]. These quotes also point to a related theme, goals, that will be presented further below.

Moving to the second theme, a key feature was how roles were shared across teams. Although each team had a cross-functional basis set up with developers, product managers, and team leaders, not all teams had all roles. This meant that sometimes teams needed to "borrow" expertise from each other within the product area. One person explained that "the designers have started to work a bit outside the team, they try to see across [the area] where they can be of help" [I06, Developer]. Additionally, there was not a one-to-one correspondence between the team leaders, product managers, and the development teams, which was explained as a benefit. "We have created flexibility in the area [...] We think more in terms of capacity than in the number of heads per team. It means that it is easier to say, 'Okay, we need an additional team, you go in there as a product manager'" [NB04, PA Manager].

Finally, as for ScanBank, ways of working were described as important in terms of structural capital in NorBank. Retrospective meetings played a crucial role for teams in driving continuous improvement and addressing emerging challenges. One PM noted that preparing by reflecting on recent work and discussing it informally before these

meetings was essential for productive conversations and saving time. As the person explained, *“Casual hallway conversations add significant value. We often check in with each other, asking, ‘What’s your take on this week?’ This way, items simply enter commitments with the whole team well-prepared.”* [NB14, PM]. The PO added, *“We handle our work quite well within our team, and other teams want to learn from us. We often visit them to explain what makes our approach effective.”* [NB14, PM]. Slack was described as essential: *“A lot of it happens on Slack. We are often members of many team channels and product area channels, to see what is going on across the teams”* [NB01, Designer].

Establishing a fitting work mode was also in NorBank a key aspect of structuring ways of working to enable the structural dimension of social capital. Several informants described physical co-location in positive terms: *“We sit in a ‘castle-shape’ [...]. We are boxed in so that we sit back-to-back, meaning that wherever you turn, you face a member of your team.”* [NB1, Designer]. Physical presence was described by several as fostering collaboration, but, as NB8 explained, many favored a hybrid work mode: *“[Mondays through Wednesdays] there are a lot of meetings, and then it’s good to be physically present, and also just small talk. On Fridays, we have focused work, then it is like ‘now you can work, get things done.’”*

Ways of working were entwined with the fourth theme, goals. For example, the teams held their own Monday Commitments and Friday Wins meetings (presented in Section 3) to define and review their weekly goals. Insights from these meetings were shared at the product area level through shared communication tools such as Slack and Miro boards. This helped both team members and the inter-team roles gain a sense of overview by knowing who was working on what. *“It is one large [Miro] board only, with canvases next to each other. It is very easy to navigate to see what the other teams are doing”* [NB01, Designer].

Additionally, the product area used all-hands meetings for information-sharing: *“We needed a shared understanding of the overarching goals [...]. At the same time, we need to tell each other about what’s happening in the teams. So the all-hands meeting is actually a combo of a show-and-tell and our goals at a higher level”* [NB04, PA manager]. Meetings within the product area management team, where the product managers, team leaders, and tech leaders attended, also contributed to synchronizing goals and priorities at the inter-team level.

4.3. Cognitive dimension of social capital

As depicted in Fig. 1, this dimension includes resources that foster shared understandings, establish a common language, as well as cultivate supportive and collaborative attitudes.

4.3.1. Cognitive dimension: ScanBank

The main themes coded for the cognitive dimension in ScanBank were 1) *shared understandings* 2) *shared language*, and 3) *attitudes*.

Regarding the first theme, *shared understandings*, much effort had been directed toward fostering a shared product culture across ScanBank. Pinpointing this, SB06, a PM said: *“I think ScanBank wants to explore how far they can go in ‘productifying’ things and getting different parts of the bank to work closer, faster, and better together.”* However, creating shared understandings around what it meant to “productify” an organization of 10,000 people had proven difficult. SB13, another PM, explained this as such: *“We are not at the stage where product management is very mature. I think you need to give that freedom at the beginning for people to figure things out.”*

A recent focus within ScanBank was making SPM more data-driven, which also led to challenges in terms of shared understanding. We saw this as overlapping with the second theme of *shared language* in this context. For instance, a PM with extensive experience in leveraging data as part of their work said: *“The term ‘insight’ can be used in different ways across various parts of the organization. So, when we talk about returning to customer insight and data-driven approaches, we may not always be working from the same customer insights or starting points”* [SB19]. At the same time, many expressed frustrations over the inconsistent naming of roles

across ScanBank, which led to varying interpretations. Thus, a more streamlined language for discussing both data and roles could have strengthened social capital in the organization.

Fronting the right *attitude*, the third theme, was also regarded as a crucial SPM skill. A collaborative mindset and a supportive attitude were frequently mentioned as central values that SPM roles need to create strong bonds with collaborators. One PM, SB13, saw it as their task to shield the team from mental noise, looking after their cognitive load: *“[Shielding the team] should happen at the right time and in the right forum, so the team remains focused and avoids overthinking irrelevant issues while feeling empowered in their respective roles.”* Taking care of the team’s cognitive load was also important to the POs, but more from the team’s internal viewpoint: *“I want them to work in a space where they are not responsible for clearing the road [...]. Making sure that dependencies are handled, that they don’t get any noise from business or other sections, or other groups is my responsibility”* [SB15, PO].

Taking responsibility for the team’s well-being also caused strain on the leader roles, however. One person said: *“I have felt like I’ve been a politician [...]. I’ve tried to be a flagbearer and to clear the way for the team. I’ve been a punching bag, which I believe the team didn’t really notice before I moved on to another role [...]. There’s often an expectation that a PM is the one who should foresee the roadmap one year, five years ahead”* [SB14, PM]. This points to, then, that although a collaborative and empathetic attitude is a catalyst for building social capital, it comes with a price for those responsible for the emotional labor behind it.

4.3.2. Cognitive dimension: NorBank

Our analysis of the cognitive dimension of social capital in the NorBank product area included two main themes: 1) *shared understanding of goals*, and 2) *shared language*. In this instance, goals relate to shared understandings of the way forward as well as identification, two other themes under the cognitive dimension, with identification overlapping into the relational dimension.

Regarding the first theme, *shared understanding of goals*, our findings showed that defining goals at the product area level was key. Working towards shared goals was described as a way of enabling better coordination across the product area network: *“Customer value and business opportunities are often created where structures meet, and often there are dependencies between teams. Common goals across teams can be a way to remove blockages”* [NB04, PA Manager]. A product manager noted, *“We work toward common goals to improve team collaboration... but collaboration can be challenging in practice. Sometimes a team comes to us asking, ‘Hey, can we do this now?’ And we have to reply, ‘Can we push it a bit? We’re tied up now.’ Then, it often just doesn’t happen.”* [NB14, PM].

Organizing into a product area was aimed at aligning teams and individuals around common issues and enabling the product area members to work closely together, both for the product management roles and for the team members. A product area manager [NB4] explained how the ultimate goal of organizing as a product area was to improve product development and delivery: *“We try to gather teams with a common goal. [...] We say we have the goal, who can contribute to this goal, and how can we achieve it quickly?”*

Another example of how goals were connected to shared understandings was the increased use of data. Like ScanBank, NorBank had a goal to become more data-driven. A/B testing facilitated shared understandings of customer insights by displaying different versions of a product to independent user groups, allowing teams to analyze which design yielded the best response. One team further validated A/B test results with sales data, making it easier to communicate findings to stakeholders and ensure data-driven decisions were well understood across the organization.

The second theme, *shared language*, revolved around aspects of effective communication between professional groups in the product area through shared language. As teams were cross-functional, team members held different professional skillsets and backgrounds. For example, the designers and developers had to make sure they

communicated in a way that ensured a shared understanding of the issue at hand, which NB06, a developer and tech leader, felt was working well in their team: *“We know that the designers do not have very deep technical insights, but we know what kind of things [language] they do understand.”*

This emphasis on adjusting terms and language to ensure a shared understanding among everyone was also illustrated by NB10, a developer: *“We [don’t] use much fancy technical language. [...] If you want to make it more concrete, you take it with people you know [understand technical terms]. If not, you just confuse each other.”*

4.4. Relational dimension of social capital

When individuals know whom to approach for specific knowledge per the structural dimension and share common understandings as conceptualized in the cognitive dimension, building relationships becomes easier. In this final section, we focus on the findings related to the relational dimension of social capital from the two cases.

4.4.1. Relational dimension: ScanBank

The two most common themes coded here were connected to 1) *building and maintaining relations* and 2) *trust*.

Regarding the first theme, we found that a variety of stakeholders each necessitated a specific relationship. These included relations at the organizational level, such as inter-team relations, relations with others in the product area and other teams, relations with ScanBank leadership, and also product customers at the external level. Additionally, it was clear that this was role-dependent and, hence, was tied to the different expectations for the SPM roles. Our findings pointed to that it was more important for PMs to establish relations with others outside the team, and also that different relations were important for the different product roles: SB14 said, *“As a PO, you work a lot with your own team and development resources, simply put. As a PM, this is exercised very differently, but from my perspective, it is much about managing expectations and thus, anchoring. So, you talk more with others than with your own team in the bank.”* While domain knowledge and technical expertise were important for product success, some PMs also noted that these skills were less critical for their specific roles compared to the skill of establishing and maintaining relations.

Underlining this point, one PM stated: *“There are some who make it work without technical competence because they initiate good conversations with others. Not all decisions are tied to the product, so to speak”* [SB03]. This view was widely shared: PMs and POs often focused on managing relationships and ensuring effective collaboration among team members. One interviewee summarized: *“It’s about people who can work with people. We have many skilled technical experts on the team. Mis-hires in ScanBank often occur because we focus too little on the human aspect of product management”* [SB11, PM].

Several also underlined the importance of building relations with product customers: SB16 said, *“It is extremely important to be able to talk to customers, as that is where you gather valuable information.”* Some were concerned there was a lack of user focus in ScanBank’s SPM approach, and especially outspoken was SB18, a PM, who stressed the crucial task of “keeping customer relations warm”. The person said, *“So if I identified some needs. It’s not like I can just let go of it and move on. You still must keep holding onto this from start to finish. Even if you’ve moved on and it’s in development, you still need to look after those [customers] who are waiting for it.”*

One type of relation, underlined as important, but few seemed to think was working well, was the relation with top management. A lack of anchoring strategic direction and goals with leaders was seen as a major hurdle, thus hindering social capital. In exemplifying how a lack of relations to leaders challenged the SPM in ScanBank, SB14 articulated that one product team had been granted “too much autonomy”: *“[This] has become a competing product, a competing business, and a competing culture within our own company. Because no one at the top had control. They have been allowed to do exactly what they want.”*

Additionally, strong relations between the product teams and managers were entwined with the third theme coded here, *trust*. For example, regular meetings between one product team [per SB14, a PM] and managers were crucial for developing a shared understanding of the importance of product thinking, thus strengthening alignment and fostering mutual trust. However, when these meetings were discontinued, the lack of a relational bond between the team and the management led to the team not feeling their visions were anchored in the organizational level of ScanBank, reducing feelings of trust and commitment.

4.4.2. Relational dimension: NorBank

Finally, at NorBank, we identified two main themes concerning the relational dimension of social capital. These included 1) *norms* and 2) *identification*. This also illustrates how multiple themes of social capital are intertwined.

The first theme, *norms*, was a broad theme that revealed much about the work culture at NorBank. The product area organization form, combined with a good working culture and strong relationships, seemed to set the basis for norms for helping and supporting each other. For example, having the right level of competency within the team, as well as the right mixture of teams within the borders of the product area, was highlighted as beneficial. Similarly, the product area organization form combined with good working relationships seemed to allow for good collaboration as people knew each other: *“In general, [people in the product area] want to help and contribute. In my experience, the Android developers are very good at what they do. If something unexpected happens, they are good at re-prioritizing and communicating what they are doing”* [NB07, tester].

NB02, a designer, elaborated on how they had established a culture of seeking to understand but also challenge one another, illustrating shared norms, attitudes and beliefs in the product area, which also touches into the cognitive dimension: *“I like [to learn things from] other professional fields, and to challenge others by asking what is and is not possible. [...] In the same way as [the more technical roles] challenge me with making more ‘native’ sketches than what we have today”.*

Somewhat related to the findings on shared understanding and shared language across professional groups (Section 4.3), and ways of working (Section 4.2), a quote by NB11, a tech lead, illustrates a culture of helping each other understand to reach agreements: *“When we disagree, it is more about what is the right direction [for the product]. I could, of course, use technical jargon that would be hard to understand, but that is not what our discussion is about; it is never so complicated that people don’t understand what others are talking about. And if so, we just ask questions.”*

A second theme illustrated a challenge with a lack of *identification* within the product area. Although the intention was to gather teams that shared goals and make them walk in the same direction and at the same pace (as explained by NB04 in Section 4.4), not all teams felt that they belonged naturally within the borders of the product area. Specifically, one horizontal platform team did not see their place in the product area, as their goals were not related to personal banking, but rather to support the vertically oriented product teams. This made them identify less with the other teams in the product area. As NB05, a developer, explained: *“It is like I work in a team that is a bit on the side. So, I notice how my interest in how [the other teams] are organized is a bit low. Because I don’t feel any particular sense of belonging with them”.* Another team member, NB07, a tester, shared this sentiment regarding how they found it difficult to relate to and understand what the product area was working with: *“I experience a greater sense of belonging with my team [than with the product area]. I have a great affinity for my team, and the [product] area is relatively new. I think I struggle a little to see the whole picture.”* These quotes illustrate the importance of not only defining shared goals for the product area but also of working to facilitate so that all teams can find their place, even with goals that are more indirectly linked to the product area.

We now turn to discuss how our findings can be interpreted from a

wider perspective.

5. Discussion

The adoption of Software Product Management (SPM) is becoming increasingly prevalent, with industry leaders such as Google and Microsoft employing this practice. However, implementing SPM in large-scale environments presents significant challenges due to the size and complexity that characterize large-scale settings. This paper has explored how SPM plays out in practice in two fintech organizations, utilizing the concept of social capital as our analytical framework and research focus. As our findings demonstrate, the three different dimensions of social capital – structural, cognitive and relational – are interconnected through different themes that sometimes overlap between the dimensions (see Fig. 1). For instance, themes such as goals, identification, and trust were crucial to more than one of the dimensions. Research consistently shows that high-quality relationships and efficient navigation across organizational networks are pivotal for efficient collaboration in large-scale settings [22,27,30], and our findings point to that social capital, and its three key dimensions, play a crucial role in driving product success in large-scale agile organizations. The fintech domain is particularly interesting in this regard because of the complexity involved with shifting to a more customer-centric approach, experimenting with new products, managing outdated technology, meeting strict compliance requirements, and simultaneously conducting an agile transformation of the whole organization [2]. To discuss our findings, we will now return to our RQ: *What is the role of social capital in large-scale agile SPM?*

Our findings from the two cases highlight the critical role of social capital throughout the organization. Successfully implementing SPM in large, complex, software-intensive organizations requires navigating networks and cultivating positive relationships across all levels of operation—within teams, across teams, and, depending on the organization’s scale, between product areas and departments. We found that building social capital also beyond the organization to the external level is necessary for SPM’s success.

Previous research on large-scale agile has similarly emphasized the importance of different operational levels, from the team level [25,46] and product area levels [6,53] to the organizational level [7,43] as well as the external level [35,38]. Accordingly, the following discussion is structured in four parts, where we examine the various facets of each social capital dimension, illustrating how it operates within and across these four operational levels within the two large-scale agile organizations under study.

Our findings show that the structural and cognitive dimensions are preconditions for the possibility of building relational social capital and are hence in line with prior research utilizing this lens to study large-scale software development (e.g., [38]). An example here from ScanBank was how the relations between the product team and the management, due to regular meetings, had led to a shared understanding of the team’s product development efforts but resulted in a lack of anchoring and alignment when these meetings were discontinued, as described in 4.4.

5.1. Social capital at the product team level

The product team level is where the actual software product development happens. This level typically consists of the core development roles, product owners, and team leaders [44,45]. However, research on large-scale agile has shown that the product management roles (both PM and POs) are not necessarily defined within the borders of the development team, but can also be placed at the product area or organizational levels [23,24,27,30]. As described in Section 4.1, the SPM roles within ScanBank were not consistently defined. In ScanBank, at times, a PM might also act as a PO and vice versa, and the PM roles were sometimes considered as part of the product teams and sometimes not.

At NorBank, the PO and PM titles were also used interchangeably.

While standardizing roles is beneficial for a common understanding and making knowledge exchange more straightforward (cognitive dimension), standardizing could also hinder efficiency in large-scale settings, due to the unique contexts of each product [32,46]. We found that the setup of product roles and teams depended on the nature and lifecycle of the product. In other words, the SPM roles need to correspond to the needs of the product. As alignment is needed to ensure quality and avoid jeopardizing interdependencies [47], there is no definitive approach to ensuring role alignment, leaving the question of how much standardization versus autonomy should be embedded in the SPM framework and roles [46].

Work mode, coded under ways of working, was highlighted as an important structural enabler of social capital at the team level, and our findings shed additional light on the role of physical co-location in software development. Research on coordination in large-scale agile has shown that the physical aspect, such as having physical meetings and on-site coordinator roles, is important [28]. The post-pandemic era, where people are increasingly working from anywhere, requires an even better understanding of the role of physical co-location for teams [48]. Despite at times a challenge, particularly regarding central SPM roles being located far away from developers in ScanBank (see Section 4.1), teams in both organizations seemed to use digital tools such as Slack innovatively to bring remote team members “closer” even for agile practices such as stand-ups.

Related to the cognitive dimension at the team level, goals and shared understandings were central. Also, for the teams, there were challenges related to the alignment of prioritization and who held responsibility for what. While NorBank invested in establishing shared goals in the product area, not all teams identified with the shared goals. Teams supporting other teams (i.e., the vertical teams) [8] had different prioritizations and goals than teams interacting with customers (horizontal teams) [42].

In discussing the role of social capital within teams, Lee et al. [14] highlight how building social capital is an essential task for team leaders. This corresponds to our findings, where the central tasks of POs (in ScanBank) and team leaders (in NorBank) included facilitating the work environment for their teams, clearing the ground, and shielding them from external distractions. This is in line with other studies on team management roles [44,45,49]. Additionally, these roles must also align their efforts with the network-building responsibilities of PMs, thereby acting as boundary-spanning agents [27,50]. The relational dimension emphasized how PMs and POs connected different roles and knowledge areas related to the product, even without possessing all the expertise themselves. This aligns with Bass’s [27] findings on the PO role in large-scale agile environments.

Building on this, product team members (i.e., data and engineering roles) further supported social capital development by fostering cognitive capital within the team. Specifically, they adapted their communication styles to bridge differences in expertise, ensuring a shared understanding across professional boundaries. This type of communication adjustment is noted in other studies (e.g., [44]), but our findings highlight the importance of adjusting from a social capital perspective.

5.2. Social capital at the product area level

Moving to the product area level, most clearly illustrated by the NorBank case, our findings show that a product area can be understood as a distinct organizational level [17] and that social capital at the product area level is related to the team configuration within the area. Research has shown that coordination can become problematic in very large development settings because when the number of teams increases, so do both system complexity and inter-team dependencies [28, 47]. This can make it more difficult to obtain and maintain shared understandings related to goals and prioritizations beyond the product team, as related to the cognitive dimension of social capital. Therefore,

very large-scale development settings require different SPM configurations than smaller settings. Our findings illustrated that at NorBank, dividing into product areas was a successful approach. In ScanBank, a much larger bank, the organization contained various configurations of product areas, both within and across organizational units. This requires other coordination mechanisms that span not only beyond teams but also across product areas. In other very large-scale organizations, such as Spotify, boundary-spanning coordination happens through, for example, the use of chapters [7] or communities of practice [45].

Also, roles with boundary-spanning responsibilities, such as the product managers, product owners, and tech leaders at NorBank, operated at the product area level. Related to the structural dimension of social capital, such boundary-spanning roles can be particularly important to connect the remote parts of organizational networks [51]. A study of knowledge networks in large-scale software development showed that teams with larger networks were able to communicate more efficiently across the organization [22]. In line with this, our findings from ScanBank show that a central PM skill is knowing how to utilize one's organizational network efficiently.

At NorBank, in terms of social capital, the product area organization form enabled information sharing and communication (structural capital) intended to support shared goals and shared understandings of common themes (cognitive capital) that would increase development speed and product delivery. A common understanding of the responsibility and function of each team made knowledge exchange between teams more effective. Moreover, being organized into a product area made it possible to build relations and develop a culture of knowledge-sharing and trust within and across teams (relational capital). However, at NorBank, one platform team felt a lower sense of belonging within the area, which made the team members less interested in the other teams. Platform teams are important in any large-scale setup because they provide important services to the product teams, thereby supporting product delivery even though their goals are not necessarily directly shared with the other teams in the product area [9, 29]. As such, our findings illustrate the importance of working to strengthen the sense of belonging by focusing on each team's purpose in a wider sense.

5.3. Social capital at the organizational level

Whereas the product area level was an organizational priority for NorBank's SPM efforts, the organizational level was paramount to ScanBank's approach to SPM. As our findings show, successfully establishing and maneuvering social ties between organizational areas was central to growing social capital in the organization to achieve a clear product direction, which ultimately would lead to product success. These points correspond to previous research, for instance, Springer et al. [9], whose study underlines the importance of shared understandings of roles and goals: If goals frequently change, SPM roles struggle with unclear and conflicting prioritizations.

Although our analysis revealed that several themes across the three dimensions of social capital were relevant at the organizational level, we found especially shared understandings (cognitive dimension), roles (structural dimension), and goals (structural and cognitive dimensions) to be crucial themes here. For instance, collaboration across the organization requires aligning and synchronizing different product areas around common goals and understandings, while maintaining a clear understanding of role responsibilities. One possible pitfall and threat to social capital, as mentioned by several PMs, was that if aligning roles, goals, and understandings was not done successfully on the organizational level, different product areas would end up *competing rather than uniting* around similar organizational objectives. Limited alignment at an organizational level in large-scale SPM contexts, as Randolph et al. [39] suggest, means needing to direct focus toward sustained cooperation among competing priorities, requiring cultivating network legitimacy, trust, and resilience. These elements correspond to the cognitive,

relational, and structural dimensions of social capital that are essential for what the authors label "technology-enabled cooperation networks", likely relevant to many different large-scale SPM contexts, including NorBank and ScanBank.

Whereas the role usually in charge of the relational connections on the team level is the Product Owner (ScanBank) or team leader (NorBank) (see Section 3.1), we found that the role responsible for linking product and team needs to other areas and organizational units was usually the product manager (PM). All ScanBank PMs talked about the importance and effort required to maneuver organizational networks. It was even underlined that knowing who to talk to and *how* to talk to them could compensate for a limited domain or technical knowledge. Hence, PMs were largely responsible for creating the social capital connected to establishing and maintaining relations (relational dimension) at the organizational level of operation. This corresponds to the findings of Smite et al. [22], who emphasize that social capital in large-scale environments depends on a well-established communication infrastructure.

It can be argued, thus, that PMs take on the primary responsibility for cultivating social capital across organizational areas on behalf of the team. This is also in line with previous research regarding social capital in agile settings [15]. These findings can however be said to contrast with the findings of Wohlin et al. [16], who highlighted that "a combination of expertise and experience" was the most central trait for those involved in software development in complex agile environments. We found that creating relational bonds across the organization was an additional – if not the main – enabler for successful SPM performance in large-scale agile.

5.4. Social capital at the external level

Two elements at this level are – or about to become – key for successful and insightful SPM. The first is the *customer*, an obvious but oftentimes obscure element in product development. The other element is *data*, which is essential in SPM because it enables teams to use the right metrics, uncover valuable insights, and ultimately build a product that truly meets user needs [24,33,34]. Although "data" is an abstract term that is arguably also situated at the other levels, we first and foremost connect it with existing and potential customers and opportunities beyond the organizational level.

Establishing relations with customers and creating shared understandings from data-driven insights were clear SPM goals for both banks we studied, and were seen as efforts that would create instant value. These aspects are connected to the themes of *establishing and maintaining relations* (relational dimension) and *shared understandings* (cognitive dimension). Knowing how to go about gaining customer insights and leveraging data in the best way, however, was hard to determine for both NorBank and ScanBank. This corresponds to recent SPM research: In studying the most common hurdles of SPM, Springer et al. [9] found that difficulty in determining the true value of one's product efforts was central to product success. Moreover, in the fintech sector, these challenges are intensified by strict regulatory requirements, which shape how customer data can be collected, analyzed, and utilized in product management decisions [1].

Olsson and Bosch [33] show that data-driven ways of working both challenge and enhance product management practices by increasing the effectiveness of SPM efforts significantly, and it is one of the emerging SPM trends described in 2.1. This also holds for social capital in large-scale SPM; data can *enable* social capital by fostering shared understanding and collaboration, but it can also *challenge* it by creating information silos or misalignments across teams. A central aspect here, however, is that SPM teams have incorporated roles that can handle leveraging data as part of their work. Sourcing knowledge about data was seen as a primary responsibility of PMs and POs in the studied banks. Hence, connecting various roles and knowledge areas related to the product without necessarily possessing all this expertise themselves

was central in their product thinking, pointing to the importance of establishing and maintaining relations also in the quest for becoming more data-driven. This finding thus extends the work of Bass [27], which focuses primarily on the PO role in large-scale agile settings.

5.5. Practical implications

The following practical recommendations outline how companies and professionals can foster productive SPM environments where teams can thrive, maintain customer focus, and drive product innovation in complex agile organizational contexts.

- **Empower product managers and product owners as “boundary-spanners”.** We found that PMs and POs play a critical role in bridging various operational levels and aligning teams on priorities. Therefore, companies need to define boundary-spanning as part of the PM and PO roles and provide networking and stakeholder management training.
- **Clarify and operationalize roles in large-scale product management.** Our study of the two companies shows that unclear or overlapping roles can hinder collaboration and reduce structural social capital. Organizations should invest in explicit definitions of SPM roles and ensure that responsibilities are understood across teams. However, there is a tension between standardization and autonomy [46,47], as the roles and processes need to be adapted to a specific product or sub-project. People in SPM roles need to rely on their network to reduce friction and promote efficient decision-making.
- **Relational expectations in leadership roles should be made explicit.** Our findings show that PMs and POs, particularly in ScanBank, carry substantial relational responsibilities, such as shielding teams from organizational noise and managing inter-team dependencies. While these practices foster social capital, they also contribute to cognitive and emotional strain. Similar dynamics in NorBank highlight how cultural norms of collaboration and challenge require sustained interpersonal effort. These relational demands are often implicit and unsupported. Organizations should therefore recognize this aspect of leadership in the design and evaluation of product management roles.

5.6. Vision for the future of research on large-scale agile and social capital

Agile software development methods were originally designed for small, co-located development teams, but are increasingly being applied in broader and more complex contexts, such as large-scale fintech environments. Methods designed for individual teams of five to nine developers have now been adapted for use in projects involving tens of teams and hundreds of developers, integrating with numerous existing systems and impacting hundreds of thousands of users [52].

In fintech, agile methodologies are adopted to increase adaptability and maintain a competitive edge. However, agility alone is not enough; a robust software product management (SPM) function is needed to define and prioritize product features and navigate conflicting priorities. Currently, three trends, described in Section 2.1, are shaping SPM practices in large-scale agile organizations: The emergence of new ways to structure teams and work processes [8], the expansion of SPM beyond the software development department [2,3], and the adoption of new technical solutions like data-driven product development and AI [33].

Our research shows that social capital plays a crucial role in shaping and improving collaboration, facilitating information flow, and driving product success in large-scale agile organizations. However, further research is needed in the following areas:

1. **Balancing standardization and autonomy in SPM roles and processes:** Future research should investigate the balance between role standardization and autonomy within large-scale agile

organizations through the lens of social capital. This research could help determine the optimal level of standardization needed to support collaboration without undermining flexibility and adaptability.

2. **The role of AI in building social capital for agile SPM:** We found that having a data-driven approach to product development is key. We also know that the case companies have started using AI tools like Microsoft and GitHub Copilot. However, the impact of AI on social capital in large-scale agile settings remains unclear, and AI has not yet become a common component of NorBank or ScanBank’s SPM efforts. Future research should examine the socio-technical dynamics of incorporating AI into social capital-building practices: Could AI act as a participant in social networks, or might it weaken social capital as people increasingly interact with AI rather than each other?
3. **Impact of physical and digital co-location on social capital:** Several respondents described physical presence as fostering collaboration. In hybrid work environments, like in NorBank and ScanBank, more detailed studies are needed to explore how physical and digital co-location affect social capital within large-scale agile product development. Understanding these dynamics could be critical in designing environments that support effective collaboration, whether remote or on-site.

5.7. Limitations

In this section, we evaluate the study against the four criteria for assessing the trustworthiness of naturalistic inquiries [53], which are suitable for qualitative research.

First, *credibility* refers to the «fit» between the data and the study’s representation of them. Some potential issues here include how well the theoretical framework represents the data, and the fact that the data was collected in two rounds. For the first point, we believe that Nahapiet and Goshal’s framework was a good choice of theoretical lens for addressing our research question, and that the findings, as presented in chapter 4, show that these analytical categories were suitable for our data. For the second point, we studied two large-scale fintech organizations that differed in size, organizational structure, and SPM configurations, as described in Section 3. Due to these differences, we interviewed different roles across the two cases. These differences may have influenced, for instance, the types of challenges reported. Despite these differences, we believe that collecting data from two cases, albeit with a time lag and slight variations in the semi-structured interview guide, provided a deeper understanding of the research topic, which contributes to the credibility of our study, compared to having only one research case.

The credibility criterion also extends to whether the data collection methods provided appropriate data. The study mainly relied on interviews, which gave us in-depth insights but also brought some limitations. People’s views can be subjective, and their responses might be influenced by personal biases or how they want to be perceived. To balance this, we included strategic documents and observations of team meetings, which helped us understand the broader context of what we learned from the interviews. Further, we have verified our case description and our findings with the company representatives, who have acknowledged that our interpretation concerning social capital and SPM is accurate.

Second, *transferability* relates to the generalizability of the findings, to the extent that readers can evaluate the applicability to their own settings. Although our findings cannot generalize to all settings, we have strived to provide thick descriptions from both case contexts with the aim that other large-scale fintech organizations can compare with their own contexts. However, it may be challenging to apply these findings directly to other industries or regions where practices and cultures might differ.

Third, a logical, clearly documented, and traceable research process is required to establish the *dependability* of the research. Fourth, and

related, *confirmability* refers to the extent to which the interpretations and findings are clearly described such that readers can understand how the conclusions have been reached. In response to these two criteria, we have strived to be as transparent as possible, clearly explaining the data collection and analytical steps, and providing examples of the coding sheet and interview guides as explained in [Section 3](#).

6. Conclusion

Our study has highlighted that building social capital in large-scale software product management (SPM) requires a combination of skills, resources, and individual personalities: It's not only about having access to networks but also about how effectively people engage with and maintain those relationships [36]. We have pinpointed how social capital is actively built and the goals it serves within large-scale agile environments, particularly in enhancing coordination, communication, and decision-making at different operational levels, providing both implications for practice and future research on large-scale agile SPM.

The focus on relationships across organizational boundaries emphasizes that social capital extends beyond individual product management teams, and even beyond organizational borders. For key SPM roles, fostering strong relationships across such boundaries is crucial to managing dependencies between products or actors and aligning work towards shared objectives. These connections allow them to respond flexibly to complex challenges, promote knowledge sharing, and drive alignment across the organization.

Our findings suggest that the value of social capital lies not only in immediate project success but also in building a resilient network that supports continuous improvement and adaptability in product development by incorporating, for example, data-driven initiatives. By supporting the development of social networks and informal connections, such as through facilitating Communities of Practice (CoPs) or informal knowledge-sharing sessions, organizations can help agile product teams better navigate the challenges of scale, contributing to improved outcomes and a more collaborative culture.

In sum, social capital is a critical asset in large-scale agile SPM, and as we have shown, by providing a model for how the social capital factors of agile SPM can be conceptualized in three different dimensions [12], a useful framework for studying the socio-technical nuances of SPM in a large-scale setting, which, ultimately, are grounded in principles of agile methodologies.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used Claude or ChatGPT in order to improve the readability and language of some of the sentences in the manuscript. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

CRediT authorship contribution statement

Astri Barbala: Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Marthe Berntzen:** Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Nils Brede Moe:** Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Astri Barbala reports financial support was provided by University of Galway. Astri Barbala reports a relationship with University of Galway that includes: employment. Astri Barbala, Nils Brede Moe, Marthe Berntzen reports a relationship with Research Council of Norway that includes: funding grants. Astri Barbala, Nils Brede Moe reports a relationship with Stiftelsen SINTEF that includes: employment. Marthe Berntzen reports a relationship with University of Oslo that includes: employment. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The Research Council of Norway supported the work through the projects 10xTeams (grant 309344) and Transformit (grant 321477).

The contribution by Astri Barbala was supported, in part, by Taighde Éireann – Research Ireland under Grant number 13/RC/2094.2. Co-funded by the European Union under the Systems, Methods and Context (SyMeCo) programme grant agreement number 101081459. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

Data availability

The data that has been used is confidential.

References

- [1] V. Murinde, E. Rizopoulos, M. Zachariadis, The impact of the FinTech revolution on the future of banking: opportunities and risks, *Int. Rev. Financ. Anal.* 81 (2022) 102103, <https://doi.org/10.1016/j.irfa.2022.102103>.
- [2] S.K. Sia, C. Soh, P. Weill, How DBS Bank pursued a digital business strategy, *MIS Q. Exec.* 15 (2016).
- [3] M. Mikalsen, N.B. Moe, V. Stray, H. Nyrud, Agile digital transformation: a case study of interdependencies, (2018).
- [4] C. Baham, R. Hirschheim, Issues, challenges, and a proposed theoretical core of agile software development research, *Inform. Syst. J.* 32 (2022) 103–129, <https://doi.org/10.1111/isj.12336>.
- [5] T. Dingsoeyr, D. Falessi, K. Power, Agile development at scale: the next frontier, *IEEe Softw.* 36 (2019) 30–38, <https://doi.org/10.1109/MS.2018.2884884>.
- [6] K. Conboy, N. Carroll, Implementing large-scale agile frameworks: challenges and recommendations, *IEEe Softw.* 36 (2019) 44–50.
- [7] D. Smite, N.B. Moe, M. Floryan, J. Gonzalez-Huerta, M. Dorner, A. Sablis, Decentralized decision-making and scaled autonomy at Spotify, *J. Syst. Softw.* 200 (2023) 111649, <https://doi.org/10.1016/j.jss.2023.111649>.
- [8] M. Skelton, M. Pais, Team topologies: organizing business and technology teams for fast flow, *IT Revol.* (2019).
- [9] O. Springer, J. Miler, A comprehensive overview of software product management challenges, *Empir. Softw. Eng.* 27 (2022) 106, <https://doi.org/10.1007/s10664-022-10134-5>.
- [10] O. Springer, J. Miler, M. Wróbel, Strategies for dealing with software product management challenges, *IEEE Access.* 11 (2023) 55797–55813, <https://doi.org/10.1109/ACCESS.2023.3282605>.
- [11] B. Fitzgerald, K.-J. Stol, Continuous software engineering: a roadmap and agenda, *J. Syst. Softw.* 123 (2017) 176–189.
- [12] J. Nahapiet, S. Ghoshal, Social capital, intellectual capital, and the organizational advantage, *Acad. Manage. Rev.* 23 (1998) 242–266, <https://doi.org/10.2307/259373>.
- [13] P. Bourdieu, The forms of capital, in: J. Richardson (Ed.), *Handbook of Theory and Research for the Sociology of Education*, Greenwood, New York, 1986.
- [14] J. Lee, J.-G. Park, S. Lee, Raising team social capital with knowledge and communication in information systems development projects, *Int. J. Project Manage.* 33 (2015) 797–807, <https://doi.org/10.1016/j.ijproman.2014.12.001>.
- [15] D. Baxter, N. Turner, Why Scrum works in new product development: the role of social capital in managing complexity, *Prod. Plann. Control* 34 (2023) 1248–1260, <https://doi.org/10.1080/09537287.2021.1997291>.
- [16] C. Wohlin, D. Smite, N.B. Moe, A general theory of software engineering: balancing human, social and organizational capitals, *J. Syst. Softw.* 109 (2015) 229–242, <https://doi.org/10.1016/j.jss.2015.08.009>.

- [17] M. Berntzen, S.A. Engdal, M. Gellein, N.B. Moe, Coordination in agile product areas: a case study from a large FinTech organization, in: International Conference on Agile Software Development, Springer Nature Switzerland Cham, 2024, pp. 36–52. <https://library.oapen.org/bitstream/handle/20.500.12657/90931/1/978-3-031-61154-4.pdf#page=46>. accessed October 23, 2024.
- [18] S.A.J. Engdal, Et pedagogisk blikk på kryssfunksjonelle produktutviklingsteam, Master thesis, 2023. <https://www.duo.uio.no/handle/10852/103126> (accessed October 31, 2024).
- [19] N.B. Moe, M. Berntzen, A. Barbala, V. Stray, Software product management in large-scale agile, in: International Conference on Agile Software Development, Switzerland Cham, Springer Nature, 2024, pp. 53–69. <https://library.oapen.org/bitstream/handle/20.500.12657/90931/1/978-3-031-61154-4.pdf#page=63>. accessed October 25, 2024.
- [20] A. Barbala, N.B. Moe, M. Berntzen, Social Capital in software product management: a case study from a large-scale agile context, in: L. Marchesi, A. Goldman, M. I. Lunese, A. Przybyłek, A. Aguiar, L. Morgan, X. Wang, A. Pinna (Eds.), *Agile Processes in Software Engineering and Extreme Programming – Workshops*, Springer Nature Switzerland, Cham, 2025, pp. 90–99.
- [21] A. Maglyas, U. Nikula, K. Smolander, Lean solutions to software product management problems, *IEEe Softw.* 29 (2012) 40–46, <https://doi.org/10.1109/MS.2012.108>.
- [22] D. Šmite, N.B. Moe, A. Šablīs, C. Wohlin, Software teams and their knowledge networks in large-scale software development, *Inf. Softw. Technol.* 86 (2017) 71–86.
- [23] J.M. Bass, A. Haxby, Tailoring product ownership in large-scale agile, (2018). <http://arxiv.org/abs/1812.06524> (accessed October 31, 2024).
- [24] A. Tkalic, R. Ulfnes, N.B. Moe, Toward an agile product management: what do product managers do in agile companies? in: V. Stray, K.-J. Stol, M. Paasivaara, P. Kruchten (Eds.), *Agile Processes in Software Engineering and Extreme Programming* Springer International Publishing, Cham, 2022, pp. 168–184, https://doi.org/10.1007/978-3-031-08169-9_11.
- [25] C. Ebert, The impacts of software product management, *J. Syst. Softw.* 80 (2007) 850–861, <https://doi.org/10.1016/j.jss.2006.09.017>.
- [26] C. Ebert, S. Brinkkemper, Software product management – an industry evaluation, *J. Syst. Softw.* 95 (2014) 10–18, <https://doi.org/10.1016/j.jss.2013.12.042>.
- [27] J.M. Bass, How product owner teams scale agile methods to large distributed enterprises, *Empir. Softw. Eng.* 20 (2015) 1525–1557, <https://doi.org/10.1007/s10664-014-9322-z>.
- [28] M. Berntzen, R. Hoda, N.B. Moe, V. Stray, A taxonomy of inter-team coordination mechanisms in large-scale agile, *IEEE Trans. Softw. Eng.* 49 (2022) 699–718.
- [29] M. Paasivaara, B. Behm, C. Lassenius, M. Hallikainen, Large-scale agile transformation at Ericsson: a case study, *Empir. Softw. Eng.* 23 (2018) 2550–2596, <https://doi.org/10.1007/s10664-017-9555-8>.
- [30] M. Berntzen, N.B. Moe, V. Stray, *The Product Owner in Large-Scale Agile: An Empirical Study Through the Lens of Relational Coordination Theory*, Springer International Publishing, 2019, pp. 121–136.
- [31] V. Stray, N.B. Moe, A. Aasheim, Dependency management in large-scale agile: a case study of DevOps teams, in: 2019.
- [32] K. Dikert, M. Paasivaara, C. Lassenius, Challenges and success factors for large-scale agile transformations: a systematic literature review, *J. Syst. Softw.* 119 (2016) 87–108, <https://doi.org/10.1016/j.jss.2016.06.013>.
- [33] H.H. Olsson, J. Bosch, Strategic digital product management: nine approaches, *Inf. Softw. Technol.* 177 (2025) 107594, <https://doi.org/10.1016/j.infsof.2024.107594>.
- [34] A.M. Barbala, G.K. Hanssen, T. Sporse, Towards a common data-driven culture: a longitudinal study of the tensions and emerging solutions involved in becoming data-driven in a large public sector organization, *J. Syst. Softw.* 218 (2024) 112185, <https://doi.org/10.1016/j.jss.2024.112185>.
- [35] D.E. Strode, A dependency taxonomy for agile software development projects, *Inf. Syst. Front.* 18 (2016) 23–46, <https://doi.org/10.1007/s10796-015-9574-1>.
- [36] J.E. Dutton, B.R. Ragins, *Exploring Positive Relationships At Work: Building a Theoretical and Research Foundation*, Psychology Press, 2017.
- [37] N.B. Moe, D. Smite, A. Sablis, A.-L. Børjesson, P. Andreasson, Networking in a large-scale distributed agile project, (2014).
- [38] K.-J. Stol, M. Schaarschmidt, L. Morgan, Does adopting inner source increase job satisfaction? A social capital perspective using a mixed-methods approach, *J. Strat. Inform. Syst.* 33 (2024) 101819, <https://doi.org/10.1016/j.jsis.2024.101819>.
- [39] R.V. Randolph, H. Hu, K.D. Silvernail, Better the devil you know: inter-organizational information technology and network social capital in competition networks, *Inform. Manage.* 57 (2020) 103344, <https://doi.org/10.1016/j.im.2020.103344>.
- [40] R.K. Yin, *Case Study research: Design and Methods*, Sage, Thousand Oaks, Calif, 2009.
- [41] P. Runeson, M. Höst, Guidelines for conducting and reporting case study research in software engineering, *Empir. Softw. Eng.* 14 (2009) 131–164, <https://doi.org/10.1007/s10664-008-9102-8>.
- [42] C.R. Wodtke, Radical focus: achieving your most important goals with objectives and key results, *Boxes Arrows* (2017).
- [43] D.S. Cruzes, T. Dybå, Research synthesis in software engineering: a tertiary study, *Inf. Softw. Technol.* 53 (2011) 440–455, <https://doi.org/10.1016/j.infsof.2011.01.004>.
- [44] R. Hoda, J. Noble, S. Marshall, Self-organizing roles on agile software development teams, *IEEE Trans. Softw. Eng.* 39 (2012) 422–444.
- [45] S.V. Spiegler, C. Heinecke, S. Wagner, An empirical study on changing leadership in agile teams, *Empir. Softw. Eng.* 26 (2021) 41, <https://doi.org/10.1007/s10664-021-09949-5>.
- [46] H. Edison, X. Wang, K. Conboy, Comparing methods for large-scale agile software development: a systematic literature review, *IEEE Trans. Softw. Eng.* 48 (2022) 2709–2731, <https://doi.org/10.1109/TSE.2021.3069039>.
- [47] S. Bick, K. Spohrer, R. Hoda, A. Scheerer, A. Heinzl, Coordination challenges in large-scale software development: a case study of planning misalignment in hybrid settings, *IEEE Trans. Softw. Eng.* 44 (2017) 932–950.
- [48] D. Šmite, N.B. Moe, E. Klotins, J. Gonzalez-Huerta, From forced working-From-home to voluntary working-from-anywhere: two revolutions in telework, *J. Syst. Softw.* 195 (2023) 111509, <https://doi.org/10.1016/j.jss.2022.111509>.
- [49] Y. Shastri, R. Hoda, R. Amor, The role of the project manager in agile software development projects, *J. Syst. Softw.* 173 (2021) 110871, <https://doi.org/10.1016/j.jss.2020.110871>.
- [50] D.E. Strode, S.L. Huff, B.G. Hope, S. Link, Coordination in co-located agile software development projects, *J. Syst. Softw.* 85 (2012) 1222–1238.
- [51] C. Manteli, B. van den Hooff, H. van Vliet, The effect of governance on global software development: an empirical research in transactive memory systems, *Inf. Softw. Technol.* 56 (2014) 1309–1321, <https://doi.org/10.1016/j.infsof.2014.04.012>.
- [52] Y. Palopak, S.-J. Huang, W. Ratnasari, Knowledge diffusion trajectories of agile software development research: a main path analysis, *Inf. Softw. Technol.* 156 (2023) 107131, <https://doi.org/10.1016/j.infsof.2022.107131>.
- [53] Y.S. Lincoln, E.G. Guba, *Naturalistic Inquiry* (1985).