SCHOOL OF COMPUTATION, INFORMATION AND TECHNOLOGY — INFORMATICS

TECHNISCHE UNIVERSITÄT MÜNCHEN

Master's Thesis in Information Systems

Investigating the Establishment of Communities of Practice in Large-Scale Agile Software Development

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Untersuchung der Etablierung von CoPs im Kontext der großangelegten agilen Softwareentwicklung

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I confirm that this master's thesis is my own work and I have documented all sources and material used.

Munich, 15.07.2023 Johannes Alexander Schmidt

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Abstract

These days, organizations need to be able to react quickly to changes due to the increased development of technology to stay competitive in the market. This is especially crucial in the case of software development. As a result, agile methods become more and more successful and used, since they enable companies to react quickly to changes in requirements or customer needs. Large enterprises have begun to use agile techniques in a broader context, known as large-scale agile software development, through the success of agile methodology on a small scale. However, the use can lead to challenges like steering or coordinating multiple layers or teams in the development process. Knowledge exchange is needed to support the different teams and collaborative working. Communities of Practice, a group with a common interest in learning, can address these challenges since they enable cross-organizational knowledge exchange and coordination. In addition, they can drive the agile transformation in a company and strengthen the self-organization and autonomy of teams, which is why they are also mentioned in some Scaling Agile Frameworks. However, the literature on Communities of Practice in large-scale agile software development is still relatively small and mainly focuses on single-case organizations. To fill this gap, this master thesis investigates the current state of establishing Communities of Practice in large-scale agile software development in the industry. To achieve this goal, this thesis first provides a theoretical foundation on agility, large-scale agile software development, and Communities of Practice in different types of organizations. Second, an interview study with experts from different companies in the large-scale agile software development area is conducted to identify the current state. Thirdly, open research areas relevant to the industry in this context are described based on the results from the interview study. Lastly, the key findings are summarized, and a limitation and an outlook on future work are provided.

Contents

Abbreviations

AI Artificial Intelligence

COO Chief Operating Officer

CoP Community of Practice

CoPs Communities of Practices

CT Computed Tomography
sasaw
CTO Chief Technology Officer

DACH Germany, Austria, Switzerland

DAD Discipline Agile Delivery

DoD Definition of Done

DevOps Software development and IT operations

IT Information Technology

LeSS Large-Scale Scrum

LSAD Large-scale agile software development

MR Magnetic Resonance

PO Product Owner

RAGE Recipes for Agile Governance in the Enterprise

SAFe Scaled Agile Framework

SM Scrum Master

SoS Scrum-of-Scrums

TUM Technical University of Munich

UI User Interface

UX User Experience

VUCA Volatility, Uncertainty, Complexity, Ambiguity

XP Extreme Programming

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1. Introduction

This master thesis investigates Communities of Practices in large organizations practicing agile development. In this first chapter, the relevance of the topic and essential information are explained. The first section (Section 1.1) shows the motivation and significance of the subject of this thesis. While in Section 1.2, the research questions and objectives are presented, Section 1.3 introduces the research methodology used to answer the research questions. The last section (Section 1.4) presents the structure of this thesis.

1.1. Motivation

Today's organizations, especially in the Information Technology (IT)-sector, need to react fast to changes in the requirements of customers to stay competitive in the market. These changes are due to increased development of technology or changes in regulations [1, 2]. For software development, the requirements change is the most crucial factor for companies to be competitive [3]. In contrast to traditional methodologies, which see the software development process as certain and therefore have infrequent releases and lack adoption [3], changes are part of agile methodology. Agile methods require feedback and adjustment over periods, enabling them to react quickly to changes in requirements or customer needs, making them suitable for the current needs in today's organizations [4]. Especially since the development of the Agile Manifesto in 2001 [5], agile methods have become standard in software development [6]. The most popular examples are Scrum [7], an agile framework, and lean programming such as Kanban [8] or Scrumban [9, 10] based on the 16th Annual State of Agile Report [6]. Next to the flexibility, agile methods can also lead to an increased collaboration or better working environment [6].

Through the success of agile methods in organizations, despite some concerns, e.g., in terms of the applicability for the acquisition in large-scale settings [11, 12], more and more large organizations adapt agile methods in a larger way [6, 13]. The use of the agile methodology in large software organizations is called Large-scale agile software development (LSAD), when teams collaborate in an agile way (on one product) [14, 15, 16] and a certain scaling size (based on scaling factors [17, 18, 19]) is reached, or

agile methods are applied in the whole organization [15, 20]. To support the adoption of agile methods to large organizations, several large-scale agile frameworks were developed [13]. Common examples are: Scaled Agile Framework (SAFe) [21, 22, 23], Scrum@Scale/Scrum-of-Scrums (SoS) [24, 7], the Spotify Model [25, 26] and Large-Scale Scrum (LeSS) [27]. Another goal of the frameworks is to address challenges, such as coordination of multiple teams or building trust [6, 23].

However, to achieve a transfer to large-scale agile methods and address challenges like team coordination [28], a knowledge exchange, for example through meetings and discussion [28, 29] is needed [4, 30, 31]. A possibility to address the need for knowledge exchange is the establishment Communities of Practices (CoPs) [31, 32, 33]. CoPs are groups of people/experts with a common interest and passion for learning who meet regularly [34]. Through their common interest, the experts aim to exchange knowledge and expertise during the meetings to improve and learn from each other [32, 34]. This concept enables, next to boundless/cross-organizational knowledge exchange and coordination [33], also the entire company to profit from the expertise of individuals [32]. In addition, CoPs can support and drive the agile transformation in an organization [35, 36, 37]. Furthermore, CoPs strengthen the autonomy [38] and self-organization of the teams and can also enable distributed decision-making [39, 23]. Due to these benefits, the concept of CoPs is also mentioned in some Scaling Agile Frameworks like SAFe [23], or in the form of guilds in the Spotify Model [25, 26].

In general, the literature about CoPs offer a lot insides about types [40, 41, 42, 43], goals [32, 44, 45], and the establishment process [46, 47, 48]. Furthermore, topics like forms of knowledge sharing [45, 49], governance [32, 50], and benefits [34, 51] are covered. However, the literature focusing on CoPs in LSAD is still quite small and often consists only of a case study of a specific organization. While also offering some general information on CoPs in LSAD [35, 36, 52], there is only a little research with a focus on providing an overview of which CoPs currently exist in practice, how and why the establishment of CoPs takes place, or providing guidance, especially on topics relevant to practice. Consequently, this master thesis tries to fill this gap by investigating the current state of CoPs in literature in LSAD by conducting an interview study with different experts from the industry. The results of this thesis are a first step in identifying the current state of the establishment of CoPs in LSAD in the industry.

1.2. Research questions

To investigate the current state of the establishment of CoPs in LSAD, five different research questions were identified to reach the overall research goal of this master thesis.

> **Research question 1:** *What types of CoPs exist in large-scale agile software development?*

Since there is a need for knowledge exchange in LSAD, and CoPs can offer a possibility to solve this issue [29, 33, 37], and research suggests further research on how CoPs work in LSAD and what they are used for [36], the first research questions aims to identify the different existing types of CoPs in LSAD. Therefore, the current literature on this topic is analyzed. Moreover, an interview study with 23 participants from 13 different organizations was conducted to gain an overview of the currently existing types of CoPs in the industry and to examine if the "real" types of CoPs matches the once identified in the literature (as suggested by Monte et al. [53]), since there is not much literature which investigates the CoPs in LSAD-organizations [36].

> **Research question 2:** *What are the goals and reasons for the establishment of CoPs in that context?*

Since goal orientation is essential for organizations, identifying a goal is a central aspect in many (management) literature like the Balanced Scorecard [54]. However, existing literature focuses on the benefits of CoPs as reasons for an establishment and does not try to identify the goals for the creation itself [35, 36]. As a result, it is necessary to look at for what purposes, or rather to achieve what goals, CoPs were established. Consequently, the second research question deals with the goals and reasons for establishing CoPs in organizations. Therefore, this paper tries to identify further aspects, next to the need for knowledge exchange, by addressing this topic in the interview study and analyzing the existing literature, especially on goals and reasons of CoPs in (large) organizations.

> **Research question 3:** *How were the CoPs established? Who was involved and how?*

The third research question focuses on the establishment process to obtain an even better view of the creation of CoPs in LSAD. This topic includes aspects of the establishment's approach (e.g., bottom-up, top-down) and the involved persons in the creation phase. This question is important because, in the literature, a need for further investigation on managers are often identified as the main drivers for the establishment of CoPs

during agile transformation [33], but not how to established further ones once the company is already working agile. In addition, further research on the role of the coordinator is suggested [55]. Thus, one objective of the interview study was to identify the mentioned aspects of the establishment process. The literature foundation of this thesis also covers this topic.

Research question 4: *How do knowledge sharing and governance take place?*

Furthermore, the literature identified the need for research on how CoPs should be cultivated in companies [36]. In addition, further research on the organizing of CoPs is suggested by Probst et al. [50]. Consequently, the fourth research question aims to cover two relevant aspects. The first one is the area of knowledge exchange since knowledge sharing and learning is the fundamental purpose of a Community of Practice (CoP) and existing literature only covers it in regards to classic CoPs [45], but not on the ones in LSAD [37]. The second aspect covered by the fourth research question is the governance of CoPs because the element of decision-making in CoPs arises more and more in literature [56], which strengthens the need for research on governance even more.

Research question 5: *What research topics in that context would be relevant/interesting for practice?*

Since this master thesis should provide a foundation and overview of the current state of the establishment of CoPs in LSAD and existing literature suggested further research in this context [36], the last research question aims to identify further relevant research areas, which are not yet covered by the existing literature and this thesis. The goal is to provide further research with specific topics the industry can adopt to support the establishment of CoPs. Thus, the interview study participants were asked about missing literature and how research can support the establishment of CoPs in the industry.

1.3. Research methodology

This thesis mainly uses two research approaches: an interview study in information system research with experts [57, 58] and the first step of the design science approach, the problem identification [59].

The design science approach in information systems was created by Hevner et al. [59] and further developed by Peffers et al. [60] through the introduction of design

science research. While the environment of this design science research is expert interviews, literature, and related work on the topics of agile development, large-scale agile development and communities of practices is the knowledge base on this thesis (see Figure 1.1). Since the current state of research on CoPs in LSAD organizations is not broadly covered in literature, this master thesis will only focus on the problem identification and not yet design and develop an artifact. However, this thesis tries to formulate relevant research questions for further work to enable the future creation of an artifact.

The goal of the interview study is to identify the current state of how and what types of CoPs are established in LSAD and to find relevant further research topics in that context [61]. The study design follows the guidelines by Runeson et al. [62]. As mentioned, the interview study was conducted with experts from the industry as part of the design science approach [57, 58]. 23 experts from 13 organizations were identified as relevant for the context, based on preliminary calls, and then interviewed. As an interview form, semi-structured interviews (based on [63]) are used following the guidelines of Myers et al. [57]. This form enabled honest answers and discussion while still providing structure. Afterward, the interviews are transcribed, coded, and analyzed to ensure the validity of the results of this thesis. In this context, the two-cyclic coding process [64] was used next to the approach suggested by Saldaña [65]. More details on the interview study, like the study design and data collection, can be found in Chapter 4.

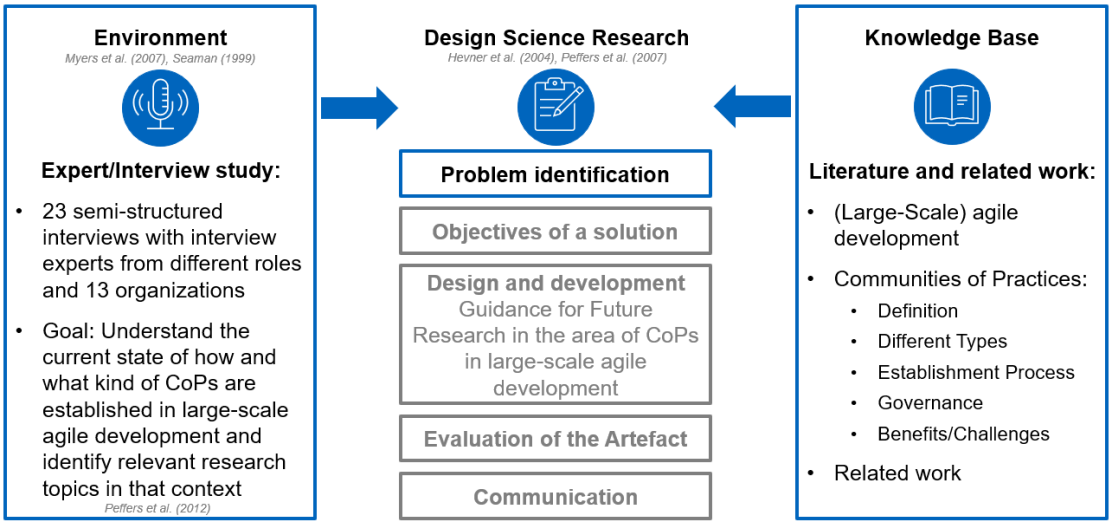

Figure 1.1.: Overview of the research approach of this thesis

1.4. Structure of the thesis

This master thesis is structured in the following way: Chapter 1 presents the motivation for this paper next to the research questions, the research methodology, and the thesis structure. The next chapter (Chapter 2) introduces relevant theoretical foundations for this paper. On the one hand, literature about agile software development is presented next to the foundations of large-scale agile software development. On the other hand, the concept of Communities of Practice is described in detail, including the use of CoPs in large-organization and agile ones. Chapter 3 presents relevant related work with a focus on CoPs in different forms of organizations (large, agile, large-scale). The method used in this master thesis (Interview study) is described in detail in Chapter 4 while the results of the interviews are presented in Chapter 5. In Chapter 6, an open research area for CoPs in LSAD is described next to a differentiation between classic CoPs and the ones in LSAD based on the interview study. In the next chapter (Chapter 7), the essential findings and limitations of this master thesis are presented. The thesis concludes with a summary of the results and a remark for further work (Chapter 8). An overview of the structure of this thesis is depicted in Figure 1.2.

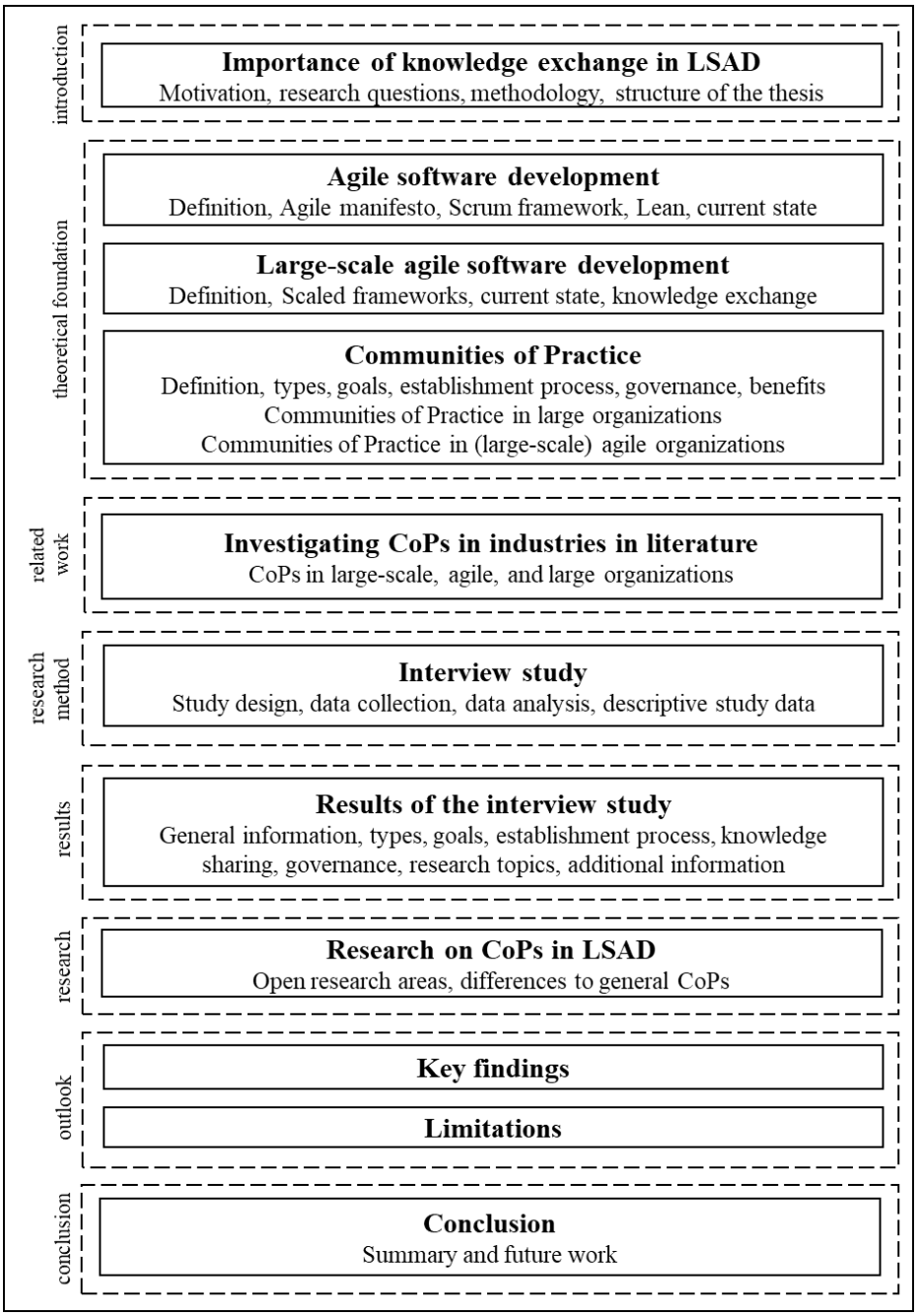

Figure 1.2.: Structure of this thesis

2. Foundations

This chapter describes the theoretical background and foundations necessary for understanding the terms and concepts used in the upcoming chapters of this thesis. The goal is to provide relevant definitions, frameworks, and essential publications in the literature. The first section (Section 2.1) provides an overview of agile software development since this knowledge is needed for the next section (Section 2.2), which deals with LSAD. The third section (Section 2.3) summarizes relevant information on CoPs in the literature. Lastly, CoPs are described for large organizations (Section 2.4) and in the context of (large-scale) agile software development (Section 2.5).

2.1. Agile and software development

This section provides information on agile software development in general. At first, a definition of agile software development is provided (Subsection 2.1.1). Next (Subsection 2.1.2), the agile manifesto is described in more detail since it can be seen as the basement of agility. After this, the concepts of Scrum (Subsection 2.1.3) and lean software development (Subsection 2.1.4) are described. Lastly (Subsection 2.1.5), the current state of agile software development is presented.

2.1.1. Definition of agile software development

As mentioned in Section 1.1, frequent and fast changes in technology, markets, and customer needs force organizations to respond quickly to remain competitive. In our digital world, these emerging requirements have particularly affected software development [1, 2]. The resulting need for agility paved the way for the success of agile software development. Consequently, many organizations are changing from traditional software development to agile methods [3, 66, 67]. As a result of the rising importance, it is useful to look at existing definitions in the literature as a foundation for the next section.

One of the most known ones is the Agile Manifesto. It was developed in 2001 and defined core values and principles for agile development [5]. More detailed information on the Agile Manifesto can be found in Subsection 2.1.2. Despite its great popularity, the definition of it is not entirely accepted by everyone. For example, the authors

Conboy et al. [68] criticize the lack of theoretical background in the Agile Manifesto. The authors also add that agile techniques do not focus on all described agile concepts mentioned in the Agile Manifesto but just some of them [68]. In 2009, Conboy [69] came up with their definition of agile software development due to their criticism of the agile manifesto. The authors define agile software development as the ability of an (information) system development methodology to react proactively to requests or sudden changes quickly. In addition, they should get the ability to learn from these changes while keeping relations to customers and their values (e.g., economy) [69]. According to Hummel [70], this definition is the most common one next to the Agile Manifesto. Through a systematic literature review, the authors also state that there is currently no wholly accepted definition of agile software development [70]. Another standard definition mentioned different attributes as characterization of agile software development (incremental, cooperative, straightforward, adaptive) [71, 72]. A broader definition of agile software development includes strategic thinking within complex and unknown settings, self-organized teams, and holographic organization theory for roles [73]. In contrast to older development processes like the waterfall model, where all requirement's are defined at the beginning before the implementation is done [74], agile development shall react to changes during the implementation phase [74].

2.1.2. Agile manifesto

In 2001, the "Manifesto for Agile Software Development" was created by a group of twelve people under the name of the "Agile Alliance" [5]. As mentioned, many authors like Al-Saqqa et al. [74] use the Agile Manifesto as a basement for their research in agile software development. It consists of four central values and twelve principles that should be promoted in the future (see Table 2.1), which are based on the experience of the people in the "Agile Alliance" and software development practices like continuous delivery [75]. Combining several concepts and activities into a fundamental framework constitutes the innovation of the Agile Manifesto [76]. In the following, the values are mentioned. Each of the four values provides an aspect to focus on (on the left) and another aspect (one on the right), which is also essential but not as relevant as the first one [5]:

1. **Individuals and interactions** over processes and tools
2. **Working software** over comprehensive documentation
3. **Customer collaboration** over contract negotiation
4. **Responding to change** over following a plan

Table 2.1 provides an overview of all twelve principles mentioned in the Agile Manifesto [5]. Furthermore, the emphasizes by [75] are listed since they are commonly used

Number	Principles	Emphasis
1	Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.	Customer satisfaction, continuous delivery, software quality, early deliveries
2	Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.	Adaptability, responsiveness, customer orientation
3	Deliver working software frequently, from a couple of weeks to a couple of months, with a preference for the shorter timescale.	Frequent deliveries
4	Business people and developers must work together daily throughout the project.	Collaboration
5	Build projects around motivated individuals. Give them the environment and support they need, and trust them to do the job.	Motivated employees, good work environment, support, trust
6	The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.	Direct communication
7	Working software is the primary measure of progress.	Progress measurement through working software
8	Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely	Sustainable development, long-term partnership
9	Continuous attention to technical excellence and good design enhances agility.	Software quality, design focus
10	Simplicity - the art of maximizing the work not done - is essential.	Simplicity, continuous improvement
11	The best architectures, requirements, and designs emerge from self-organizing teams.	Self-organizing teams
12	At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly	Continuous improvement and learning, effectiveness

Table 2.1.: Principles of the agile manifesto with Emphasis [5, 75]

in the literature [71, 77, 78, 79]. The first principle stresses four aspects: Customer satisfaction, continuous delivery, software quality, and early deliveries. Agile software development aims to develop and test fast based on shortly occurring customer changes. The acceptance of these changes in requirements is emphasized in principle 2, next to the frequent delivery of software in principle 3. The next three principles all emphasize parts of the working environment: collaboration (principle 4), support, trust, and motivated employees (principle 5), and direct communication (principle 6). Principle 7 expresses the progress measurement through working software, while principle 8 emphasizes long-term partnerships. The next aspect emphasizes the quality of the software (principle 9). The last three principles all deal with needed aspects for teams: simplicity (principle 10), self-organization (principle 11), and continuous improvement (principle 12) [75, 77].

The acceptance of these twelve principles can differ in practice. Bustard et al. [78] and Williams [79] both conducted surveys on this topic. While some principles (1, 3, 5, 7, 12) are commonly supported in both surveys by practitioners, the importance of principles 2 and 6 is different in both. In Williams [79], principle 6 has more importance, while in Bustard et al. [78], principle 2 is more relevant. According to Dingsøyr et al. [80], the main characteristics of agile methods can be divided into groups based on the acceptance of change, evolutionary delivery, and involvement of the customers (end-users) [80]. Furthermore, short life cycles, regular client input, and continual learning are characteristics of agile approaches [81].

2.1.3. The Scrum framework

The most known agile methodology is the Scrum framework. According to the 16th State of Agile Report from 2022, 87% of the (participator's) companies are leveraging Scrum [6]. Ken Schwaber and Jeff Sutherland developed and presented it in 1995 at the OOPSLA conference [82]. The authors also defined Scrum as "a lightweight framework that helps people, teams, and organizations generate value through adaptive solutions for complex problems" [39]. It is based on empiricism (decision-based on observations) and lean thinking (focus on central aspects, reduce waste) [39]. More in detail, Scrum tries to control risk and optimize predictions by an iterative, incremental approach (Sprints). On top, Scrum involves teams of individuals who possess all the knowledge and skills necessary to complete the task and share or gain knowledge as necessary. The pillars of Scrum are transparency, inspection, and adaption [39], next to the five needed values for people (commitment, focus, openness, respect, and courage) [39]. In the following, a more detailed overview of the main components of Scrums is provided.

Scrum team

In Scrum, the team plays one of the central roles. The team should be cross-functional and self-organized. In addition, there should be no hierarchies or sub-teams. Usually, a Scrum Team consists of ten or fewer people, including one Product Owner (PO), one Scrum Master (SM), and more developers [39]. In case of a too large team size, the authors suggest the creation of multiple different teams with the same goal and same PO [39]. More in detail, the PO is responsible for the value and the developed product itself. Furthermore, the management of the Product Backlog (communication and transparency of the product goal and backlog items) is also done by the PO or at least delegated. The PO is also the only person representing stakeholders' needs in the Scrum Teams [39]. The SM is responsible for helping all members in the agile transformation and improving effectiveness by removing the barriers between stakeholders and team members. Another task is to ensure a successful time plan and to help the PO with the Product Backlog [39]. The developers are responsible for creating a usable Increment within each Sprint. This includes creating the Sprint Backlog, ensuring quality by the concept of Definition of Done (DoD), and adapting to changes each day to achieve the Sprint Goal [39].

Scrum events

The most important Scrum Event is the so-called Sprint. It is the heartbeat of Scrum and aims to create value through ideas. By ensuring examination and modification of progress toward a Product Goal, sprints provide predictability [39]. The length of a Sprint is fixed, and a new Sprint immediately starts when the previous one ended [39]. Each Sprint consists of five time-boxed events (Sprint itself, Sprint Planning, Daily Scrum, Sprint Review, and Sprint Retrospective) and aims to achieve a part of the Product Goal [39]. Since Sprint Planning is the first initial meeting of a Sprint, it defines a plan for the upcoming Sprint, including the work to be done [39]. The whole Scrum Team does this plan and leads to the Sprint Backlog, which includes the overall Sprint Goal and the part of the Product Backlog relevant for this Sprint [39]. A Sprint Planning meeting addresses the following questions: Why is this Sprint valuable? What can be done in this Sprint? How will the chosen work get done? [39]. After the meeting is done and the Sprint Backlog is created, the Sprint begins [39]. Through the Daily Scrum, an overview of the progress towards the Goal of the Sprint is provided. It is, most of the time, a daily 15-minute meeting for Developers (and PO, SM if they also code), which is held at the same time (and place) every day [39]. Daily Scrums enhance communication, spot obstacles, encourage rapid decision-making, and reduce the need for additional meetings [39]. However, the Sprint Review aims to inspect

Sprint's outcome by presenting the key results and the progress to stakeholders. Based on the discussion in the Sprint Review, further steps and possible adjustments of the Product Backlog are developed [39]. The Sprint Retrospective is the last meeting of a Sprint. The team reviews all relevant aspects of the past Sprint in the meeting. This includes "individuals, interactions, processes, tools, and their Definition of Done" [39]. In addition, the most crucial points are added to the Sprint Backlog for upcoming Sprints [39]. Through this process, the Scrum Team identifies and develops further changes for the upcoming Sprint to increase effectiveness and quality [39]. Figure 2.1 summarizes all Scrum Events based on the Scrum Guide [39].

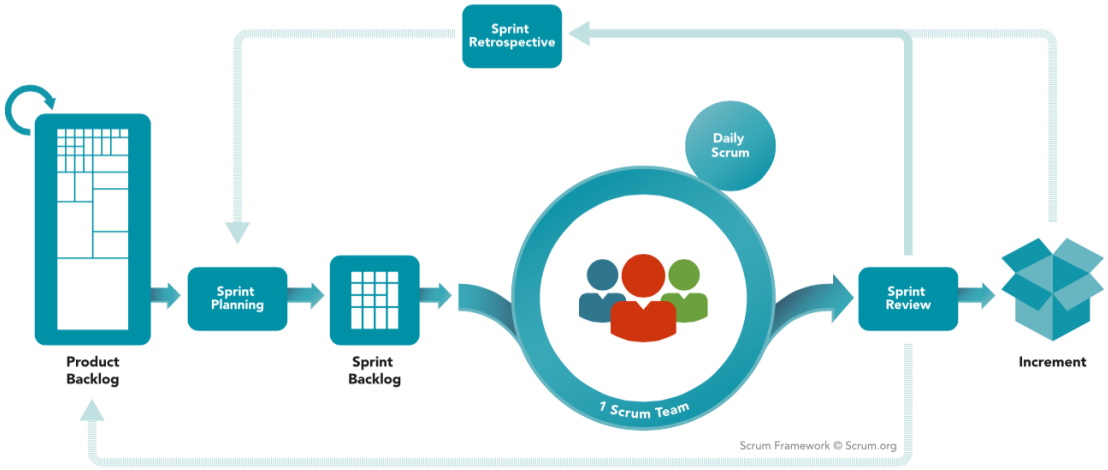

Figure 2.1.: The Scrum Framework according to the Scrum Guide [83]

Scrum artifacts

Scrum has three artifacts (Product Backlog, Sprint Backlog, and Increment) representing work or value. The primary goal is maximizing transparency to create the same basis for adaption for everyone [39]. The Product Backlog contains a list of the product's needed improvements, making it the single source of work for the Scrum Teams [39]. Product Backlog items are constantly improved until they are specified in a way that allows the Scrum Team to complete them in the time frame of a single Sprint. This is achieved by dividing the list items into smaller, more manageable components and adding information, such as a description or workload [39]. The developers do this sizing process while the PO can influence and support the process. Overall, the Product Goal, contained in the Product Backlog, is an objective to work toward while making plans for the product's future state [39]. In addition, the requirements that need to

be fulfilled for a successful product are mentioned in the Product Backlog [39]. On the other side, the Sprint Backlog contains the Sprint Goals (why), the set of Product Backlog items selected for the Sprint (what), and plans for delivering the Increment (how) [39]. The Sprint Backlog is updated continuously and is under review in the daily progress review. The developers create the Sprint Goal during the Sprint Planning to enable collaboration [39]. Increments of specific steps toward the Product Goal can be created within a Sprint and delivered to stakeholders before the end of the Sprint [39].

2.1.4. Lean software development

Another quite similar concept to agile software development is lean software development. It goes back to the 1950s when Toyota (Japanese car manufacturer) introduced the concept of leanness [81, 84]. According to Poppendieck [85], lean consists of seven principles, which are listed in the following:

1. Eliminate Waste
2. Build Quality In
3. Create Knowledge
4. Defer Commitment
5. Deliver Fast
6. Respect People
7. Optimize the Whole

Lean software development techniques include implementing the cumulative flowchart and removing bottlenecks. The approach also includes abstaining from excessive local optimization, constant self-reflection, and continual improvement [81]. Furthermore, lean requires structures where the value and quality can be easily measured [69]. The lean method was translated to software development by Anderson [8] under the name Kanban. The goal was to increase the development team's performance at the case organization Microsoft [8, 86]. The principles of Kanban are based on the listed ones of lean software development (quality, fast delivery, waste elimination) [8, 85]. In addition, one central element of Kanban is the so-called "Kanban board." It displays the assigned work of each developer (including priorities) and possible bottlenecks to improve the transparency of the software development. Consequently, the developers can better focus on the crucial parts to ensure continuous delivery and address feedback faster [86]. The 16th Annual State of Agile Report states that, in total, 56% of their survey participants are leveraging Kanban [6].

Due to the importance of Kanban, but also Scrum, there was the idea of combining them which resulted in the creation of ScrumBan [9, 10], which is leveraged by 27% based on the 16th agile report [6]. Nevertheless, lean and agile methods diverge in three key areas. Firstly, businesses are still agile when they adapt quickly to become cost-efficient and productive, even when not working perfectly initially. This is impossible in lean since a Lean organization has to be both from the beginning [69]. Secondly, leanness removes all waste [85] while agility sometimes keeps waste to adapt to changes [69]. Thirdly, the most crucial difference is that leanness excels in controlled environments while agile needs to be variable [69].

2.1.5. Current state

According to the 16th Annual State of Agile Report, the three main reasons for implementing agile practices are accelerated time to market, delivery predictability, and lower risks. Moreover, agile teams are measured mainly by on-time delivery and business objectives achieved. Interestingly, the trend is that currently, 80% of the respondents of the Agile Report have geographically distributed agile teams [6]. In addition, the report also mentioned the advantages of agile methods. The three most common answers are: Increased collaboration (69%), better alignment to business reads (54%), and better working environment (39%) [6]. On the other side, also challenges are provided, for example missing management support (39%), lack of clear priorities (31%), and unawareness of what agile does (31%) [6]. Overall, agile methods are rising in popularity but are only accepted by some organizations, especially in the large-scale context, because of concerns about their appropriateness for use in large-scale situations [11, 12].

2.2. Large-scale agile software development

This section provides information on the theoretical background of large-scale agile software development. First (Subsection 2.2.1), a definition of LSAD is provided. A summary of scaling factors is shown in the next part (Subsection 2.2.2). After that (Subsection 2.2.3), the most common frameworks in LSAD are described, and the current state of LSAD is presented (Subsection 2.2.4). Lastly, the need for knowledge in LSAD is shown (Subsection 2.2.5).

2.2.1. Definition of large-scale agile development

As described in Subsection 2.1.5, agile methods are popular on a small-scale but not commonly accepted for LSAD [11, 12]. This is because agile software development was

designed for use in a small-scale [87]. Nevertheless, in recent times the agile methodology is also used increasingly by larger organizations or projects [6, 13]. Therefore, and for the context of this thesis, it is necessary to define the term large-scale agile (software development). In literature, the term has no common interpretation [14] and is mostly based on different factors regarding the scale like team size, number of teams, overall people involved, costs, or number of requirements [14, 15, 16]. The scaling factors will be described in more detail in Subsection 2.2.2. In the opinion of Dingsøyr et al. [20], the team size is the most crucial dependency for LSAD. This is the reason why the authors created three different categories of agile development: less-scale (one team), large-scale (two to nine teams), and very large-scale (ten or more teams) [14, 20]. Other definitions, which mostly rely on the overall number of people, are summarized by Dingsøyr et al. [15]. Menzel [88] summarizes four interpretation derived from Dingsøyr et al. [14, 20]. The author identified two general applications (use of agile methodologies in multi-team settings and the use of agile approaches in large organizations) and two other views (use of agile methods in large teams, company-wide deployment of agile approaches) [88].

To sum it up, large-scale agile software development depends on many people and systems which collaborate and are dependent on each other, increasing the complexity [16]. In this thesis, the term large-scale agile software development will be defined based on the definition by Dingsøyr et al. [14] as a case where multiple teams are working together on an identical product while using agile methodology within the teams.

2.2.2. Scaling factors

Kruchten [17] created a Development Context Framework. The author proposes a model to support agile development and environmental change. The model aims to benefit from agile practices in projects that are not in the so-called agile sweet spot but within the bitter spot [17]. Table 2.2 overviews the agile sweet and bitter spot.

Based on these points mentioned by Kruchten [17], agile scaling factors were developed [18, 19]. In 2009, the author mentioned eight different scaling factors, which are the reason for the need for scaling agile development. These factors are team size, geographical distribution, regulatory compliance, domain complexity, organization distribution, technical complexity, organizational complexity, and Enterprise discipline [18].

Agile sweet spot	Agile bitter spot
Small team of 10 to 15 people	Large team with more than 15 people
Co-location	Distributed team
Continuous availability of customer	No empowered customer representative
Development of business application	Development of embedded real-time systems
Development of new software	Maintenance projects
Rapid programming environment	Inefficient, slow programming environment
Short life-cycle projects	Long life-cycle projects
Common culture	Different development cultures

Table 2.2.: Agile sweet and bitter spot based on Kruchten [17]

Figure 2.2 provides an overview of these factors, including information on the simple (based on the agile sweet spot, shown on the left) and complex (based on the agile bitter spot, shown on the right) environment [89]. However, S. W. Ambler [18] published another paper in 2016, in which the Scaled Factors are slightly adapted when faced by IT delivery teams. For example, the sweet spot of team size was adjusted from under ten developers to two teams [19]. Moreover, the factors of organizational complexity and enterprise discipline are not mentioned anymore [19].

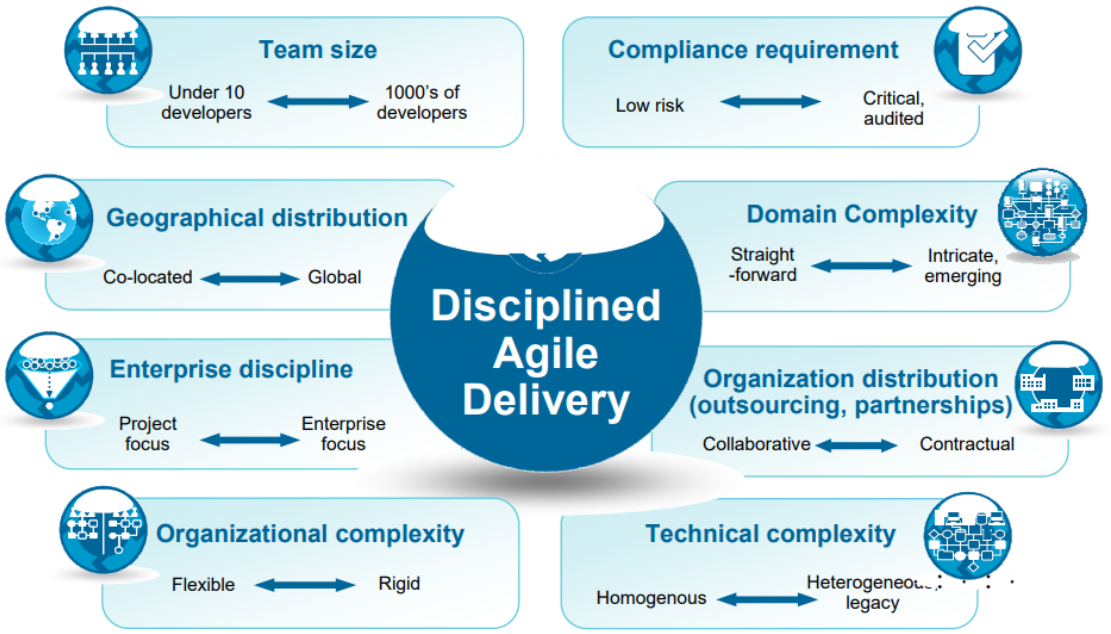

Figure 2.2.: Agile Scaling Factors [18, 89]

2.2.3. Scaled agile frameworks

In LSAD, many different frameworks exist, which have been developed to support (large) organizations in the transformation to agile methodology in scale [13]. Most of these frameworks have been modified to meet the increased demands of multi-team projects but are still based on established agile techniques like Scrum [90]. According to the 16th Annual State of Agile Report, SAFe is the most common scaling agile framework used in organizations with 53% [6]. SAFe is followed by Scrum@Scale/SoS (28%), Lean Management (8%), Agile Portfolio Management (7%), and the Spotify Model (7%). Other frameworks mentioned are Enterprise Scrum (6%), LeSS (6%), Discipline Agile Delivery (DAD) (3%), Nexus (3%), and Recipes for Agile Governance in the Enterprise (RAGE) (1%). In addition, other frameworks (8%) and unsure (15%) were provided [6]. This subsection will explain these mentioned frameworks in more detail.

Scaled Agile Framework - SAFe

SAFe was created in 2012 by Dean Leffingwell, aiming at scaling methods in large organizations [21]. The values and tenets of agile and lean product development are the foundation of SAFe. It combines Scrum with Kanban and Extreme Programming (XP) practices. Furthermore, SAFe defines the concept of Agile Release Trains [21, 22]. Agile Release Trains include multiple teams and work similarly to Team Sprints; in addition, multiple synchronized Agile Release Trains are responsible for the creation of large and complex solutions [21, 22]. There are four options available: Essential SAFe, Large Solution SAFe, Portfolio SAFe, and Full SAFe [22]. An overview of Full Solution SAFe of the newest version (6.0) is shown in Figure 2.3. The Essential Layer is the starting point for implementing SAFe and therefore contains roles, events, and artifacts needed to create a solution. It covers Agile Release Trains and teams [21, 22]. The portfolio layer is responsible for the funding and strategic analysis of the several activities that the organization is currently undertaking. Consequently, it involves the agile methods up to the portfolio level but does not involve Large Solutions [21, 22]. Large Solution SAFe describes the different roles and guidance for organizations that use complex systems. This scales agility up to the Large Solution level but not to the portfolio level [21, 23]. The most comprehensive configuration, which includes all seven key competencies of Business Agility, is called Full SAFe (see Figure 2.3). Large organizations mainly use it to maintain portfolios of expansive and complicated solutions. Multiple instances of different SAFe configurations can be necessary for some circumstances [23]. SAFe also suggests the use of CoPs in Portfolio SAFe, Large Solution SAFe and Full Solution SAFe to ensure improvement and knowledge exchange [23].

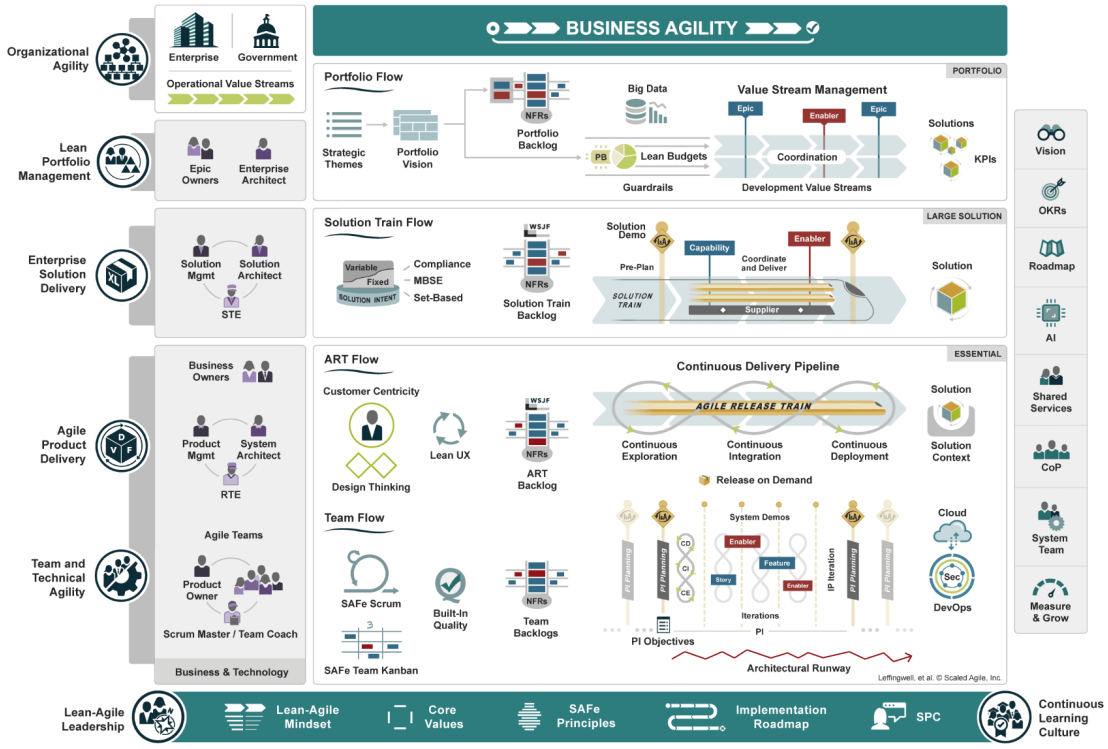

Figure 2.3.: Full Solution of SAFe 6.0 [91]

Scrum@Scale & Scrum-of-Scrums

In this part, Scrum@Scale and SoS are both described together since they were mentioned as one category in the 16th State of Agile Report independent of the discussion, if they are the different frameworks or the same [6]. SoS is used in scaling Scrum when more teams are involved. A regular meeting allows the participants to discuss their work and focus on overarching topics, issues, and integration [24]. The meeting is similar to the team-level Daily Scrum but consists of representatives of each Scrum team. Furthermore, the frequency depends on the project size, and topics discussed are, for example, bottlenecks or possible blockers by a Scrum team for other ones [24]. Scrum@Scale is a framework in which multiple teams operate collaboratively and consequently with the Scrum Guide while delivering a product [7]. Scrum@Scale uses SoS following to scaled agile Events and Roles [7] to coordinate these teams. Each team has a SM and a PO as in Scrum. Furthermore, a scaled version of the Daily Scrum and the Sprint Retrospective is used [7]. The meetings are coordinated by a SM called Scrum of Scrum Master [7]. The scaled form of Sprint Planning is held jointly by the

PO Team and the different SM [7]. While using Scrum@Scale in large-organization, different SoS meetings can exist next to each other. In this case, they are typically coordinated by an Executive Action Team (leadership). Furthermore, the Executive Action Team is responsible for creating a Product Backlog consisting of initiatives for the ongoing transformation to achieve higher agility [7].

Lean Management

Lean Management is using the Lean principles and methods (see Subsection 2.1.4) on a large scale. The concept of lean needs to be adopted throughout the organization to count as a framework for large-scale agile software development [92]. Furthermore, in most cases, Lean Management is used in a hybrid form with other agile approaches [92].

Agile Portfolio Management

Portfolio management has often been done from the top down, focusing on risk management, resource allocation, and strategy alignment. However, there has been a move toward adopting agile ideas at the portfolio level in the context of agile approaches like Scrum or Kanban, which stress flexibility, cooperation, and continuous learning [93]. Agile portfolio management breaks the portfolio into smaller, more manageable parts to plan and prioritize them iteratively, enabling flexibility and adaptability [93].

Spotify Model

The Spotify Model is another framework suitable for large organizations. Its primary goal is to deal with various teams in a product development organization [25]. The suggested team size is around 30, with 250 to 300 people involved. It allows Scrum, Kanban, Software development and IT operations (DevOps), and Lean Startups [25]. Compared to Scrum, a Scrum Team is called Squad in the Spotify Model. It also has a PO and an Agile Coach [26]. Multiple Squads work together in Tribes ordered by their related working area [26]. Next to the Tribes, also so-called Guilds exist. A collection of people who desire to exchange information, resources, code, and best practices form a guild, a more natural and extensive "community of interest." Chapters are always specific to a Tribe, but a guild typically spans the whole company. Examples of Guilds in Spotify are the web technology guild, the tester guild, and the agile coach guild [26]. These guilds aim to solve different problems and exchange knowledge company-wide together [25].

Enterprise Scrum

Enterprise Scrum is a company-wide extension of Scrum based on different factors like a generalization that can be used in large-scale [94, 95]. Applying Scrum company-wide can lead to benefits like self-improvement [94].

Large-Scale Scrum - LeSS

LeSS provides two different versions based on the size of the Scrum teams: LeSS (up to eight teams with up to eight people in each) and LeSS Huge (up to a few thousand people). For both, the people need to work on the same product [27]. The teams are self-organized, cross-functional, long-living, and can be co-located [27]. Method LeSS fully adapted Scrum and is mainly recommended for large traditional organizations [25]. More in detail, LeSS can be seen as a scaled-up version of one-team Scrum since it uses the same practices. For example, all teams have just one Product Backlog since they are working on just one product. There is also just one DoD, one potentially final Product Increment, one Product Owner, and one Sprint [27]. Figure 2.4 provides an overview of the LeSS framework.

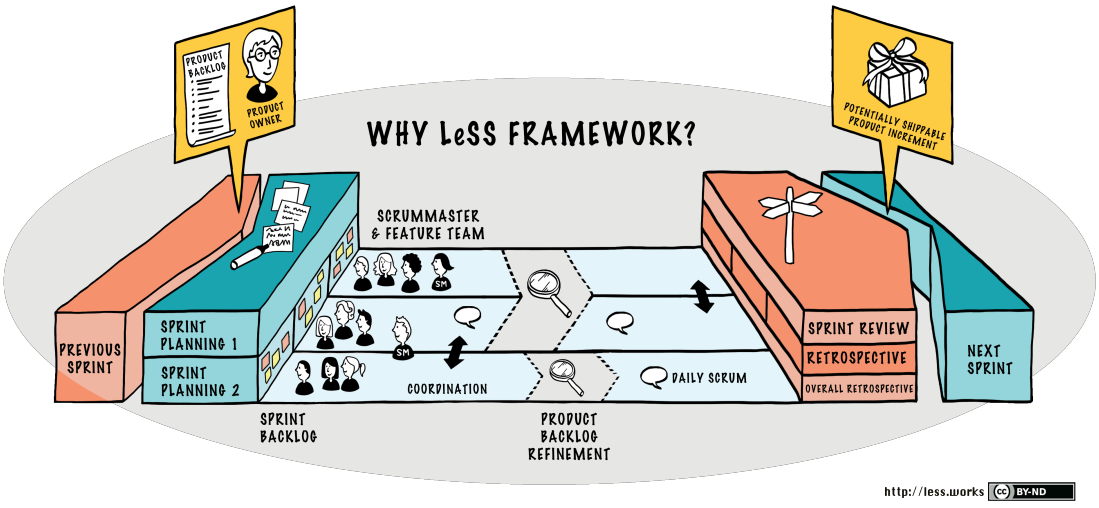

Figure 2.4.: Overview of LeSS [27]

Discipline Agile Delivery - DAD

DAD intends to fill the gaps by, on the one side, extending Scrum to address the entire delivery lifestyle, and, on the other side, including practices from Lean and Kanban

[25]. The roles in DAD are the same as in Scrum, but a Team Lead, similar to the SM, is added. Furthermore, secondary roles like Specialist, Tester, Domain Expert, Technical Expert, and Integrator are added to address common issues in LSAD [25]. The methods and practices adopted in DAD are Scrum, Kanban, Agile Modeling, Unified Process, Agile Data, and Test Driven Development [25]. The recommended team size is 200 people or more, but it also supports smaller teams. Therefore, DAD is also usable in multiple organizations [25].

Nexus

The next scaled agile framework is Nexus. It is based on Scrum (through the use of similar events like Nexus Sprint Backlog) but developed new techniques for resolving dependency-related problems across multiple teams [96]. The team size in Nexus is three to nine Scrum Teams working on the same Product Backlog to create a product. As a result of this, one PO is responsible for the Product Backlog [96]. The use is suggested on the portfolio level for medium-sized projects [25]. In the project phase itself, the Nexus Integration Team (consisting of PO, SM, and some members of the Scrum Teams) is responsible for a so-called Integrated Increment, which includes all work from all Scrum Teams and is created at least once a Sprint [96].

Recipes for Agile Governance in the Enterprise - RAGE

The main goal of RAGE is to allow quick decisions and changes using minimum work. Therefore, it is adaptable [25]. RAGE allows Kanban, Scrum, plan-driven, and even hybrid approaches. In addition, it is also usable for different team sizes [25]. The scaled framework is suggested for traditional and agile organizations [25]. RAGE adapts the Scrum roles and most Scrum events. In addition, the practices of RAGE at project level are similar to the ones in Scrum [25]. Nevertheless, on program level, there are differences since release planning meetings, Scrum of Scrum meetings, and release reviews should be conducted. Furthermore, portfolio grooming meetings and planning meetings are suggested to ensure that each team is working on the proper requirements [25].

2.2.4. Current state, benefits, and challenges

As mentioned, increasingly larger organizations or projects are implementing agile at scale [6, 13]. A publication that deals more closely with this topic was published in 2022 by Uludağ et al. [28] in which the authors conducted a systematic mapping study on the state of the art of LSAD research. Firstly, the authors unlined three notable aspects of Agile practice at scale: The adoption of agile practices in large-scale projects

has several advantages (e.g., improved project management and transparency, better learning and comprehension through face-to-face communication), but it also introduces new challenges (e.g., increased administrative burden and team coordination) [66, 28]. Moreover, prior experience with agile methods and management support are crucial success factors for scaling agile practices, while resistance to change, an overly aggressive adoption timeline, and integration with current non-agile business processes are major obstacles [28, 97]. In addition, agile methods are more effective than traditional methods as project size increases. Therefore medium and large software projects utilizing them perform better overall than non-agile methods [28, 98]. Regarding the large-scale transformation, Uludağ et al. [28] also noted three crucial findings: The majority of respondents do not want to go back to the previous way of working because large-scale agile transformation brings benefits, such as increased satisfaction, a sense of effectiveness, and more transparency and autonomy independent from challenges [28, 99]. Furthermore, when agile practices are implemented in a previously plan-driven organization, various benefits result, such as increased release frequency and better customer focus, but there are also challenges, such as managing a large number of teams and integrating release projects into the overall development process [13, 28]. As a summary for large-scale agile transformations, a list of 35 problems, including the difficulty of adopting Agile and the integration of non-development operations, and 29 success factors, including management support and choice and adaption of the agile model, have been documented by Petersen et al. [100] in 2010 [28].

2.2.5. Knowledge in large-scale agile development

As mentioned in the previous subsection, a challenge of LSAD is team coordination [28]. As a result, the increased complexity makes knowledge sharing, creation, and cross-team collaboration even more relevant for LSAD than in agile context [30, 31]. This situation also applies to large-scale agile projects, when work is done by several developers and development teams at once, and the frequent delivery requires work and knowledge synchronization at all levels [28]. Another aspect is that, due to the mismatched planning activities at the team and inter-team level, the combination of traditional team-level planning and agile development results in inefficient coordination in LSAD [28, 4]. Furthermore, coordination between teams in LSAD through (un-)scheduled meetings and discussions (in open space) can support coordination [28, 29]. Networking is also essential in LSAD [28, 31].

A possible solution for coordination and networking is the concept of CoPs, groups of experts that share a common interest, meet to exchange experiences, and learn from each other about a topic [32, 31]. They can help solve issues spanning multiple

teams and effectively share and create knowledge on a higher organizational level [33]. Therefore, the topic of CoPs will be displayed in more detail in the following sections.

2.3. Fundamentals about Communities of Practice

Through the previous sections, which defined and described the topic of agile software development (Section 2.1) and LSAD (Section 2.2), a good foundation of the current working environment in software development is provided. Since there is a need for knowledge exchange in these environments and some frameworks (e.g., SAFe) already mention the concept, this section will deal with laying the foundation of literature about Communities of Practices (CoPs). This will also be relevant for our Interview Study later in this thesis. In the first subsection (Subsection 2.3.1), a definition of a CoP is given next to the principal and working model. Next (Subsection 2.3.2), the different types of CoPs in literature are described. Subsection 2.3.3 deals with the goals and reasons for the establishment, while Subsection 2.3.4 presents information on the establishment process itself. Furthermore, in Subsection 2.3.5, the knowledge sharing and the governance of CoPs are described. The last subsection deals with additional relevant information (Subsection 2.3.6) and further research topics which are described by the literature (Subsection 2.3.7).

2.3.1. Definition and foundation of Communities of Practice

Although the term "Community of Practice" was established in recent years, the phenomenon itself is quite old. The concept provides a useful perspective on knowledge sharing and learning [34]. A CoP defines itself through three dimensions: What is it about, how it functions, and what capability it has produced [32]. More clearly, Wenger [34] defined CoPs as:

Def.: *"Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly." [34]*

This definition allows intentionality since learning can be either a desired goal or an unexpected outcome. As a result, not everything, like neighborhood talk, can be called CoP [34]. Another definition states that a CoP is a group of experts with similar tasks and responsibilities [101, 102]. Another important remark is that there are several definitions of CoPs in literature, but almost every study refers to the definition by Wenger et al. [32] or one of the other publications. Consequently, the definitions are quite similar to each other [102].

CoPs emerge through an ongoing interaction of knowledge and experience that involves communication and collaboration. By leveraging direct participation, they provide opportunities to enhance and share competencies. As a result, even in large systems, they continue to be crucial social learning units [103]. For example, the concept of CoPs is used in many different cases such as organizations, government, education, association, social sector, international development, and web [34]. Moreover, a CoP has three crucial characteristics:

1. **Domain:** A CoP is more than just a group of friends or social network. A shared interest establishes its identity. Membership implies a commitment to the profession and shared expertise that distinguishes members from others [34].
2. **Community:** Members work together on projects and discuss, provide a hand to one another, and share knowledge as they pursue their interests (in their profession). They establish connections that allow them to learn from one another [34].
3. **Practice:** A CoP is more than just a group of people with common interests. Members of a CoP are practitioners. They create a shared repertoire of experiences, stories, techniques, and approaches to recurring challenges. This takes time and consistent interaction [34].

Wenger et al. [32] identified different forms of CoPs based on their span in an organization: Within business (office form of communication to deal with information), across business units (in cross-functional teams or along the fragmentation of product lines), and across company boundaries (e.g., in fast-moving industries) [32]. In addition, the relationships of CoPs to official organizations can differ from unrecognized to strategic or trans-formative ones (see Table A.3 for more details). Furthermore, CoPs also go through distinct stages of growth marked by differing degrees of member involvement and various activities which are shown in Figure 2.5 [32].

CoPs are not called Communities of Practice in all organizations. Sometimes various names like learning networks, thematic groups, or tech clubs are used [34]. In addition, further variants of the name CoP such as a community of interest [32], or community of learning [104] exist in literature. Moreover, the term guild is also commonly used for group knowledge exchange. The reason is the use of the term in the Spotify framework (see Subsection 2.2.3).

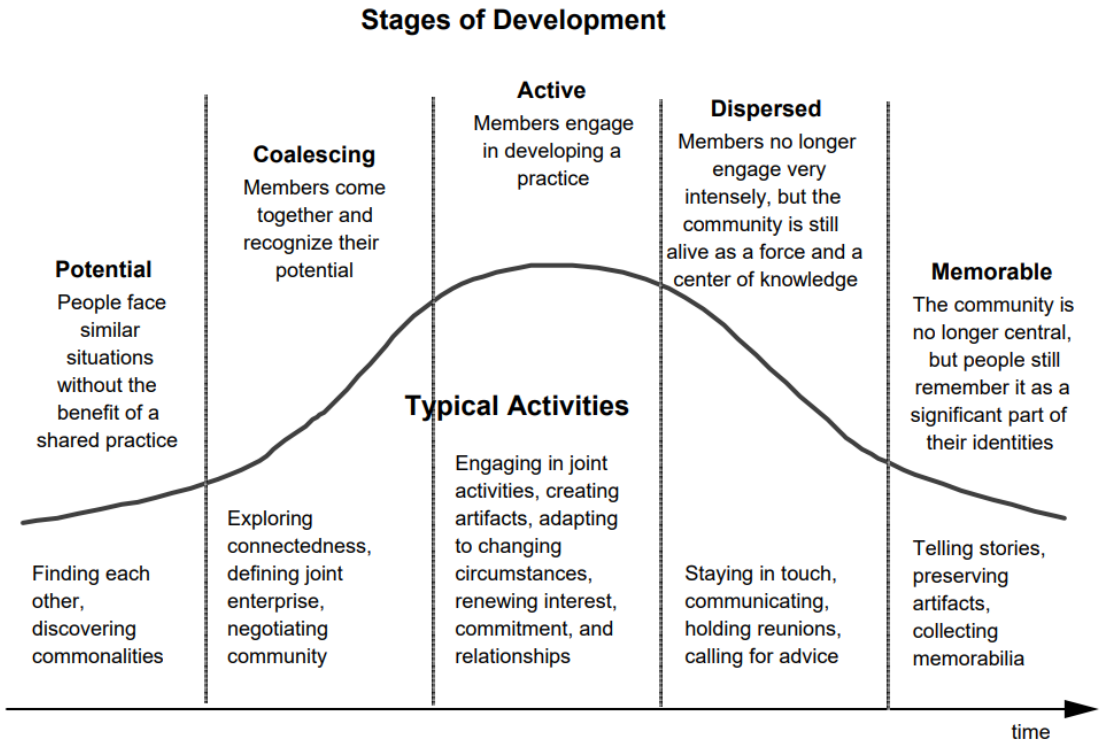

Figure 2.5.: Stages of Development of CoPs based on Wenger et al. [32]

2.3.2. Types and forms of Communities of Practice

In literature, there are various forms of categorizing CoPs into different types, like interest communities, learning communities, and commitment communities [40, 41]. In this regard, they are formed from several organizational units that interact with one another due to shared ideologies. As a result, four categorizations appear: formal/informal, organic/structured, normal/engineered, and virtual/face-to-face [40]. Furthermore, in almost all literature, the categorization of CoPs is often based on the components of it [40]. For example, Cuddy [42] mentioned seven features regarding CoPs: size, lifetime, geographical distance, member's proportionality, boundary, purpose, and recognition [42]. Jassbi et al. [40] investigated the different types and components of a CoP in literature as part of their paper. The authors summarized them in eleven different components, mainly based on aspects Hara et al. [43] and Dubé et al. [105] mentioned based on other literature [40]. For example, the geographical distance mentioned by Cuddy [42] got translated into communication (virtual or face to face) [40]. An overview of these eleven components identified by Jassbi et al. [40] can be seen in Table 2.3.

Component	Sub-component	Definition
Size	Large Small	Refers to the number of community members.
Process of member selection	Open Close	The process of member selection for the community can be either open (whereby anyone can become a member and participate, e.g., an internet community) or close (selected members only). Closed membership restricted to people who meet certain criteria).
Members'enrollment	Voluntary Compulsory Mixed	Members' participation in the community can be voluntarily (the members themselves tend to attend in the community) or compulsorily (by management order or a mixture of both.
Form of dispersion	Intradepartment Interdepartment	A community can be established in its internal boundary or among several organizations or countries.
Members' homogeneity	Homogeneous Heterogeneous	All the members of the organization can have similar or different experiences. It is also possible that they know each other or meet each other in the community for the first time.
Formation process	Top-down Bottom-up	A community can be established by the management or can be created by the members of the organization.
Leadership	Participative Prescriptive	The roles and functions in the community may be indicated in advance by the management or can be defined and identified by the very members of the group.
Organizational support	High support Low support	The organization can support a community, or its presence never be felt in the organization.
Members' stability	Stable Fluid	Membership may be completely permanent fluid.
Orientation	Strategic (long term approach) Operational (short term approach)	The approach of the community can be short term to solve the problems on the ad hoc basis or long term in line with the strategic goals of the organization.
Communication	Virtual Face to face	The way and degree of using information and communication technology tools can describe the communication type of the members of the community. The more the members use these tools, the more the community approaches to be considered virtual.

Table 2.3.: CoPs components based on Jassbi et al. [40]

For this master thesis, these components are relevant and used (partly) in the interview study. More in detail, the interviewees were asked about the member selection process, member enrollment, formation process, leadership, and communication, while other components (size, organizational support, orientation) were just targeted indirectly. Furthermore, topic-based and role-based CoPs are relevant for this thesis. More about the method of the interview study can be found in Chapter 4.

2.3.3. Goals and reasons for the establishment

According to Wenger et al. [32], CoPs provide five important functions, which can be reasons for organizations to establish them: CoPs educate (through knowledge sharing), support (through interactions and collaboration), cultivate (through aiding teams to launch and maintain their learning), encourage (through promoting work) and integrate (thought applying knowledge for change in work) [32]. More in general, the major reason for the establishment of CoPs is knowledge sharing and learning since it was acknowledged that knowledge is a valuable resource that needs to be managed strategically [32, 34]. Other early attempts than CoPs at knowledge management were unsuccessful because they centered on information systems [34]. Furthermore, through knowledge exchange and interactions, members of CoPs can develop new skills, which also is a reason for the establishment [44]. In addition, CoPs are established because they can positively influence innovation and creativity. By bringing together people with different perspectives and expertise, the CoPs foster the investigation of new concepts, experimentation, and the creation of solutions [32, 45]. Another reason is the social connection and networking through a CoP. These social links may result in partnerships, collaborations, and an overall better working environment in organizations [32, 106]. Also, CoPs can support organizational restructuring processes [45].

Next to the mentioned reason, like knowledge exchange or networking, further goals of CoPs can also be the development of implementations or training techniques, the responses to needs for customization of a standard product [45], and to inform people about relevant topics [107]. Furthermore, there are many (other) advantages of CoPs which might also influence the establishment. Next to potential challenges, they are presented in more detail in Subsection 2.3.6.

2.3.4. Establishment process

As Wenger [34] states, CoPs are created by people who share a common field of human endeavor and are passionate to share knowledge [34]. As a consequence, they can rise naturally [32]. Furthermore, it is widely acknowledged that bottom-up created CoPs are

the most effective and successful ones [46]. One example of a CoP created successfully in this way is at Siemens [47]. Roberts [108] even goes further. The author states that management cannot establish a CoP. They only can support already developed ones [108]. However, in some cases, organizations can also influence the development of CoPs [32] or even introduce them top-down [46]. At the same time, top-down CoPs enjoy high acceptance within the organization and frequently have official status. Some others struggle to gain full employee support. Top-down CoPs may lack the passion and drive for a particular subject that frequently contribute to the development of a bottom-up CoP [46]. Furthermore, members of top-down CoPs might feel to be forced to share knowledge which can lead to a failure of the CoP [46]. In contrast, bottom-up CoPs may lack organizational support, while top-down CoPs are highly accepted since they align with business strategy and interests [46].

Independent from who is responsible for the creative approach, Wenger [103] mentions different aspects which are relevant for developing a new CoP: events (including the type and frequency), leadership (role of "community coordinator"), connectivity (support networking), membership (a critical mass of people having an interest in the CoP needs to be fulfilled), learning program (create a learning agenda) and artifacts (define artifacts) [103]. Wenger et al. [48] also deal with establishing communities of practice by providing a practical guide on establishing knowledge exchange in organizations. The authors identified seven principles that should be the basement of knowledge before creating a CoP. Being more adaptable and improvisational is feasible when design concepts are made apparent. The seven aspects are shortly described in the following based on Wenger et al. [48]:

1. **Design for evolution:** Due to their dynamic nature, CoPs should be open to changes
2. **Open a dialogue between inside and outside perspectives:** To create CoPs, people from inside (a team) and outside are needed since just insiders know what really drives the teams.
3. **Invite different levels of participation:** Successful CoPs require all forms of participation. More in detail, a coordinator is needed next to members who just participate actively in the knowledge exchange.
4. **Develop both public and private community spaces:** The authors argue that a private one should be possible next to a public knowledge exchange in front of a large audience, since a good relationship between community members supports the sharing of knowledge in a wider environment.
5. **Focus on value:** With this point, the authors mean that the value of being part of a community is clear for the participants. CoPs can exist longer if this value is

clear for all and members see advantages in participating.
6. **Combine familiarity and excitement:** To be more successful, CoPs should be a trustful and neutral place. If the members feel uncomfortable when being part of a community, it can not work.
7. **Create a rhythm for the community:** As Humans like regularity, CoPs should offer some form of persistence. This could be, for example, in the form of regularly scheduled meetings.

In addition, no matter how they are established, and even if the CoP does not undertake much of the work, well-known professionals must be involved in some capacity to keep the CoP alive [32]. A form of leadership is also crucial, no matter if it is informal or formal. Leadership must be legitimated by the members of a CoP to be effective, and therefore, managers or others must work with the members from the inside to succeed [32]. Also Iaquinto et al. [107] support this aspect through their study. The authors identified that the role of a coordinator is mandatory, especially in the case of formal CoPs with a lot of organizational and administrative load [107]. Furthermore, organizations can help to establish CoPs by financial/management support [107] or by creating a company-wide team responsible for and helping the developing process. The team can provide guidance and resources, help with the agenda, encourage and include the right people and help in the networking process (between different communities) [32].

To sum it up, CoPs typically do not need substantial infrastructures, but they do need enough time and space for their members to collaborate. Although they do not need much management, they can benefit from a form of leadership [32].

2.3.5. Way of knowledge sharing and governance

Forms of knowledge exchange

In literature, different forms of knowledge exchange are described. The most common one is an informal conversation and discussion. Members connect in person or online to share experiences and concepts relevant to their field [32, 107, 109]. Furthermore, there are discussions based on a predefined topic or agenda next to speeches or presentations [32, 110]. In the studied communities by Lesser et al. [45], the authors identified the following activities of CoPs: Seminars (speeches and discussions), training sessions, conferences with outside seekers (speeches), informal discussions, and face-to-face discussions. Moreover, some of the studied CoPs offers websites or forums to seek information asynchronously [45]. Also, for non-collocated workers, knowledge exchange in e-mails, electronic discussion groups, and chat rooms exist [45]. Knowledge

sharing through chat, documents, and websites is also mentioned by McDermott et al. [49]. Other forms of knowledge sharing of CoPs are: Workshops (people are working (shortly) collaborative on a specific topic) [42, 110] and seminars (commonly a mix out of expert presentations and discussions) [32, 45, 111]. A summary of the different forms of knowledge sharing in CoPs is presented in Table 2.4.

Form	**Communication Form**	**Example**	**Exemplary Literature**
Chat Rooms	asynchronous	Rooms in Microsoft Teams	Lesser et al. [45] and McDermott et al. [49]
Documents	asynchronous	Documentations or slides on a specific topic	McDermott et al. [49] and Hildreth et al. [44]
E-Mail	asynchronous	E-Mail with information	Lesser et al. [45] and Cothrel et al. [112]
Formal Discussion	synchronous	Discussions on a given topic	Lesser et al. [45] and Johnson [102]
Informal Discussion	synchronous	Coffee talks	Lesser et al. [45], Wenger et al. [32], Iaquinto et al. [107], and Lave et al. [109]
Seminar	synchronous	Mix of discussion and speeches	Wenger et al. [32], Lesser et al. [45], and Putz et al. [111]
Speeches	synchronous	Talks or presentations by internal or external speakers	Wenger et al. [32], Lesser et al. [45], Kimble et al. [110], and Probst et al. [50]
Training	synchronous	Training sessions	Lesser et al. [45] and J. S. Brown et al. [113]
Web-pages	asynchronous	Website which provides information to a specific topic	Lesser et al. [45] and McDermott et al. [49]
Workshops	synchronous	Joint working	Cuddy [42] and Kimble et al. [110]

Table 2.4.: Overview of different forms of knowledge sharing

Next to the described forms of knowledge exchange, Wenger [34] provided information about typical activities and questions addressed by CoPs. This includes different forms of discussion next to workshops and visits to other institutions/areas [34]. The identified activities can be seen in Table 2.5.

Form	Question
Problem solving	"Can we work on this design and brainstorm some ideas; I am stuck."
Requests for information	"Where can I find the code to connect to the server?"
Seeking experience	"Has anyone dealt with a customer in this situation?"
Reusing assets	"I have a proposal for a local area network I wrote for a client last year. I can send it to you, and you can easily tweak it for this new client."
Coordination and synergy	"Can we combine our purchases of solvent to achieve bulk discounts?"
Discussing developments	"What do you think of the new CAD system? Does it really help?"
Documentation projects	"We have faced this problem five times now. Let us write it down once and for all."
Visits	"Can we come and see your after-school program? We need to establish one in our city."
Mapping knowledge and identifying gaps	"Who knows what, and what are we missing? What other groups should we connect with?"

Table 2.5.: Examples of activities of CoPs based on Wenger [34]

Governance

As mentioned in Subsection 2.3.4, CoPs need a form of leadership to keep it alive [32]. This could be, for example, in the form of a coordinator [107]. In addition, this person must have a driver and promoter role [50]. Also, CoPs draw in new members when the CoP leader advertises their advantages across the entire organization [50]. Furthermore, CoPs can be supported by organizations by acknowledging the effort required to maintain them, providing members with the time to participate in activities, and fostering an environment where the benefits communities provide are valued [32]. Moreover, Probst et al. [50] suggested forming governance committees with sponsors and CoP leaders, which meet regularly. This committee analyzes and assesses the overall operations of all CoPs in their organizational domains. The governance committee constantly thinks about whether the individual CoPs' actions make strategic sense for the business and how to best promote them to upper management to win more funding [50]. Another relevant aspect is that the membership in CoPs should be voluntary and therefore not be controlled [32].

2.3.6. Benefits and challenges

As mentioned in Subsection 2.3.3, CoPs provide many advantages and challenges. These aspects will be presented in the following:

Benefits of CoPs

The author Etienne Wenger-Trayner outlined many advantages of CoPs in his publications. Firstly, they empower members to manage information collectively, understanding that they are most effective when properly organized [34]. Secondly, because the same people participate in CoPs, teams, and business units, there is a clear link between learning and performance [34]. Thirdly, CoPs are not restricted by formal institutions since they foster networking and relationships beyond geographical and organizational borders [34]. In addition, CoPs provide several advantages concerning creating, accumulating, and disseminating knowledge in an organization [32]. CoPs are hubs for sharing knowledge while the members share a common understanding and goal. Consequently, they can easily share best practices across the whole organization, which makes them an ideal channel for sharing information [32, 45]. Moreover, CoPs protect the knowledge's implicit components that formal systems cannot record. Consequently, they are perfect for introducing new employees to a discipline [32] since they can reduce the duration of the learning curve [45]. Another benefit of CoPs is that they manage current skills through the discussion of new ideas or collaborative working on problems, which can keep the organization up-to-date. When a CoP decides to lead in a certain field, its members are jointly responsible for following or initiating new advancements. Since people stake their professional identities in belonging to a forward-thinking group, this partnership makes membership valuable [45]. Furthermore, CoPs can be a place of home and trust since they are mostly not as temporary as teams in an organization because they focus on important aspects relevant to the members. This feeling can support the creativity of humans and, respectively, the employees' skills [32]. Wenger [51] also answered the question why to focus on CoPs. For this aspect, the author identified short- and long-term values for both the members of a CoP and the organizations which establish CoPs. An overview is provided in Figure 2.6.

Other authors also mentioned further benefits of CoPs. Lesser et al. [45] stats that through CoPs, the organizations are faster in responding to customer needs and inquiries [45]. They also reduce duplication in work (e.g., reworks, same problems or inventions) and can lead to new inventions [45]. Additionally, CoPs can help organizations in the change from a slow-moving traditional hierarchy to a fast-moving economy [45]. Furthermore, CoPs may be used to create and maintain long-term

Figure 2.6.: Values of CoPs based on Wenger [51]

organizational memory. The value acquired by each community member in improved learning and increased drive to put what is learned into practice is complemented by these outcomes, which are an essential but frequently underappreciated component [45]. Also, CoPs can lead to a better working environment, higher job satisfaction, and collaboration, more trust between employees, and more operational efficiency [114].

Challenges and problems of CoPs

Despite the many advantages of CoPs, challenges and problems exist. First, the organizational environment might hinder the creation of CoPs. This could be, for example, management interest and support, reward systems, work processes, organizational culture, and organizational policies [32]. For instance, salary and recognition problems frequently arise since the knowledge exchange takes time. It is challenging to use reward systems as a way to manipulate behavior or micro-manage the CoP because CoPs must be self-organizing in order to learn effectively and because participation must be voluntary [32]. However, organizations should not completely neglect the issue of rewards and recognition. Instead, they should modify their reward systems to encourage participation in learning communities by including volunteer work and leadership responsibilities in performance reviews [32]. In addition, a manager should ensure that time spent in CoPs is not mistakenly penalized by the existing compensation structures [32]. Another publication identified power, trust, predispositions, size, and spatial reach as limits to CoPs [108]. Next to these points, in a survey among members of different CoPs and companies, Tarmizi et al. [115] identified the following aspects as most challenging: encouraging new members to participate (70.5%), promoting the

ownership and encouraging group responsibility (61,4%), creating and maintaining an open, positive, and participative environment (56.8%) [115].

Furthermore, Probst et al. [50] identified five reasons for failure of CoPs:

- **Lack of a core group:** A core group emerges typically in the creation phase of a CoP and consists of members who participate regularly and support others within the CoP. Without a stable core group, CoPs might fail [50].
- **Low level of one-to-one interaction between members:** Too less participation (e.g., in the form of face-to-face discussions or e-mails), less knowledge exchange and therefore no common problem solving can lead to failures [50].
- **Rigidity of competences:** Missing trust between members and the unwillingness to adapt new competencies from others are challenging the use of a CoP [50].
- **Lack of identification with the COP:** People do not see taking part in a CoP as helpful in their day-to-day jobs. As a result, they do not view others as peers who can provide them with important information and advice. Also, members frequently find it difficult to relate to CoP practices simply because they are not sufficiently evident to outsiders [50].
- **Practice intangibility:** When members fail to communicate with one another in a way that enables them to show the practice and make it sufficiently concrete for other members to grasp and envision its purpose, practice intangibility results [50].

2.3.7. Further research

In the CoP literature, further research areas are mentioned, which will be summarized in this subsection. Firstly, the social-cultural environment might impact the success of CoPs and therefore should be investigated. For example, studying the differences between different cultural environments like the United States and China would lead to a better context [108]. An organizational context study is a second area of interest: How do communities of practice connect with an organization's formal structure? [108]. Jassbi et al. [40] also agree on future research in this direction: The authors suggested investigating the causal relationships between organizational aspects, internal components of organizational aspects, and features of CoPs and their internal components [40]. In addition, the authors suggested value management procedures and CoP interactions in network contexts as relevant for future studies [40]. Thirdly, investigating the influence of different sizes and sectors of organizations would be useful [108]. Fourthly, in the governance context, future studies may concentrate on developing strategies to keep committees active or creating a hierarchy to control and

formalize their work [50]. Additionally, Probst et al. [50] suggested focusing on success factors and moreover on why CoPs fail since literature did not address this aspect [50]. Fifthly, Lesser et al. [45] mentioned two further aspects: How management actions can influence CoPs and the social capital, and how can the value and outcome of CoPs be measured [45].

2.4. Communities of Practice in large organizations

Although a complete separation of the fundamental literature of CoPs and one of the large organizations is not always possible (e.g., Wenger et al. [32] describe in one part of their study the CoP of a large insurance company), this section focuses on relevant aspects and examples of CoPs in large-organizations (Subsection 2.4.1). Afterward, the aspects are compared with the ones from classic literature about CoPs in non-agile organizational contexts, including potential differences (Subsection 2.4.2).

2.4.1. General information

As mentioned, Probst et al. [50] identified ten success factors and five challenges of CoPs. For each of these factors, the authors mentioned an example in a large organization to increase the validity of the aspects [50]. Organizations studied are, for example, Daimler, Mitsubishi, Siemens, and IBM [50]. Exemplary, for a large organization (IBM), the author identified that the "electronics" CoP of 200 people enabled the members to connect to other global sections of the company [50]. Furthermore, in large organizations, CoPs can be a co-located hub for the whole company and act as bridges and brokers to connect different groups. In addition, through CoPs, individuals have an access point to engage and can create an identity [116]. In another publication, a concept model of relations between organizational variables and components of communities of practice was created based on CoPs in large organizations [40]. The model contains 13 different aspects, such as the formation process (top-down, bottom-up) or enrollment (voluntary, compulsory, mixed), to look at during the creation of a CoP. Furthermore, it addressed organizational variables for each of the thirteen aspects [40]. The conceptual model is presented in Figure 2.7.

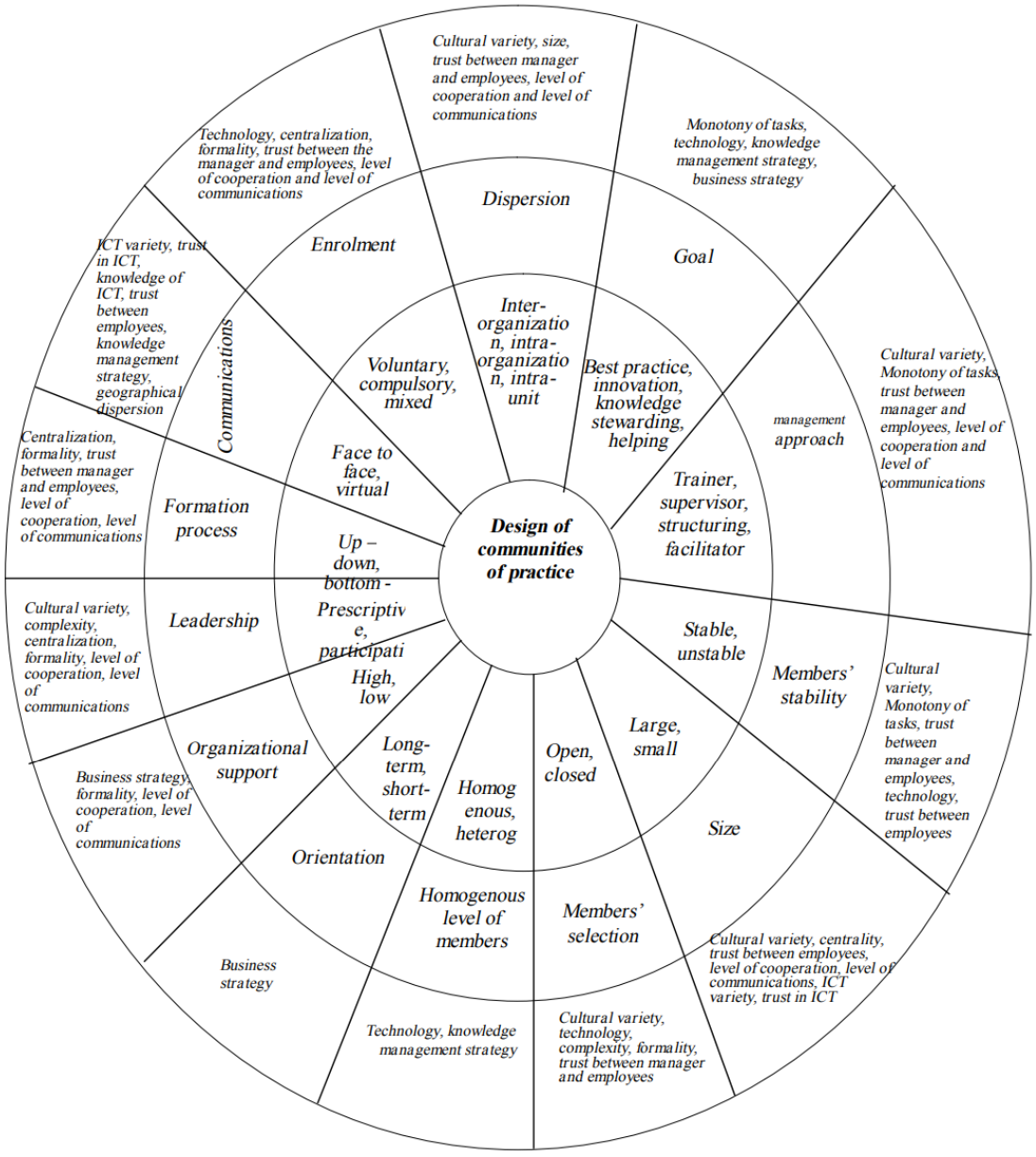

Figure 2.7.: Concept model based on Jassbi et al. [40]

2.4.2. Differences to classic literature of Communities of Practice

As stated, the differences between large and small organizations are insignificant since it is hard to separate the literature. However, some smaller differences could be identified. Firstly, regarding the size and membership: Smaller organizations tend to have just a few members in a CoP which enables closer relationships and personal connections. In contrast, large organizations have the potential to form larger CoPs which might lower close relationships but offers the possibility to connect people from different locations or departments and to bring in more expertise [32, 34, 117]. Secondly, there could be differences regarding the structure and formality: While the most common form of CoPs in small organizations is often an informal discussion (in person), CoPs in large organizations generally have more defined roles, responsibilities and governance [32, 103, 117]. Thirdly, the available resources differ. Small organizations often have limited resources in time and budget, while large organizations have more space, funding, and tools available for knowledge exchange. This also includes using digital tools for the knowledge exchange [32, 102, 117]. Fourthly, smaller CoPs might have more impact on decision-making than CoPs in the larger organizations since they are often aligned to organizational objectives and goals [32, 103, 117].

2.5. Communities of Practice in (large scale) agile software development

Next to large organizations, for this thesis, especially CoPs in (large scale) agile software development organizations are essential. Consequently, this section will present relevant literature on CoPs in LSAD (Subsection 2.5.1) and compare the results and differences with CoPs in (large) organizations (Subsection 2.5.2).

2.5.1. General information

Types and forms of CoPs

Since lean-agile principles promote cross-functional teams and lean thinking places a focus on assembling individuals from various fields and skill sets around a value stream, domain-focused interactions are required. Consequently, in agile organizations, role-based CoPs, e.g., for PO or SM, are created because they offer a possibility to share specific knowledge across team boundaries in the entire organization [118]. Furthermore, topic-based (multiple roles talking about the same topic) CoPs emerge when role-based CoPs are accepted [118]. These types of CoPs are also mentioned in a study by Santos et al. [119]. Other types described in the literature are technical, domain-

specific, and cross-functional CoPs [53]. In contrast, Korbel [55] defined five different types of CoPs based on their recognition status by the organization: Unrecognized, bootlegged, legitimized, supported, and institutionalized [55].

Goals and reasons for the establishment

Silva et al. [35] mentioned the organizational change to agility as one reason to establish a CoP since the adaption of agile exposes boulders, which can not be solved by individuals but by a CoP (Agile Coach Community) [35, 37]. Moreover, the role of the CoPs can support the agile transformation and the move to large-scale and continuous improvement [36]. Furthermore, the identification of a need for knowledge exchange between different persons in the role of agile coach was another factor for the establishment [35]. Kähkönen [37] supports this by adding that CoPs can enable cross-functional work and learn from each other [37]. Knowledge sharing and learning, coordination, design, and organizational development are purposes identified by Paasivaara et al. [36].

Establishment process

CoPs in agile development can be established through the organizational need (bottom-up) or be created on purpose (top-down) [52, 38]. This is also addressed in a study by Paasivaara et al. [33] CoPs are created when they are needed (bottom-up) and ceased when the purpose of them is fulfilled [33]. Furthermore, the authors identified eight success factors to consider in creating a CoP [33]. Another publication deals with the same topic: Korbel [55] mentioned seven guidelines to establish a CoP: a design for evolution, open dialogue (between inside and outside participants), inviting different levels of participation, having both public and private events, focus on value, combine familiarity with excitement, and create a cadence for the community [55].

Way of knowledge sharing and governance

As in literature on CoPs in classic software engineering, CoPs are voluntary and held in the form of meetings [35]. Another form of knowledge sharing is workshops [37]. Furthermore, Šmite et al. [52] states that CoPs are a mix of four archetypes with one dominant one. These are book clubs (sharing and learning, discussions), open source societies (coordination and technical work), support lines (onboarding), and standardization communities (decisions) [52, 120].

Santos et al. [119] stat that leadership plays an essential role in CoPs in agile environments because a leader can encourage teamwork and support the knowledge exchange

[119]. Furthermore, there are a formalized reporting structure (goals, results) and a program team that supports the CoPs [35]. Another factor for successful CoPs, next to a passionate leader, is management support in the establishment process and to encourage employees to participate in the knowledge exchange [33]. Furthermore, a proper agenda and decision-making might be helpful, too [33]. These decision-making CoPs can decrease executive power but empower the members and influence of a CoP in LSAD [38].

Future research

Paasivaara et al. [36] suggest that there should be more publications on how to use CoPs in practice in LSAD [36]. This also includes providing organizational support, benefits, challenges, and "how to best achieve the possible benefits" [36]. Furthermore, the influence of existing organizational culture, structure, and national culture should be investigated next to the influence of different countries and working sectors [33].

2.5.2. Differences to Communities of Practice in (large) organizations

As for large organizations, the basic concept of CoPs in LSAD is the same as in classic literature. However, there are also some differences. First of all, it is possible to recognize that literature about LSAD often mentions role-based and topic-based CoPs [118, 119], while CoPs in general are often defined by their components like size [40, 42]. A reason for that could be that CoPs in LSAD are mostly cross-departmental or even organizational-wide [37] since in LSAD many different teams are working together on the identical product at the time and have to adapt changes collaboratively fast [20], which is not (often) the case for traditional development. As a result, CoPs offer a possibility to exchange knowledge between employees with similar roles, which are company-wide distributed [36]. Furthermore, CoPs in LSAD are often used when the organization changes to a (large-scale) agile working environment [35, 36]. This further goal of CoPs to support organizational changes is just a minor goal in the literature about CoPs in non-agile organizational contexts [45]. Another difference is based on the organizational structure of LSAD organizations, which differs from traditional organizations: Agile companies typically have a more decentralized and flat structure. This often also enables self-organizing teams and distributed decision-making [5, 39, 23]. In contrast, traditional organizations have a more hierarchical structure with central decision-making [121, 122]. As a result, CoPs in LSAD sometimes have the permission to decide on specific topics [53, 38]. Two other differences arise through the contrast between agile methodology and traditional development: flexibility/adaption and focus on continuous improvement. To follow the agile methodology, organizations in LSAD

must be flexible and adaptable to respond to customer requests or market changes [1, 2, 69]. In addition, continuous improvement is a core principle of agility [75, 77]. As a result, CoPs in LSAD actively participate in determining areas for improvement, fostering innovation, exchanging best practices, and promoting change within the whole organizations [119, 55, 37]. In contrast, traditional organizations have a more static approach to changes or improvements [123], for that reason CoPs do not need to focus explicitly on continuous improvement of the organization but have other goals like knowledge exchange and collaboration [32, 109, 45].

3. Related work

While Chapter 2 presented the relevant theoretical foundations and key concepts for this master thesis, this chapter provides an overview of the key publications related to the topic of this master thesis. The related work in this chapter will address the topics of Communities of Practice in different forms of organizations. First of all, relevant papers which deal with the topic of CoPs in large-scale agile software development are presented (Section 3.1). In the second section (Section 3.2), all relevant publications on CoPs in agile firms are mentioned. The last section (Section 3.3) highlights the knowledge exchange in (large) organizations independent from agile working. The related work is ordered by the publication year.

3.1. Investigation of Communities of Practice in large-scale organizations

Monte et al. [53]

The paper's goal by Monte et al. [53] is to investigate the use of CoPs in large-scale agile software development. More in detail, the authors deal with the concept of CoPs in large-scale agile software development by conducting a systematic literature mapping in this area. Firstly, the role of CoPs in supporting knowledge exchange, teamwork, and learning among practitioners is discussed in the study. Secondly, the publication emphasizes the importance of CoPs in dealing with issues like knowledge silos and communication gaps, and creating a sense of community among different agile teams. Thirdly, the authors investigated, similar to one goal of this thesis, the different types of CoPs. In this case, technical, domain-specific, and cross-functional CoPs are identified and described. Furthermore, aspects like decentralized decision-making, free participation, and leader engagement are discussed. Lastly, the paper mentions the need for empirical studies in further research to validate the effectiveness of CoPs [53].

Moe et al. [38]

The paper of Moe et al. [38] focuses on the balance between organizational control and team autonomy in large-scale agile software development. Furthermore, it also

investigates, like this thesis, the establishment of CoPs. The data used in the publication is based on a study of two large-scale software development organizations in the telecom industry. According to the paper, finding the sweet spot where control and autonomy are properly balanced, is crucial to maximizing project results. Therefore, the challenges of achieving this balance, including organizational hierarchies and conflicting goals, are described. Since one way to face these challenges is the creation of CoPs, different CoPs were introduced in the development organization. The establishment of CoPs decreased managerial power due to the fact that some decisions (e.g., related to features or the teams themselves) are now being made by the teams while it still provides the centralized structure and alignment that is needed. Furthermore, the creation of CoPs can be done top-down or bottom-up, but the top-down alignment was permanently achieved through centralized decisions, supervisors, and mandatory aspects. To conclude, the authors suggest establishing strong organizational CoPs and also some CoPs with decision-making authority [38].

Sporsem et al. [120]

Sporsem et al. [120] also conducted a case study (based on interviews, meeting notes of CoP meetings, and documents) to investigate the influence of Communities of Practice on the success of internal startups within large organizations. In addition, the collected information about the existing guilds, like the frequency (bi-weekly meetings), a form of knowledge exchange (speeches and discussions), and the governance (one facilitator who is in charge of the invitations and agenda). The authors also described challenges and the achievements and impact of the created guilds, which is also relevant for this thesis (see Table 3.1).

Challenges	**Achievements of the guild**	**Impact**
Idea owners lacked customer contacts and know-how to approach customers	Acquiring common practices to approach customers in exploring customer-problems	Higher quality on feedback from customers and reduced time acquiring them
Lack of guidelines on pricing digital products, need to map the existing financial expertise	Increasing expertise in pricing digital products	Obtaining a pricing solution in line with the organization's existing strategy in less time
Insufficient knowledge on building and scaling products	Improving coordination with software development unit	Managers committed to dedicating developer resources earlier

Table 3.1.: Challenges and achievements of the guilds by Sporsem et al. [120]

In addition to that, the authors also describe different types of CoPs based on Šmite et al. [52] in their publication [120]:

- Book clubs: Emphasising discussion on better working practices rather than decision-making
- Open source societies: Developing plans for member-owned components
- Support lines: offering solutions to technical problems and fostering solution conversations (for less experienced staff)
- Standardizing committees: Create artifacts and align the (whole) organization

Sporsem et al. [120] conclude their publication by the confirmation of their study that overarching structures, like a CoP, can help large organizations to be more successful.

Šmite et al. [124]

In 2019, Šmite et al. [124] conducted a multiple-case study of different CoPs at the company Ericsson by conducting semi-structured interviews with CoP-Leaders. The paper aimed to identify blockers for participation-based parallel structures in LSAD and to find supporting aspects for them [124]. Since CoPs are primarily horizontal and the knowledge of potential failures is crucial during the establishment process, this publication is also relevant for this thesis. As a result Šmite et al. [124] identified challenges in the area of decision-making authority (corporate interests versus local interests, lack of influence for new members), breadth of involvement (cross-organizational agreement takes time, one representative member is insufficient in LSAD, poor attendance and activity), and visibility in the organization (depends on the local network of the members) [124]. Furthermore, four different aspects to support participation-based parallel structures were identified: Enable decision-making, invite and include all people independent from their level of participation, get the needed resources, and strengthen the image of the CoP in the organization [124].

Šmite et al. [52]

Another relevant topic, since it addresses the different forms of CoPs, is how to create successful knowledge exchange in large-scale agile development organizations. Šmite et al. [52] address this topic in the context of the organization Spotify by conducting an interview study with core members of CoPs/guilds. Guilds are volunteer organizations that unite people with related interests or skill areas to share knowledge and work together. The authors discuss the advantages of CoPs, such as encouraging a learning culture, team collaboration across divisions, and knowledge exchange in general throughout Spotify. In addition, they describe the different types of guilds in the

organization and name common challenges. Furthermore, the authors designed clear guidelines and aspects to look at while establishing knowledge exchange, which is also relevant for this paper [52]. These criteria for the successful guild can be found in Figure 3.1.

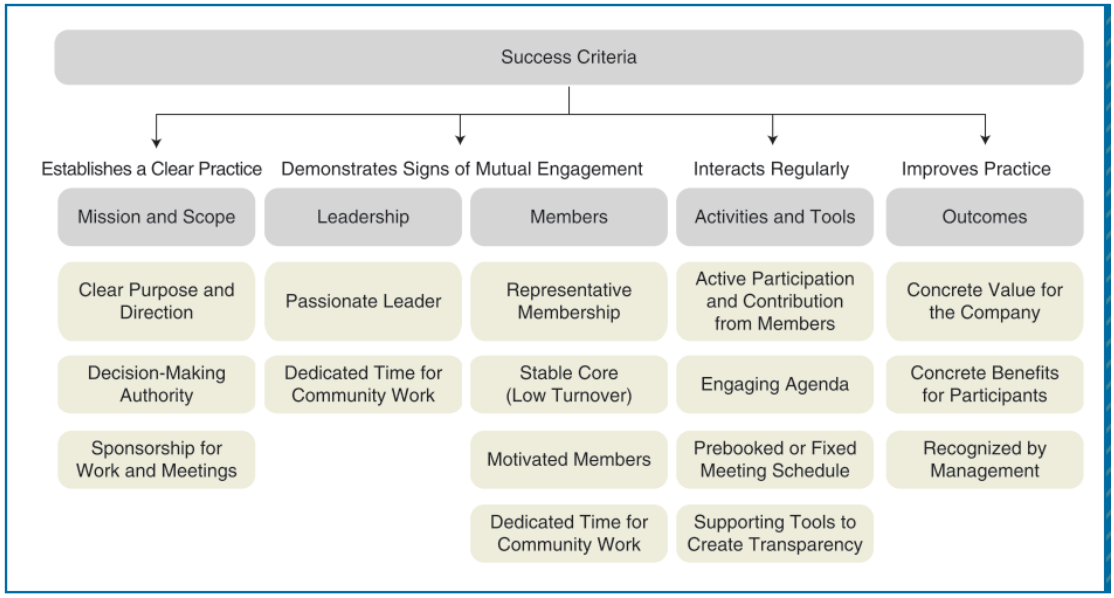

Figure 3.1.: Aspects for a successful knowledge exchange [52]

Paasivaara et al. [33] & Paasivaara et al. [36] & Paasivaara et al. [56]

Two other publication, which investigates, like this paper, the establishment of CoPs are by the authors Paasivaara et al. [33, 36]. They deal with the topic of CoPs in large-scale agile software development in the organization Ericsson by conducting semi-structured interviews, similar to the method used in this thesis, over a while. The paper explores how CoPs were established and addresses challenges in knowledge sharing and decision-making. For example, the authors identified CoPs with decision-making where participants were empowered to make choices as long as they were within their tolerance limits. In addition, the study finds that CoPs boost productivity and quality and improve the working environment in the software development organization. On top, the case study emphasizes the importance of active participation, passionate leaders, clear goals, and a supportive organizational culture. Eight different success factors were found, described in Figure 3.2 [33, 36].

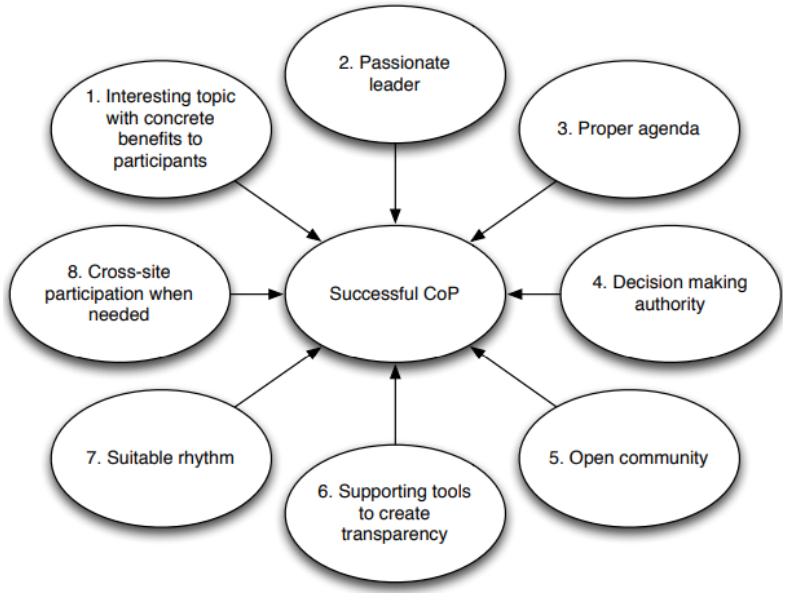

Figure 3.2.: Success-factors for CoPs [33]

In 2019, the authors published another paper on this topic with a focus on decision-making, which is also a relevant aspect of this thesis. It is based on the older publications from 2014 [33, 36] but includes more interviews until 2018 since Ericsson moved partly to the cloud in this time frame. The authors identified that the change to decisions in CoPs requires time since the teams need to learn to brighten their horizons and to take responsibility. In addition, it should be a transparent process in which decisions are made by one team and by the CoP itself. Furthermore, feedback needs to be implemented fast [56].

Korbel [55]

Similar to this thesis, Korbel [55] tries to identify the current state of CoPs in a case organization. The author describes the situation and use of CoPs in his organization Digital Globe using the scaled agile framework SAFe. The paper discusses different aspects of CoPs based on a documented experiment of using CoPs in the company for alignment and improvement: At the beginning, the author defines CoPs and mentions their importance for collaboration and cross-team knowledge sharing. Next, the author described the different types of CoPs (see Table 3.2) and guidelines for the establishment to address challenges faced by Digital Globe in terms of coordination and cooperation amongst various teams and departments to achieve a culture of sharing

and learning. Lastly, the author presents the experiment results, which concluded that CoPs are worth the effort and help to align people and processes over different teams. In addition, the leadership also recognized the value of CoPs. But there is also room for improvements in the context of visibility of improvement measures and closer work with the coordinators of the different CoPs [55].

Community type	**Definition**	**Typical Challenges**
Unrecognized	Invisible to the organization and possible to its members	Hard to see the value of the community to the organization or members; probably doesn't include all the right members
Bootlegged	Visible but only to a small select group of insiders	Difficulty gaining resources or credibility; difficult to make an impact
Legitimized	Officially sanctioned as a valuable entity	Unrealistic expectations; rapid growth and assimilation of new members
Supported	Provided with resources (time, money, facilities, people)	Accountability for the return on invested resources; short-term pressure to prove value
Institutionalized	Given official status and responsibilities in the organization	Over management; slow moving; outlives its usefulness; permanent members become separate from actual projects

Table 3.2.: Types of CoPs at Digital Globe by Korbel [55]

Kähkönen [37]

In the publication from Kähkönen [37], the author discusses implementing agile methods in large organizations and emphasizes the importance of building Communities of Practices to succeed in multiple-team settings. Therefore, Kähkönen [37] explains three different agile methods, which were developed at Nokia (RaPiD7, Integration Camp, and SEED), and explains, with the use of CoPs, why these methods work in this setting. The author argues that CoPs are seen as a possibility to promote knowledge sharing and collaboration within a company since they can enable cross-functional teams to work together and learn from each other. Furthermore, Communities of Practice can aid in bridging organizational silos and promoting a collaborative and continuous improvement-oriented culture. The paper examines the difficulties and methods for developing effective CoPs, such as getting support from the leadership, forging a common vision, offering resources, and cultivating a positive organizational

culture. Additionally, like in this thesis, the publication identified already successfully implemented CoPs in the case organization, which supports the agile transformation. They can be found in Table 3.3. The paper highlights the importance of Communities of Practice in large organizations again if the company wants to drive success through agile transformation and organizational change.

	Community	**Practice**
RaPiD7	People interested in a specific system. Includes development team, related teams and specialists	System specification is elaborated and documented in workshops
IC	People delivering software for a common platform	Software is integrated in workshops
SEED	Project managers of the subsystem	Subsystem development is planned and tracked in workshops
SEED	Concept Group = Team Architects	Requirements and architecture of the subsystem are managed in workshops

Table 3.3.: Summary of CoPs at Nokia by Kähkönen [37]

3.2. Investigation of Communities of Practice in agile organizations

Kopf et al. [125]

Based on their experience, Kopf et al. [125] describe patterns for the establishment of CoPs in agile IT environments. The paper aims to provide a list of potentially crucial points for managers, team leaders, or architects to make an establishment of a CoP easier. Since the authors provide results and insights from different companies, this paper is relevant even though they did not do a case study with organizations. In total, eight different patterns were identified as a result, which are presented in the following [125]:

- **Management alignment:** Get a commitment by management for funding and the possibility to spread out the information on the establishment of a new CoP in the company.
- **Strategy alignment:** Facilitate strategic direction of the CoP with the appropriate management colleagues. The right management level may vary depending on the company's size and culture.
- **Point of contact:** Identify a contact person (patron) who can actively support the CoP by reviews, guidelines, budget questions, and links to higher-management.

- **Kick-off:** An individual kick-off meeting should be held to launch a new CoP and the CoP-Lead should invite all key participants, including the person responsible for the funding, to present and launch the CoP.
- **Guidelines:** Establish standards for CoPs that guide new members and ensure a common goal.
- **Review and appreciation:** To ensure a successful knowledge exchange, frequent retrospectives should be done to track the progress and value of the CoP, and to address potential issues.
- **Separate ways:** Since the way of working of CoPs might differ depending on the members' expertise and topic, a change can happen over time. This is no problem since the self-organization of CoPs is capable of taking on mixed forms.
- **Membership models:** Since it is almost impossible that every member is enthusiastic, the CoP-Lead should think about different membership models for all forms of participation (active and permanent participation to peripheral participation) to show all people the benefits of the CoP.

Santos et al. [119]

Another paper deals with knowledge exchange in agile software development, from Santos et al. [119]. Moreover, potential challenges and solutions are relevant to this thesis. The authors collected data from four different Brazilian organizations and experts in the implementation of agile methods. As in this thesis, a part of the data collection is also interviews. The study examines the issues and solutions for fostering productive team knowledge-sharing in agile software development. It emphasizes the value of knowledge sharing between teams to foster better teamwork, reduce duplication, and raise project effectiveness as a whole. In addition, geographical dispersion, organizational culture, and communication gaps are obstacles that the authors mention in their discussion of inter-team knowledge exchange. In contrast, the utilization of communication technology, cross-team meetings, and knowledge transfer activities are among the strategies for promoting efficient inter-team information sharing. Furthermore, the research paper emphasizes the significance of developing a supportive organizational culture that promotes and rewards actions related to knowledge sharing. The authors also review the part that leadership plays in encouraging teamwork and offering resources for knowledge sharing and learning to facilitate inter-team information exchange. To conclude, the authors empathize with the need for ongoing efforts and continuous improvement in knowledge sharing to improve project outcomes in environments that support agile software development [119].

Silva et al. [35]

Another paper whose goal is to investigate the establishment of a Community of Practice in a large organization similar to this thesis is by Silva et al. [35]. The authors also conducted a case study including observations, questionnaires, and interviews to gain insights into the industry. The publication focuses on the Agile Coach community over a time frame of two years. The paper mentions relevant aspects of the establishment process: a formalized reporting structure (goals, agenda), regular voluntary meetings, passionate people who drive a CoP, and management support. In addition, Silva et al. [35] present challenges during the creation. These include keeping motivation high and finding the right people. Further results mentioned are the importance of agile coaches for communities and the agile transformation, and that the community increased the project outcomes.

3.3. Investigation of Communities of Practice in large organizations

Jassbi et al. [40]

Another paper, which also deals with the establishment process of Communities of Practice, is by Jassbi et al. [40]. In general, their goal is to describe the structure of CoPs in line with the organizational context and to create a model for it. More in detail, one of the research questions focuses on the establishment and maintenance of CoPs. As a Method, the authors use a literature review followed by interviews and the fuzzy Delphi panel. In the literature review, Jassbi et al. [40] also describe different types of CoPs based on their structure and communication. As a result, the paper provides a model with relations between variables and organizational components in the context of CoPs. This model could be used by organizations to affect the (creation of) CoPs. In addition, the study finds essential aspects, such as management support, specified goals, and high member engagement, that help CoPs to align. Moreover, the study emphasizes the importance of spending time and resources to make CoPs successful in an organization.

Probst et al. [50]

Another relevant topic for this paper is what aspects are needed in the establishment process for CoPs to be successful. Probst et al. [50]'s goal is to identify points why CoPs fail or succeed. The authors conducted multiple communities of practice in large organizations in Europe and the United States to gain a result. In conclusion, Probst et al. [50] identified ten different success factors for governance and five reasons for failure, and described them in detail in their paper. Some of the mentioned aspects, like having "a sponsor and a CoP leader" [50], are relevant for the establishment, while others are important in the maintenance process. In the following, these detected points are presented.

Success factors based on Probst et al. [50]:

- Stick to strategic objectives
- Divide objectives into sub-topics
- Form governance committees with sponsors and CoP leaders?
- Have a sponsor and a CoP leader who are "best practice control agents"
- Regularly feed the CoP with external expertise
- Promote access to other intra- and inter-organizational networks
- The CoP leader must have a driver and promoter role
- Overcome hierarchy-related pressures
- Provide the sponsor with measurable performance
- Illustrate results for CoP members

Failures based on Probst et al. [50]:

- Lack of a core group
- Low level of one-to-one interaction between members
- Rigidity of competence
- Lack of identification with the CoP
- Practice intangibility

4. Interview Study

This chapter describes the interview study conducted as part of this thesis to investigate the establishment of CoPs in large-scale agile software development. The first part of the following sections (Section 4.1) presents the interview study design, which includes all relevant information about the study plan. The following section (Section 4.2) describes how the data was collected. Section 4.3 then provides information about the data analysis. In the last section (Section 4.4), a more detailed description of the data received from the interviews is given. This includes information about the analyzed companies, the interviewed experts, and the working environments.

4.1. Interview study design

In the following, the interview study is presented based on the guidelines described by Runeson et al. [62]. Consequently, in this section, the objective, the case, and the case study method are described to give the reader a more detailed overview of the design decisions.

Objective - what to achieve?

The first objective of this interview study is to investigate knowledge sharing and cross-team coordination with a focus on establishing and managing CoPs in the context of large-scale agile software development. Moreover, as a second objective, this interview study aims to identify topics in the context of CoPs in large-scale agile software development relevant to practitioners that require more research/guidance. The goal of these findings is to provide relevant topics for further research in this area, and to create an updated version of the used questionnaire to gain further results, and the creation of an artifact or best practices.

The case - what is studied?

This interview study takes part in the context of large-scale agile software development. In this case, experts from different organizations were interviewed. Although all interviewees work in agile software development, the selected organizations are active

in different industry sectors to cover a picture as broad as possible. This includes IT departments in different firms, software providers, and consulting. The selected organizations are all suitable and exciting research objects since they all use different forms of knowledge exchange in their working process. More detailed information about the case companies is provided in Subsection 4.4.1 of this chapter.

Theory - frame of reference

The theoretical background for this interview study focuses on two main parts: general information about (large-scale) agile software development and Communities of Practice. In this thesis, the foundations of this theoretical frame are described in Chapter 2. Furthermore, related literature is mentioned in Chapter 3 to make the context of the interview study more clearly for the reader.

Research questions - what to know?

This objective is based on the research questions of this thesis described in Section 1.2 since the research questions outline the information needed to achieve the goal of this interview study [62]. As this thesis is the initial research, the interview study covers all five research questions and the literature foundation. The following main questions will be addressed by conducting and evaluating the outcomes of the expert interviews:

- What types of CoPs exist in the different companies?
- What was the reason and goal for establishing the CoPs?
- Who is/was involved in establishing the CoPs?
- How frequent is the knowledge exchange?
- How does the steering and governance of the CoPs work?
- What are potential failures and problems for CoPs?
- How can research support CoPs in the industry?

Through analyzing these questions, knowledge about the current state of CoPs in the industry will be gained.

Methods - how to collect data?

As mentioned in Section 1.3, the method used to collect relevant data was via semi-structured interviews [126, 57, 58, 63]. Additionally, the guidelines of Myers et al. [57] were used. The use of semi-structured interviews is possible in this research because this thesis is motivated by a practical problem, and this method allows to get broad insights into the current state of CoPs in the industry [58]. Moreover, through

semi-structured interviews, it is possible to resolve any uncleanness up front, gather specific information from the experts, and have an honest, open discussion. Therefore, the interviewees can add any interesting and relevant topic that comes into their minds.

During the semi-structured interviews, a questionnaire that focuses on the aspects mentioned in the previous paragraph was used to ensure that all relevant aspects are covered by the experts next to a possible open discussion on further topics. The questions contained in the interview are divided into three main sections, while the second one contains multiple subsections:

1. Questions about the role and company of the interviewed person
2. Questions regarding the establishment of CoPs in large-scale agile software development
   a) Questions on the establishment of CoPs directly
   b) Questions about the time and frequency of knowledge exchange
   c) Questions on the involved persons in (the establishment of) the CoPs
   d) Organizational-related questions
   e) Questions regarding changes of CoP
   f) Communication and documentation-related questions
   g) Additional Questions
3. Open discussion on the support of the establishment of CoPs in the industry by research

The questionnaire can be found in Appendix A.1. Furthermore, the questionnaire was sent out in advance to interviewees because a high level of general knowledge was required to answer the questions, and the interview structure was to be better understood. The interviews were expected to last between 40 and 60 minutes.

Selection strategy - where to seek data?

The experts who participated in the interview study were chosen based on their working experience in large-scale agile software development. Email invitations to participate in the interview study were sent to numerous industry professionals. In addition, details about the interview series were disseminated on LinkedIn[1]. Several preliminary talks were conducted using different video communication methods to ensure the relevance of the responses. Furthermore, to guarantee a wide variety of responses and expertise, several different positions, such as Agile Coach, Scrum Master, or manager, were contacted [57].

[1] https://www.linkedin.com

4.2. Data collection

During the data collection for this master's thesis, 23 experts from 13 organizations were interviewed for this study. The interviews were mainly conducted from the 28th of February, 2023, until the 5th of April, 2023. One additional interview (26th May) was added in a later stage of this thesis. All interviews were done virtually via Microsoft Teams[2] or Zoom[3], depending on the participant's preference. The shortest one was 34 minutes, and the longest was 62 minutes. The total average duration was around 47 minutes per interview. This time frame includes short technical errors or small interview distractions but not the time needed for introduction and clarification at the beginning. Parts of the clarification are the permission to record the meeting, questions regarding the interview structure, and explanations on the questionnaire. The length of the different interviews varies due to multiple reasons: Firstly, some participants had time constraints due to a full work schedule. Secondly, the amount of described CoPs by the experts differs. Thirdly, since the method was a semi-structured interview, the open discussion time (mainly part three of the interview) varies. Interview 7 was divided into two sessions due to the mentioned time reasons.

Almost all interviews were conducted by two researchers to avoid personally bias through triangulation [58]. In one case (Interview 2), just one researcher was present due to a sudden personal matter, and rescheduling the interview was impossible. The questionnaire stayed the same for all interviews. Just one question was rewritten since an uncleanness on the question of the experts was determined, but the meaning of it did not change. In addition, since semi-structured interviews were used, the order and the wording of some questions might have changed slightly during the interviews. 22 out of the 23 interviews were recorded for further processing. Due to company/department rules, one interview was not recorded. Both researchers took notes during the session, and the questionnaire was filled out afterward based on the combined notes. More details on the analysis can be found in the following section (Section 4.3).

4.3. Data analysis

The two-cyclic coding process was used for the data analysis and coding. It implies that the first coding cycle involves assigning tags to data pieces before further analysis in the second coding phase [64]. In this case, the approach suggested by Saldaña [65] was used, and each step is presented in detail in this section.

[2]https://www.microsoft.com/microsoft-teams
[3]https://explore.zoom.us

4.3.1. Transcription

The data analysis software MAXQDA[4] was used for the transcription process. In this process, two researchers transcribed the audio recordings of 22 out of the 23 interviews. In addition, the transcripts were rechecked by the other researcher. The missing interview was, as already mentioned, not recorded. Therefore, the notes of the two researchers were combined and added to the questionnaire. This will be used as a transcript for the interview in MAXQDA[4]. To ensure the anonymity of the interview experts, personal data (including name and company) was translated into identification numbers. In addition, sensitive internal information was not transcripted.

4.3.2. Coding and analysis

Both forms of coding (deductive and inductive) were used for the 23 interview transcripts in MAXQDA[4]. Firstly, the text segments were given descriptive first cycle code [64]. Secondly, the codes were given higher-order second-cycle codes under the two-cyclic technique. In this case, an initial list of codes served as the beginning stage [65]. This starting point was mainly based on topics related to the questionnaire and the five research questions of this thesis. Several new codes were developed and assigned inductively [65] during the transcription process. A reason for that is, for example, a relevant statement of an expert which does not fit to an existing second-cycle code yet. All (already) transcribed interviews were rechecked for the newly developed code to ensure the validity of these new codes. As a result, the final coding structure was only completed with the transcription of the 23rd interview. One researcher in MAXQDA[4] did the coding process, further developed through working sessions with another researcher. In the end, all codes were merged into 15 different code categories. Each code category consists of multiple sub-codes (and sub-sub-codes), representing crucial aspects of the code category. For example, for the establishment process, one subcategory is divided into a top-down approach, a bottom-up approach, and a mixture of both. The categories can be overviewed in Table 4.1.

Delimitation of Communities of Practice

Since not every knowledge exchange in an organization is a community, a delimitation of CoPs is needed to set the space for this master thesis. For this context, Wenger et al. [127] provided an overview of the differences between CoP, formal work group, project team, and informal network, which is shown in Table 4.2 [127].

[4]https://www.maxqda.com/de

Code Category	Description	Example	# sub-codes	# statements
Experts	Information about the interviewed expert	Large-scale agile software development role	3	93
Organization	Information about the organizations of the interviewed experts	Working environment	7	185
Types of communities of practice	Statements regarding the different types of CoPs	Topic-based CoPs	3	114
Goals & reasons	Statements regarding goals and reasons of CoPs	Alignment	9	150
Establishment process	Statements regarding the establishment process	Top-down approach	3	74
Failure & problems	Statements regarding the establishment process	No common goal	6	70
Time	Statements regarding the time of the knowledge exchange	Frequency	2	107
Involved Persons	Statements regarding the involved persons and roles in a CoP	Role of the interviewed person in the CoP, funding	4	165
Governance	Statements regarding the governance and steering of CoPs	setting or maintaining the backlog	3	133
Changes	Statements regarding changes in CoPs over time	Change from local to global	3	87
Communication & documentation	Statements regarding communication and used documentation	Recording of Meetings, Use of Confluence for documentation	3	130
Research topics	Statements regarding interesting research topics for the industry	Guidelines for the establishment of a CoP, Comparison of CoPs in different Industries	10	126
Further information on communities of practice	Further statements about CoPs in general	Form of Knowledge Exchange, voluntary/-mandatory participation	13	331
Frameworks & other terms	Statements about Frameworks, Tools and other terms mentioned	SAFe, MS Teams	3	234
Not actively analyzed	Statements relevant for an overall understanding but not analyzed in the scope of the thesis	Contact information, clarification of questions or answers	4	148
			Total	2147

Table 4.1.: Coding structure

Meeting form	What's the purpose?	Who belongs?	What holds it together?	How long does it last?
Community of practice	To develop members' capabilities; to build and exchange knowledge	Members who select themselves	Passion, commitment, and identification with the group's expertise	As long as there is interest in maintaining the group
Formal workgroup	To deliver a product or service	Everyone who reports to the group's manager	Job requirements and common goal	Until the next reorganization
Project team	To accomplish a specified task	Employees assigned by senior management	The project's milestones and goals	Until the project has been completed
Informal network	To collect and pass on business information	Friends and business acquaintances	Mutual needs	As long as people have a reason to connect

Table 4.2.: Delimitation of Communities of Practice based on Wenger et al. [127]

4.4. Descriptive study data

In this section, detailed information on the descriptive study data is presented. Firstly, an overview of the analyzed companies is provided. Secondly, information on the interview experts is illustrated. This includes, for example, information about their role and working experience. Thirdly, the working environment of the different interviewees is described. This is needed because, in total, 23 interviews with 13 companies were conducted, and some experts are part of the same company but might be working in another sector, team, or product area. As mentioned, this thesis aims to have a broad overview of the current state of CoPs. Therefore, the experts and companies cover different roles, sectors, genders, and working experiences.

4.4.1. Analyzed companies

In total, experts from 13 different organizations have been interviewed. Table 4.3 shows detailed information about the analyzed companies. To ensure our broad perspective, the industry sector of the organizations differs: Automotive (2 interviews), Consultancy (7 interviews), Retail (3 interviews), Insurance (3 interviews), Medical Devices (1 interview), and Software Development (7 interviews) are covered by this study. To ensure anonymity, the companies' names were translated into a code name, which is used in the rest of this thesis as a unique identifier. Eight out of the 13 organizations are large companies with more than 50.000 employees worldwide. The

largest one is ConsultCo1, with more than 360.000 employees. Two other consultant firms (ConsultCo3, ConsultCo5) have between 1.000 to 50.000 salaried. The smallest company was SoftwareCo1, with just 29 employees. The data of the employees was gained from the public homepage of the companies in May 2023. To guarantee anonymity, the sources of the web pages are not listed. Furthermore, for ConsultCo2 and ConsultCo4, the experts are self-employed (see Table 4.3). They are still relevant for this thesis since they described CoPs in their client's organization in a large-scale agile environment. All non-consultancy organizations use CoPs internally, and the experts were asked to describe them.

Sector of company	**Code name of company**	**Company size (employees)**	**Number of interviews**
Automotive	CarCo1	149.400+	1
Automotive	CarCo2	87.000+	1
Consultancy	ConsultCo1	360.000+	3
Consultancy	ConsultCo2	self-employed	1
Consultancy	ConsultCo3	5.000+	1
Consultancy	ConsultCo4	self-employed	1
Consultancy	ConsultCo5	27.700+	1
Electronic Retailer	ElectRetailCo1	52.000+	2
Food Retailer	FoodCo1	161.000+	1
Insurance	InsuranceCo1	159.000+	3
Medical Devices	MedicDeviCo1	66.000+	1
Software Development	SoftwareCo1	29	1
Software Development	SoftwareCo2	105.000+	6

Table 4.3.: Overview of the companies of the expert

As seen in Table 4.3, the number of interviewees variates from one up to six experts from one organization. To prevent duplicates of statements about the same CoP in one company, experts from different areas were interviewed since these are all large organizations and often different departments exist next to each other without direct working contact. In Table 4.4, the different covered areas of SoftwareCo2 are exemplarily described in more detail since it is the company with the most experts in this thesis. Three out of the six people work in the commerce software area, with two in Poland and one in Germany. The other three employees are also located in Germany but in different areas: manufacturing software (2) and software Delivery (1). More details on the working environments of the experts can be found in Subsection 4.4.3.

Area	Location	Number of interviews
Commerce	Germany	1
Commerce	Poland	2
Manufacturing	Germany	2
Software Delivery	Germany	1

Table 4.4.: Different working areas in SoftwareCo2

The experts were also asked to provide information about the start of the use of agile methods in their company compared to the organization's experience in large-scale agile software development. Unfortunately, in some cases, the interview experts from the same organization answered the question within different time frames. This could be because of multiple reasons: Firstly, there could be a difference in the working areas of one company, and the experts are not aware of the agile state in the other ones. Secondly, some interviewees were unsure if they could answer the question right since they either recently joined the organization or the agile transformation happened not company-wide but in specific teams initially. In Figure 4.1, an overview of the experience of the different companies is presented. For SoftwareCo2 and ElectRetailCo1, the experts provided different answers on the length of experience due to the mentioned reasons. Therefore, in Figure 4.1, the longest mentioned time is shown since the expert might not know the agile work in other areas. For InsuranceCo1 and ConsultCo1, the provided answer is (almost) the same. Therefore, the (average) experience is presented. A detailed overview of the answers of each expert can be found in the Appendix (see Table A.1).

The majority of the organizations have between six to ten years of experience in agile development (around 61,5%), which is also the minimum answer for this question. While SoftwareCo2 has just about two years of expertise in the Poland commerce sector, another expert mentioned 16 to 20 years of experience in this area. Six to ten years of experience (30,7%) is the most given answer for large-scale agile software development next to three to five years (30,7%). However, the distribution is broader than for agile development. SoftwareCo1 has just one to two years of experience in this area, while ConsultCo4 and SoftwareCo2 have 16 to 20 years of experience (see Figure 4.1).

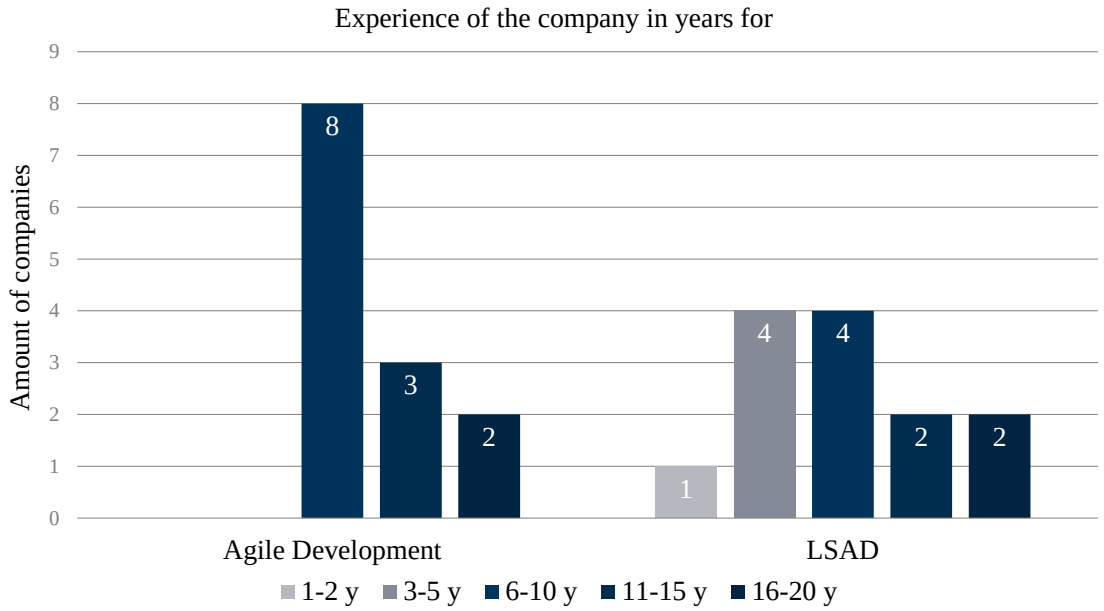

Figure 4.1.: Experience of the company in years in (large-scale) agile development

4.4.2. Interview experts

During the data collection, 23 experts were interviewed. Table 4.5 shows an overview of all experts, including the company code, their selected roles, and their working experience in both fields, agile and large-scale agile software development.

Eleven out of 23 experts (E2, E4, E5, E10-E12, E14, E16, E20-E22) (47,8%) selected just one working role. More in detail, three experts (E10, E14, E20) (13,0%) have selected Agile Coach as their only role. Furthermore, two interviewees have stated each to have just the role of Scrum Master (E12, E16) (8,7%) or Software Architect (E5, E22) (8,7%). In three cases (E3, E7, E13) (13,0%), Agile Coach & Manager were mentioned as roles. Next to these two roles, E3 and E13 (8,7%) also selected Scrum Coach as their role. The combination of Scrum Coach & Manager also appeared for E1, which in total leads to three cases with these two roles (E1, E3, E13) (13,0%). Other combinations that appeared multiple times are Software Architect & Manager (E1, E19) (8,7%) and Consultant & Product Owner (E17, E19) (8,7%). Combinations that appeared just once are, for example, Developer & Scrum Master (E9) or Agile Coach (E15), next to Agile Coach & Quality Assurance (E6) or Scrum Master (E18). Looking more closely at the amount of mentioned roles, the most common one is Agile Coach, which was

ID	Company	Role	Time in agile software development	Time in LSAD
E1	SoftwareCo1	Manager, Scrum Coach, Enterprise Architect, Software Architect, Solution Architect, DevOps Engineer	11-15 years	11-15 years
E2	InsuranceCo1	Enterprise Architect	1-2 years	1-2 years
E3	SoftwareCo2	Manager, Scrum Coach, Agile Coach	11-15 years	11-15 years
E4	ConsultCo1	Manager	6-10 years	6-10 years
E5	SoftwareCo2	Software Architect	16-20 years	16-20 years
E6	ConsultCo2	Quality Assurance, Agile Coach	11-15 years	1-2 years
E7	CarCo1	Agile Coach, Manager	6-10 years	6-10 years
E8	SoftwareCo2	Scrum Master, Security Expert	11-15 years	< 1 year
E9	SoftwareCo2	Developer, Scrum Master	16-20 years	11-15 years
E10	CarCo2	Agile Coach	6-10 years	3-5 years
E11	ConsultCo1	Business Analyst	6-10 years	6-10 years
E12	SoftwareCo2	Scrum Master	11-15 years	3-5 years
E13	ElectRetailCo1	Scrum Coach, Agile Coach, Manager	16-20 years	6-10 years
E14	ElectRetailCo1	Agile Coach	6-10 years	1-2 years
E15	FoodCo1	Developer, Agile Coach	11-15 years	6-10 years
E16	SoftwareCo2	Scrum Master	6-10 years	6-10 years
E17	ConsultCo3	Agile Coach, Senior Consultant, Product Owner, Circle Lead	11-15 years	11-15 years
E18	ConsultCo1	Scrum Master, Agile Coach	6-10 years	6-10 years
E19	ConsultCo4	Developer, Manager, Product Owner, Quality Assurance, Software Architect, Process Consultant	>20 years	16-20 years
E20	ConsultCo5	Agile Coach	11-15 years	11-15 years
E21	InsuranceCo1	Security Guilt Lead	3-5 years	3-5 years
E22	MedicDeviCo1	Software Architect	11-15 years	11-15 years
E23	InsuranceCo1	Agile Coach, Enterprise Architect	6-10 years	6-10 years

Table 4.5.: Overview of the interview experts

mentioned by 11 different experts (E3, E6, E7, E10, E13-E15, E17, E18, E20, E23) (47,8%). It is followed by Manager (including Program Manager) with six occurrences (E1, E3, E4, E7, E13, E19) (26,1%) and Scrum Master with five experts (E8, E9, E12, E16, E18) (21,7%). An overview of all mentioned roles can be found in Figure 4.2.

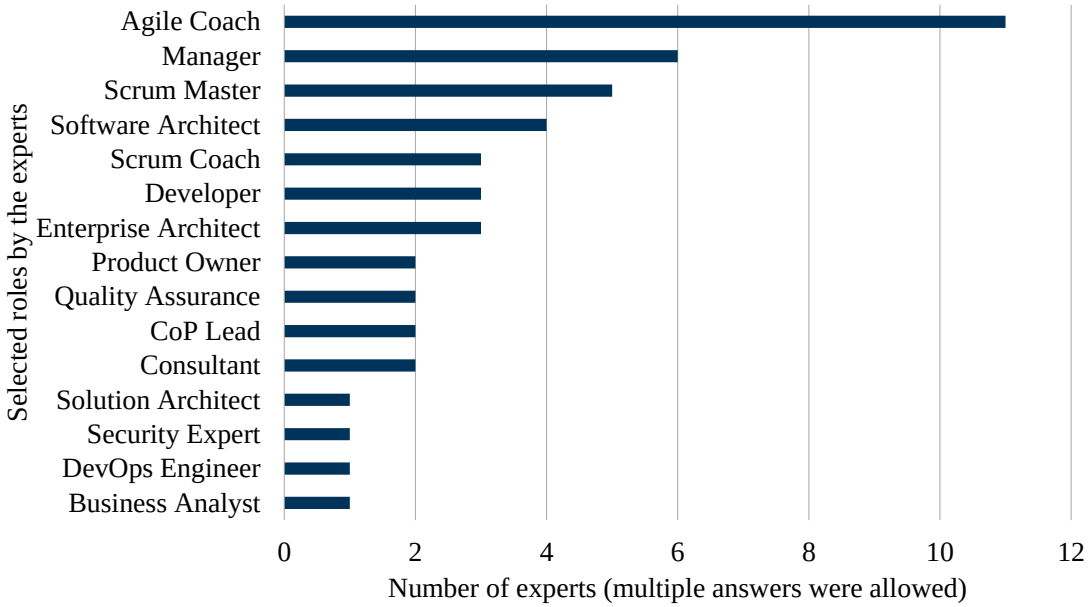

Figure 4.2.: Overview of the selected roles by the experts

Figure 4.3 shows a summary of the experience of the experts in agile development compared to large-scale agile software development. More than half of the experts (E1, E3, E5, E6, E8, E9, E12, E13, E15, E17, E19, E20, E22) (56,5%) have more than eleven years of experience in agile development. The highest amount of working experience in this area is E19, with more than 20 years. Most others (E4, E7, E10, E11, E14, E16, E18, E23) (34,7%) have six to ten years of experience. Only one expert (E2) has less than three years of experience in agile development. The experience distribution for large-scale agile software development looks quite similar, but a sharp decrease is to be noted. Only eight experts have worked more than eleven years in LSAD (E1, E3, E5, E9, E17, E19, E20, E22) (34,7%), with the highest being 16 to 20 years experience (E5, E19) (8,7%). Again eight interviewees (E4, E7, E11, E13, E15, E16, E18, E23) (34,7%) selected six to 10 years of experience. The rest of the experts (E2, E6, E8, E10, E12, E14, E21) (30,4%) have worked less than six years on a large scale with less than a year (E8) being the lowest amount of experience (see Figure 4.3).

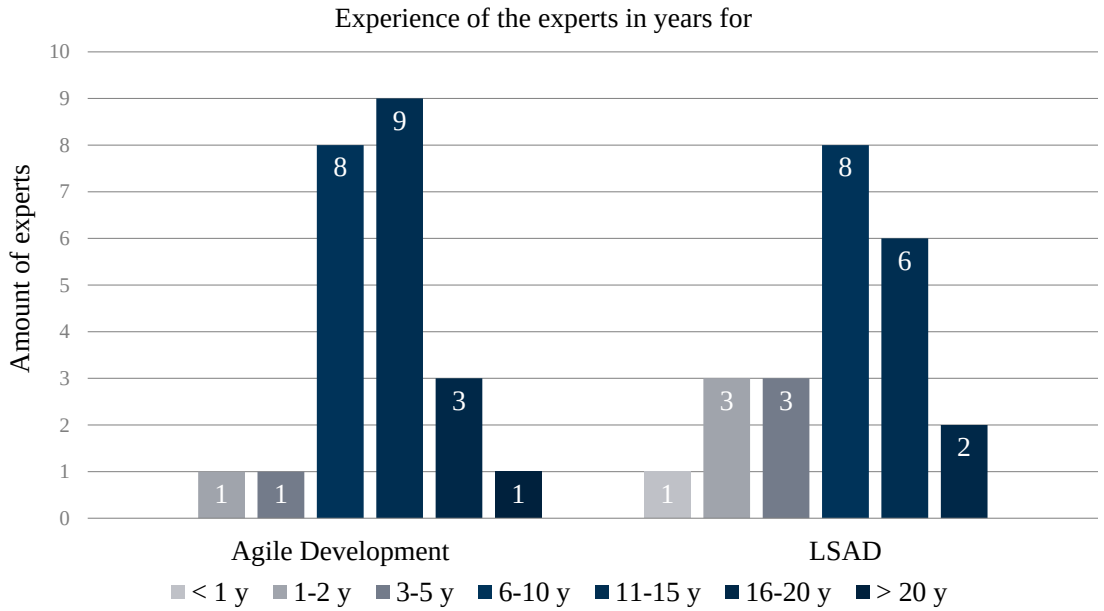

Figure 4.3.: Experience of the experts in years in (large-scale) agile development

Also relevant for this master thesis are the different roles of the experts in CoPs since different roles might cover other views or aspects. In addition, it might be useful to provide the possibility to check if particular statements or results from Chapter 5 are based on specific roles. In total, 16 participants (E1, E3, E4, E7, E8, E10-E12, E14-E18, E20, E21, E23) (69,6%) are Lead of at least one CoP. Nine experts (E2, E5, E6, E8-E10, E13, E15, E22) (39,1%) are participants in some CoPs, while three of them (E8, E10, E15) also leading a CoP. Other roles of the experts mentioned are Facilitator (E12, E13, E16, E19) (17,3%) and Moderator (E6, E15, E17) (13,0%). Figure 4.4 shows the roles' distribution. When all results and answers of the interviews are compared, it is possible to see that sometimes the role of CoP-Lead includes aspects of moderation or facilitation. Consequently, not all experts might have mentioned these roles when asked. More information on the roles can be found in Subsection 5.5.5.

4.4.3. Working environment

Next to their experience in (large-scale) agile software development, the experts were asked to describe their current working environment in their companies. Since each organization is different regarding its structure and the role of the interview experts

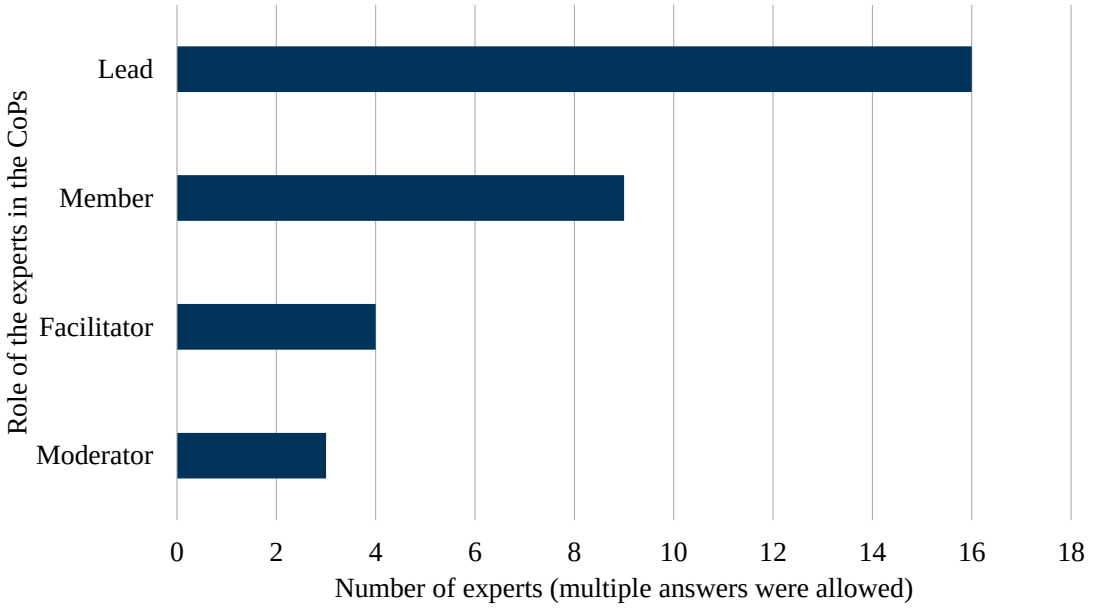

Figure 4.4.: Overview of the mentioned roles in CoPs by the experts

differs, the interviewees refer to either the team they are working in or the whole department (e.g., IT development). As a result, due to the high variations, the situation in each company is described individually, and differences in the working environment of the experts of the same company are presented in the following.

CarCo1

CarCo1 is an automotive company with headquarters located in Germany. The whole company operates worldwide and, therefore, has locations around the globe, for example, in the United States and China. The company's expert (E7) works in the IT-department of CarCo1. The distribution of the IT sector is also worldwide: The central part is in Bavaria, but there are also other German locations next to people working from the United Kingdom. Furthermore, the department is working (agile) with IT-Hubs in Portugal, South Africa, and India. Looking more closely at the working area of the team of E7, the working environment is enterprise IT (around 600 internal employees), which focuses on enterprise software for the company and not on the software in the fabricated cars. The team is responsible for logistics and shop-floor IT within this area. E7 is responsible for around 40 to 50 scrum masters (called agile masters in CarCo1).

CarCo2

E10 is part of a different German car manufacturing company (CarCo2). More in detail, E10 is part of the IT department related to enterprise IT, which consists of around 900 internal employees divided into about 120 to 140 different teams. It is mainly located in two locations in Germany but has worldwide connections, e.g., to the United States, Mexico, and Asia Pacific. Also, the main decisions are made in Germany. Another important remark is that CarCo2 primarily outsources the IT-department. As a result, many internal products are developed by external partners (more than 90% of product teams are sourced externally).

ConsultCo1

ConsultCo1 is an international consulting company. In total, three experts (E4, E11, E18) of this organization were interviewed, all currently working in the automotive area. For E4, the company is, from a secular point of view, basically an IT service provider for the current project. The interviewee is part of the development center, comprising over 6000 people in over 67 teams. It is located in several European places and India.

For E11, the environment looks different. The expert works in an area with around 450 employees divided into 35 teams, responsible for 40 applications in eight engagements. Each engagement is its own "organization" and has its own tasks, which could include refinement sessions. Furthermore, the employees are located in ten different countries.

E18 is also working on a project in the automotive area. Five different scrum teams and a set of cross-functional members are assigned to the project. Each team consists of around eight members, which leads to a total number of 60 people working for the automotive company. The expert is also responsible for ensuring that the development process runs agilely. In addition, knowledge exchange inside of ConsultCo1 over the project's borders exists, where multiple hundred people in the development area can participate. They are located mainly in Germany, Poland, other European countries, and India.

ConsultCo2

E6 is an independent consultant working in the automotive context (project) for over two years. This automotive context was used in the interview as a setting. The project consists of seven scrum teams with a total number of around 110 employees. In addition, there are also cross-functional roles, such as quality assurance or coordinator, which work with multiple scrum teams. A business division is involved, which has the

overall project lead and represents the customer, while the IT-department represents the technical and implementation view. A mixture of different frameworks (e.g., LeSS, Scrum@Scale) was chosen for the work. The location of the project members is Europe-wide, with several languages and time zones included.

ConsultCo3

The organization of E17 is a (small) consulting company that was acquired by ConsulCo3 in 2021. Counting all employees of the companies owned by the main one leads to several, around 770.000 people. The company of E17 itself consists of multiple hundred people. The team of experts is called "Transformation Engineers" (about 50 people), and they are consulting different clients, mainly in automotive manufacturing but also companies in rail, health or medical technology, and defense. The clients can be international, and the team is also distributed worldwide.

ConsultCo4

E19 is an independent consultant, which is why the experts provided information on projects/clients. Two areas are relevant for this thesis: one is in the insurance sector, and one is in workflow systems. The project in the insurance area consisted of around 2300 people in the development, responsible for developing a buffalo system. The distribution was worldwide (Europe, United States, Israel). The project in the workflow system was smaller than the insurance one and also just located in two German cities.

ConsultCo5

E20 is also an independent consultant but described the experience in a technology development company, which is relevant to this thesis. The size is more than 100 people divided into eight teams. The teams are responsible for the 4G development, which means the product is used for a higher network. The client's area was air and defense, and the company was located in Germany and Greece.

ElectRetailCo1

ElectRetailCo1 is an electronic retailer with its headquarters located in Bavaria. The company itself has stores in several countries and also an online one. Two experts (E13, E14) of ElectRetailCo1 were interviewed separately. The working environment of E13 is focused on tech management, shared services, and PO business. Over 1.000 employees work in this area in around 130 different teams. The distribution of the team

is worldwide but mainly located in Europe.

In the case of the other expert (E14), the sector is domain technology foundation analytic or infrastructure. This includes all topics about infrastructure and the workplace, mainly internal company applications. Around 800 employees (in about 100 teams) are working in this sector, next to around 5200 additional external ones. The main parts of the team are located in Ingolstadt and Munich, but many employees work from home since Covid-19, which automatically leads away from co-location.

FoodCo1

The working sector of FoodCo1 is trading since the company is one of the biggest food suppliers and trading companies in Europe; also, non-food strategic business units focusing on other trades exist. E15 is part of the IT-development of the company. Currently, about 2100 people with different roles, like test software developers, requirement engineers, or business analysts, are employed in this area. The number of products the department develops is between 150 to 200, representing the number of teams. The department is located Europe-wide: The main focus is in Germany (Cologne, Frankfurt, Kiel), but there are also locations in other cities like Sofia or Malaga.

InsuranceCo1

InsuranceCo1 is one of the biggest insurance companies worldwide, and three different experts (E2, E21, E23) were interviewed. E2 is working in one of the 30 companies of InsuranceCo1. There are about 20 to 24 different tribes that are working cross-functional over the companies. The development teams can also be cross-functional but are normally part of the "German technology company," which is the IT-service provider and contains two tribes. The size of the different tribes is very different and can range from two to 25 teams per tribe. The development part is co-located mainly in Germany, but a part of the "technology company" is also in India.

Another expert (E21) is part of the "German technology company". The interviewee added that InsuranceCo1 needs many insurance products internally, which are not on the market. As a result, the "technology company" is developing them by itself. The IT sector, which consists of around 2.300 employees in the "German technology company," is mainly working in Germany but also shares some products with other entities worldwide (e.g., other European countries or Australia). The average working size of a team is around ten people.

E23 is also part of the "German technology company". The expert states that around 3.000 people work in the IT sector and mentions the distribution into tribes, which have a size of 40 up to 120 people. The employees are located mainly in Germany, but also some developers are in India, Spain, and the Czech Republic. Regarding the working environment, in the company, around 80 % of the teams use agile frameworks while the rest still use the waterfall model. More in detail, the oldest tribe started to use LeSS, but newer tribes follow the Object-Role Modeling. In addition, the experts state that the company has developed its framework, called agile at scale. It includes, among others, aspects from LeSS and SAFe. However, E23 thinks that InsuranceCo1 is scaling down the effort of transformation at the moment since, in some areas (like enterprise architecture), the agile way did not generate the expected benefits.

MedicDeviCo1

MedicDeviCo1 is a global health and care player and builds medical devices like Computed Tomography (CT)- or Magnetic Resonance (MR)-scanners. E22 is part of the development organization in the company. On average, around 200 to 250 developers, divided into roughly 30 teams, work in Scrum teams on different projects. There are also additional roles next to the organization's developers, leading to about 1.000 to 1.200 employees. The project is mainly (80 to 90%) based on agile methodology. In addition, the company tries to avoid co-located teams since the employees come from different worldwide locations (mainly India, followed by Hungary, Slovakia, Germany, and the United States).

SoftwareCo1

SoftwareCo1 is a small software development company. They develop software as a service that supports sales teams of automotive suppliers (focus on first and second-tier suppliers). At the time of the interview, were 29 employees in the company. The expert (E1) describes the composition of the people as follows: DevOps engineers, back-end developers, and a front-end team. Since the company's size is relatively small, the Chief Technology Officer (CTO) is still part of the back-end team.

SoftwareCo2

SoftwareCo2 is one of the world's biggest software development organizations headquartered in Germany. In this thesis, six experts from the company were interviewed. In this case, three experts (E9, E12, E16) are working for software development in the commerce area, two (E5, E8) are part of manufacturing software, and one (E3) is

working in software delivery. Overall, the company has several thousands of developers.

One expert (E9) is working in German commerce development, where they are working on commerce applications. The department has over 400 employees divided into roughly 40 teams (normally Scrum teams of 10 people). The teams are self-contained and do not interact much with other company parts. In addition, about half of the employees are located in Munich, while the majority of others are in Canada. The other two experts (E12, E16) are located in Poland and the area of the commerce platform. In contrast to E9 and E16, E12 states that there are around 600 employees. This difference could be based on the count of managers and other persons with multiple topics or functions. The expert (E12) also adds that there are employees of the commerce section in China. E16 further described the commerce application in detail as business to business approach for different sectors and different large clients all around the globe.

E5 and E8 work in the manufacturing environment, mainly dealing with material requirement planning and production processes. The number of people varies over time, with around 80 being the least and 140 being the highest. The area is organized into seven scrum teams, two in Munich, two in Bangalore (India), and three in the German headquarters. Each team normally consists of twelve people. E8 added that almost all teams (in the company) work in Scrum mode, and several teams work together on one product. However, the teams are not working on the same backlog and do not use large-scale agile frameworks like SAFe.

E3 added that since he is responsible for software delivery, the global workforce in product engineering in technology innovations is the working area. Furthermore, around 95% of teams connected with E3 are development teams. Almost all of them are doing a form of Scrum, but they had the freedom to choose from several methods and frameworks. As a result, multiple forms, which are not often "Scrum by the books", are used in the development.

5. Results

This chapter aims to present the results of the conducted interview study, which are based on the coding and analysis of the interviews. In the first section (Section 5.1), general information on CoPs are mentioned. Afterward, the following sections deal with key findings, statements, and statistics related to the five research questions of this thesis: Section 5.2 deals with the different types of CoPs, Section 5.3 with the goals and reasons, Section 5.4 with the establishment process itself, Section 5.5 with the knowledge sharing and governance, and Section 5.6 with future research relevant for the industry. The chapter closes with further relevant information, mentioned by the interviewees, on the topic of CoPs in LSAD (Section 5.7).

5.1. General information on CoPs

This section aims to shortly present general information on CoPs mentioned by the experts, which are not targeting the research question but still were considered relevant since they try to clarify the context of CoPs. While Subsection 5.1.1 deals with the definition of a CoP, Subsection 5.1.2 provides different names used by the interviewees.

5.1.1. Definitions by experts

Starting with the definition of a CoP, many experts are aware of and using the definition presented by Wenger et al. [32]. For example, E20 stated that "communities of practice [are] people sharing a passion" (E20). In addition, the book "Cultivating Communities of Practice: A Guide to Managing Knowledge" from Wenger et al. [117] is used by one expert (E7) since it contains relevant ideas on (the establishment of) CoPs. However, there were also own definitions of CoPs by the experts. For E7, CoPs are "horizontal organization which dives through different departments and different general departments" (E7) and deal with knowledge sharing. Another interviewee (E17) goes even more in detail: a CoP is a (virtual) place "where people with the same interest and knowledge come together, and it is the important thing, the knowledge" (E17). Furthermore, the experts add that people's knowledge levels may vary, but they all work on the same problem or challenge. In the CoP, the people then discuss these challenges and possible solutions based on their experience with them. Furthermore,

these discussions and knowledge exchange should aim at the development of training or product which can improve the situation and help in the future to address, solve and prevent these challenges (E17).

5.1.2. Other names for CoPs

Before looking at the results regarding the research questions, an important remark is the use of different names for CoPs by the experts. While some experts (E1, E7, E10) use the term "community," others use "round-table" to describe (a part of) CoPs (E3, E8, E23). Also, the "community of excellence" (E7) or "community of learning" (E17) was mentioned by the experts. Furthermore, the most commonly used terms by the interviewees, next to CoP, are "guild" (E2, E11, E15, E17-E19, E21, E23) and "circle" (E2, E8, E17, E23). However, the meaning of both terms differs a bit from expert to expert. While E17 uses "circle" for the CoPs itself, for E2 and E23, it is a small working group inside of a CoP or guild. E23 added that the circles are mainly driven by one topic or domain in the context of a larger area or CoP. Regarding guilds, the span is even broader. Again, some experts use the term instead of CoP (E11, E17), and in the organization of E18, CoPs "split into different kind of subdivisions, which are called guilds" (E18). In the case of E15, all topic-based CoPs are called guilds. In contrast, the other interviewees (E2, E19, E21, E23) all divided groups of knowledge exchange based on the governance aspect: a voluntary exchange is called CoP, while a mandatory aspect leads to the term "guild". In this case, an important remark is that E2, E21, and E23 are all employees of the same company (InsuranceCo1). Moreover, E19 is not completely clear if guilds can be considered in the context of CoP since they are not voluntary.

In the following chapters, this master thesis uses the term CoP for all mentioned aspects by the experts, no matter which names the interviewee used. However, if a mandatory part is involved, this will be mentioned to provide the possibility of separating these results. More on the governance of CoPs in the organizations can be found in Section 5.5.

5.2. Types of CoPs

This section presents the different CoPs that the experts mentioned during the interview. Firstly, an overview of the different types will be provided (Subsection 5.2.1). Secondly, the role-based CoPs will be described in more detail (Subsection 5.2.2), and lastly, the topic-based ones are presented (Subsection 5.2.3).

5.2.1. Overview of the different types

During the interviews, it became clear that differentiation on the types of CoPs should be done between topic- and roll-based once. The reason for that were the different target groups of the CoPs. For some CoPs, the target group are specific roles such as SM as stated by E3 & E20, or (lead) architects (E23). In other cases, everyone interested in the CoP could join the meeting. For example, E18 states that there are no barriers to joining a CoP. In addition, more and more different roles joined the different CoPs, e.g., the one for a software solution by a specific company (E5) or the agile community (E20). Furthermore, E20 mentioned that the various mix of roles (manager, developer, SM, and PO) in the agile community is aimed and healthy for the CoP. Therefore, it makes sense to differentiate between role-based and topic-based CoPs.

In total, most interviewees were aware of both types of CoPs existing in their company (E2-E4, E6, E9, E12-E15, E18, E20-E23) (60,9%). While two experts (E7, E16) (8,7%) just know or are part of roll-based ones, seven others (E1, E5, E8, E10, E11, E17, E19) (30,4%) mentioned just topic-based CoPs. Figure 5.1 shows an overview of the different types of CoPs mentioned by the experts. Interesting to see is the fact that people from the same company answered differently. For example SoftwareCo2, E5, and E8 mentioned just topic-based once, while others (E3, E9, E12) described both types or just role-based CoPs (E16). This could be the case since the experts worked in different areas or locations (e.g., E5, E8 manufacturing) and did not know other (local) ones. The same thing occurs for ConsultCo1 (E4, E11, E18). A more detailed view (including the names/topics) of all CoPs identified by the interview study can be found in Table A.4.

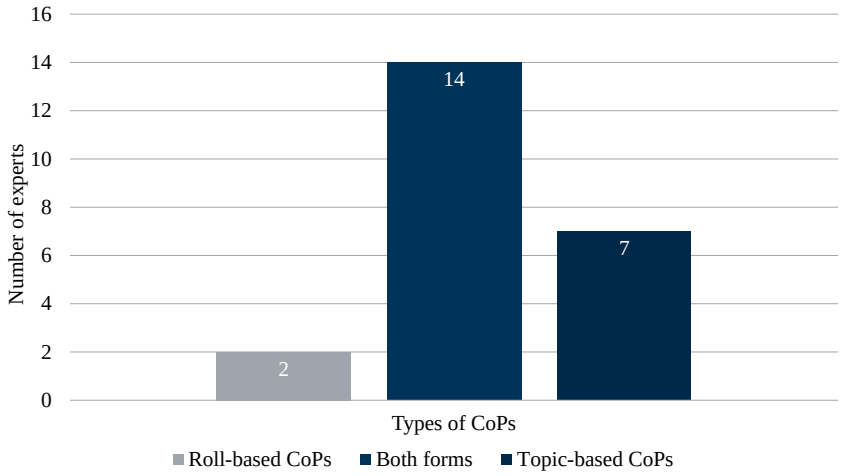

Figure 5.1.: Different types of CoPs

5.2.2. Role-based CoPs

Starting with the role-based CoPs, the experts mentioned a total of 43 ones. In addition, two experts (E3, E21) said there are further role-based CoPs in their company, but they did not mention a specific role for them. The most common role-based CoPs, based on the interviewees, are for SM (E3, E6, E12, E15, E16, E18, E20, E22) (34,8%) or for PO (E2, E4, E9, E15, E16, E20, E22, E23) (34,8%). In both cases, eight experts mentioned them. As E15 states, these are the main agile roles, which might be the reason for their high appearance. The next frequent one is a CoP for architects with four occurrences (E4, E7, E13, E23) (17,4%). In addition, four other role-based CoPs were mentioned multiple times: Manager (E7, E20, E23) (13,0%), Testing (E6, E7, E22) (13,0%), Agile Master/Coaches (E2, E7, E14) (13,0%), and Engineers (E13, E15) (8,7%). Furthermore, ten CoPs, such as one for User Experience (UX) & User Interface (UI) (E23) (4,3%) or Quality (E9) (4,3%), were mentioned once. Figure 5.2 provides and overview of all identified role-based CoPs.

A relevant remark needs to be made for the role-base CoPs mentioned by E23 (UX&UI, Security, Architecture, and Software excellence). They are all mandatory for specific roles, and theoretically, every other person is free to join the community. However, the target group is still the specific role of the CoP.

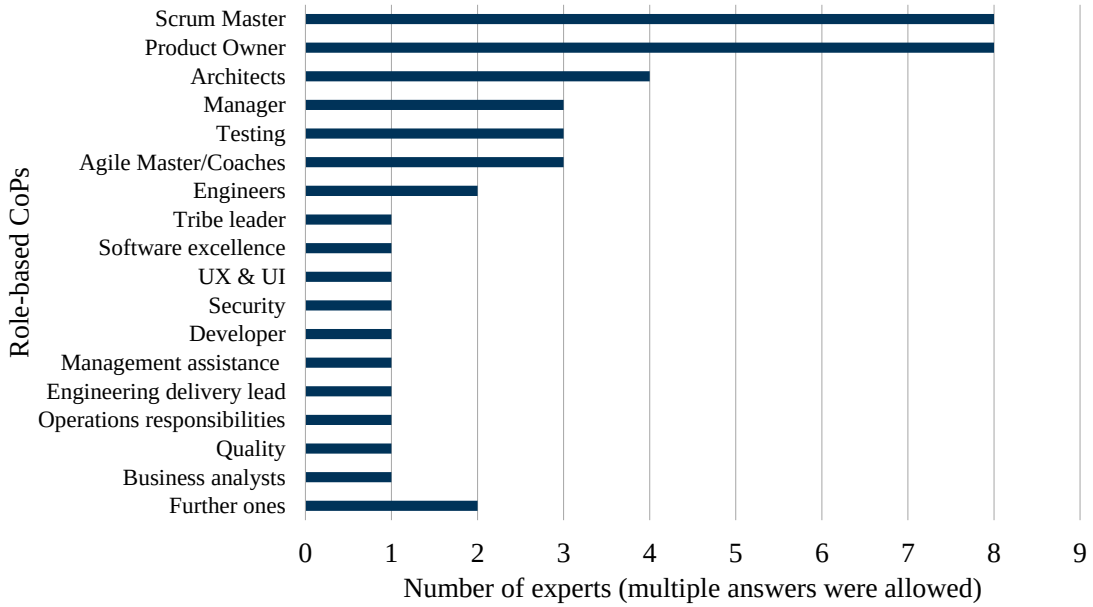

Figure 5.2.: Overview of the role-based CoPs

5.2.3. Topic-based CoPs

Coming to the topic-based CoPs, overall, 48 specific ones were mentioned, next to five further ones, where the experts (E3, E8, E14, E18, E21) gave the information that other or additionally topic-based CoPs exist. The total number is barely higher than the roll-based one: 52,7% of all mentioned CoPs are topic-based (excluding the further ones for both types). Furthermore, the variation of mentioned topic-based CoPs is higher since, for different companies, other topics might be interesting or useful. The most commonly mentioned CoP was about agility, mentioned by seven experts (E4, E10-E12, E17, E18, E20) (30,4%). It is followed by Architecture (E9, E10, E15, E22) (17,4%) with four occurrences and UX (E2, E4, E11) (13,0%), Security (E2, E6, E20) (13,0%), and Cloud (E6, E10, E17) (13,0%) each with three ones. Other topics identified multiple times CoPs for software solutions of a specific company (E5, E10) (8,7%) and Operations (E4, E11) (8,7%). In addition, 24 different CoPs were mentioned by the experts once. Examples are technology trends like Artificial Intelligence (AI) (E17) or meta-verse (E17), but also other areas like business (E11), consultancy (E19) or accounting (E18). Furthermore, E13 mentioned that there are chats based on different topics like architecture, and E19 described a company overarching CoP with multiple large Germany, Austria, Switzerland (DACH)-companies. A summary of all mentioned topic-based CoPs can be seen in Figure 5.3.

Regarding the target group, the topic-based CoPs are open for anyone interested or multiple roles. For example, on the one side, a CoP, mentioned by E8, is addressed for SM, PO, and managers, and also the DevOps one is for multiple roles (E20). On the other side, the Cloud CoP is open "for anyone developing in the Cloud. So it is quite broad" (E23). Also, the one mentioned by E5 consists of people from different cross-functional areas like finance, sales, or manufacturing.

5.3. Goals and reasons of CoPs

This section deals with why CoPs are established in the industry. At first, goals and reasons for the establishment of the different CoPs, mentioned by the experts, are presented (Subsection 5.3.1). Afterward, the achievement of the goals is studied and presented (Subsection 5.3.2). The motivation for employees to join and participate in a CoP is described based on findings of the interviews (Subsection 5.3.3).

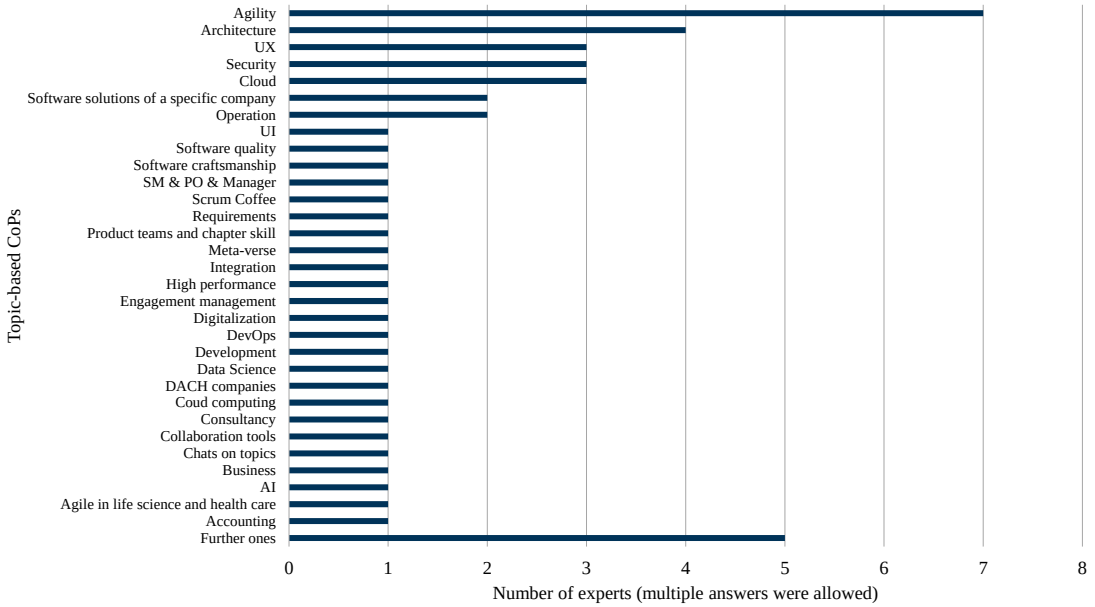

Figure 5.3.: Overview of the topic-based CoPs

5.3.1. Goals and reasons for the establishment

During the interview study, the experts were asked to describe the reasons and goals for establishing the CoPs that they are aware of. The statements were then grouped into knowledge exchange, networking, support for joint work, alignment, drive topics, and others. More details on each area of goals are presented later in this subsection. Overall, 19 out of 23 experts (E1-E6, E8, E10-E12, E14-E18, E20-E23) (82,6%) directly mentioned the exchange of knowledge as one goal for the CoP. The second common reason, stated by fifteen experts (E1-E3, E6, E7, E10, E11, E13-E18, E21, E22) (65,2%), was the alignment of people or teams. It is followed by the support of joint working with eleven occurrences (E1, E2, E4, E5, E7, E8, E10, E11, E18, E19, E21) (47,8%) and networking with nine ones (E2, E4, E5, E7, E11, E13, E14, E16, E18) (39,1%). In addition, the drive of specific topics was stated by seven experts (E7, E9, E13, E15, E16, E22, E23) (30,4%). Further goals mentioned are the empowerment of people/teams (E2, E15, E17, E19, E23) (21,7%) and the support of the agile transformation of the organization (E2, E3, E8) (13,0%). With less than three occurrences, other goals or reasons were grouped under others (E1, E6, E11, E16-E18, E23) (30,4%). An overview of the types of goals mentioned by the experts can be seen in Figure 5.4.

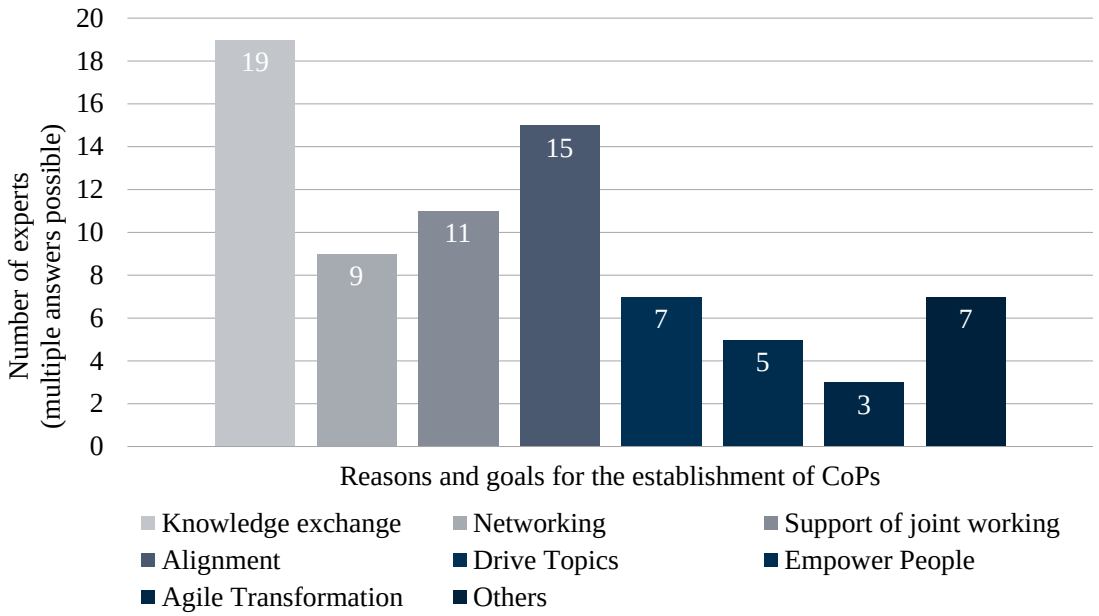

Figure 5.4.: Goals and reasons for the establishment of CoPs

Knowledge exchange

The most common reason is the need for a knowledge exchange since it is part of the definition of a CoP, where experts share knowledge (E4, E14, E21). In addition, there was the need for a specific place to discuss specific topics, which a CoP offers (E15, E17). Furthermore, according to the experts, the goal of the CoPs was to enable "collective improvement and collective sharing" (E20) and "continuous development" (E23) through the exchange of experience. Also, knowledge sharing should break "silos of knowledge" (E6), e.g., in the area of Commerce (E12), since a CoP is a cross-organizational place. However, what knowledge is sought differs among the experts and communities, based on the type of the CoP. The needed area of knowledge variates for topic-related ones and is based on a specific topic or domain (E10). While E8 mentioned the need for Scrum during the transformation to agility from the waterfall model, E1 states that data science and machine learning knowledge should be exchanged. Other topics identified during the interview study are technology stack (E11) or a cross-team experience sharing on developed applications (E5). For role-related CoPs, the topics discussed are mainly related to the role itself, e.g., SM (E3). Also, experience from previous organizations in the role can be shared (E16). In general, the experience of conferences (E20), challenges based on the same technology or product (E18), and best practices

are also relevant topics of knowledge exchange in CoPs (E2, E21, E22). Furthermore, exchanging nonprofessional topics is part of some CoPs (E2).

On top, the knowledge exchange in CoPs should help (young) people who are coming from the university or are new in the job/role to get information quickly (E2, E8) and, in general, to enable real experience (E1), a development (E11) and "upskilling" (E23) of the employees.

Networking

Another goal for the establishment of CoPs identified in the interview study is networking (E7, E11, E13, E14, E18). For E2, this networking is even one of the most important goals of a CoP. For example, in the case of role-based CoPs, it is possible to get to know and connect to other SM in the organization (E16), which the experts otherwise would not have met. This aspect is also supported by E4, who states that it is "not always easy to know what anybody else has been developing" (E4) due to the organization's size. A CoP can therefore be a place to connect to experts from different areas, get to know what they are doing, and learn from them (E5).

Support of joint working

Supporting the joint working of employees is a further reason for the establishment of CoPs since there might be "a knowledge gap between different cross-functional areas" (E5) which can be solved through co-working. CoPs offer the possibility of creating synergies and a faster learning process (E11). In addition, it can improve the self-service of the teams and the joint work (E19). This aspect is supported through the transparency which a CoP offers to find the right people if a problem occurs (E2). Staying at problems, knowledge exchange can prevent duplicates since often different teams in a company use similar tools and settings (E4, E11) and lead to possible solutions (E18) (e.g., through coding together (E1)). This creation of best practices can support co-working (E2, E5, E21), and assets can be commonly used for similar problems (E4). Next to work itself, a CoP is also a place for training, helping each other (E7, E8), and trying something out together (E10). This also supports the joint working and atmosphere of a team. One expert even stated that CoPs are "not only [for] exchanging ideas but [for] really getting support from others and working on topics together" (E18).

Alignment

Another goal for the establishment of CoPs mentioned by the experts is alignment (E13, E18), which is sometimes closely related to the support of the co-working. This could be role-specific, for example, the alignment of the SM-role in the company (E3). E21 added that in today's fast-changing environment, people need to synchronize with others from their roles since fighting alone does not work anymore. However, in general, a CoP can also coordinate the teams and bring them together since they are often located in multiple locations (E6, E10, E15). E2 and E7 also mentioned this horizontal synchronization for coordinating tribes. In addition, this exchange can enable a broad overview of what the company is doing (E11, E14) and therefore bring the employees to the same page (E16). This is especially relevant for consultancies since an alignment through CoPs allows the project to have a standard view and create one picture for the customer (E6, E11, E17). Another aspect mentioned by the experts was an alignment on new methodology through CoPs, for example, "to get the people in the mode of the agile software development" (E22).

Drive topics

A further reason for establishing CoPs is to drive specific topics throughout the company (E13). With this, the organization recognizes the importance of a specific topic that a particular area of experts could address. Then the management will drive this topic in the related CoP to start a discussion on it (E15). As a result, this process is sometimes done as an order to the communities by management (E7). This spread of information is often the case for topic-based communities (E9). For example, a chat on different topics, like engineering, was created (E13), or the CoP is used to share new approaches in terms of how to develop new products (E16). In addition, in a mandatory one, new guidelines for the employees are shared (E23). However, the spread of information can also be on specific roles, e.g., in agile development (E22). For example, if organizations want to drive agility-related topics, they can use an agile master community (E7).

Empower people and teams

CoPs should strengthen the people (E23) and the teams (E2) by getting them more ownership and autonomy (E19). Furthermore, the teams should become more self-reliant (E15) and self-organized to counteract frequent management changes (E17).

Support of the agile transformation

Furthermore, CoPs were created to support the agile transformation in the organizations since the teams needed knowledge (E2). This is the case since before using Scrum or Lean, the teams used other methods, such as the waterfall model, and did not know anything about agility (E3, E8).

Other goals

Next to the already described goals for the establishment of CoPs, there are also some fuhrer ones mentioned by some experts. Firstly, one expert (E23) mentioned the governance of a specific topic as the goal of a CoP (in this case, a mandatory one). Secondly, another reason for the establishment is the creation of different things. The experts mentioned that CoPs should develop products for their working area (E6), new approaches for specific topics (E11), and getting innovation to have a competitive advantage (E17). Thirdly, another reason for the establishment of CoPs was the enhancement of the product for the customer by improving the quality, e.g., clean code (E1), integrating specific topics in it (such as AI (E1)) or for marketing reasons (E18). Further goals mentioned by the experts are the possibility to invite special quests, ask questions, and share ideas with them (E16), and to give people a "home" because since Corona open discussions and talks in the office disappeared (E23).

5.3.2. Achievement of the goals

After the experts described the goals and reasons for establishing CoPs, they were asked if they thought the goals were already achieved. Eleven experts mentioned CoPs, where a goal is already fulfilled. Regarding the knowledge sharing, the goal is reached for three interviewees (E3, E4, E19) since the CoP existed for a long time frame with continuous participation (since 2009/2010 (E3), more than six years (E19). Another expert (E22) also agrees since the CoP is "really living that idea [of] exchanging know-how [and] discussing things" (E22). In supporting the joint work, E1 states that based on feedback, the teamwork improved, and therefore, the goal was achieved. In addition, E10 mentioned that the team is more resilient to management and strategy changes through the CoP. Regarding the drive of specific topics, the goal is fulfilled for E9 but can always be better. For other interviewees, the goal is also reached since the value and benefits of CoPs are seen and recognized by employees (E2, E10, E11, E13, E14).

However, most of the experts (E1, E2, E4-E8, E12, E13, E15-E18, E20, E21, E23) stated that at least one of the goal is an ongoing process. For example, E21 states that they are

in a good way due to the improvement in the team's self-organization, but the goals still need to be reached. Especially in knowledge exchange, there is always more to learn, and the members can develop further (E1, E4, E5, E13). In addition, people "have to learn every time [they]'re doing something new" (E8), which is the reason why the goal of knowledge exchange is hard to achieve finally. Regarding networking, E5 states it is either a hit or a miss, depending on the people. In other cases, due to company changes (E16), new driving topics as goals (E6), or changes in the scale of the CoP (E23), it will take some time to achieve the goals. For E7, a goal of a CoP is always ongoing since if it is fulfilled, the CoP would be closed. E18 agrees with this statement: "I think [...] we always need goals, and we always need to readjust these goals. And I would also see most of these goals maybe more as a stretch goal. I am not sure if the goals are set in a way that we really achieve them and say, Hey, we can call it the day that's done" (E18).

In three cases, experts mentioned that the goal is not fulfilled. The reason for the data science community of E1 is the short time since its creation, which was just two weeks at the time of the interview. In the case of E15, the drive of specific topics and information to the members is not achieved since it is always unknown who will join the CoP and who not. Lastly, a lack of discussion is why the goal of the test and architecture CoP is not fulfilled.

5.3.3. Motivation of people to join CoPs

After describing the goals and reasons for the establishment of CoPs, it is useful to look at why the people join the meetings (if they are not mandatory). E20 refers to the definition of CoPs and states that passion, curiosity, and learning motivate people. E12 added interest in knowledge sharing. Another point is personal development. Through taking part in CoPs, the people get new insights, can have fun with like-minded people, and be more self-organized (E19). Moreover, a crucial motivation point are the benefits and value a CoP offers (E2, E4). This can include getting feedback (E2, E3) or possible solutions for challenges (E6). More in detail, also one expert states: "That [people] take value out of the meeting. And that they have the feeling when leaving the meeting that they learned something, or at least that they had fun talking to some other people" (E11). E21 also mentioned that at first, the mandatory character of a CoP was the main motivation, but now the people join based on the benefits they get. In addition, if the CoPs are also making decisions, being part of them (E2, E19), to work on topics that matter (E18), and to shape small parts of the future of the company are a motivation for employees (E22). Other factors are also getting heard, increasing visibility (E2, E18), and getting recognition by others (E18), which can also lead to a potential faster

promotion in some cases (E4, E13). Furthermore, for new employees, CoPs can offer a safe place to connect to others and to learn faster at the start (E14). Also mentioned as motivation was free beverages during on-site meetings (E1).

For mandatory ones, the motivations are mainly to receive information (E9, E22), to stay up to date (E5), or to work on topics together that need to be done (E17).

5.4. Establishment of CoPs

In this section, relevant information provided by the experts on the establishment of CoPs in LSAD is presented. First, the situations when CoPs were established are described (Subsection 5.4.1). Second, the used approach (top-down or bottom-up) is presented (Subsection 5.4.2). The third subsection (Subsection 5.4.3) then describes more in detail how they are established and who was involved in the establishment process. In the following, the funding and management support of CoPs (Subsection 5.4.4) and the communication/documentation of the establishment (Subsection 5.4.5) are mentioned. The section concludes with the topic of further planned creations of CoPs in LSAD in the companies of the interviewed experts (Subsection 5.4.6).

5.4.1. When are CoPs established?

As already stated in Subsection 5.3.2, the goal of some CoPs was to support the agile transformation (E2, E3, E8). This is also when many of the CoPs were established. For example, in InsuranceCo1, the management decided to become agile at scale in general, which led to the establishment of CoPs (E2). In addition, E21 added that the employees did not know how to work agile, so the management was asked to create CoPs in the agile context. The same situation occurred in SoftwareCo2, during the introduction of Lean (E3) and through the need for knowledge at the transformation to Scrum (E8), and also in ElectRetailCo1 (E13). The agile transformation also led to identifying crucial topics in MedicDeviCo1, again resulting in the creation of CoPs on this aspect (E22). In the case of ConsultCo3, the company identified that they are consulting in the area of agile development but are not agile themselves. As a result, they started to build CoPs to transform (E17). Another expert (E7) also added that the CoPs emerged during different organizational transformations (not just the agile one) since "they all have kind of a clear position within the official organization of the company" (E7).

There are also a few other goals, next to the (agile) transformation, mentioned in the interview. Two experts (E8, E10) stated that there was a need for knowledge identified on specific topics, and the people saw a need to exchange knowledge, which led to

the establishment of CoPs. In addition, E16 mentioned that the topic of CoP emerged during a discussion with the manager on the job role. A particular case is the DACH-CoP since it includes multiple companies. In this situation, the organizations saw a need for a trusted space between large companies since they face similar problems, which are different ones than for smaller companies. In addition, conferences or similar activities could not fulfill the need for knowledge, but CoPs offered a solution (E19).

5.4.2. Approach

Regarding the approach, two different primary forms exist: Top-down means that the management decided to create CoPs on specific topics or for specific roles. In contrast, the employees made the bottom-up approach, which saw, for example, the need for knowledge exchange in an area. While Figure 5.5 provides an overview of the different approaches of CoPs known by the experts, more details on the establishment process itself can be found in Subsection 5.4.3. Overall, the majority of experts (E1-E3, E5, E7, E8, E13, E15, E17, E18, E20, E23) (52,2%) were aware of CoPs which were created either bottom-up or top-down, so both forms exist in their companies. Seven interviewees (E4, E6, E11, E12, E16, E21, E22) (30, 4%) stated they know just top-down established ones. Often, these ones have a mandatory part in it (E21, E23). In contrast, four experts (E9, E10, E14, E19) (17,4%) mentioned just bottom-up created ones (see Figure 5.5).

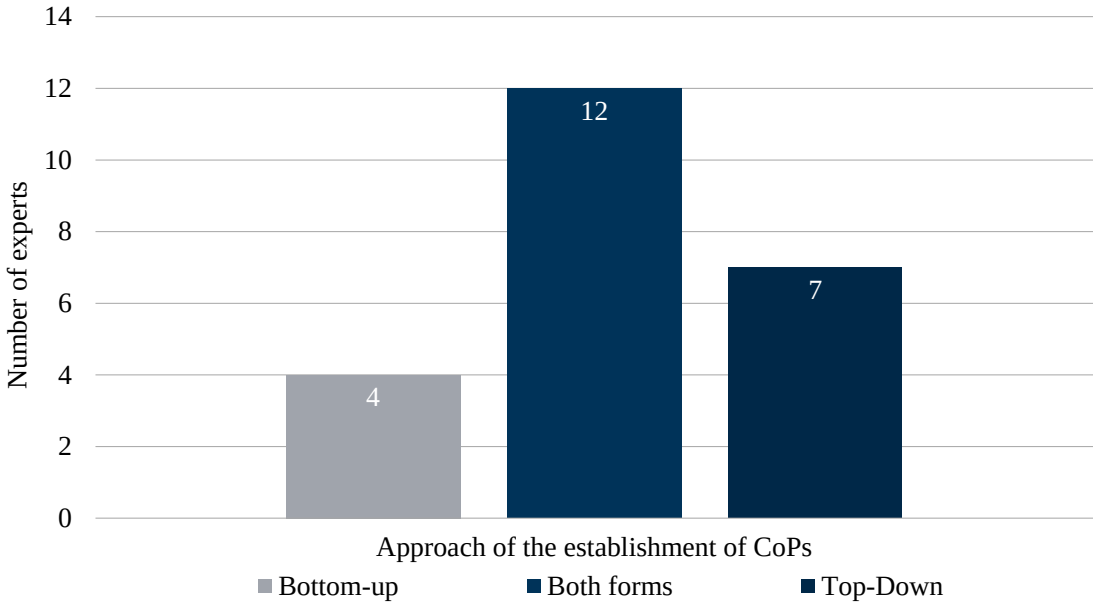

Figure 5.5.: Approach of CoPs known by the experts

5.4.3. How are they established, and who was involved?

Top-down approaches

In all top-down approaches, the (high) management started the establishment of CoPs since they identified a need for knowledge (E1), wanted to become agile (E2, E7, E8), or saw similar problems across the whole organization (E4). On top, E6 states, "The initiative came from the term and the concept being described in scaling frameworks" (E6). The approach, however, differs in some cases. One manager established the CoPs by creating an informal atmosphere with drinks in free time after work and started to watch (learning) videos next to it (E1). In other cases, the agile masters/coaches supported the managers in the creation (E2, E6, E7, E13) or even a core team was created, which was responsible for the establishment and the support of CoPs (E2, E22). In the case of E7, the agile coaches supported the management and developed a concept over time. In another company, the managers were supported by the later CoP-leads to being closer related to the topic. Furthermore, E11 states that top-down approaches must come with a problem to be successful and accepted by the employees. A CoP-lead was also created by management in another organization to drive their establishment. In this case, the role owners should spend 50% of their working time on establishing and supporting the CoP.

Bottom-up approaches

Regarding the bottom-up approach, all procedures are mainly the same. The people start talking to each other (in small groups) in the office during coffee breaks (E1). Through the same mindset (E10), an identified need for knowledge exchange (E7, E9, E20), and a common topic, this discussion grows over time and leads to the establishment of a CoP (E10, E15). More in detail, one expert mentioned, that: "It is [...] the usual things. So you have often the same ideas at the [...] same time and you have [already] meetings also. I think the need was supposed to be the ignition of all the stuff" (E8). In another case, a SM established a CoP at the beginning for just four others, but then it grew over time (E14). Furthermore, in some cases, the project management was involved in a later stage to support the creation further (E9). Also, management needs to be addressed to make the CoP "official." However, "it is better to ask for forgiveness than for permission" (E20), which implies that the employees should first start with the knowledge exchange, and then later inform the management that they spent time in CoPs (E20). More in general, most of the time, every employee can create a CoP. Nevertheless, a strategy and pitch are needed in the case of E17. Furthermore, a formula, which includes the nomination of a CoP-Lead, is required to be filled out in order to have permission to establish a new CoP (E15).

Summary of the involved persons

In the case of bottom-up created CoPs, no specific persons or roles were involved in the establishment process. The employees just started with a knowledge exchange, and then it grew. However, in two cases (E10, E20), the management was asked to make the bottom-up created ones "official." Regarding top-down established CoPs, multiple roles could be identified. Clear is the involvement of the manager (E1, E2, E4, E7, E11, E12, E15, E17, E18, E20-E23) since they want or came up with the idea of CoPs. In addition, they are also often responsible for the funding (E2). Even the chief information security officer was involved in one case (E21). Other roles involved in the establishment process are stakeholders (e.g., PO) (E5), project management (E6, E9), and SM (E16). On top, the role of a CoP-lead in the creation was mentioned four times (E2, E11, E12, E15). Furthermore, in some cases, the agile masters/coaches (E2, E6, E7, E13) or a special team created for this purpose (E2, E22) support the managers in the establishment of the CoPs.

5.4.4. Funding and support from management

Some experts also mentioned information regarding the funding of CoPs, related to money or the time employees need to participate in a CoP. Starting with the time, nine experts (E1, E3, E8-E11, E13, E15, E18) (39,1%) provided information in the interviews. In some cases, the managers allow the employees to spend time for knowledge exchange (E1, E13, E15), while in other cases taking part in a CoP is seen as part of the daily job (E8, E9). Also, the manager accepts the spending of time leading a CoP (E3). In addition, E18 mentioned that people could spend time since this was agreed on at the start of the project. E1, E3, and E11 also stated the booking and allocating time on projects. However, in the case of E10, just in special cases, like the agile global community, an official investment of time is possible. It is important to say that allocating time also involves money.

Closely related to the time is the management support since employees need the time (and money) to participate in CoPs if they are during working hours. Two experts (E10, E21) stated that the managers are seeing and accepting the need for CoPs and also understand the benefits from them (E10). E19 added that it is a major achievement if management starts to accept and support the knowledge exchange. In some other cases, the management even wants people to join CoPs (E5) and promote and support them in the whole company (E12); in contrast, in other cases, they needed to be convinced at first that CoPs offer benefits (E18) or they still dislike them (E1).

Coming back at the topic of money, next to the already mentioned booking of time, eight experts (E2-E4, E10, E15, E17, E18, E23) (34,8%) provided insight on a budget of CoPs. In two cases, the top management is responsible for how much budget a CoP gets (E2, E17). In the case of E4, the knowledge exchange is funded through the projects, and everybody can freely decide how much they want to spend on it. On top, the expert mentioned that it is hard to fund CoPs company-wide since this would not be billable (E4). E18 agrees that most budget is coming out of the projects. However, some general funding exists for significant events where people come together (E18). Also, in the case of E10, there is funding for significant events, e.g., catering (also mentioned by E15) and inviting external speakers (E10). Next to the CoPs itself, people related to it are sometimes funded. E2 mentioned the funding of an agile master, who should support the architects in creating a CoP (E2). In addition, people who lead a CoP are partly paid (E10). As a remark, in some companies, dedicated positions for the role of a CoP lead exist (e.g., E21), which are also part of the funding. Another aspect mentioned for a mandatory CoP is that "every tribe is mandated to have at least one resource with 50% of the time dedicated as lead architect to participate and drive this topic" (E23).

In contrast, three experts (E7, E8, E16) (13,0%) directly mentioned that there is no funding in any form from the company.

5.4.5. Communication and documentation of establishment

Formal communication

The experts mentioned many aspects related to a formal communication of the establishment of CoPs. Examples are the invitation to architects who are supporting agile teams (E2), a small invitation at the start (E7, E17), an invitation via scrum-of-scrums meeting (E9), a calendar invite (E6), or an official invitation for product specific CoPs (E10). In addition, also an internal social media platform (E10) was used for sharing the establishment of a CoP, next to the communication via the agile playbook, which was shared with the whole organization (E21). More in detail, often an e-mail is distributed with relevant information on the CoPs (E3, E9, E19, E20). The receiver could be the whole organization, new employees (E8), or potentially interested people (E16). However, in some cases, this distribution list is not working well (E9). Furthermore, they are often used for top-down created CoPs. Next to the e-mail, the establishment can also be shared via newsletters (E11, E18), regular or kick-off meetings (E11, E16, E23), or through other, already existing, CoPs (E10). Also, people responsible for or supporting their creation, like agile coaches, can share the information (E13). Furthermore, in the case of FoodCo1, a form needs to be filled during the establishment process of a

CoP, which is then published. As a result, every employee can always check which forms/CoPs exist and can freely join them (E15).

Other communication

Next to formal communication, there are also other ways of sharing the establishment of CoPs. Firstly, managers can popularize them in their team (E12) or even nominate people for them in some cases (which might then be partly mandatory) (E5). Secondly, mouth-to-mouth communication is also commonly used, e.g., in the case of the agile masters CoP of E7. This method can be done everywhere, from in the canteen (E20) to slack channels to gain higher participation in the CoPs (E16). E20 even states that people should "unofficially use all possible methods to bring people in" (E20). In addition, mouth-to-mouth communication can be even more efficient than formal ones (E18). Since every employee can do this process, it is often used for bottom-up created CoPs. Thirdly, people newly joining the company can also hear from the knowledge exchange through existing members (E3) or get invited by SM or managers (E8). On top, in ElectRetailCo1, new joiners are invited to the CoPs through onboarding tasks (E13, E14). Fourthly, there might not be a public announcement of a new CoP (E1) or just at the start (E16), but people accidentally see the meeting and decide to join (E1).

5.4.6. Further establishment

The experts were also asked if they knew of any other planned CoPs in their company. Six experts (E1-E3, E16, E19, E20) (26,1%) answered yes. While E19 and E20 did not mention any specific ones, the other interviewees also mentioned the area of the further CoPs. SoftwareCo1 planned to build one on the topic of security since the importance of the topic is not recognized by all employees (E1). In the case of InsuranceCo1, a CoP on the topic of insurance (change management) is planned (E2). In SoftwareCo2, two experts are aware of further CoPs both in the IT-space of the company (E3, E16). The majority of the experts (E4, E5, E8-E10, E12-E14, E17, E18, E21-E23) (56,5%) stated that there are no specific plans to establish further CoPs at the moment, but they think, that there will be new ones in the future since it is a continuous process (E4). In addition, the experts also mentioned that a new crucial topic (E4, E8, E9, E12, E13, E17, E21-E23) or the identification of the need for knowledge in an area might be reasons for additional CoPs next to the success of already existing ones (E13). In addition, the need of a client can also lead to new CoPs (E18), next to organizational changes in the company (E5). Furthermore, two experts (E10, E14) mentioned that CoPs, which were closed in the past due to different reasons, might be started again since the topic is again identified as relevant or the right people, who can keep the CoP alive, are there. On the other

side, just three experts (E6, E7, E11) (13,0%) are unaware of any further ones in their company. While E6 and E7 say that the current variate of CoPs covers all needs, E11 goes even further. The interviewee states, "If you have too many CoPs, they lose their value" (E11). This question was not covered in one interview due to time reasons (E15). Figure 5.6 provides an overview of the answers to the planned establishment of further CoPs.

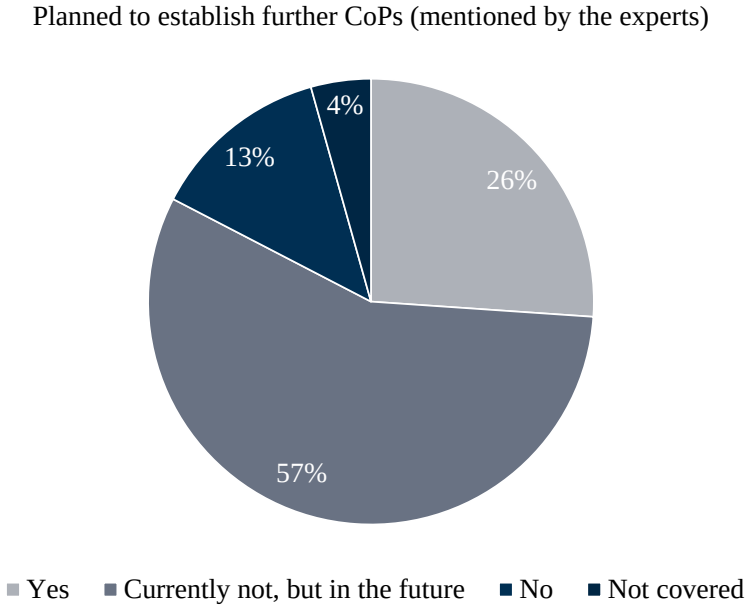

Figure 5.6.: Overview on the planned establishment of further CoPs

5.5. Knowledge sharing and governance of CoPs

After describing the establishment process, the experts were asked to provide information on the knowledge sharing and governance of CoPs, presented in this section. The first part deals with the knowledge exchange. In the beginning, the place and time of the CoPs are presented (Subsection 5.5.1). Afterward, Subsection 5.5.2 describes the different forms of it, while Subsection 5.5.3 mentions the different tools used for the exchange. Communication and documentation of results are closely related, which is presented in the following subsection (Subsection 5.5.4). The part related to knowledge sharing concludes with the involved roles in a CoP (Subsection 5.5.5). The last three subsections deal with the governance-related topics: Subsection 5.5.6 provides information on the participation of employees, Subsection 5.5.7 on the agenda,

and Subsection 5.5.8 deals with the governance and steering of CoPs itself. The last subsection provides information on the decision power of the CoPs mentioned by the experts (Subsection 5.5.9).

5.5.1. Time and location

Time

Regarding knowledge sharing, it is useful to look at the time of the knowledge exchange, more in detail, at the frequency and duration of CoPs. Starting with the duration of the meetings, the most common one is a one-hour meeting (E2, E3, E5, E8, E13, E15, E17, E23) (34,8%). Other durations mentioned by more than one expert are 30 minutes (E1, E11) (8,7%), one and a half hours (E12, E23) (8,7%), and two hours (E1, E7) (8,7%). Furthermore, two and a half hours (E7) (4,3%), a whole working day (E21) (4,3%), and length on demand (E7) (4,3%) appeared once (see Figure 5.7). However, since the duration was not asked directly, just twelve experts provided information on the topic.

In terms of the frequency, the majority of experts mentioned weekly meetings (E1-E3, E5, E7, E8, E10, E11, E13-E15, E18, E22, E23) (60,1%). The second most common one is bi-weekly (E1, E2, E4, E6-E8, E10, E17, E19, E20, E22) (47,8%), followed by monthly/every four weeks (E6, E10, E12, E16, E19-E22) (34,8%). In addition, every three weeks (E15) (4,3%), every six weeks (E15) (4,3%), and every six months (E21) (4,3%) were mentioned once. Furthermore, three experts (E10, E20, E22) (13,0%) state that CoPs should be regularly. On top, six interviewees (E6, E7, E9, E13, E15, E18) (26,1%) stated that the knowledge exchange is done on demand (see Figure 5.7).

Furthermore, next to the meetings, all interviewees, except E7, mentioned the possibility of exchanging knowledge at every wanted time. These could be through information provided in different tools such as Jira (E2), Confluence (E2, E10), SharePoint/Wiki (E10, E21, E22), or through pair programming (E1). In addition, 21 experts (E2-E6, E8-E23) (91,3%) named the existence of a chat in the CoPs in which the members could ask questions also between the meetings (E21, E23). More in detail, E5 stated that "recently this became a trend that people are now using this in an active posting or people asking questions and then getting answers. So something like Stack Overflow. So people are asking questions in there and most of the time get an answer" (E5). Next to asking questions, these chats are also used for sharing exciting information (E16) or the agenda of the CoP (E14). The tool used therefor, was mainly Microsoft Teams (e.g., E2-E4) or Slack channels (e.g., E9, E12, E19).

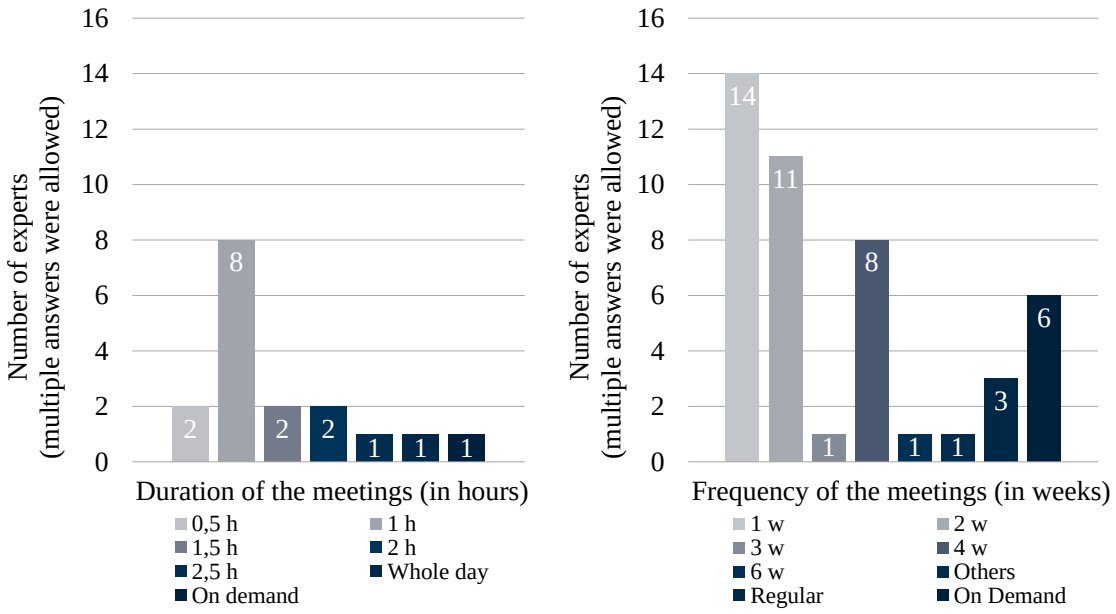

Figure 5.7.: Duration and Frequency of Meetings

Location

Starting with the knowledge sharing itself, it is firstly interesting to know where the CoPs take place. Almost all experts (E2-E9, E11-E18, E20-E23) (87,0%) mentioned that the knowledge exchange is taken place virtually. The reasons for this setting are mainly Corona and the following work from home (E3, E5, E7, E14, E16, E18, E21, E23) or the (global) distribution over multiple countries and cities of the employees (E3, E4, E9, E17). Furthermore, a hybrid (virtual and onside) knowledge exchange was mentioned by eight experts (E1, E7, E8, E10, E14, E15, E20, E22) (34,8%). In these cases, the CoP meeting is conducted virtually, but colleagues at the office also come together in one room to exchange knowledge (E1, E7, E8, E20). Furthermore, nine interviewees (E2, E3, E14, E15, E18-E22) (39,1%) are aware of CoPs which are taking place just in person, e.g., discussions in small groups (E2). On top, the knowledge exchange in "an on-site meeting [is] even more living" (E22) and recommended by E20. A summary of the mentioned locations by the experts can be seen in Figure 5.8.

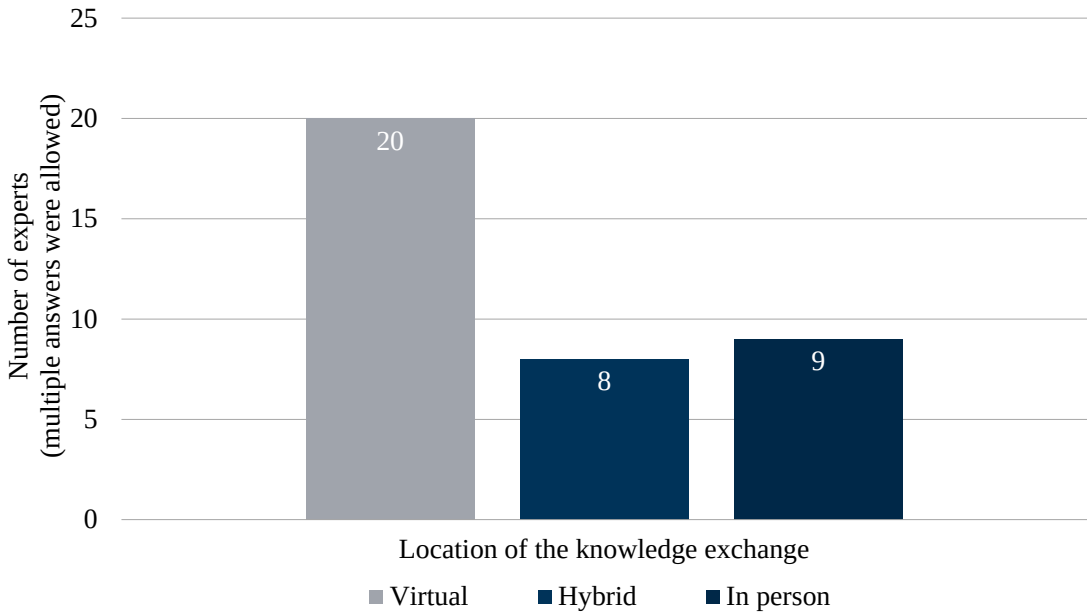

Figure 5.8.: Location of the knowledge exchange

5.5.2. Form of knowledge exchange

Overview

Next to the time and location of CoPs, the experts were also asked how the knowledge exchange in the CoP takes place. An overview of all identified forms can be seen in Figure 5.9. Overall, all interviewees (E1-E23) (100%) mentioned that a discussion is the most common form of knowledge exchange. Furthermore, the majority of CoPs are using speeches or presentations on specific topics (E1-E5, E7-E10, E12-E14, E16-E23) (87,0%). Additionally, workshops as form of CoPs are named by eight experts (E2, E4, E7, E9, E10, E12, E17, E18) (34,8%). Other forms that occurred multiple times are demonstrations (E1, E5, E17) (13,0%) and training (E3, E5, E11) (13,0%). On top, four other forms were identified (E1, E3, E14, E19) (17,4%). The different forms will be described in more detail in the following. Furthermore, E3 and E20 added that a mixture of different forms is the best way for knowledge exchange.

Discussions

Every expert mentioned discussion as a form of knowledge exchange. However, this aspect includes different formats. First, some experts mentioned Lean Coffee discussions

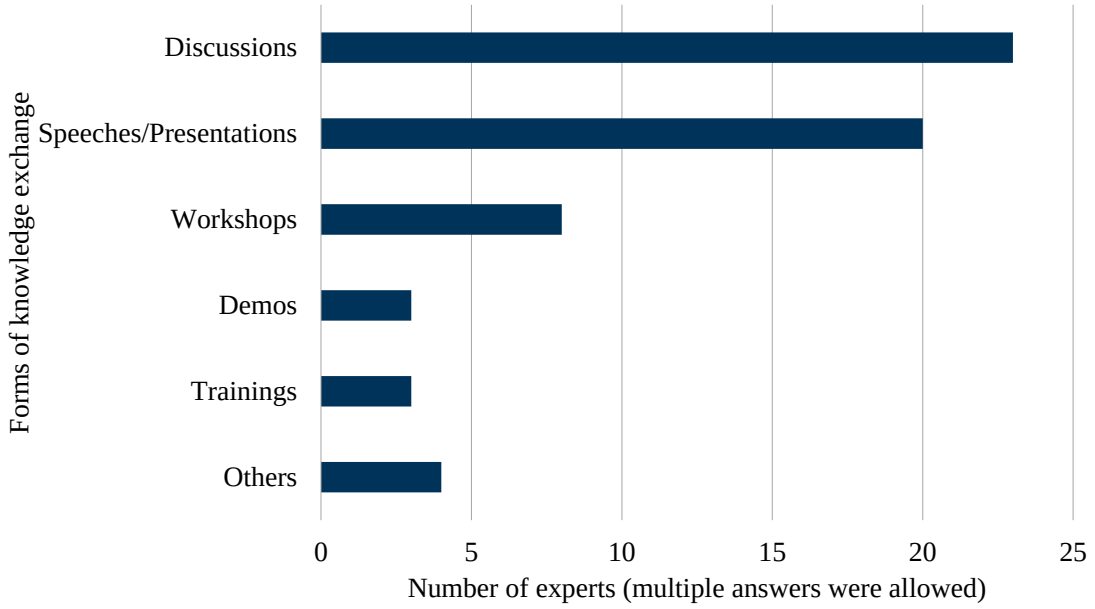

Figure 5.9.: Different forms of knowledge exchange in CoPs

or talks in the coffee corner (E3, E7, E8, E16, E18, E20). Secondly, there are conversations on specific topics. These could be either after some speeches/presentations/demos (E1, E3, E5, E7, E9, E10, E14, E16, E22) or based on an agenda point (E6, E11, E16, E22, E23). Thirdly, there can also be open debates, often done in small groups and in an informal way with no agenda (E2, E7, E8, E11, E14, E17-E19, E21). E10 even states that "the most successful format [of knowledge exchange] is open space" (E10). Overall, the discussion is higher in smaller groups of people (E8).

Speeches and presentations

Also, standards are speeches and presentations in CoPs. They can be on specific topics (e.g., E1, E2) or should provide the members with needed information (e.g., E2, E7, E8, E23). The goal can also be to build a basement for the following discussion (E2, E10, E22). In addition, the speakers can be (external) guest speakers (E3, E8-E10) or also the management (E17), but also "if [a member] wants to present a topic, then they have a stage for that" (E18).

Workshops

Next to classical discussions or speeches, workshops were mentioned by the interviewees. However, they might also include a presentation and discussion (E4). In some cases, the topic discussed in a CoP is divided into smaller subgroups, e.g., through breakout sessions (E10), which then work on the dedicated topic (E2, E10, E18). The goal could be to dive deeper into specific topics (E7) or create models or applications (E17).

Demonstrations

Three experts mentioned demonstrations in their CoP. While E17 did demos on past achievements and work, the others named demonstration on code as a form of knowledge exchange (E1, E5), e.g., of applications and problems (E5).

Training

Regarding training in CoPs, E3 mentioned that pilot training for SM is part of the knowledge exchange. In addition, dedicated training sessions on specific topics (E11) or training on applications with technical details (E5) are other aspects mentioned in this area.

Other forms

Next to the already mentioned forms, other ones appeared just one time. E1 named watching videos to reflect coding and pair programming sessions, while E3 mentioned scrum games. In the case of E14, also games are used to receive feedback from other participants. In addition, also dedicated fact-finding and coordination sessions can be part of CoPs (E19).

5.5.3. Used tools

After the knowledge exchange, the experts were also asked to provide information on the tools used in CoPs. An overview of all named ones can be found in Figure 5.10. The most common instrument is Microsoft Teams[2], possibly due to the high percentage of virtual exchanges, with 19 occurrences (E1-E5, E7-E18, E22, E23) (82,6%). Teams are mainly used for meetings (e.g., E3), asynchronous knowledge exchange via chat (e.g., E4), documentation of the results (E10), or recordings of the knowledge exchange (e.g., E22). The second most common one is SharePoint[5] or a Wiki (E1-E3, E5, E8-E10, E12,

[5]https://www.microsoft.com/de-de/microsoft-365/sharepoint/collaboration

E15, E17, E18, E21, E22) (56,5%). It is used as a "centralized document management system" (E5) for the agenda (E9) and also to provide a list of all existing CoPs (E8). The use of e-mails is explicitly mentioned by twelve experts (E1-E3, E7-E9, E15, E16, E19, E20) (52,2%). They are used for sharing the agenda (E2) or the results (E9, E16), and for the invitation of people (E3, E8, E9, E19). The tool Atlassian Confluence[6] occurred eleven times (E1, E2, E4, E6, E7, E10, E13, E15, E17, E18, E23) (47,8%) and was mainly used for the documentation of the results (e.g., E17), but also for some voting processes (E2). In addition, eight experts (E3, E8, E9, E12, E15, E16, E17, E18) mentioned the use of Mural[7], a digital whiteboard. It is a "very good collaboration platform" (E2) and also the main tool used in CoPs (E16, E17). Microsoft PowerPoint[8] (E3, E10, E11, E16, E17, E21) (26,1%) for presentations, and other whiteboards, such as Miro[9], Concept Board[10] or internal ones (E6, E13-E15, E19, E23) (26,1%), are mentioned by six experts. Jira[11], another tool from Atlassian, is named five times (E2, E7, E13, E17, E23) (21,7%) and is used for tracking the tasks or topics (E2, E7, E23). Slack[12] as an alternative for Microsoft Teams regarding chats occurred four times (E9, E12, E16, E19) (17,4%). Furthermore, Microsoft Excel[13] was mentioned by three experts (E3, E8, E10) (13,0%) as storage of all past results, links, and topics (E3, E8). Other tools (E3, E10, E21, E23) (17,4%) named by the experts are Zoom[3] for breakout rooms (E3), Microsoft Yammer[14] for documentation (E10), Slido[15] for extensive discussions (E21), Wemik (internal tool) for recording (E21), and Connect (internal one) for decision communication (E23).

In addition, the experts were also asked if they found the tools used helpful or if they would like to use other ones. Overall, 15 interviewees (E1, E2, E4, E9, E10, E12-E16, E18-E22) (62,2%) directly stated that the used tools are sufficient and helpful for the knowledge exchange. Furthermore, E2 says that: "They are helpful because they enable us to provide direct information like to specific teams, groups and the community, but also outside the community, what we are doing in the community. And therefore, they provide transparency" (E2). Especially the visualization tools like whiteboards are highlighted by experts as good (E13, E20). In addition, the tools should be stable (E22).

[6] https://www.atlassian.com/software/confluence
[7] https://www.mural.co
[8] https://www.microsoft.com/de-de/microsoft-365/powerpoint
[9] https://miro.com/de
[10] https://conceptboard.com/
[11] https://www.atlassian.com/de/software/jira
[12] https://slack.com
[13] https://www.microsoft.com/de-de/microsoft-365/excel
[14] https://support.microsoft.com/de-de/office/yammer-das-soziale-netzwerk-ihres-unternehmens-5a72290d-725b-4c19-af48-599207d16b47
[15] https://www.slido.com/de

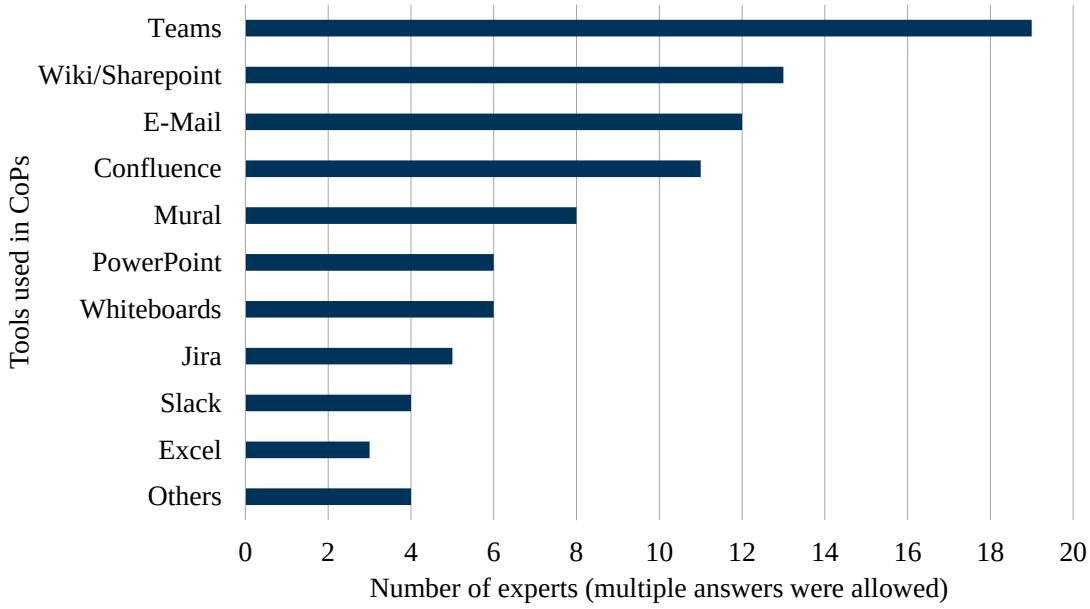

Figure 5.10.: Different tools used in CoPs

However, seven experts mentioned they would like to use other tools: A central place for documents (E1), Slack (E2), Miro or Mural (E6, E10, E22), a tool for collaborative working on tasks (E15), and one for team building and databases (E16). Furthermore, tool failures were also identified: Two experts mentioned the aspect of limited tools due to company regulations (E6, E17). In addition, E8 wants to eliminate Microsoft PowerPoint, and in the case of E11, the use of whiteboards failed. Also, using Confluence or SharePoint can lead to missing information due to their structure (E18, E22). Overall, E23 states that there are too many tools in CoPs, and E20 adds that "a tool has never solved a problem. So the community of practice is not running [based on] a tool" (E20), which implies that tools are not the main factor for the success of CoPs.

5.5.4. Communication and documentation of results

Next to the already mentioned communication of the establishment of CoPs (see Subsection 5.4.5), also communication and documentation on the results were studied. However, some part was already covered by the tools used in CoPs (see Subsection 5.5.3).

Documentation

Overall, 17 experts (E2, E3, E5-E15, E17, E21-E23) (73,9%) provided explicit information regarding the documentation of results. In some cases (E3, E5, E11, E17, E22), SharePoint was used to document all results, including PowerPoint presentations (E17). Another interviewee mentioned uploading slides to the intranet (E21). Furthermore, Microsoft Excel with all important topics and links is used by E3 and E8. While E5 just mentioned Microsoft Teams as a documentation space, three other experts (E9, E10, E15) named Wiki as their space for documentation of results, mainly for general information. In addition, Confluence (E7, E10, E13, E15, E23) was used for documenting all relevant results, including information on what was on the agenda and what was voted on (E2). However, in the case of E13, just aspects that impact PO were written in Confluence. Another space for documentation is a whiteboard, which is saved in the project spaces (E6). It contains all information on past meetings to enable all members to go back to meetings in the past (E14).

Furthermore, five experts (E3, E5, E12, E21-E23) (26,1%) mentioned the meeting recording as an aspect of the documentation of the results. This can include speeches and questions afterward, but not open discussions like the Lean Coffee. Other sessions are recorded on request (E3). The reason for the recording is to offer employees, who could not attend the meeting due to time issues, the possibility to watch it (E5, E21).

Communication

Next to the documentation, 13 experts (E1-E7, E9, E16-E18, E22, E23) (56,5%) mentioned communication of the results. This could be done via presentations (e.g., at the start of the following CoP-meeting (E3) or sharing them in company-wide calls (E17)), in review meetings (E4, E18, E23), or in the form of newsletters (E4, E5, E7, E18) or e-mails (E5, E7, E9, E16, E22). In addition, Microsoft Teams can notify members if a new result is published (E5). However, this needs motivation (E18); in some cases, the results can be shared based on request (E6). Furthermore, E2 mentioned the reporting of important decisions of the CoP to the management. Lastly, E1 has the idea of sharing the results in the future, but it is not done now. In contrast, E20 states: "I would be very careful with reporting" (E20). Another expert (E19) is also skeptical about knowledge management and documentation since too many of it can overwhelm the participants.

5.5.5. General roles

Overview

In the context of CoPs, multiple roles could be identified. Firstly, a CoP is driven, led, or facilitated by a leader (e.g., E3). This can be one person or a small group (E13). In this thesis, the role of a facilitator is equated with the role of a CoP-Leader. A person in the role could be a regular employee at the organization (e.g., E12), an agile coach (E15), or a member of the management of the company (E5). The agile coaches can also be ordinary members of CoPs (E3, E6). In addition, they can support the CoP-Leader (E2). Furthermore, also the management can be part of the knowledge exchange (E17). Another role identified is the role of a moderator, which is often done by the CoP-Leader (e.g., E9) but can also be done by a standard participant (E6, E18). In addition, speakers are sometimes involved, either the participants themselves (E2, E6) or external (E10). An overview of the different roles in a CoP can be seen in Figure 5.11.

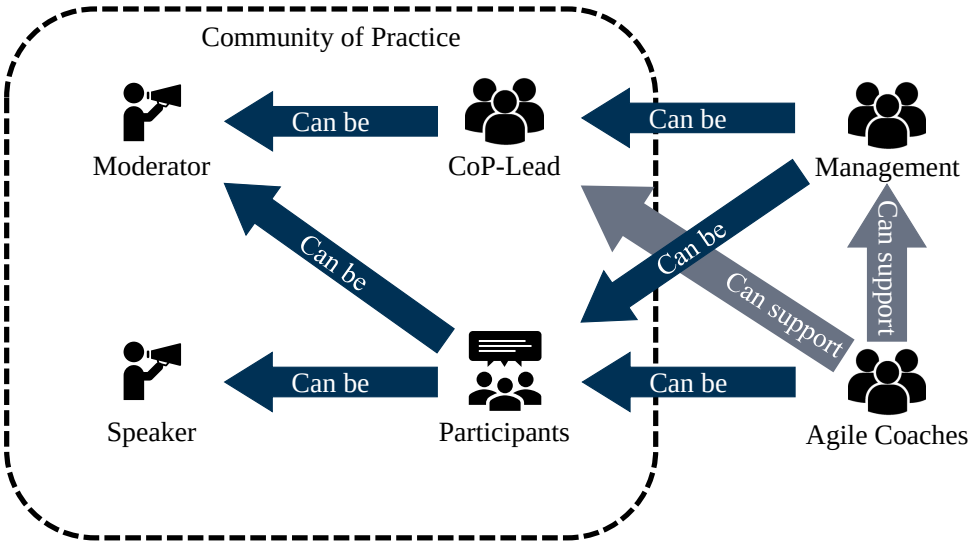

Figure 5.11.: Overview of the different roles in a CoP

CoP-Lead

The CoP-Lead is the primary person responsible for knowledge sharing. The task of the role is, firstly, to invite (E3, E16) and motivate everyone (E1, E12, E23) and

to increase interest and engagement in the CoP (E11). This is also mentioned by E2, who stated that "each CoP has one dedicated person which is the one responsible for organizing and for improving this CoP further and ensure that the people are still engaged, actively engaged in this" (E2). Another task is the facilitating of the CoP (E3, E12, E15, E16) and also often the moderation during the meetings (E3-E5, E9, E12, E14, E15, E18, E22, E23). E5 added that the leader is also the main presenter (E5). Furthermore, the role owner is the go-to person regarding feedback on the knowledge exchange (E5, E7, E13, E18). On top, the CoP-Lead is often responsible for (collecting) the agenda through observations and supporting of the members (E7, E9, E14, E16-E18, E22, E23). Sometimes, also steering is involved (E18). Additionally, the role coordinates with the central unit or sponsors since they represent the CoP (E7, E17, E23).

Furthermore, the role of a CoP-Lead can also be fulfilled a group, not just a single person. For example, E13 mentioned three facilitators, E14 a core team of three people, and E10 a team of community managers since the role is voluntary (E10). In general, it is possible to say that a CoP "should be driven by someone who sees a value behind it" (E14).

Moderator

The next role mentioned is the role of a moderator. There could be either a moderating team (E17) or a person out of the CoP is the moderator. In most cases, the moderation was done by the CoP-Leader (E3-E5, E9, E12, E14, E15, E18, E22, E23). However, agile coaches (E6, E15) or active members (E6, E18) can also be the moderator. Furthermore, an expert mentioned that the role is also including the responsibility for the agenda (E20).

Participants

"Central for the working and the Constitution of the CoPs are always the people that have a common need to come together and exchange their exchange or learn or get reassurance from this CoP" (E15). Therefore, they, of course, also play a role in the knowledge exchange (E17). Members can be ordinary employees (E10) from different areas (E5), dependent on the topic of the CoP (E19). In addition, they can also be experts in some areas (E1, E13). For example, E3 mentioned that there "are four, five, six others, and they are very experienced, very skilled and very smart guys. So [a CoP is] even the platform of the experts" (E3). Tasks of the members are, next to participation in discussions (E22), also sometimes the presentation of topics (E2, E5, E22), or participating in essential votings (E2).

Management and stakeholder

The next role is the management, which can also be part of some CoPs; for example, E1 mentioned that the CTO joins the knowledge exchange. Also, in the case of E4, the stakeholder sometimes joins and decides on agenda topics. E17 also mentioned this point. In another case, the PO is the CoP-Leader (E5).

Other roles

Other roles mentioned are the coordinator (responsible for agenda) (E5), speakers (can be members (E2, E6) or external ones (E10)), and agile coaches. The last named ones can only support the CoP-Leaders (E2) or also participate in the meetings (E3, E6). On top, agile coaches can also moderate and lead CoPs (E6, E15) and drive them (E19).

5.5.6. Participation

Coming to the governance and steering of CoPs, the first area studied was the duty of attending them. An overview of the experts' answers can be found in Figure 5.12. In total, 21 interviewees (E1-E8, E10-E20, E22, E23) (91,3%) mentioned that the participation is voluntary. However, E17 wishes for an attendance list and more forcing of participation. In contrast, another expert said: "Do not try. If it is mandatory, it is not a CoP" (E19). Furthermore, E7 mentioned that "forcing people to join the community would also put a very heavy burden on the community regarding the value of the meeting and the value of training and the value of interaction and the value of helping each other" (E7). More detailed information on the motivations for employees to join CoPs was already mentioned in Subsection 5.3.3.

In contrast to voluntary participation, a partly mandatory duty of attendance was identified by four interviewees (E2, E9, E10, E13) (17,4%). The reason for that is decisions made inside the CoPs in the case of E2 and E10. Being part of them is mandatory, while the typical knowledge exchange is not (E2, E10). Particular agenda points are another reason for mandatory parts (E13). Furthermore, E9 states that the motivation of joining CoPs is more intrinsic than it is forced, but "If you are not taking part in those meetings, then you will be lost sooner or later because the teams have to work together. They depend on each other" (E9). As a result, it is partly forced by the given circumstances. Moreover, three experts (E2, E21, E23) (13,0%), which were all part of InsuranceCo1, mentioned mandatory CoPs. More in detail, in the case of E21, three specific roles have to join the meeting since the CoP aims for them. In the case of E23, the attendance is checked since the CoP focuses on "governance and governance does require people participating" (E23).

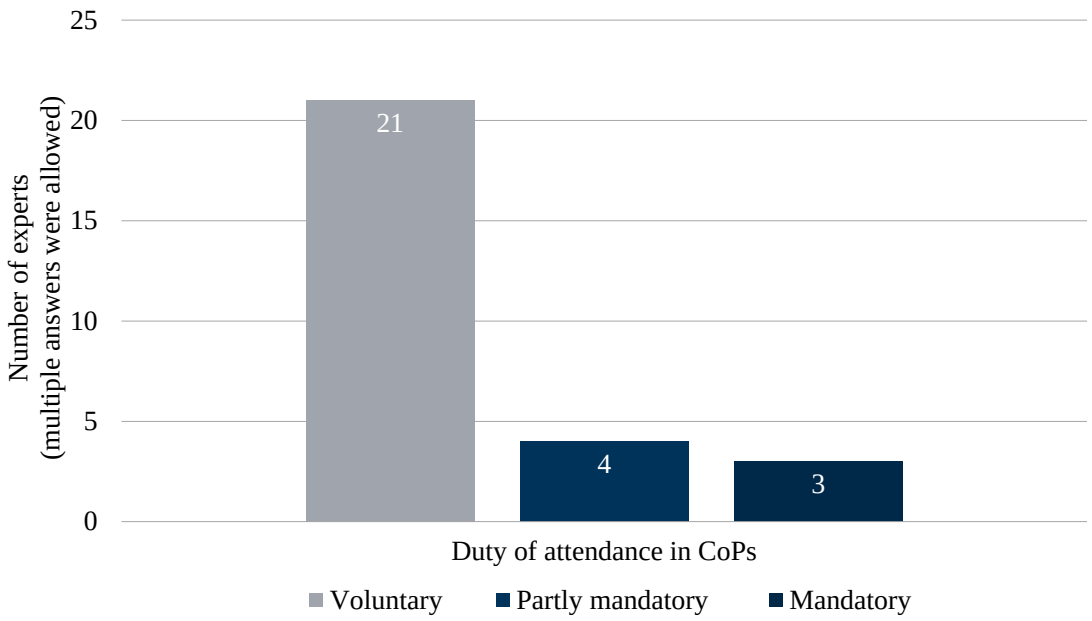

Figure 5.12.: Duty of attendance in CoPs

5.5.7. Agenda

The next aspect regarding governance is the agenda in CoPs. Firstly, it is necessary to say that many open/informal discussions do not have an agenda, and the people start talking (E11). However, an agenda is recommended in the other forms of knowledge exchange (E20), so the experts provide information on who is responsible for putting topics on the agenda. An overview can be seen in Figure 5.13. As a result, nine experts (E1, E2, E4, E5, E7, E10, E13, E17, E23) (39,1%) mentioned that managers could add topics to the agenda or are completely responsible for it. This could be done, for example, through a steering meeting (E23). The reason for management involvement is to drive interesting topics for them (E2, E4, E7), which are also relevant for many teams (E2). For example, E5 mentioned the agenda point of new product features after releases, and E10 mentioned that mainly the product-related ones have a strict agenda by management. However, the agenda can also be provided by management but can change based on feedback from the members of a CoP (E2).

In addition, the CoP-Lead is (partly) responsible in 15 cases (E4, E5, E7-E9, E12, E14-E18, E20-E23) (65,2%). More in detail, the role seeks relevant and interesting topics for the team and puts them on the agenda (E15, E21). However, in other cases, the CoP-Leads

are creating the agenda, but every member can go to them and ask them to include particular topics (E14, E17, E18).

Furthermore, 17 experts (E2, E3, E5-E7, E9, E10, E12, E14-E20, E22, E23) (73,9%) mentioned, that members can put topics on the agenda. Next to the already covered creations of the agenda with management (E2) or the CoP-Lead (E14, E17, E18), there are also some cases where the members alone are responsible for the topics in the knowledge exchange. For example, the agenda could be decided based on open/coffee discussions (E3, E15) or question and answers sessions (E7). In addition, there is also the possibility to collect topics in front of the CoP meetings, e.g., on a Wiki page (E6, E9, E16).

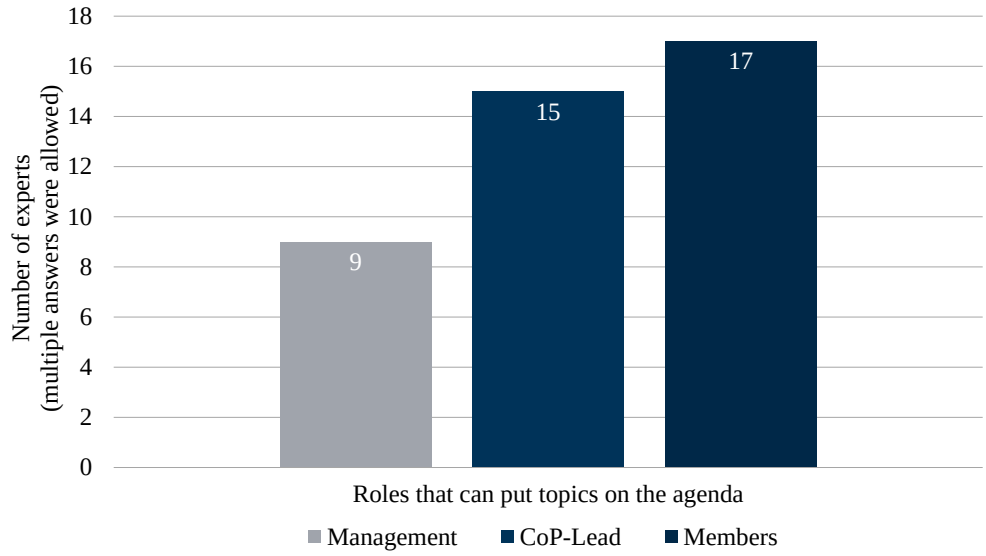

Figure 5.13.: Roles that can put topics on the agenda

5.5.8. Governance and steering

Overview

Next to the agenda and the duty of attendance, some experts also mentioned further aspects regarding the governance and steering of CoPs. Regarding this topic, E23 states: "I would be careful with the word governance in the CoP context. That is why we use a different word. If you put governance in the CoP word, as I said, you have a high risk of killing it instantly because suddenly people go from trying to share

and learn to "I have to be careful what I say." I might be reprimanded. So steering CoPs [...] with governance, I'd be very, very, very careful" (E23). Overall, if there is a form of governance, the prominent responsible persons for it are management (E2, E4, E5, E7, E10, E12, E17, E21, E23) (39,1%) or a dedicated person/a CoP-Leader (E3, E4, E7-E9, E11, E13, E14, E17, E18, E20, E22, E23) (56,5%). In one case (E1) (4,3%), it was unclear if the expert steers the CoP in the role as manager or CoP-Lead. An overview is also shown in Figure 5.14. However, it needs to be added that there are also CoPs without any governance. The experts did not mention this aspect often since they were just directly asked if they were aware of any steering. Just four interviewees mentioned that the CoPs have a self-governance and no steering, e.g., large ones in the case of E10. More in detail, an expert stated: "They are usually left alone a bit unless something is really expected of them to come up with. Then it's a bit more steering from the outside, but other than that; it's usually driven from within the community" (E6). Furthermore, in some other cases, the members of the CoP defined rules for the knowledge exchange. In one case, a Code of Conduct, which includes soft rules like participation or activeness, was created (E15). In another one, the participants agreed on three rules: the degree of support of the companies in the CoP, some guardrails such as just two members per organization, and the "Vegas" principle (What happens in the CoP stays in it) (E19).

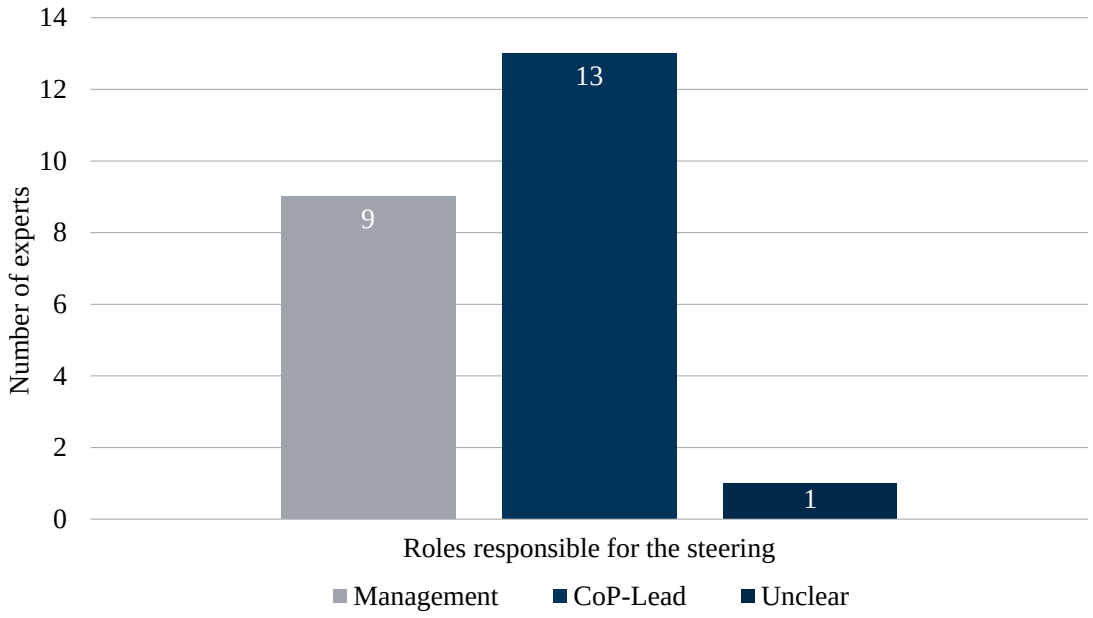

Figure 5.14.: Roles responsible for the steering

Management

As mentioned, managers can be responsible for the steering of CoPs (E5), for example, in smaller ones (E10). This governance can work differently. While E17 mentioned the creation of a backlog and the discussed topics with the sponsors of a CoP, others use a steering committee (including the Chief Operating Officer (COO) (E2)) with retrospectives (E2, E12). In another case, the governance is "mainly part of the information security officers because they tell the people what the requirements are and they also check if the requirements [of a CoP] are met" (E21). Furthermore, the governance by management can also be done in meetings with them. This can be, for example, preparation meetings upfront of the CoP (E2, E4), quarterly revenue meeting (E4, E7), which can also include all members (E7), or retrospectives for the top management circles (E7). Additionally, E21 mentioned an information security steering board meeting (E21). Furthermore, E23 mentioned a "classic steering board and Strategic Enterprise Architecture Management Board, where all the CIOs and COOs as well as their direct reports are participating, where we also funnel information into to basically also ensure that we work on the relevant topics" (E23).

CoP-Leader

Furthermore, some experts stated that there needs to be a dedicated person in the CoP, which is responsible for organizational tasks (E3, E11, E20). More in detail, one expert stated that a CoP is "community driven. And from this perspective, I would say you do not have steering and governance. You have someone who organizes it and other colleagues who can take over in case of vacation or something" (E8). This can also include the agenda, as mentioned in Subsection 5.5.7. In addition, also other interviewees believed that a CoP is self-organized but needs a leader or host to take care of it (E7, E9, E13, E22). Furthermore, there are also steering meetings, in which CoP-Leaders participate. For example, the leads of different CoPs meet regularly to synchronize the topics and decide their further development (E4, E17, E18, E23).

5.5.9. Decision power

Another aspect identified through the interview study is the decision power of CoPs. In total, eight experts (E2, E10, E15, E18, E20-E23) (34,8%) out of seven different companies (CarCo2, ConsultCo1, ConsultCo5, FoodCo1, InsuranceCo1, MedicDeviCo1) (46,2%) are aware of CoPs in their organization which influence or decide things based on the knowledge exchange. In InsuranceCo1 (mandatory CoPs), the company tries to allow the CoPs to make decisions when possible with the goal of empowering the teams (E2). This works well in the case of the architecture-CoP, which can decide, for

example, on new policies or guidelines through voting (E2, E23), but can also be a challenge in areas such as security since these decisions are "bounded to regulatory things" (E21). However, if the decision affects not only the CoP area but the entire company, the result of the vote within the CoP is not seen as a final decision but only as a possible influencing factor on the management's decision (E2). Furthermore, other experts mentioned decisions in voluntary CoPs. These can be on specific domains for topic-based CoPs (E10) or role-specific topics like guidelines for the role for role-based ones (E15, E18). In addition, "the depth of decisions that can be made, it's usually agreed upon by the CoP participants" (E15). Similar to the statement on company-wide decisions by E2, another expert states that "this decision is not done by the CoP, but they can influence the decision" (E22), as feedback from a CoP on a particular topic within its area of focus is a good argument for management's decision-making process (E22). On top, regarding decisions in voluntary knowledge exchange, E20 adds that companies should care what decisions are made since a CoP can quickly become mandatory if important ones are made inside it.

5.6. Potential research topics

This section deals with the fifth research question of this thesis. The goal was to identify research areas that are relevant to the industry. The first subsection (Subsection 5.6.1) provides an overview of the identified topics. They are presented in more detail in Subsection 5.6.2. Furthermore, the experts were asked what would be the one thing they would like to change in the context of CoPs in LSAD. These answers are presented in the last subsection (Subsection 5.6.3).

5.6.1. Overview

In the last part of the questionnaire, the area of further research relevant to the industry was addressed. In total, 14 different topics were identified. An overview of them, including the number of experts which mentioned the topics, can be seen in Figure 5.15. The most common area is best practices, which were mentioned by 12 experts (E1, E2, E4-E6, E8, E10, E15, E17, E18, E21, E22) (52,2%). It is followed by the impact of CoPs (E1, E10, E12, E15, E17-E20, E22, E23) (43,5%) and the establishment of CoPs (E5, E6, E9, E11-E15, E21) (39,1%). The area of active participation (E2, E4, E5, E11, E13, E14 E20, E22) (34,8%) was mentioned eight times, and research related to roles and people involved in a CoP (E2, E5, E7, E8, E12, E15, E23) (30,4%) was mentioned seven times. In addition, a comparison with other companies (E5, E7, E9, E11, E14, E20) (26,1%) and the attendance (E4, E7, E11, E12, E19, E21) (26,1%) was identified just six times. Further research areas, which appeared multiple times, are types of CoPs (E6, E13, E20,

E23) (17,4%), specific tools (E1, E11) (8,7%), and decision making (E2, E22) (8,7%). In addition, seven different topics were only mentioned by one expert each (E3, E4, E6, E13, E14, E19, E23) (30,4%). More details on the identified research areas are presented in the following (Subsection 5.6.2).

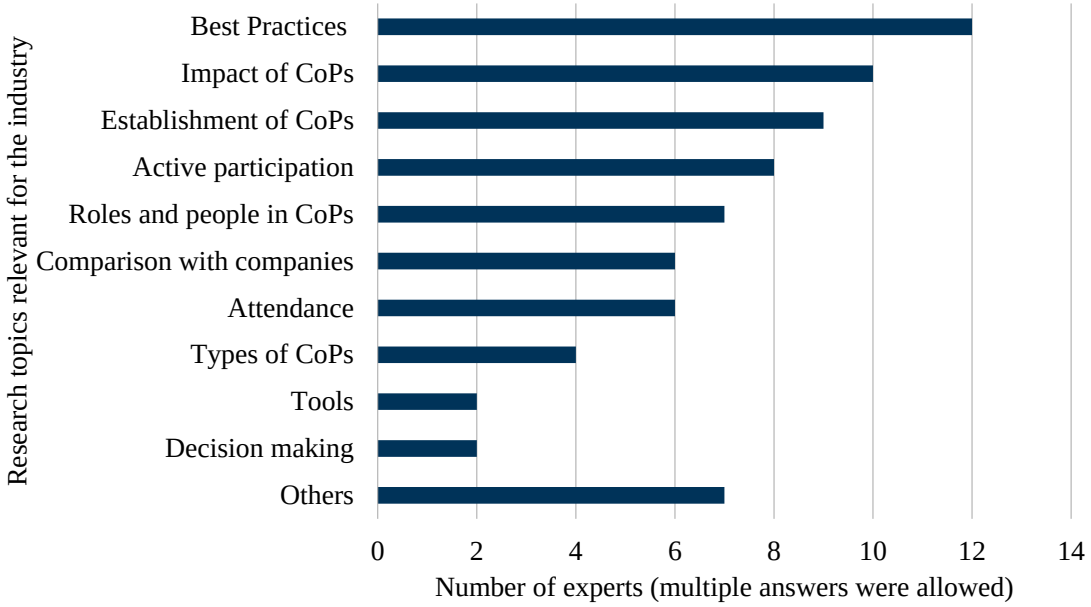

Figure 5.15.: Research topics relevant for industry

5.6.2. Identified research topics

Best practices

The most commonly mentioned area for further research was identifying best practices for CoPs (E2, E4, E10, E17, 22). In this context, the comparison with other companies could also be relevant (E6). More in detail, E5 mentioned the need for best practices for setting empathy in a company, E8 for SM-CoPs, and best practice on "How a community of practice could be, what formats are there, what really helps the people" (E21). E15 also wishes for a practice-oriented guide on what and how to do things related to CoPs which should include aspects required in early stages to keep it healthy. Furthermore, stories by people working in a similar context might also be helpful (E18). Overall, one expert even stated that "the most obvious [further research area] is do's and don'ts in CoPs" (E2). Moreover, according to some experts, these anti-patterns should also be part of the best practice (E1, E2, E15, E22). While E2 and E15 want to know proven

pitfalls for CoPs, E22 sees the need to "don't do that or ten things to spoil your CoP or something like that based on scientific research" (E22). Also, E1 thinks that research on why CoPs fail, including misused or missed opportunities of tools, is needed.

Impact of CoPs

The second most commonly demanded research area is the impact of CoPs. In this case, most experts wish for hard data regarding the value of them (E1, E10, E12, E20), e.g., the revenue they "create" in order to justify the establishment of them in front of management (E15, E17). More in detail, E1 wishes for data on the impact of CoPs regarding the costs, while E10 wants to know if it is worth investing money in knowledge exchange. For E17, research on the impact of CoPs in agile environments is missing. Furthermore, measuring the success of CoPs concerning the invested engagement is relevant to the industry (E18). Moreover, data on the impact of a particular CoP compared to others for a specific role/group is an area which E23 is missing, since there are many possibilities to exchange knowledge, and it is impossible to join all of them. On the other side, it would be interesting to see what happens if a company in LSAD does not use CoPs (E1) or if they suddenly would not exist any longer (E22). In contrast to other experts, E19 states that it is hard and not always good to measure CoPs since it can influence the freedom and self-organization of it and demotivate people. Therefore research on this area needs to be careful (E19).

Establishment of CoPs

Through the interview study, also a need for research on the topic of the establishment of CoPs could be identified. Mainly, the experts are missing some concrete guidelines for the creation based on experience/proven ways (E5, E6, E9, E12, E14, E21). More in detail, E11 wishes for a plan over a longer time frame for the early phases of a CoP, and E13 would like to see data on goal setting, synchronizing, and artifacts. E15 goes even further in detail. The experts are interested in research on fostering and the emergence of CoPs, next to identifying critical points in the establishment. Furthermore, a lighthouse should be created to address and solve these critical aspects (E15).

Active participation

Since the "silver bullet" (E22) of CoPs is a lively discussion, many experts also want further research on active participation. The focus of the research, however, differs over different time frames. While E22 is interested in how to set up CoPs that people actively take part from the beginning, E2, E5, and E13 want to research how and through what actions an increase of engagement can be reached when the knowledge

exchange and participation already exist. Closely related is the involvement of less experienced people, which should be studied according to E11. Furthermore, once the CoP grew already, it might be interesting to know how to enable active participation in larger sizes (E4). On top, if there is already a high motivation for knowledge exchange, research on how to keep it on a high level would be great (E14, E20).

Research related to roles and people in CoPs

Other research topics mentioned by the experts are related to roles and the people involved in the CoPs. The most common aspect, in this case, is the involvement of management, e.g., how to make high-management join the meetings and make CoPs more visible for them (E2, E5, E8, E15). Furthermore, the role of leadership and control of CoPs is a relevant industry topic. For example, E7 is interested in research on how to control and manage a CoP, e.g., "how do you lead a group of agile master" (E7). In addition, E23 wants to research the need for a dedicated CoP-Lead, and if one is needed or helpful, and what are the required skills people must have to take ownership of a CoP. Another relevant area mentioned by E12 is the research on the impact of cultural differences on CoPs, since, in the organization, the concept worked in the European and American areas but not in China.

Comparison with other companies

Moreover, six experts mentioned that a comparison of CoPs in many companies would be a relevant research area for the industry (E14). More in detail, E5 is interested in comparing their impact on other organizations, while for E7, the management area in different companies is more important. On the other side, an overview of which different types of CoPs are used by different companies is suggested by E9. Another aspect wanted is the investigation of CoPs over multiple organizations. In this case, a connection of CoPs in the same area but in different companies (E20) or overarching ones with a customer (E11) is interesting for the experts.

Attendance

In the context of the attendance, the experts wish for similar literature. Firstly, literature should focus on how CoPs can involve as many people as possible (E4, E7). Secondly, how to ignite the feeling that it is worth participating (E11, E12), and thirdly, how to keep the attendance high once it reaches a high level (E19, E21).

Types of CoPs

In the area of types of CoPs, four experts are interested in research. While E6 is generally looking for literature on the different existing types of CoPs, E23 is interested in CoPs which are relevant when scaling up the organization in an agile environment. On top, E20 mentioned the differences and occurrence of product-oriented CoPs versus not operative ones. In contrast, E13 wants the literature to identify differences between role-based and topic-/skill-based CoPs.

Research on tools

E1 and E11 suggest research on tools. While E1 is generally interested in which tools a CoP can use for knowledge exchange, E11 is looking for tools to support the collaborative approach and the knowledge exchange in virtual settings, since most meetings occur virtually these days.

Decision making

Regarding decision making in CoPs, E2 wants to know "what are the pitfalls and how they are done in other companies" (E2). More in general, E22 is interested to see what decision power a CoP can have and what happens if CoPs are allowed to make some decisions.

Others

Furthermore, seven experts mentioned other research areas which just occurred once. While E3 wishes for research on collaborative coding in CoPs in virtual settings (through the corona development), E13 is interested in what CoPs can do in delivery-focused organizations. Another expert (E19) in general is looking for research on open innovation. Furthermore, E23 is interested in including training in the CoPs. Additionally, since for E5, it is essential to involve as many people as possible, another aspect for the expert is how to keep the character of a bottom-up initiative while still including many people. In addition, E6 is interested in research on knowledge exchange between different CoPs. Furthermore, for E14, it is relevant to study if a CoP fulfills their purpose (regarding goals and reasons).

5.6.3. Magic button: changing one thing in the context of CoPs immediately

Overview

Next to the questions about relevant research areas for the industry, the experts were also asked which would be the one thing they would like to change in the context of CoPs in LSAD. In this case, the goal was to identify which topic was the most relevant and crucial for them and to find starting points for further research. Figure 5.16 provides an overview of the given answers by the experts. In total, six interviewees (E4, E7, E9, E13, E21, E23) (26,1%) wish for changes regarding attendance in CoPs. In addition, six interviewees (E6, E10-E12, E16, E19) (26,1%) mentioned a change regarding the mindset of people on CoPs. Furthermore, three other experts (E5, E18, E22) (13,0%) provide answers related to active participation in the knowledge exchange. Other changes, which could not be grouped due to a different area or context, are mentioned by nine experts (E1-E3, E7, E8, E14, E15, E17, E20) (39,1%). Although the question aimed for just one answer, E7 provided two different aspects, which are both crucial. A more detailed overview of the provided answer by the experts can be found in the following.

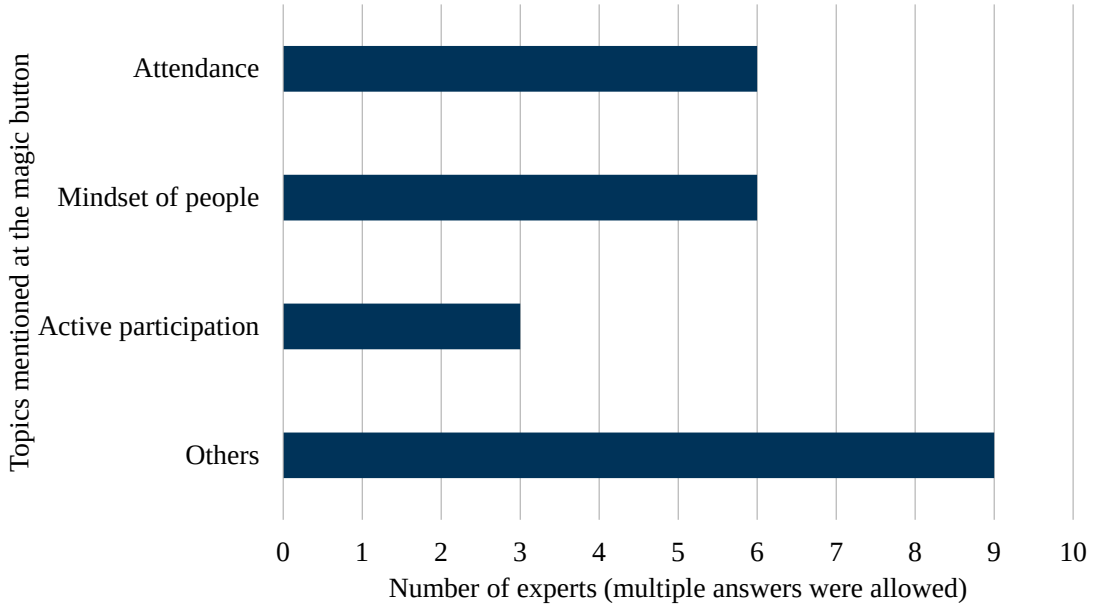

Figure 5.16.: Topics mentioned at the magic button

Attendance

As mentioned, six experts wish for changes related to the attendance of people in CoPs. Finding the right target audience was mentioned by E9 and E21 to increase participation, since it is hard to identify all interested people inside an organization (E9). Two other experts mentioned aspects related to the motivation to join a CoP. While E13 wishes for general excitement about joining a CoP, E7 talks more about how to force or establish high participation. Closely related is the aspect mentioned by E23, which is the identification of topics relevant for many people to make it enjoyable for them to join a CoP. Furthermore, E4 wishes for free time slots in every employee's calendar so that everybody can participate in knowledge exchange.

Mindset of the people

Another topic mentioned more often was a mindset change of the people. E2 wishes that the people understand the concept of CoPs and see what communication and knowledge exchange can do. This is also supported by E11, who mentioned a change in the awareness of the potential benefits a CoP can provide. E10 is even more specific since the expert wishes that people "accept and not only accept but welcome that those sorts of sharing knowledge and sharing experience is really the main base or driver of growth in the company" (E10). Closely related is the ignite of collaboration and knowledge sharing, as mentioned by E12. Another point regarding the mindset of people is that they should see CoPs as a place of trust and openness to feel encouraged to discuss every topic they want (E16). On top, E19 states that everybody should aim to become a leader in some capacity, and CoPs can help reach this mindset.

Active participation

Next to the attendance, three experts mentioned changes related to the active participation of the members of a CoP. E5 wished for more discussions, questions, and general engagement. Another expert (E7) also wants excellent discussions, next to high motivation. Furthermore, the interviewee states that everyone, not just a lot of people, should actively participate (E7). In the case of E22, since some CoPs face a problem of one-way communication, the expert wishes that "the people don't only consume, but they start the discussion, and they work together on a solution" (E22).

Other changes

There are also further changes after the already covered changes by the experts. Some of them are related to the establishment of CoP, like the wish for best practices on the

process (e.g., related to different companies or cultures) (E17), or the skipping of critical phases at the start of a CoP (E15). Others are related to different roles. For example, E8 wishes to see how the management can be directly involved in the knowledge exchange, and E3 wants to see the impact of a missing CoP-Lead who usually would drive it. Furthermore, E7 wants to ensure that mandatory parts of a CoP also work, while E2 wishes for faster decision-making. Other aspects mentioned are the transparency of the benefits of a CoP (E1), ensuring that all discussed topics are relevant (E2), or that all CoP meetings can be on-site to make it possible to see each other's faces (E20). Interesting is also the wish of E14, who wants to see the effectiveness and happiness of each member.

5.7. Additional information

The last section deals with additional information, which was asked in the questionnaire or the expert mentioned during the interview, that are not directly related to the five research questions of this master thesis but still relevant for the overall context of CoPs in LSAD. The first subsection (Subsection 5.7.1) provides a potential supporting aspect for (the establishment of) CoPs. In contrast, Subsection 5.7.2 describes identified challenges and failures in the different companies. The last subsection, Subsection 5.7.3, deals with changes of CoPs mentioned by the experts.

5.7.1. Support of CoPs

Overview

Closely related to the relevant future research for the industry, the experts also provided information on what can additionally support CoPs in LSAD in their opinion. Overall, the statements were categorized into eight groups, presented in Figure 5.17. The topic related to the mindset of people is the most commonly mentioned one with eight occurrences (E1, E8, E10, E12, E14, E15, E17, E22) (34,8%). It is followed by the areas of management (E6, E8, E9, E18, E20, E22, E23) (30,4%) and format & structure of CoPs (E3, E7, E11, E14, E23) (21,7%). Moreover, four experts mentioned knowledge on CoPs (E6, E7, E9, E13) (17,4%) and the areas of time (E11, E16, E18) (13,0%) and training (E5, E7, E8) (13,0%) were both stated by three interviewees. In addition, the topic of people was mentioned in two interviews (E3, E20) (8,7%). All other support areas are grouped under others (E4, E6, E19, E22) (17,4%). A detailed explanation of the categorization can be found in the following.

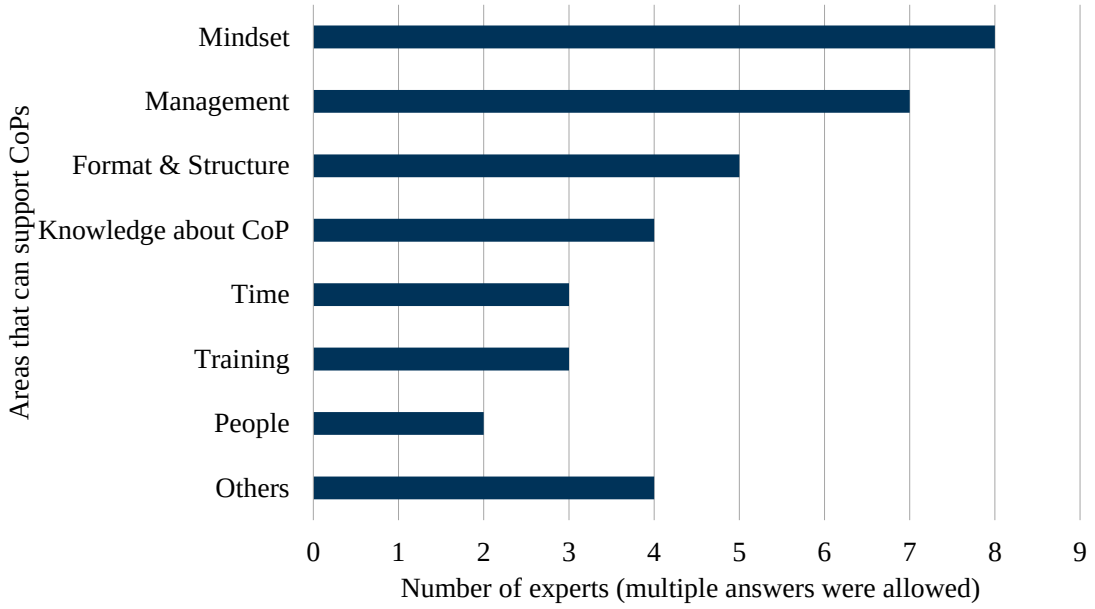

Figure 5.17.: Areas that can support CoPs

Mindset of people

The most common group for additional support of CoPs is the mindset of people. More in detail, two experts (E8, E10) mentioned that a mindset of trust and openness of the people helps support colleagues and improves the knowledge exchange (E8). E10 added that "if you have a [...] closed mindset and a mindset that is probably based on fear and something like that, then it would [...] make it quite hard to have successful formats like communities or CoPs then" (E10). Furthermore, the mindset of people regarding self-organization (E15) and the ability to learn more things (E1) can additionally support knowledge exchange. Another aspect mentioned is the organizational culture/overall mindset of the people. The right organizational environment and people (E22), a common and transparent understanding of CoPs (E17), and a culture of learning and not failing (E14) support CoPs. In addition, a mindset in which taking part in knowledge exchange is standard (but not forced) can also help (E1).

Management

Another aspect that can support CoPs is management acceptance. In this context, the experts stated that the support of CoPs by the management could promote them (E20) or is even required due to the needed time for knowledge exchange (E6, E22). This also

includes aspects of funding (E8, E20), and the involvement of managers in CoPs (E9, E23), but also the recognition of CoPs themselves (E8, E18) and the work/value done by employees in them (E18).

Format and structure

Also, aspects related to the format and structure of CoPs can support them. One expert (E23) states, that space and time are needed for knowledge exchange. More in detail, E3 suggested a consistent time slot, while E11 mentioned personal meetings since they can improve the networking effect more than virtual ones. Furthermore, in the opinion of E14, an agenda, which is known in front of the meeting, can support the value and interest in CoPs. E7 added that a mixture of speeches and interactive parts could further support CoPs.

Knowledge about CoPs

Another crucial area that can support CoPs is the knowledge about them, since knowing what a CoP is and does is a needed basement for successful knowledge exchange (E6). To be more precise, the knowledge of benefits (E7) or best practices (E13) are supportive factors. To reach this information, E9 suggested using guidelines or books on CoPs, while training for all employees at the beginning about the concept of CoPs is suggested by E6.

Time

Also conducive to CoPs is the aspect of time because employees must have the capacity to go there. Otherwise, knowledge sharing is not possible or meaningful (E11, E18). In addition, E16 added that people who work as SM and are part of CoPs should not have other roles next to the SM one, since this would otherwise lead to an overload of work and prevents the possibility to focus on the knowledge exchange (E16).

Training

Furthermore, different trainings might support CoPs. E8 mentioned Scrum Training to understand agile topics, like frameworks, better. In addition, E7 thinks that coaching of CoP-Leaders might be helpful for the further establishment of successful CoPs. On top, E5 states that training should also be integrated into CoPs since they already have experts. This could help to increase participation or motivation (E5).

Involved people

Next to the management, also other aspects regarding the involved persons can support CoPs. In this context, one expert (E3) mentioned the participation of experts with much experience, well-educated coaches, and an open-minded facilitator as crucial for CoPs. On top, E20 mentioned the need for one or two people who are driving the CoP with passion and are also motivating others to join.

Others

There are also other aspects that can support CoPs according to the experts. Firstly, people need perseverance since it can take time to see the benefits of a CoP (E4). Secondly, not too much organized knowledge exchange, e.g., regarding the agenda, can help to gain a stable membership (E19). Thirdly, knowledge exchange between different CoPs would support them (E6), and fourthly, prove the CoPs with the power to face specific decisions since this could help "people [to] even feel more involved" (E22).

5.7.2. Failures and closing of CoPs

Overview

In the interview, the participants were also asked if they were aware of any aspects or failures of CoPs in their company that led to the closing of CoPs (or to problems). Overall six different areas were identified, next to one expert (E12) (4,3%) who was not aware of closed CoPs in his organization. An overview of them can be seen in Figure 5.18. The lack of attendance is the most mentioned problem with 13 occurrences (E1, E3, E4, E6, E8, E10, E14, E15, E1-E21) (56,5%). The second most frequent one is the missing of a common goal (E2, E4, E6, E7, E10, E11, E13-E15, E22, E23) (47,8%). Furthermore, in eight interviews (E3, E7, E9, E10, E13, E17, E19, E23) (34,8%), an achieved goal was mentioned as a reason for the closing of a CoP. This is followed by the area of lack of member involvement (E2, E5, E14, E16, E20, E22, E23) (30.4%) and problems related to management involvement (E10, E19, E21, E23) (17,4%). In addition, three experts (E10, E13, E16) (13,0%) mentioned that there are too many alternatives in their organization, which led to the closing of some CoPs.

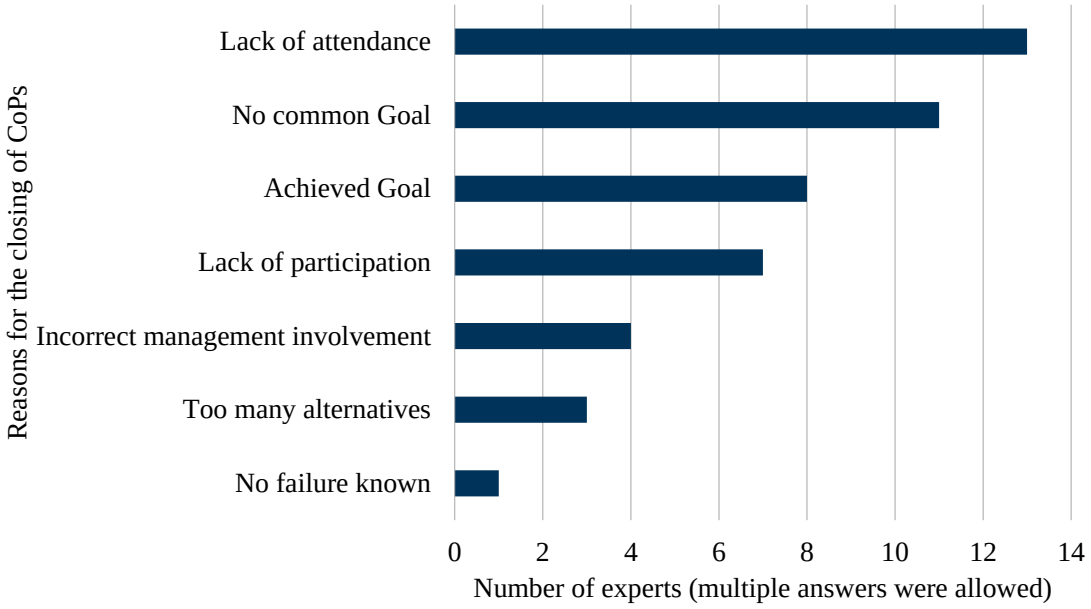

Figure 5.18.: Reasons for the closing of CoPs

Lack of attendance

The most common reason for a failure of CoPs is the lack of attendance. This could be either through a too-small target group (E1, E3) or not reaching all relevant people (E8), an unclear benefit (E4), or just a "lack of interest" (E19). However, the main reasons for less participation are time issues (E4, E6, E10, E14, E17) or (related) working overload (E15, E18-E20). In the context of time, under time pressure CoPs are often not highly prioritized (E4, E6, E17), the customer comes first (E17), or the time for knowledge exchange is not chargeable in case of consultancies (E17). Regarding the work overload, two additional aspects should be mentioned; firstly, since CoPs are voluntary, they are dropped fast if there is a lot of work to do (E20). Secondly, people fall into the "busyness trap. The trap of overload. There is no creativity, and there's no community event. You don't consider there must be some free time" (E19).

No common goal

Another main problem area for the failure of CoPs is the agreement on a common goal. Firstly, an unclear focus (E4) or goal due to alignment issues (E7, E13) or a different expectation (E2, E13), such as too many discussions (E14), can lead to less attendance and a failure (E13). Secondly, differences regarding the (focus) topic of CoPs (E15) can

be a problem due to a different mindset of the people (E10, E23), next to too many topics discussed (E22) or the wrong ones (E22, E23). The third problem is that the participants do not know the benefit or the value regarding the goal of the CoP (E6, E11).

Achieved goal

Another aspect of the closure of CoPs is the achievement of its goal (E10, E13, E19). This aspect is not a real problem but was still mentioned by eight experts in the interview, which is why it is also addressed in this subsection. The reasons why the goal is achieved can differ, but they are closely related to the topic of the CoP (no achievement of a goal for role-based CoPs was mentioned). In most of the cases, the topic of the knowledge exchange is no longer relevant for the company (E3, E9, E10, E23) or its customers (E17), which leads to the closure of the CoPs. In some other cases, the topic was integrated into other CoPs (E17), for example, because the target audience was too small to keep a specific one alive (E3).

Lack of participation of the members

The next problem area, the involvement of participants, can be split into two parts. Firstly, a missing CoP-Leader, or too less organization of them by the role, can lead to failures of CoPs (E14, E20). Secondly, the engagement of the members is also a common problem that can lead to the closure of CoPs (E2, E5, E16, E22), since it is the most crucial aspect of knowledge exchange (E16). For example, in the case of E2, the meeting always ended after already 15 min since nobody wanted to participate. In addition, it is mostly the same people who interact, and there is no broad engagement (E5). On top, the virtual situation caused by Covid-19 and the global work in different time zones, make it even harder to engage actively in CoPs (E16). In the worst case, the lack of involvement can lead to a one-way communication in the CoPs, as in the case of MedicDeviCo1 (E22). Another problem regarding the involvement of participants is the size of the CoP, since it is more difficult to engage or interact with larger audiences than with smaller ones (E22, E23).

Incorrect management involvement

Management involvement can also lead to problems in CoPs. Thereby, the engagement can be wrong in both directions. On the one side, E10 mentioned the lack of managers in the knowledge exchange as a problem for CoPs since their experience would make it interesting for other members. On the other side, if the management tries to control the CoPs, also problems can arise. This could be overall governance of them which

could make "people feel controlled, and they don't want to share" (E23) knowledge, or the control of the agenda/topics discussed, which can lead to less participation since employees might think "Why should I go to a second-day job?" (E19). Another aspect occurred in InsuranceCo1, where the knowledge exchange kept switching between being mandatory and not, leading to its failure (E21).

Too many alternatives

As already said, three experts mentioned that too many alternatives were the reason for failed CoPs. For example, in the case of E10, too many global alternatives existed, which resulted in the closure of local ones. E16 even states, regarding too many CoPs: "Sometimes it burns, right, because too many meetings will kill you" (16). On top, in ElectRetailCo1, agile coaches currently try to solve this problem (E13).

5.7.3. Changes of CoPs

Overview

Next to the topics relevant to the support or the failure of CoPs, the experts were also asked if the CoPs in their organization changed over time, if they think the changes make sense, and if there are changes that should be done. Figure 5.19 provides an overview of the areas of change in CoPs mentioned by the interviewees. The most frequently made changes concern the format (E4, E12-E14, E17, E18, E23) (30,4%). Frequency ones in the context of the meetings (E6, E9, E11, E12, E16, E22) (26,1%), changes regarding the size and people (E3, E6, E8, E20, E21, E23) (26,1%), and the split of CoPs (E4, E5, E7, E11, E15, E23) (26,1%) all occurred six times. They are followed by topic-changes (E2, E3, E8, E9, E16) (21,7%). In addition, changes regarding the mindset of people through CoPs (E1, E5) (8,7%) and tools (E2, E9) (8,7%) are mentioned more than one time. Furthermore, three other changes were described (E3, E11, E17) (13,0%).

Regarding the acceptance of these changes, the majority of the experts agreed with them. For example, the change from local to global made sense to scale it (E3). Additionally, changes made by the CoP itself are good due to the "swarm intelligence" (E22). In contrast, two experts (E3, E5) are skeptical about some changes. E3 mentioned "do not do any change for the sake of the change" (E3), while E5 states that a split of CoPs in terms of public and private cloud makes no sense due to emerging duplicates of knowledge exchange.

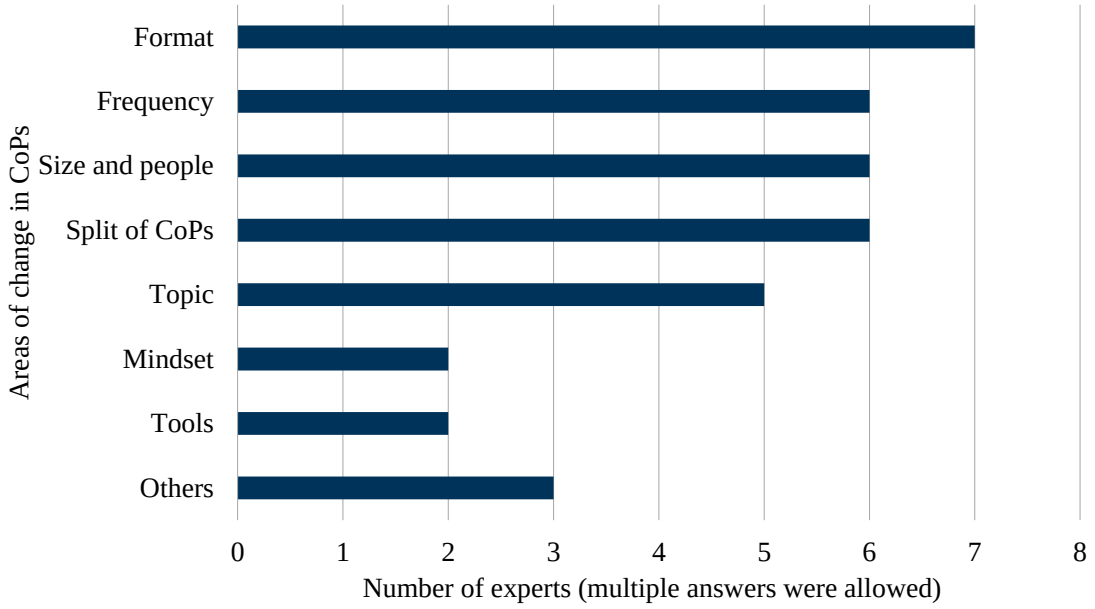

Figure 5.19.: Areas of change in CoPs

Format

The most common changes described by the expert were related to the format of CoPs. While E4 mentioned the change from presentations to more discussions, E23 named changes about "who is presenting when and how" (E23). Another aspect is the change from on-site to virtual settings caused by Covid-19 (E13). Furthermore, three experts mentioned changes regarding the agenda (making it more formal) to increase the value of the CoP (E14, E17, E18); E17 added that this change led to a minimal smaller attendance but higher participation in the meeting. In addition, E12 mentioned that by more volunteers, the facilitating of a CoP changed.

Frequency

Another standard change was the frequency of the CoP meetings. While in some cases, the rate of the meetings increased or will in the future, e.g., from monthly to bi-weekly (E12, E16), in other cases, the rate dropped, e.g., from weekly to monthly (E22), due to the amount and importance of topics discussed (E22).

Size and people

Furthermore, the experts also mentioned changes regarding the size and the people involved in the CoPs. Some experts just stated that the members change over time (E6, E8) like a "roller-coaster" (E20) or that the CoP scaled up very quickly (E23). More in detail, E21 mentioned the change from just consultants involved to all team members, and E3 named the transfer from a local SM-CoP to a global one.

Split of CoPs

Changes regarding the split of CoPs are mainly related to their topics. If the organization or the CoP-Lead identifies that the current topic of the CoP is too broad or there are different areas to focus on in it, it is often decided to split the CoPs related to the identified "sub-topics" (E4, E5, E7, E11, E15, E23). For example, E15 described the following: "So you might have a CoP, for example, on the topic of Kanban. So all the combined users come together in a CoP. But [...] you could recognize that within [...] this CoP, there are certain areas of focus that are only interesting for a small part of the group, and then you could evolve a passion group out of this" (E15). In another case, the split was done based on the departments since it made more sense to discuss the topic specifically related to the individual departments (E7).

Topic

In addition, in some CoPs, the focus topic changed. The reasons for that were: a reorganization of the company (E16), the changing importance of topics (E9), a change of scope or agenda (E2, E3), or the identification of a new topic (E8).

Mindset

Regarding the mindset of people, two experts stated that the "work" in CoPs changed over time because everybody started to share knowledge (E1) or more actively participated in the meetings and the chats (E5).

Tools

Two other experts mentioned changes regarding their tools in CoPs. While E2 noted only that there are changes, but not too often, E9 cited in detail the shift from sharing significant results or information on Slack back to e-mail.

Others

Other changes were also mentioned that do not fit directly into one of the other groups. Firstly, E3 mentioned a change from the native language/German to English during making the CoP global. Secondly, E11 named a change from a more top-driven approach to a bottom-up one since this engages and motivates the employees more. Thirdly, changes on the CoP based on the client situation were described by E17. The experts added that if the knowledge exchange is chargeable to a client, they focus more on innovation for the customer and themselves, while in the usual case, the focus is on sales-related activities (E17).

Regular changes

Next to the already mentioned areas of changes, almost half of the experts (E2, E4, E7, E10, E12, E13, E15, E16, E19, E20) (47,8%) stated that there are regular changes of CoPs. The reasons, therefore, are the following: CoPs have a life-cycle (E19)/are living things since they "grow and disappear" (E20) and also evolve due to a changing community (E10). This continuously changes the CoPs over time (E10, E19, E23). To identify what regular changes should be done, the experts mentioned the use of feedback (E2, E4, E10, E12, E13, E16) (26,1%) or retrospectives (E4, E7, E12, E15, E23) (21,7%). Both forms are often done regularly (E4, E10), e.g., quarterly (E4), to keep high participation (E15) and motivation of the employees (E12). An important remark by E10 is that when feedback is provided, new changes should be made and given time to prove themselves, but not too much, since not all might be useful (E10).

Changes that should be done

Furthermore, seven changes that should be made were mentioned by the experts. Most of them are based on format changes. While E1 wishes for a more formal structure of a CoP, E5 and E6 wish for more interactive elements, like workshops (E6), to get more active participation (E5). Furthermore, in the context of the size and people, another expert (E21) wants to scale the size of the CoP even more and open it for the global company. In addition, a change must be made to enable less experienced employees to participate actively (E11). Other changes mentioned are to not start a CoP without a clear goal and to split a CoP since some topics are not relevant for all agile masters (E7).

6. Research on CoPs in LSAD

In this chapter, firstly, potential open research questions on the topic of CoPs in LSAD are displayed (Section 6.1). Secondly, the differences between CoPs in non-agile organizational contexts and the ones in LSAD are described based on the results of the interview study (Section 6.2).

6.1. Open research areas for CoPs in LSAD

Although there is already some literature on CoPs in LSAD, there is still a need for future industry-relevant research [36, 33]. Therefore, open research questions for CoPs in LSAD related to the topics mentioned by the experts (see Section 5.4 for more details) are presented.

Best practices: What are best practices for the establishment and management of CoPs?

1. What are practice oriented guidelines for CoPs in LSAD?
2. What are topics that can help people to participate in CoPs?
3. How to keep a CoP in LSAD healthy in the early stages?
4. How can an empathetic attitude be achieved in a company with regard to CoPs in LSAD?
5. What are dos and don'ts for CoPs in LSAD?
6. What are the anti-patterns of CoPs in LSAD?
7. What are proven pitfalls of CoPs in LSAD?

Impact of CoPs: What is the impact of CoPs on the organizations and their outcome?

1. How can the impact on of CoPs on the organizational performance in LSAD be measured?
2. What is the revenue that a CoP can create in LSAD?
3. In which cases is it worth (regarding money and time) to create a CoP in LSAD?
4. What is the impact of CoPs on the agile transformation?

5. What would happen, when CoPs in LSAD suddenly do not longer exist?
6. How does self-organized work in LSAD looks like without CoPs?
7. Is it good and useful to measure CoPs in LSAD?

Establishment of CoPs: What is the best way to establish CoPs in LSAD?

1. What are guidelines for the establishment of CoPs in LSAD?
2. What are the critical factors while establishing CoPs in LSAD?
3. What is a good example of setting up CoPs in LSAD?
4. What are crucial elements for the goal setting of a CoP in LSAD?
5. How should the establishment of CoPs be communicated to reach many people?
6. How can a long-living CoP be established in LSAD?
7. How can an environment be created that is conducive to the emergence of CoPs?

Active Participation: How can active participation be achieved in all phases of a CoP?

1. How can active participation in a CoP be achieved from the beginning?
2. How can the engagement of members of CoPs in LSAD be increased?
3. How can active participation work with many members in CoPs?
4. How can less experienced employees be involved in the knowledge exchange?
5. How can high active participation be kept once it is reached in CoPs in LSAD?

Roles and people in CoPs: What are the roles and people involved in a CoP and what are their tasks?

1. How can CoPs in LSAD be more visible for the management?
2. How can high management be involved in CoPs in LSAD?
3. What is the role of leadership in CoPs in LSAD?
4. How does governance and steering look like in CoPs in LSAD?
5. What skills and tasks are required to lead a CoP in LSAD?
6. For what roles should a CoP be established in LSAD?
7. Are there cultural differences regarding the knowledge exchange in CoPs, and how can they be addressed?

Comparison with other companies: What CoPs are used by other companies (in the same area)?

1. What types of CoPs are used in organizations in different sector?

2. How do CoPs, e.g., of the same role, look like in different companies?
3. How can CoPs in LSAD in different organizations be compared?

Cross-company CoPs: Are there any cross-company CoPs?

1. What are the advantages of a cross-company CoP?
2. In which cases is a cross-company CoP useful?
3. How can a CoP over multiple companies be created?
4. How can a CoP with a customer be created?

Attendance: How can high attendance be achieved in all phases of a CoP?

1. How can CoPs increase the attendance?
2. How can as many people as possible be involved in a CoP in LSAD?
3. What makes it feel worth to participate in a CoP in LSAD?
4. How can high attendance be kept over a longer time?
5. What is the impact of voluntary versus mandatory participation in CoPs in LSAD?

Types of CoPs: What are the different types of CoPs in LSAD?

1. What are the different types of CoPs in organizations?
2. What are the differences between role-based and topic-/skill-based CoPs in LSAD?
3. What is the role of product-oriented CoPs in LSAD?
4. Which role-based CoPs are needed when scaling up a company?

Tools: What tools do the different CoPs use for the knowledge exchange?

1. What tools are suggested to be used in (virtual) CoPs in LSAD?
2. How can tools support the collaborative approach of CoPs in LSAD?
3. What tools should be used for documentation and communication?
4. Are there any misused or missed opportunities for tools?
5. What tools should not be used in CoPs?

Decision Making: What decision-making authority should and do CoPs have in LSAD?

1. How can a CoP make decisions in LSAD?
2. What decisions should be done by CoPs in LSAD?

3. What are the consequences of allowing CoPs to decide specific things?
4. How to avoid a mandatory character, when CoPs can make decisions?
5. What are pitfalls for decision making in CoPs in LSAD?

Others: What are other topics relevant for the industry?

1. How can collaborative coding in CoPs in virtual settings work?
2. What can CoPs do in delivery-focused organizations?
3. Can CoPs in LSAD lead to (open) innovation?
4. How can CoPs keep the character of a bottom-up initiative while including more and more people?
5. How can it be measured if a CoP in LSAD fulfills its purpose?

6.2. Differences between classic CoPs and the ones in LSAD

As already described in Subsection 2.4.2 and Subsection 2.5.2, there are differences between general CoPs in classic software engineering and the ones in large, agile, or LSAD organizations. This section will shortly outline the differences between them based on the literature and the results of the interview study.

Firstly, as the literature on LSAD also mentioned [37], the interview study identified the use of roll-based and topic-based CoPs. However, the roles and topics differ compared to classic software engineering, since they mainly focus on agile areas. More in detail, the most common role-based communities, in the interview study, were the ones, which are important in the context of the agile methodology (e.g., SM or PO). Also, CoPs for agile coaches were mentioned. In addition, also the most common topic-based CoP dealt with agility, next to the ones for SM, PO, manager, or Scrum coffee.

Secondly, regarding the goals and reasons for the establishment, CoPs in LSAD are sometimes used for organizational changes [35, 36]. The interview study could also verify this goal since three experts especially mentioned the agile transformation as a reason for creating a CoP. In addition, there were further goals for establishing CoPs in LSAD. While the literature on CoPs in classic software engineering focus mainly on the networking and knowledge exchange [32, 106] as a reason for the creation, the experts of the interview study also mentioned the alignment of people, e.g., of the same roles, support of joint working, and to drive particular topics as goals.

Thirdly, there are some small differences regarding the approach and format of the

CoPs in LSAD compared to classic ones. In non-agile organizational contexts, the most common and successful way to establish a CoP is the bottom-up approach [32, 34, 46]. However, the experts of the interview study mentioned that the initiative of creating CoPs came mainly from management, since they recognized that such a format is needed for coordination and knowledge exchange. Furthermore, the interviewees also stated that the knowledge exchange is mainly virtual and, in some cases, even mandatory.

Fourthly, while traditional organizations have a more hierarchical structure with central decision-making [121, 122], CoPs in LSAD aim to enable self-organization and distributed decision-making according to the literature [3, 23, 39]. This aspect was also addressed in the interview study and was verified by eight experts (see Subsection 5.5.9).

7. Discussion

This chapter summarizes the key findings of this master's thesis and will compare the results of the interview study with the related literature (Section 7.1). In addition, the potential limitations of this paper are reflected and described (Section 7.2).

7.1. Key findings

Role-based CoPs in LSAD are almost equally frequent than topic-based ones

While in classic literature, CoPs are often defined by their components, e.g., size or formation process [40], the interview study identified that almost half of the mentioned CoPs are role-based ones (47,3%) while the rest (52,7%) are topic-based ones. These role-based CoPs are newly appearing in LSAD since it is needed to inform employees about or synchronize the different roles throughout the organization. The most common role-based CoPs were for SM (34,8%), PO (34,8%), or Architects (17,4%).

Next to knowledge exchange, also the alignment of people and roles is a common reason for the establishment of CoPs in LSAD

. As in the case of the classic literature of CoPs in non-agile organizational contexts, the main reason for the establishment of CoPs, mentioned by the experts in the interview study, was the need for knowledge exchange (82,6%). While networking is the second most common in literature [32, 106], the alignment of the people and different roles was mentioned second most frequently by the interview experts (65,2%). The reasons for that are the introduction and alignment of new roles such as SM or the cross-functional synchronization due to today's fast-changing environment.

The initiative to establish CoPs comes from management more often then in classic software engineering

While classic literature mentioned that the most common and successful CoPs are the bottom-up created ones [32, 34, 46], in the interview study, a top-down approach was stated more frequently. 19 of the 23 experts (82,6%) mentioned an initiative to

establish CoPs from management, while the establishment bottom-up was just stated in 16 interviews (69,6%).

CoPs play an essential role for (large-scale) agile organizations

Furthermore, CoPs play an essential role for organizations in LSAD. This is possible due to the high amount of top-down created ones and the planned establishment of further CoPs in the future (around 83%). There are multiple reasons for this importance. Firstly, as mentioned, CoPs are established for a particular goal. The reach of this goal, like the alignment of the people or the support of the agile transformation, can help companies to face coordination problems or other issues more efficiently. Secondly, newcomers can be integrated faster through the knowledge exchange and further offer insights into their previous experience. Thirdly, especially in the top-down created ones, the management can reach a cross-functional, broad audience and drive particular topics or inform the employees about new requirements, while maintaining the autonomy of the CoPs.

The knowledge exchange is mainly done virtually on a regular basis

The interview study identified that a CoP mainly takes place in the form of meetings virtually (87,0%). The main reasons for that are the Covid-19 pandemic and the distribution of the employees. In addition, this meeting is mainly done regularly and has a fixed duration. Here, the most common one is a one-hour meeting (34,8%) once per week (60,1%). Outside of the meetings, there is also the possibility to share knowledge via chats, which offers an asynchronous communication for the CoPs.

Discussion and speeches are the most common forms of knowledge exchange

Regarding the form of the knowledge exchange which is used in CoPs in LSAD, there is no real difference to the literature on CoPs in classic software engineering. Every expert mentioned that discussions are part of the CoP (100,0%). The second most common form is speeches or presentations (87,0%).

A leader is needed for successful CoPs in LSAD

Next, while investigating the roles involved in a CoP in LSAD, the interview study identified the need for a dedicated person or team, which is mainly responsible for the CoP. This includes the drive of it, organizational aspects like invitations or the agenda, and motivating people to join the CoP. In most cases, the role of a CoP-Lead is done voluntarily in the employees' free time. Without a leader, a CoP might fail over time.

CoPs can have a decision power

Another aspect, which the interview study identified and was also mentioned in the literature on CoPs in LSAD, is the decision power of CoPs. This aspect was mentioned in seven of the thirteen companies (46,2%). More in detail, the decision-making should increase the self-organization and power of teams and lead to a more decentralized structure. The range of the decision can vary and is mainly discussed at the creation of the CoP. Furthermore, if no actual decision is made in a CoP, but members still vote on particular topics, such as which framework to use in the future, this process can influence management in making those decisions.

Future research on best practices and the impact of CoPs in LSAD is needed

Another relevant aspect of this thesis is identifying further research topics relevant to the industry. Here, the interview study identified the need for best practices (52,2%), e.g., particular guidelines, and the impact of CoPs (43,5%) as the most common and wished research areas. Research on the impact of CoPs could convince the management to establish further ones, while research on best practices could make CoPs more successful.

A mindset of trust and openness of the people and the organization can support CoPs

Furthermore, based on the statements of the experts, the mindset of the people and the organization is the most common area (34,8%) which can additionally support CoPs in LSAD. Here, a mindset of trust and openness and an organizational culture and environment, that support learning, not failing, can be positively influence the establishment and the success of CoPs.

CoPs mainly fail due to a lack of attendance or an unclear common goal

One additional question in the questionnaire dealt with the problems and failures of CoPs. In this context, the most common reasons mentioned by the experts are a lack of attendance (56,5%), which was then also addressed as a topic for future research relevant to the industry, and an unclear or different common goal (47,8%), which means, that the participants of the CoP expected different topics, outcomes, or benefits from taking part in the knowledge exchange.

CoPs in LSAD should change regularly

Lastly, also changes of CoPs in LSAD were identified. In this context, the results of the interview study show that most CoPs are and should change regularly based on feedback provided by the members. The reason for that is the development of CoPs over time - based on the people, topics, or requirements.

7.2. Limitations

This section deals with the limitations and threats of this master's thesis. The first limitation is the short time frame for conducting this research which could influence both parts of this thesis, the theoretical foundation and the interview study. On the one hand, the number of papers reviewed was limited by the time constraint, also new relevant papers may have been published in the meantime. On the other hand, the number of participants and the available time for the transcription and analysis of the data was also limited due to the short time-frame. Secondly, the theoretical foundation might only cover some relevant papers because the author's opinion might have influenced the publication selection. As a result, irrelevant papers may have been selected, or important papers may have yet to be mentioned. The third limitation is the potentially limited generalizability of the results of this work, as the interview study focused on a restricted group of organizations and expert roles. To oppose this limitation, in the interview study, experts with different roles from different organizations from various sectors were interviewed. Furthermore, experts from the same organization are mainly part of different sectors, locations, or working teams.

As described in this thesis, potential threats in qualitative research [58, 64] were addressed to increase the validity of this thesis and the interview study. The selection of experts was done with looking for different experience, roles, and organizations to oppose the threat of the representatives of the experts [58, 64]. The bias and influence on the interview study of the author was addressed by the creation of a questionnaire with the help of another researcher [58, 64]. Furthermore, the concept of triangulation [58] was used to counteract the threats to validity. As a result, two researchers were present in all interviews, except the second one (due to a sudden personal reason). In addition, the coding steps were performed based on a permanent exchange and discussion between the two researchers.

8. Conclusion and future work

The last chapter of this thesis provides a summary based on the research objectives (Section 8.1). Lastly, an outlook for future work is presented (Section 8.2).

8.1. Summary

In this thesis, the current state of the establishment of CoPs in LSAD in the industry was investigated. For this purpose, the different types, reasons, goals, establishment process, knowledge exchange, and governance of CoP were studied. Furthermore, research topics relevant to the industry in this context were identified. The following section provides a summary of the answers to the research questions.

> **Research question 1:** *What types of CoPs exist in large-scale agile software development?*

Based on the literature review and the interview study, two main types of CoPs were identified: topic-based and role-based ones. Overall, 43 role-based CoPs (47,3%) and 48 topic-based CoPs (52,7%) were mentioned by the experts. For role-based CoPs, multiple ones may exist in the same organization for the same role, e.g., a local SM-CoP and a global one. The most common ones are for the role of the SM (34,8%) or PO (34,8%), but also five CoPs for other roles (Architects, Managers, Testers, Agile coaches, Engineers) appeared multiple times. In the context of topic-based CoPs, most of them just were mentioned in a single interview since the topics can vary based on the need and interests of the different organizations, sectors, or working environments. However, a minority was also mentioned by multiple experts, such as on the topic of agility (30,4%) or architecture (17,4%).

> **Research question 2:** *What are the goals and reasons for the establishment of CoPs in that context?*

The results of the interview study reveal several goals and reasons for the establishment of CoPs in LSAD. Overall, seven reasons were mentioned by more than three experts. Two of them were similar to the literature of CoPs in non-agile organizational contexts,

the need for knowledge exchange (82,6%) and networking (39,1%). Next to them, alignment of roles or peoples (65,2%) and the support of joint working (47,8%) were the most common. In addition, the drive of specific topics (for the whole organization) (30,4%), the empowerment of people or teams (21,7%), and the support of the agile transformation (13,0%) were mentioned by multiple interviewees. Furthermore, seven other experts stated goals, which occurred less than three times. An example, therefore, would be the governance of a specific topic.

Research question 3: *How were the CoPs established? Who was involved and how?*

Another goal of this thesis was to investigate the establishment process and the people involved in it. Two main approaches were identified in this context: CoPs can be created bottom-up by the employees or top-down by management. Most experts were aware of both approaches in their company (52,2%). While seven interviewees mentioned only top-down established CoPs (30,4%), just four experts mentioned only bottom-up created ones (17,4%). This high occurrence of CoPs created by management differs from the classic literature on CoPs. Regarding the involved persons, management was part of establishing CoPs in 13 cases based on the experts (56,5%). Furthermore, other roles like a CoP-Lead (17,4%) or agile coaches (17,4%), or a dedicated team (8,7%) can also be involved in the creation process.

Research question 4: *How do knowledge sharing and governance take place?*

In the context of knowledge sharing, the interview study identified many relevant aspects like the location (mainly virtual (87,0%)), the frequency (mainly weekly (60,1%)), or the duration of the meetings (mainly one hour (34,8%)). Furthermore, different forms of knowledge exchange were identified. Every expert mentioned a formal or informal discussion as part of the knowledge sharing (100,0%). The second most common format is speeches and presentations (87,0%), followed by workshops (34,8%). In addition, the tools used for the knowledge exchange were identified (e.g., MS Teams, SharePoint, E-Mail, Confluence). Regarding the involved persons and roles in a CoP, the following were found: CoP-Lead, moderator, regular members, and management. In addition, some experts mentioned also agile coaches, which support the CoP-Lead or the management (in the establishment and organization). The participation was mainly voluntary and not controlled. In the context of the agenda, depending on the CoP, the members, the CoP-Lead, or the management can put topics on it. Furthermore, there are also forms of knowledge exchange without an agenda, such as a coffee discussion. Lastly, there are CoPs with formal governance aspects in it and some without. More in detail, if there is a form of steering, it is done by the management (39,1%) or the CoP-Lead (56,5%).

Research question 5: *What research topics in that context would be relevant/interesting for practice?*

Since this thesis should be a foundation for further research, the interviewees were also asked which research topics in the context of CoPs in LSAD are relevant for them and the industry. Overall, ten different research areas were identified. The most common one was research on best practices (52,2 %), followed by the impact of CoPs (43,5%) and guidance for the establishment of them (39,1%). In addition, research on how to keep active participation (34,8%), on the roles and people in CoPs (30,4%), and on attendance was mentioned by the experts (26,1%). Other identified research areas are related to the comparison of CoPs in different companies (26,1%), the types of CoPs (17,4%), tools (8,7%), and decision-making of CoPs (8,7%).

8.2. Future work

As mentioned, this master's thesis only focuses on the problem identification of the establishment of CoPs in LSAD, due to the limited time frame. As a result, it was impossible to get feedback on the interview study's identified results and create an artifact as described in the design science approach in information systems [59, 60]. Research can use this master thesis as a base for a further investigation of the topic and the development of an artifact to support organizations. Moreover, further research should address the identified research topics regarding CoPs in LSAD, which are relevant for the industry, like best practices or the impact of CoPs. For this case, Section 7.1 offers an overview of open research areas for CoPs in LSAD. A closer investigation of the decision-making of CoPs might also be helpful since this mainly appears in the area of LSAD. Also, the support of CoPs in the agile transformation and the implementation process of large-scale frameworks might be relevant areas for further work. Furthermore, although many case organizations work globally, all experts were mainly in Germany (next to Poland). Investigating other organizations from different countries like the United States, India, or China might be helpful to get an even better overview of the current stand on establishing CoPs in LSAD. Finally, this master's thesis mainly focuses on the types of CoPs, goals and reasons, forms, and approaches. Although the working environment of the experts was also part of the interview study, it might be relevant to study further the influence of an organizational or environmental culture, e.g., related to the origins, traditions, and customs of the people involved in a CoP.

A. Appendix

A.1. Interview study questionnaire

1. **General questions about your role and organization**
   a) What is your large-scale agile software development role?
      - Developer
      - Product Owner
      - Scrum Master
      - Software Architect
      - Manager
      - Agile Coach
      - Enterprise Architect
      - Business Analyst
      - Solution Architect
      - Scrum Coach
      - Quality Assurance
      - Other

   b) How long have you been working in agile software development?
      - 1-2 years
      - 3-5 years
      - 6-10 years
      - 11-15 years
      - 16-20 years
      - > 20 years

   c) How long have you been working in large-scale agile software development?
      - 1-2 years

- 3-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- > 20 years

d) How long has your company been working in agile software development?

- 1-2 years
- 3-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- > 20 years

e) How long has your company been working in large-scale agile software development?

- 1-2 years
- 3-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- > 20 years

f) Please describe your development organization. (Including number of employees, teams)

g) Please describe your team and working environment. (e.g., sector, distribution)

h) Are we allowed to contact you again for further research? (For example, for questions regarding the given answers)

2. **Questions on the establishment of CoPs**

a) Establishment of CoPs

i. What types of CoPs exist in your company?

ii. What was the reason for the establishment of the CoPs?

iii. What are the goals of the CoPs?

iv. In your opinion, have the goals been achieved?

v. How did the CoPs emerge in your company?

vi. Are there any failed CoPs/resolutions of CoPs? If yes, why did they fail?

b) Time and frequency of knowledge exchange

i. When does knowledge exchange within the CoPs take place?

ii. Are the CoPs meeting on a regular basis? If yes, on which basis?

c) Involved persons

i. What is your role (and task) in the CoPs?

ii. Who is/was involved in the establishment of the CoPs (e.g., creation, funding, organization, management)?

iii. Which other persons/stakeholders are involved in the CoPs and what are their tasks?

d) Organization

i. How does knowledge sharing within the CoP take place (e.g., virtual, via discussion/speeches)?

ii. How does the steering and governance of the CoPs work?

e) Changes

i. Do the CoPs change over time? If yes, Why? / When? / How often?

ii. Do you think these changes make sense? If not, what changes should be done?

f) Communication and documentation

i. How are the establishment of CoPs and their results communicated (company internally e.g., to other employees or management)?

ii. How is participation in the CoPs fostered?

iii. Are you using any tools as a support for the CoPs (e.g., monitoring, knowledge exchange, documentation)?

iv. Are those tools helpful in supporting the knowledge exchange?

g) Additional questions

i. Is it planned to establish further CoPs in your company?

ii. In your opinion, do large-scale agile frameworks support organizations in the establishment of CoPs?

3. **Discussion: support by research**
   a) How can research support CoPs in the industry? Which research topics are relevant for the industry?
   b) Imagine having a "magic button" which can change one thing in the context of CoPs immediately, what would it be?
   c) In general, what do you think can additionally support the establishment of CoPs?
   d) Do you want to add any further information, comment, or a topic that we missed?

A.2. Time of the companies in (large-scale) agile development

ID	Company	Time in agile software development	Time in LSAD
E1	SoftwareCo1	6-10 years	1-2 years
E2	InsuranceCo1	6-10 years	3-5 years
E3	SoftwareCo2	11-15 years	11-15 years
E4	ConsultCo1	6-10 years	6-10 years
E5	SoftwareCo2	16-20 years	16-20 years
E6	ConsultCo2	6-10 years	3-5 years
E7	CarCo1	6-10 years	6-10 years
E8	SoftwareCo2	11-15 years	3-5 years
E9	SoftwareCo2	16-20 years	11-15 years
E10	CarCo2	11-15 years	6-10 years
E11	ConsultCo1	11-15 years	11-15 years
E12	SoftwareCo2	> 2 years (no info)	> 2 years (no info)
E13	ElectRetailCo1	6-10 years	3-5 years
E14	ElectRetailCo1	3-5 years	1-2 years
E15	FoodCo1	6-10 years	3-5 years
E16	SoftwareCo2	1-2 years	1-2 years
E17	ConsultCo3	6-10 years	6-10 years
E18	ConsultCo1	6-10 years	6-10 years
E19	ConsultCo4	16- 20 years	16-20 years
E20	ConsultCo5	11-15 years	11-15 years
E21	InsuranceCo1	6-10 years	3-5 years
E22	MedicDeviCo1	11-15 years	11-15 years
E23	InsuranceCo1	3-5 years	3-5 years

Table A.1.: Time of the companies in (large-scale) agile development

A.3. Duration of the interviews

ID	Company	Duration
E1	SoftwareCo1	40 min
E2	InsuranceCo1	52 min
E3	SoftwareCo2	53 min
E4	ConsultCo1	41 min
E5	SoftwareCo2	41 min
E6	ConsultCo2	45 min
E7	CarCo1	52 min
E8	SoftwareCo2	54 min
E9	SoftwareCo2	23 min
E10	CarCo2	62 min
E11	ConsultCo1	47 min
E12	SoftwareCo2	41 min
E13	ElectRetailCo1	44 min
E14	ElectRetailCo1	53 min
E15	FoodCo1	51 min
E16	SoftwareCo2	46 min
E17	ConsultCo3	44 min
E18	ConsultCo1	50 min
E19	ConsultCo4	46 min
E20	ConsultCo5	37 min
E21	InsuranceCo1	41 min
E22	MedicDeviCo1	44 min
E23	InsuranceCo1	53 min

Table A.2.: Duration of the interviews

A.4. Relationships of CoPs to official organization

Relationship	**Definition**	**Challenges typical of the relationship**
Unrecognized	Invisible to the organization and sometimes even to members themselves	Lack of reflexivity, awareness of value and of limitation
Bootlegged	Only visible informally to a circle of people in the know	Getting resources, having an impact, keeping hidden
Legitimized	Officially sanctioned as a valuable entity	Scrutiny, over-management, new demands
Strategic	Widely recognized as central to the organization's success	Short-term pressures, blindness of success, smugness, elitism, exclusion
Transformative	Capable of redefining its environment and the direction of the organization	Relating to the rest of the organization, acceptance, managing boundaries

Table A.3.: Relationships of CoPs to Official Organization based on Wenger et al. [32]

A.5. Types of CoPs mentioned by experts

ID	Roll-based	Topic-based
E1	-	Data Science, incognito software quality
E2	PO, agile master	UX, UI, information security
E3	SM, further ones	multiple in the whole company
E4	Business analysts, architects, PO	Agility, UX, operation
E5	-	Fiori-Elements
E6	Testing, SM	Security compliance, cloud technology
E7	Agile masters, architects, operations responsibilities, testing, disciplinary manager	-
E8	-	Big one (SM, PO, manager), further small ones
E9	Quality, PO	Security architecture
E10	-	Architecture, methodology topics, SAP domain, cloud domain, agile domain, collaboration tools
E11	-	Business, development, operations, UX, engagement management, agility
E12	SM	Agile academy, product teams and chapter skill based (e.g Agile Coaches)
E13	Engineers, architects	Chats based on different topics (e.g., architecture)
E14	Agile coaches, engineering delivery lead	on several topics
E15	PO, SM, principle engineers, management assistance	Architecture, software craftsmanship
E16	local and global SM, PO	-
E17	-	Agility, high performance, digitalization, agile in life science and health care, meta-verse, cloud computing, AI
E18	SM	Agility, technology related ones, account related ones
E19	-	DACH companies, consultancy, Scrum Coffee
E20	SM, manager, PO	Security, DevOps, Agility
E21	no specific mentioned	no specific mentioned
E22	Developer, testing, SM, PO	Integration, requirements, architecture
E23	Security, architects, UX&UI, software excellence, PO, tribe leader, manager	Cloud

Table A.4.: Types of CoPs mentioned by experts

A.6. Recommendations by experts

In total, six different experts mentioned recommendations regarding the questionnaire or the research topic itself. For the questionnaire, removing the scrum coach was suggested since the role does not exist, according to the opinion of E20. Another aspect mentioned is the training topic in CoPs, which should be added to the questionnaire (E5). "Because knowledge sharing is one thing, but building people's willingness to share that knowledge in a specific session so that other people can learn from this is also a good thing" (E5). Regarding the context of the thesis, E7 recommended the book "Cultivating Communities of Practice: A Guide to Managing Knowledge" by Wenger et al. [117] since it can inspire people and deals with the topic of the establishment of CoPs. However, this book was already known to the author of this thesis. On top, E13 lacked a clear differentiation of CoPs to other meetings. This was also mentioned by another expert (E17), who suggested a differentiation between a CoP, a guild, and different variants of names. In addition, the experts recommended a clearer "focus on the value that they can generate and the impact that they can have" (E17). Other topics mentioned by E19 are to look into open innovation in CoPs and how they can influence a Volatility, Uncertainty, Complexity, Ambiguity (VUCA)-World.

Bibliography

[1] M. Van Oosterhout, E. Waarts, and J. van Hillegersberg. "Change factors requiring agility and implications for IT." In: *European journal of information systems* 15.2 (2006), pp. 132–145. DOI: 10.1057/palgrave.ejis.3000601.

[2] K. Preiss, S. L. Goldman, and R. N. Nagel. *Cooperate to compete: Building agile business relationships*. Van Nostrand Reinhold, 1996.

[3] J. A. Highsmith and J. Highsmith. *Agile software development ecosystems*. Addison-Wesley Professional, 2002.

[4] S. Bick, K. Spohrer, R. Hoda, A. Scheerer, and A. Heinzl. "Coordination challenges in large-scale software development: a case study of planning misalignment in hybrid settings." In: *IEEE Transactions on Software Engineering* 44.10 (2017), pp. 932–950. DOI: 10.1109/TSE.2017.2730870.

[5] K. Beck, M. Beedle, A. Van Bennekum, A. Cockburn, W. Cunningham, M. Fowler, J. Grenning, J. Highsmith, A. Hunt, R. Jeffries, et al. *Manifesto for agile software development*. 2001.

[6] VersionOne. *16th State of Agile Report*. 2023. URL: https://info.digital.ai/rs/981-LQX-968/images/AR-SA-2022-16th-Annual-State-Of-Agile-Report.pdf (visited on 06/03/2023).

[7] J. Sutherland and Scrum Inc. *The Scrum At Scale Guide - The Definitive Guide to the Scrum@Scale Framework*. 2022. URL: https://www.scrumatscale.com/scrum-at-scale-guide-online/#Metrics-and-transparency (visited on 06/03/2023).

[8] D. J. Anderson. *Kanban: successful evolutionary change for your technology business*. Blue Hole Press, 2010.

[9] A. Reddy. *The Scrumban [r] evolution: getting the most out of Agile, Scrum, and lean Kanban*. Addison-Wesley Professional, 2015.

[10] M. Stoica, B. Ghilic-Micu, M. Mircea, and C. Uscatu. "Analyzing agile development-from waterfall style to scrumban." In: *Informatica Economica* 20.4 (2016), p. 5. DOI: 10.12948/issn14531305/20.4.2016.01.

[11] B. Boehm. "Get ready for agile methods, with care." In: *Computer* 35.1 (2002), pp. 64–69. DOI: 10.1109/2.976920.

[12] T. Dyba and T. Dingsoyr. "What do we know about agile software development?" In: *IEEE software* 26.5 (2009), pp. 6–9. DOI: 10.1109/MS.2009.145.

[13] K. Dikert, M. Paasivaara, and C. Lassenius. "Challenges and success factors for large-scale agile transformations: A systematic literature review." In: *Journal of Systems and Software* 119 (2016), pp. 87–108. DOI: 10.1016/j.jss.2016.06.013.

[14] T. Dingsøyr, T. E. Fægri, and J. Itkonen. "What is large in large-scale? A taxonomy of scale for agile software development." In: *Product-Focused Software Process Improvement: 15th International Conference, PROFES 2014, Helsinki, Finland, December 10-12, 2014. Proceedings 15*. Springer. 2014, pp. 273–276. DOI: 10.1007/978-3-319-13835-0_20.

[15] T. Dingsøyr and N. B. Moe. "Towards Principles of Large-Scale Agile Development: A Summary of the workshop at XP2014 and a revised research agenda." In: *Agile Methods. Large-Scale Development, Refactoring, Testing, and Estimation: XP 2014 International Workshops, Rome, Italy, May 26-30, 2014, Revised Selected Papers 15*. Springer. 2014, pp. 1–8. DOI: 10.1007/978-3-319-14358-3_1.

[16] K. Rolland, T. Dingsoyr, B. Fitzgerald, and K.-J. Stol. "Problematizing agile in the large: alternative assumptions for large-scale agile development." In: *39th International Conference on Information Systems*. Association for Information Systems (AIS). 2016, pp. 1–21. DOI: 10.13140/RG.2.2.27795.07207.

[17] P. Kruchten. "Contextualizing agile software development." In: *Journal of software: Evolution and Process* 25.4 (2013), pp. 351–361. DOI: 10.1002/smr.572.

[18] S. W. Ambler. "The agile scaling model (ASM): adapting agile methods for complex environments." In: *Environments* (2009), pp. 1–35.

[19] S. Ambler and M. Lines. "Scaling agile software development tactically: Disciplined agile delivery at scale." In: *Disciplined Agile Consortium (White Paper)* (2016).

[20] T. Dingsøyr, N. B. Moe, T. E. Fægri, and E. A. Seim. "Exploring software development at the very large-scale: a revelatory case study and research agenda for agile method adaptation." In: *Empirical Software Engineering* 23 (2018), pp. 490–520. DOI: 10.1007/s10664-017-9524-2.

[21] M. Marinho, R. Camara, and S. Sampaio. "Toward unveiling how SAFe framework supports agile in global software development." In: *IEEE Access* 9 (2021), pp. 109671–109692. DOI: 10.1109/ACCESS.2021.3101963.

[22] D. Leffingwell. *SAFe 4.5 reference guide: scaled agile framework for lean enterprises*. Addison-Wesley Professional, 2018.

[23] Scaled Agile, Inc. *SAFe 6.0*. URL: https://scaledagileframework.com/safe/ (visited on 06/06/2023).

[24] S. A. Qurashi and M. Qureshi. "Scrum of scrums solution for large size teams using scrum methodology." In: *arXiv preprint arXiv:1408.6142* (2014). DOI: 10.48550/arXiv.1408.6142.

[25] M. Alqudah and R. Razali. "A review of scaling agile methods in large software development." In: *International Journal on Advanced Science, Engineering and Information Technology* 6.6 (2016), pp. 828–837. DOI: 10.18517/ijaseit.6.6.1374.

[26] H. Kniberg and A. Ivarsson. *Scaling agile@ spotify*. 2012.

[27] The LeSS Company B.V. *LeSS Framework*. URL: https://less.works/less/framework (visited on 06/03/2023).

[28] Ö. Uludağ, P. Philipp, A. Putta, M. Paasivaara, C. Lassenius, and F. Matthes. "Revealing the state of the art of large-scale agile development research: A systematic mapping study." In: *Journal of Systems and Software* (2022), p. 111473. DOI: 10.1016/j.jss.2022.111473.

[29] D. Šmite, N. B. Moe, A. Šāblis, and C. Wohlin. "Software teams and their knowledge networks in large-scale software development." In: *Information and Software Technology* 86 (2017), pp. 71–86. DOI: 10.1016/j.infsof.2017.01.003.

[30] D. Leffingwell. *Scaling software agility: best practices for large enterprises*. Pearson Education, 2007.

[31] N. B. Moe, T. Dingsøyr, and K. Rolland. "To schedule or not to schedule? An investigation of meetings as an inter-team coordination mechanism in large-scale agile software development." In: *International Journal of Information Systems and Project Management* 6.3 (2018), pp. 45–59. DOI: 10.12821/ijispm060303.

[32] E. Wenger et al. "Communities of practice: Learning as a social system." In: *Systems thinker* 9.5 (1998), pp. 2–3.

[33] M. Paasivaara and C. Lassenius. "Communities of practice in a large distributed agile software development organization–Case Ericsson." In: *Information and Software Technology* 56.12 (2014), pp. 1556–1577. DOI: 10.1016/j.infsof.2014.06.008.

[34] E. Wenger. *Communities of practice: A brief introduction*. 2011.

[35] K. Silva and C. Doss. "The growth of an agile coach community at a fortune 200 company." In: *Agile 2007 (AGILE 2007)*. IEEE. 2007, pp. 225–228. DOI: 10.1109/AGILE.2007.56.

[36] M. Paasivaara and C. Lassenius. "Deepening our understanding of communities of practice in large-scale Agile development." In: *2014 Agile Conference*. IEEE. 2014, pp. 37–40. DOI: 10.1109/AGILE.2014.18.

[37] T. Kähkönen. "Agile methods for large organizations-building communities of practice." In: *Agile development conference*. IEEE. 2004, pp. 2–10. DOI: 10.1109/ADEVC.2004.4.

[38] N. B. Moe, D. Šmite, M. Paasivaara, and C. Lassenius. "Finding the sweet spot for organizational control and team autonomy in large-scale agile software development." In: *Empirical Software Engineering* 26.5 (2021), p. 101. DOI: 10.1007/s10664-021-09967-3.

[39] K. Schwaber and J. Sutherland. *The 2020 Scrum Guide*. 2020. URL: https://scrumguides.org/docs/scrumguide/v2020/2020-Scrum-Guide-US.pdf (visited on 06/03/2023).

[40] A. Jassbi, J. Jassbi, P. Akhavan, M.-T. Chu, and M. Piri. "An empirical investigation for alignment of communities of practice with organization using fuzzy Delphi panel." In: *Vine* 45.3 (2015), pp. 322–343. DOI: 10.1108/VINE-06-2014-0040.

[41] N. Hara. *Communities of practice: Fostering peer-to-peer learning and informal knowledge sharing in the work place*. Vol. 13. Springer Science & Business Media, 2008.

[42] C. Cuddy. "Cultivating communities of practice: A guide to managing knowledge." In: *The Bottom Line* 15.2 (2002). DOI: 10.1108/bl.2002.17015bae.001.

[43] N. Hara, P. Shachaf, and S. Stoerger. "Online communities of practice typology revisited." In: *Journal of Information Science* 35.6 (2009), pp. 740–757. DOI: 10.1177/0165551509342361.

[44] P. M. Hildreth and C. Kimble. *Knowledge networks: Innovation through communities of practice*. Igi Global, 2004.

[45] E. L. Lesser and J. Storck. "Communities of practice and organizational performance." In: *IBM systems journal* 40.4 (2001), pp. 831–841. DOI: 10.1147/sj.404.0831.

[46] K. Pastoors. "Consultants: love-hate relationships with communities of practice." In: *The Learning Organization* 14.1 (2007), pp. 21–33. DOI: 10.1108/09696470710718320.

[47] E. Enkel, P. Heinold, J. Hofer-Alfeis, and Y. Wicki. "The power of communities: How to build Knowledge Management on a corporate level using a bottom-up approach." In: *Davenport, T./Probst, G.(Ed.)* (2000), pp. 86–104.

[48] E. Wenger, R. McDermott, and W. M. Snyder. "Seven principles for cultivating communities of practice." In: *Cultivating Communities of Practice: a guide to managing knowledge* 4 (2002).

[49] R. McDermott and C. O'dell. "Overcoming cultural barriers to sharing knowledge." In: *Journal of knowledge management* 5.1 (2001), pp. 76–85. DOI: 10.1108/13673270110384428.

[50] G. Probst and S. Borzillo. "Why communities of practice succeed and why they fail." In: *European management journal* 26.5 (2008), pp. 335–347. DOI: 10.1016/j.emj.2008.05.003.

[51] E. Wenger. *Cultivating communities of practice a quick start-up guide*. 2002. URL: https://www.wenger-trayner.com/wp-content/uploads/2022/06/2001-EWT-Quick-start-up-guide-English.pdf (visited on 06/08/2023).

[52] D. Šmite, N. B. Moe, G. Levinta, and M. Floryan. "Spotify guilds: how to succeed with knowledge sharing in large-scale agile organizations." In: *Ieee Software* 36.2 (2019), pp. 51–57. DOI: 10.1109/MS.2018.2886178.

[53] I. Monte, L. Lins, and M. Marinho. "Communities of Practice in Large-Scale Agile Development: A Systematic Literature Mapping." In: *2022 XVLIII Latin American Computer Conference (CLEI)*. IEEE. 2022, pp. 1–10. DOI: 10.1109/CLEI56649.2022.9959929.

[54] R. S. Kaplan and D. P. Norton. *Balanced scorecard*. Springer, 2007.

[55] A. Korbel. *Using Communities of Practice for Alignmentand Continuous Improvement at DigitalGlobe*. 2014.

[56] M. Paasivaara and C. Lassenius. "Empower your agile organization: Community-based decision making in large-scale agile development at ericsson." In: *IEEE Software* 36.2 (2019), pp. 64–69. DOI: 10.1109/MS.2018.2886827.

[57] M. D. Myers and M. Newman. "The qualitative interview in IS research: Examining the craft." In: *Information and organization* 17.1 (2007), pp. 2–26. DOI: 10.1016/j.infoandorg.2006.11.001.

[58] C. B. Seaman. "Qualitative methods in empirical studies of software engineering." In: *IEEE Transactions on software engineering* 25.4 (1999), pp. 557–572. DOI: 10.1109/32.799955.

[59] A. R. Hevner, S. T. March, J. Park, and S. Ram. "Design science in information systems research." In: *Management Information Systems Quarterly* 28.1 (2008), p. 6. DOI: 10.2307/25148625.

[60] K. Peffers, T. Tuunanen, M. A. Rothenberger, and S. Chatterjee. "A design science research methodology for information systems research." In: *Journal of management information systems* 24.3 (2007), pp. 45–77. DOI: 10.2753/MIS0742-1222240302.

[61] K. Peffers, M. Rothenberger, T. Tuunanen, and R. Vaezi. "Design science research evaluation." In: *Design Science Research in Information Systems. Advances in Theory and Practice: 7th International Conference, DESRIST 2012, Las Vegas, NV, USA, May 14-15, 2012. Proceedings 7*. Springer. 2012, pp. 398–410. DOI: 10.1007/978-3-642-29863-9_29.

[62] P. Runeson and M. Höst. "Guidelines for conducting and reporting case study research in software engineering." In: *Empirical software engineering* 14 (2009), pp. 131–164. DOI: 10.1007/s10664-008-9102-8.

[63] A. Fontana, J. H. Frey, et al. "The interview: From structured questions to negotiated text." In: *Handbook of qualitative research* 2.6 (2000), pp. 645–672.

[64] M. B. Miles, A. M. Huberman, and J. Saldana. *Qualitative Data Analysis: A Methods Sourcebook*. SAGE Publications, 2018.

[65] J. Saldaña. *The coding manual for qualitative researchers*. SAGE Publications, 2021, pp. 1–440.

[66] K. Petersen and C. Wohlin. "A comparison of issues and advantages in agile and incremental development between state of the art and an industrial case." In: *Journal of systems and software* 82.9 (2009), pp. 1479–1490. DOI: 10.1016/j.jss.2009.03.036.

[67] T. Javdani, H. Zulzalil, A. A. A. Ghani, A. B. M. Sultan, and R. M. Parizi. "On the current measurement practices in agile software development." In: *arXiv preprint arXiv:1301.5964* (2013). DOI: 10.48550/arXiv.1301.5964.

[68] K. Conboy and B. Fitzgerald. "Toward a conceptual framework of agile methods: a study of agility in different disciplines." In: *Proceedings of the 2004 ACM workshop on Interdisciplinary software engineering research*. 2004, pp. 37–44. DOI: 10.1145/1029997.1030005.

[69] K. Conboy. "Agility from first principles: Reconstructing the concept of agility in information systems development." In: *Information systems research* 20.3 (2009), pp. 329–354. DOI: 10.1287/isre.1090.0236.

[70] M. Hummel. "State-of-the-art: A systematic literature review on agile information systems development." In: *2014 47th Hawaii International Conference on System Sciences*. IEEE. 2014, pp. 4712–4721. DOI: 10.1109/HICSS.2014.579.

[71] P. Abrahamsson, O. Salo, J. Ronkainen, and J. Warsta. "Agile software development methods: Review and analysis." In: *VTT Publications 478* (2002). DOI: 10.48550/arXiv.1709.08439.

[72] P. Abrahamsson, N. Oza, and M. T. Siponen. "Agile software development methods: a comparative Review1." In: *Agile software development: Current research and future directions* (2010), pp. 31–59. DOI: 10.1007/978-3-642-12575-1_3.

[73] S. Nerur and V. Balijepally. "Theoretical reflections on agile development methodologies." In: *Communications of the ACM* 50.3 (2007), pp. 79–83. DOI: 10.1145/1226736.1226739.

[74] S. Al-Saqqa, S. Sawalha, and H. AbdelNabi. "Agile software development: Methodologies and trends." In: *International Journal of Interactive Mobile Technologies* 14.11 (2020). DOI: 10.3991/ijim.v14i11.13269.

[75] M. Laanti, J. Similä, and P. Abrahamsson. "Definitions of agile software development and agility." In: *Systems, Software and Services Process Improvement: 20th European Conference, EuroSPI 2013, Dundalk, Ireland, June 25-27, 2013. Proceedings 20*. Springer. 2013, pp. 247–258. DOI: 10.1007/978-3-642-39179-8_22.

[76] L. Williams and A. Cockburn. "Agile software development: It's about feedback and change." In: *Computer* 36.6 (2003), pp. 39–43. DOI: 10.1109/MC.2003.1204373.

[77] S. Misra, V. Kumar, U. Kumar, K. Fantazy, and M. Akhter. "Agile software development practices: evolution, principles, and criticisms." In: *International Journal of Quality & Reliability Management* 29.9 (2012), pp. 972–980. DOI: 10.1108/02656711211272863.

[78] D. Bustard, G. Wilkie, and D. Greer. "The maturation of agile software development principles and practice: Observations on successive industrial studies in 2010 and 2012." In: *2013 20th IEEE International Conference and Workshops on Engineering of Computer Based Systems (ECBS)*. IEEE. 2013, pp. 139–146. DOI: 10.1109/ECBS.2013.11.

[79] L. Williams. "What agile teams think of agile principles." In: *Communications of the ACM* 55.4 (2012), pp. 71–76. DOI: 10.1145/2133806.2133823.

[80] T. Dingsøyr, S. Nerur, V. Balijepally, and N. B. Moe. *A decade of agile methodologies: Towards explaining agile software development*. 2012.

[81] X. Wang, K. Conboy, and O. Cawley. ""Leagile" software development: An experience report analysis of the application of lean approaches in agile software development." In: *Journal of Systems and Software* 85.6 (2012), pp. 1287–1299. DOI: 10.1016/j.jss.2012.01.061.

[82] K. Schwaber. "Scrum development process." In: *Business Object Design and Implementation: OOPSLA'95 Workshop Proceedings 16 October 1995, Austin, Texas*. Springer. 1997, pp. 117–134. DOI: 10.1007/978-1-4471-0947-1_11.

[83] K. Schwaber and J. Sutherland. *https://www.scrum.org/learning-series/what-is-scrum*. 2020. URL: https://www.scrum.org/learning-series/what-is-scrum (visited on 06/03/2023).

[84] M. Poppendieck and T. Poppendieck. *Lean software development: an agile toolkit*. Addison-Wesley, 2003.

[85] M. Poppendieck. "Lean software development." In: *29th International Conference on Software Engineering (ICSE'07 Companion)*. IEEE. 2007, pp. 165–166. DOI: 10.1109/ICSECOMPANION.2007.46.

[86] M. O. Ahmad, J. Markkula, and M. Oivo. "Kanban in software development: A systematic literature review." In: *2013 39th Euromicro conference on software engineering and advanced applications*. IEEE. 2013, pp. 9–16. DOI: 10.1109/SEAA.2013.28.

[87] B. Boehm and R. Turner. "Management challenges to implementing agile processes in traditional development organizations." In: *IEEE software* 22.5 (2005), pp. 30–39. DOI: 10.1109/MS.2005.129.

[88] L. M. Menzel. *Investigating the Adoption and Management of Metrics in Large-Scale Agile Software Development at a German IT-Provider*. Technical University Munich, Germany, 2021.

[89] IBM. *Agile Scaling Model: Be as Agile as You Need to Be*. 2011. URL: https://www.agilealliance.org/wp-content/uploads/2016/01/Agile-Scaling-Model.pdf (visited on 06/03/2023).

[90] Ö. Uludağ, M. Kleehaus, X. Xu, and F. Matthes. "Investigating the role of architects in scaling agile frameworks." In: *2017 IEEE 21st International Enterprise Distributed Object Computing Conference (EDOC)*. IEEE. 2017, pp. 123–132. DOI: 10.1109/EDOC.2017.25.

[91] Scaled Agile, Inc. *SAFe 6.0 - Full Solution*. URL: https://scaledagileframework.com/# (visited on 06/06/2023).

[92] J. Pernstål, R. Feldt, and T. Gorschek. "The lean gap: A review of lean approaches to large-scale software systems development." In: *Journal of Systems and Software* 86.11 (2013), pp. 2797–2821. DOI: 10.1016/j.jss.2013.06.035.

[93] C. J. Stettina and J. Hörz. "Agile portfolio management: An empirical perspective on the practice in use." In: *International Journal of Project Management* 33.1 (2015), pp. 140–152. DOI: https://doi.org/10.1016/j.ijproman.2014.03.008.

[94] M. Beedle. *Enterprise Scrum Introduction*. 2016. URL: https://medium.com/@mikebeedle/enterprise-scrum-introduction-a4987ee690d0 (visited on 06/03/2023).

[95] K. Schwaber. *The enterprise and Scrum*. Microsoft press, 2007.

[96] Scrum.org. *Nexus Guide*. 2021. URL: https://www.scrum.org/resources/online-nexus-guide (visited on 06/03/2023).

[97] M. Kalenda, P. Hyna, and B. Rossi. "Scaling agile in large organizations: Practices, challenges, and success factors." In: *Journal of Software: Evolution and Process* 30.10 (2018), e1954. DOI: 10.1002/smr.1954.

[98] M. Jørgensen. "Do agile methods work for large software projects?" In: *Agile Processes in Software Engineering and Extreme Programming: 19th International Conference, XP 2018, Porto, Portugal, May 21–25, 2018, Proceedings 19*. Springer. 2018, pp. 179–190. DOI: 10.1007/978-3-319-91602-6_12.

[99] M. Laanti, O. Salo, and P. Abrahamsson. "Agile methods rapidly replacing traditional methods at Nokia: A survey of opinions on agile transformation." In: *Information and Software Technology* 53.3 (2011), pp. 276–290. DOI: 10.1016/j.infsof.2010.11.010.

[100] K. Petersen and C. Wohlin. "The effect of moving from a plan-driven to an incremental software development approach with agile practices: An industrial case study." In: *Empirical Software Engineering* 15 (2010), pp. 654–693. DOI: 10.1007/s10664-010-9136-6.

[101] C. Wick. "Knowledge management and leadership opportunities for technical communicators." In: *Technical communication* 47.4 (2000), pp. 515–529.

[102] C. M. Johnson. "A survey of current research on online communities of practice." In: *The internet and higher education* 4.1 (2001), pp. 45–60. DOI: 10.1016/S1096-7516(01)00047-1.

[103] E. Wenger. "Communities of practice and social learning systems." In: *Organization* 7.2 (2000), pp. 225–246. DOI: 10.1177/135050840072002.

[104] A. L. Brown and J. C. Campione. "Communities of learning and thinking, or a context by any other name." In: *Contemporary issues in teaching and learning* (2002), pp. 120–126. DOI: 10.1159/000418984.

[105] L. Dubé, A. Bourhis, and R. Jacob. "The impact of structuring characteristics on the launching of virtual communities of practice." In: *Journal of Organizational Change Management* 18.2 (2005), pp. 145–166. DOI: 10.1108/09534810510589570.

[106] V. Allee. "Knowledge networks and communities of practice." In: *OD practitioner* 32.4 (2000), pp. 4–13.

[107] B. Iaquinto, R. Ison, and R. Faggian. "Creating communities of practice: scoping purposeful design." In: *Journal of Knowledge Management* 15.1 (2011), pp. 4–21. DOI: 10.1108/13673271111108666.

[108] J. Roberts. "Limits to communities of practice." In: *Journal of management studies* 43.3 (2006), pp. 623–639. DOI: 10.1111/j.1467-6486.2006.00618.x.

[109] J. Lave and E. Wenger. *Situated learning: Legitimate peripheral participation*. Cambridge university press, 1991.

[110] C. Kimble and P. Hildreth. *Communities of Practice-Vol. 1: Creating Learning Environments for Educators*. IAP, 2008.

[111] P. Putz and P. Arnold. "Communities of practice: Guidelines for the design of online seminars in higher education." In: *Education, Communication & Information* 1.2 (2001), pp. 181–195. DOI: 10.1080/14636310120091922.

[112] J. Cothrel and R. L. Williams. "On-line communities: helping them form and grow." In: *Journal of knowledge management* 3.1 (1999), pp. 54–60. DOI: 10.1108/13673279910259394.

[113] J. S. Brown and P. Duguid. "Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation." In: *Organization science* 2.1 (1991), pp. 40–57. DOI: 10.1287/orsc.2.1.40.

[114] M. A. Fontaine and D. R. Millen. "Understanding the benefits and impact of communities of practice." In: *Knowledge networks: Innovation through communities of practice*. IGI Global, 2004, pp. 1–13. DOI: 10.4018/978-1-59140-200-8.ch001.

[115] H. Tarmizi, G. de Vreede, and I. Zigurs. "Identifying challenges for facilitation in communities of practice." In: *Proceedings of the 39th Annual Hawaii International Conference on System Sciences (HICSS'06)*. Vol. 1. IEEE. 2006, 26a–26a. DOI: 10.1109/HICSS.2006.210.

[116] C. Kimble and P. M. Hildreth. "Communities of practice: Going one step too far?" In: *9e colloque de l'AIM,(May), Evry, France*. 2004. DOI: 10.2139/ssrn.634642.

[117] E. Wenger, R. A. McDermott, and W. Snyder. *Cultivating Communities of Practice: A Guide to Managing Knowledge*. Harvard Business School Press Boston, MA, 2002.

[118] Scaled Agile, Inc. *Communities of Practice*. URL: https://scaledagileframework.com/communities-of-practice/ (visited on 06/10/2023).

[119] V. Santos, A. Goldman, and C. R. De Souza. "Fostering effective inter-team knowledge sharing in agile software development." In: *Empirical Software Engineering* 20 (2015), pp. 1006–1051. DOI: 10.1007/s10664-014-9307-y.

[120] T. Sporsem, A. Tkalich, N. B. Moe, M. Mikalsen, and N. Rygh. "Using guilds to foster internal startups in large organizations: a case study." In: *Agile Processes in Software Engineering and Extreme Programming–Workshops: XP 2021 Workshops, Virtual Event, June 14–18, 2021, Revised Selected Papers 22*. Springer International Publishing. 2021, pp. 135–144. DOI: 10.1007/978-3-030-88583-0_13.

[121] M. A. Maher. "Diagnosing and changing organizational culture: Based on the competing values framework." In: *Journal of Organizational Change Management* 13.3 (2000), pp. 300–303. DOI: 10.1108/jocm.2000.13.3.300.1.

[122] R. L. Daft and D. Marcic. *Understanding management*. Cengage Learning, 2022.

[123] M. Tushman, M. L. Tushman, and C. A. O'Reilly. *Winning through innovation: A practical guide to leading organizational change and renewal*. Harvard Business Press, 2002.

[124] D. Šmite, N. B. Moe, J. Wigander, and H. Esser. "Corporate-Level Communities at Ericsson: Parallel Organizational Structure for Fostering Alignment for Autonomy." In: *XP*. 2019, pp. 173–188. DOI: 10.1007/978-3-030-19034-7_11.

[125] M. Kopf, V. Sauermann, and F. Frey. "Implement Communities of Practice in an agile IT environment." In: *Proceedings of the 23rd European Conference on Pattern Languages of Programs*. 2018, pp. 1–9. DOI: 10.1145/3282308.3282345.

[126] H. Kallio, A.-M. Pietilä, M. Johnson, and M. Kangasniemi. "Systematic methodological review: developing a framework for a qualitative semi-structured interview guide." In: *Journal of advanced nursing* 72.12 (2016), pp. 2954–2965. DOI: 10.1111/jan.13031.

[127] E. Wenger and W. M. Snyder. "Communities of practice: The organizational frontier." In: *Harvard business review* 78.1 (2000), pp. 139–146.