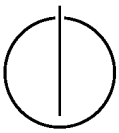
Master's Thesis
for the Attainment of the Degree Master of Science
at the TUM School of Management
of the Technical University of Munich

Investigating Large-Scale Agile Transformation Approaches: A Multiple-Case Study

Untersuchung von Ansätzen zur Durchführung von großen agilen Transformationen: Fallstudien mehrerer Unternehmen

Examiner:	Prof. Dr. Florian Matthes Software Engineering for Business Information Systems
Person in Support:	Ömer Uludağ, M. Sc.
Course of Study:	Management and Technology
Author:	Katharina Kusche
Submission Date:	05.06.2020



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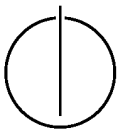

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Munich, June 5, 2020 Katharina Kusche

Abstract

With the advent of the digital era and the resulting volatile market environments, traditional companies face several challenges. These include shorter time-to-market cycles, continuously changing customer needs, and new technological advances. Enterprise agility is a popular concept for coping with these uncertain market environments and is, therefore, a key factor for the success of companies. Thus, enterprise agility enables companies to recognize and react quickly to environmental changes. The use of innovative and agile methods is one way of tackling these problems and requirements. Although the use of agile practices was initially designed for projects with small, single, co-located teams, there is a discernible trend that an increasing number of large traditional companies are taking advantage of agile development. Accordingly, in-the-large adoption of agile practices often leads to challenges and problems, such as cross-team coordination or communication. Moreover, the widespread adoption of agile practices and methods often forces traditional companies to undertake a large-scale agile transformation.

Although there are already several publications that describe challenges and success factors that companies face in large-scale agile transformations, research in the field of large-scale agile transformation processes and related coaching and training approaches, as well as enterprise agility as a whole, is still scarce. Therefore, it is essential to continue the research to obtain comprehensive insights and thereby create a profound and holistic understanding that is of great interest to researchers and practitioners alike. Consequently, this thesis aims to contribute to this field of research employing a multi-case study of large-scale agile transformations in six large traditional enterprises from various industries. Therefore, an in-depth analysis of transformation approaches to implementing and adopting agile practices is conducted. The thesis's findings comprise three parts: First, the motivators that induce organizations to opt for large-scale transformations are examined. In the second part, the transformation processes and thus, the implementation approaches of the respective companies are analyzed. Finally, the impacts on the work system, as well as challenges and success factors in the context of agile change, are determined.

Contents

Outline of the Thesis

CHAPTER 1: INTRODUCTION

The first chapter looks at the thesis' motivation with regards to the state of the current research and practice. Additionally, the objectives, as well as the research approach to achieve these, are described.

CHAPTER 2: FOUNDATIONS

The second chapter describes all relevant terms and concepts essential for the comprehension of the thesis. In the context of change management, the socio-technical systems theory is explained. Furthermore, an overview of agile development and large-scale agile development is given, and distinction to large-scale development is made. Finally, large-scale transformation strategies are derived.

CHAPTER 3: RELATED WORK

Chapter 3 reviews the literature on large-scale agile transformation processes and the resulting challenges, success factors, and consequences of introducing agile practices in organizations.

CHAPTER 4: CASE STUDY

The embedded multiple-case study that was conducted in the thesis is presented. First, the case study procedure is described, followed by an introduction to the large-scale agile transformations of the respective case organizations. In the next steps, the impacts, challenges, and success factors are derived.

CHAPTER 5: DISCUSSION

The discussion chapter presents the main results of the thesis and discusses its limitations.

CHAPTER 6: CONCLUSION

The last chapter gives a summary of the results and refers to approaches for potential future work.

1. Introduction

This chapter describes the rationale for research in large-scale agile transformation processes and approaches (see Section 1.1). Section 1.2 presents the objectives and particular research questions of this master's thesis. Subsequently, the research approach building the basis of this thesis is described in Section 1.3.

1.1. Motivation

In times of digital transformations, traditional companies are faced with several challenges. Volatile market environments require new innovative processes and business models. These are due to continually changing customer needs, severe time-to-market pressures, and the continuous emergence of new advances in information technology (IT) [12, 43]. Organizational agility is a popular concept used to cope with these uncertain market environments and is, therefore, an essential factor for companies' success. Organizational agility enables companies "to sense environmental change and respond readily" [48]. By using innovative, agile methods, it is possible to achieve a higher success rate in software development, improve the quality and speed of market introduction, and increase the motivation and productivity of IT teams [54]. One of the best-known methods is the introduction of Scrum [64] or Extreme Programming (XP) [73]. According to the State of Agile survey 2019 [73], 97% of all respondents stated that they practice agile development methods within their enterprises [73]. With 1,319 respondents from companies of different sizes, geographical locations, and industries, the study offers a comprehensive insight into the current market situation [73].

However, agile methods were initially designed for small, individual, co-located teams [13]. Nevertheless, large enterprises are increasingly interested in applying agile practices due to proven success stories. Even though implementation in large projects is much more difficult, there is a growing tendency for large organizations to opt for agility [56]. This is revealed in the State of Agile survey 2019 [73], in which 28% of the respondents worked in companies with more than 20,000 employees, compared to 26% in 2017 [72, 73]. Furthermore, the widespread adoption of agile practices often makes it essential for traditional companies to undergo a large-scale agile transformation [20, 28]. One reason for this is that these practices present many challenges in large-scale environments, as the complex socio-technical interdependencies increase with the size of the organization [19, 28, 56].

Nonetheless, the process of a large-scale agile transformation is not paltry and is associ-

ated with significant management challenges and consequences for the entire organization [27]. These challenges include the lack of flexibility, as well as coordination and communication problems [19]. To overcome these difficulties, consultants and practitioners propose agile scaling frameworks, such as Scaled Agile Framework (SAFe) [59], Large-Scale Scrum (LeSS) [36], or the Spotify Model [35]. These are designed to support companies in introducing agile practices. One shortcoming, however, is the neglect of company specifics [33].

Furthermore, there is little evidence of success or advice from software engineering research [19, 53]. This lack of studies on large software development organizations using agile methods is illustrated by the systematic literature research of Dikert et al. 2016 [20]. They identified only 10% of all papers as scientific studies on large-scale agile transformations [20]. Although the empirical literature describes challenges and success factors in the implementation of large-scale transformations [19, 20, 28, 70], there are only a few relevant studies available that describe the large-scale agile transformation process and provide insights into the coaching and training approach, as well as the impacts of enterprise agility as a whole [27, 28, 49]. Furthermore, there are almost no insights concerning the large-scale agile transformation approaches of companies, i.e., how companies proceed when implementing agile practices and methods. Thus, the available literature only sparsely describes two polarized large-scale agile transformation approaches as a one-time big bang transfer [26] or a step-by-step approach with pilot projects [27, 49]. Against this backdrop, we are pursuing the call for further research in the field of large-scale agile transformation processes [20, 27, 49]

The present master's thesis attempts to fill this gap by providing an embedded multiple-case study of large-scale agile transformation processes, focusing on the respective approaches and procedures of agile changes in six leading companies from various industries. The aim of the thesis is thus twofold: on the one hand, to contribute to empirical research and, on the other hand, to provide insights for practitioners.

1.2. Objectives

Based on the motivation of this research, we have developed specific objectives to provide a more in-depth and well-founded insight into large-scale agile transformation processes. Thus, the following five research questions (RQ) are examined in this thesis:

> **Research question 1:** What are reasons for large organizations to undergo agile transformations?

As already mentioned, literature and practice indicate that an increasing number of large companies are adopting agile methods, which, depending on their scope, can lead to a large-scale agile transformation. However, there is little information about what their rationales and intended goals are. Therefore, the first research question deals with the

drivers and triggers as well as the objectives for such an agile transformation.

> **Research question 2:** What transformation approaches exist to perform large-scale agile transformations?

The second research question aims to analyze the large-scale agile transformations and to identify the underlying approaches. Accordingly, we analyze the transformation processes of the individual enterprises in the first step to gain insights into the process. In the second step, we derive the transformation approaches applied by the respective companies. In the last step, we draw a comparison of the large-scale agile transformation processes based on the previous steps.

> **Research question 3:** What consequences do organizations face?

The third research question intends to illustrate the changes and, thus, the consequences on a company's work system caused by a large-scale agile transformation. Therefore, the aim is to identify the implications of introducing agile practices in the first step and cluster them in the second step. The analysis is built on the socio-technical systems (STS) theory [15, 16, 38]. According to this theory, the clustering is based on four components: management and organizational structures, people, work structures and processes, and technology.

> **Research question 4:** What challenges are associated with large-scale agile transformations?

To provide a holistic picture of large-scale agile transformations, we examine the challenges that companies are facing in the fourth question. This contributes to confirming and extending the list of problems already identified in literature [19, 20, 30, 49, 70, 73].

> **Research question 5:** What success factors are associated with large-scale agile transformations?

In contrast to RQ4, this fifths research question examines the most critical success factors that companies see in the course of a large-scale agile transformation. This confirms and expands the findings in literature [19, 20, 30, 73].

1.3. Research approach

This thesis's approach comprises two parts: a literature review and a case study (see Figure 1.1). This ensures both the accuracy and relevance of the research. The literature review aims to identify, on the one hand, general transformation approaches in the field of

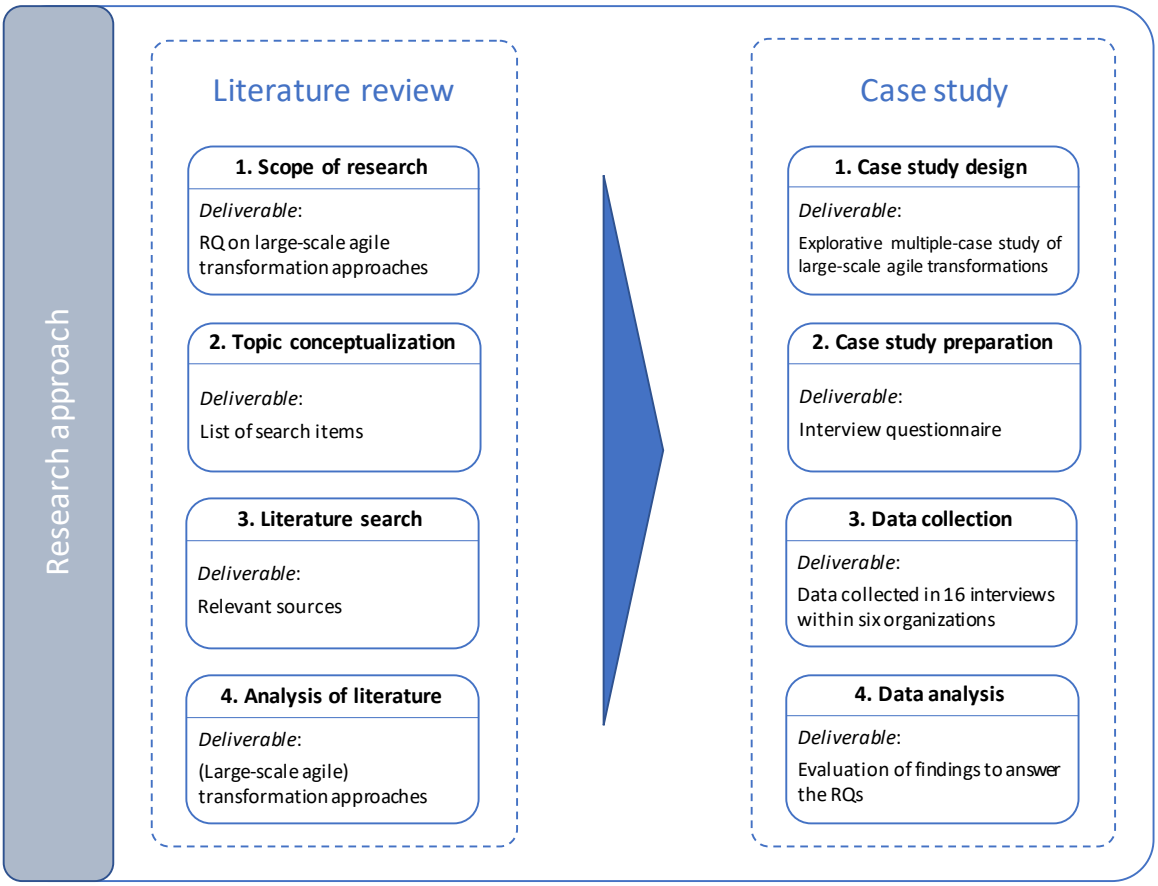

Figure 1.1.: Overview of research approach

information systems (IS) and, on the other hand, large-scale agile transformation processes, especially those exploring the adaptation approach of agile practices and methods. This provides the basis for answering RQ2. We apply the procedure described by vom Brocke et al. [17] for structured literature research in the field of IS, consisting of four phases. The first phase includes the scope definition of the study and the research questions. In the second step, relevant search terms are defined based on concept mapping. These include *transformation approach/strategy, (large-scale) agile transformation (approaches/strategies), large-scale agile implementation/adoption approach/strategy, scaled agile approach/strategy*, and are then used in the third phase, the literature search. The databases EBSCOhost, Sciencedirect, IEEE Explore, SpringerLink, Semantic Scholar, Scopus, and Google Scholar, are used to search for relevant articles, books, and white papers on the corresponding topics. In the fourth and last phase, the results are systematically evaluated.

In the second step, we conducted a case study to investigate large-scale agile transformation processes, which are the cornerstones of our research. According to the classification of

Yin [76], the present case study is an embedded multiple-case study. This research methodology examines contemporary phenomena in their natural context [58], and therefore, it is an appropriate research method. Moreover, it enables us to generate information and data that help us to address the goals and research questions formulated in Section 1.2. Our explorative multi-case study follows the layout, according to Runenson and Höst [58], as their methodology and guidelines are designed for research in software engineering. A detailed description of the case-study approach is given in Section 4.1.

The structure of the master's thesis is as follows. Chapter 2 explains the concept of socio-technical systems theory in the context of change management. Additionally, key terminologies and essential concepts are introduced and discussed, such as agile and large-scale agile development, with possible established agile methods, and the distinction to large-scale agile transformations. Furthermore, various large-scale agile transformation approaches are described; they are based on the analogy of the strategies for IS implementing IS strategies. Chapter 3 draws connections to related research. In Chapter 4, the embedded multiple-case study on large-scale agile transformation approaches and resulting consequences, as well as challenges and success factors, are described. Subsequently, Chapter 5 highlights the key findings and limitations. Chapter 6 closes the thesis with a summary of results and an outlook for future research.

2. Foundations

In this chapter, key terminologies and basic concepts are explained and defined to provide an understanding of the remaining parts of the thesis. First, a short introduction to change management, and in this context to STS theory is given (see Section 2.1). After that, the concepts and principles of classical agile development are introduced (see Section 2.2). Followed by a description of the large-scale agile development that has evolved from it, and known relevant frameworks in this context are outlined (see Section 2.3). Finally, the large-scale agile transformation, which will take a significant role in this paper, will be discussed. Therefore, a distinction to large-scale development is drawn. Based on the analogy of implementation strategies of large information systems within organizations, large-scale agile transformation approaches are described (see Section 2.4).

2.1. Change management

2.1.1. Definition

Modular and company-wide transformations are characteristics according to which organizational change can be classified as [18]. Large-scale agile transformations show considerable correspondence with these transformations. Since these transformations also involve changes at the departmental, divisional, or enterprise-wide level. The latter may even be characterized by a shift in the business strategy [24, 67]. Examples of such changes may include "reorganization, revision of interaction patterns, reformed organizational mission, and core values, and altered power and status" [24]. Therefore, a large-scale agile transformation can be seen as a change management process in an organization's information systems. Moreover, large-scale agile transformations can be considered as "a particular type of organizational change" [46]. According to Moran and Brightman's [47] definition, change management is [47]:

> *"[...] the process of continually renewing an organization's direction, structure, and capabilities to serve the ever-changing needs of external and internal customers. Mastering strategies for managing change is more important today since the rate of change is greater than at any time in history."*

Due to rapid entrepreneurial growth, many companies are confronted with the need to manage changes that this entails. However, about 70% of all change initiatives, such as the introduction of new technologies, downsizing, restructuring, or attempts to change the

corporate culture, end up in failure, which illustrates the difficulty that companies are faced with [11].

The most important aim is to maintain focus and understand the nature and process of change much better. Basically, two types of changes can be distinguished:

- **E change**, which is a reactive approach that emphasizes economic value. It increases yields by providing economic incentives, radical redundancies, and restructuring. It can be seen as "crisis change", and
- **O change**, which is a proactive approach that emphasizes the development of business culture and personal skills, acquiescently encouraging trust and emotional attachment to the enterprise through collaboration and communication. It can be seen as a "chosen change".

It is essential to have a strategy while planning change, be it crisis-driven or decision-driven. Often a combination of both strategies is chosen, which is very challenging, as both procedures are very different [11, 52]. Additionally, several factors are crucial for a successful change in a company: support from top management, a correct vision, open communication, persuading and reaching a critical mass, quick wins and short-term goals, and taking responsibility [32, 50].

2.1.2. Socio-technical systems theory

From a socio-technical perspective, enterprises are regarded as organizational work systems [15, 16, 38]. The socio-technical systems approach is introduced as a realistic view of organizations and as a framework for successfully realizing organizational change, especially concerning design and modification of information systems [5, 16]. A work system consists of two independent but interrelated systems, a *technical* subsystem and a *social* subsystem (see Figure 2.1).

The technical subsystem is made up of the dimensions *technology* and *task*. Task refers to "industrial organizations raison d' être: the production of goods and services, including the large numbers of different but operationally meaningful subtasks that may exist in complex organizations" [38]. Whereas, technology refers to "direct problem-solving techniques or computers [...]" [38], including both, machines and programs. Therefore, the technical part of the approach addresses development tools and technical platforms, as well as organizational and work processes [14, 42].

The social subsystem is made up of the dimensions *actor* and *structure*. Accordingly, the first component actor is related to the relationships between people and their characteristics, such as mindsets, abilities, and values [16]. Conversely, structure is concerned with "systems of communications, systems of authority (or other roles), and systems of work flow" [38]. Thus, the social part of the approach deals with both the project organization and institutional arrangements as well as with the individuals acting, e.g., users, managers, etc., in the work system [14, 42].

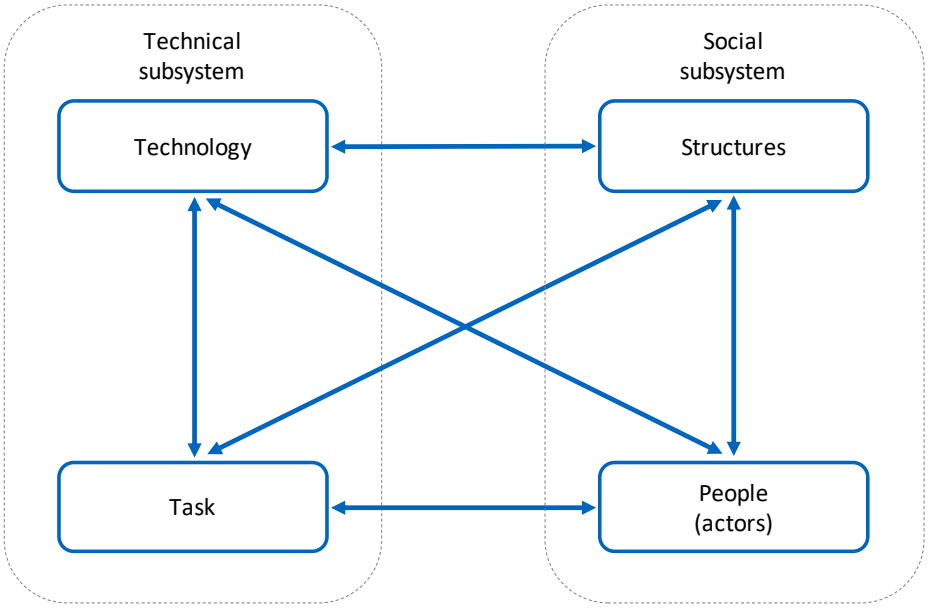

Figure 2.1.: The socio-technical model [16, 38]

As the arrow links illustrate in Figure 2.1, the four dimensions are highly interdependent and correlated with each other, so that changing one of the four levels usually results in changing one of the others to compensate this [38]. Thus, the intended results can only be achieved if these interdependencies are explicitly addressed and taken into account [14]. The crucial issue is to organize the tasks in such a manner that the two subsystems achieve a positive result, called "joint optimization", to avoid degradation in system performance and system utility [5].

In many management practices and research, the use of the socio-technical model as a guideline for implementing organizational change and improvement has a long history [5]. Moreover, it is appropriate to use the socio-technical systems theory as the underlying research objective, as it allows a holistic view of organizational change. By applying this theory, we are able to identify and cluster the observed consequences of the introduction of agile practices with the four dimensions of a working system and thus to the enterprise (see Section 4.6).

2.2. Agile development

2.2.1. Principles and values

"Agility is the ability to both create and respond to change in order to profit in a turbulent business environment" [29]. Moreover, it is a broad term and has become increasingly important over the last two decades [1]. In the field of software development, in particular,

a movement towards the increased adaptation of agile methods can be observed. Hence, more and more methods and practices evolving in the field of software development embrace higher change rates instead of rejecting them, as it is common in plan-oriented approaches [74]. However, agile software development is more about understanding than just applying agile methods. This is why 17 software developers, who designed many of the agile development methods, created and published the Agile Manifesto [10] in 2001. It comprises four values and twelve principles and laid the theoretical foundation for agile development [10]. The four values are as follows [10]:

"**Individuals and interactions** over processes and tools."

"**Working software** over comprehensive documentation."

"**Customer collaboration** over contract negotiation."

"**Responding to change** over following a plan."

The values are structured in such a way that although the segment on the right is essential, it is valued lower than the segment on the left. Thus, in each statement, the first part of the sentence indicates a preference, while the second part describes a lower priority issue. Nevertheless, the right side, i.e., tools, procedures, documentation, or contracts, cannot be neglected entirely. This distinction is the core of agility, but asking people to list what is valuable does not lead to significant differences. Therefore, it is not a "silver bullet" theory, but more an approach to help people with the use of agile practices [29]. In addition to this, the authors of the Agile Manifesto defined the following twelve principles that support these four statements [10]:

1. "Our highest priority is to satisfy the customer through early and continuous delivery of valuable software."
2. "Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage."
3. "Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale."
4. "Business people and developers must work together daily throughout the project."
5. "Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done.
6. "The most efficient and effective method of conveying information to and within a development team is face-to-face conversation."
7. "Working software is the primary measure of progress."

8. "Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely."
9. "Continuous attention to technical excellence and good design enhances agility."
10. "Simplicity – the art of maximizing the amount of work not done – is essential."
11. "The best architectures, requirements, and designs emerge from self-organizing teams."
12. "At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly."

The Agile Manifesto focuses on "continuously delivering working software while allowing for and supporting changing requirements" [39]. Benefits derived through adopting agile working methods are, for instance, an increase in productivity, quality, and job satisfaction, as well as faster time-to-market [39]. However, it is essential to understand that agility is a journey and that the right mindset is almost more vital to success than the mere implementation of agile tools, practices, or principles; these are primarily intended to facilitate and support this process [44]. Therefore, the values and principles are mainly focused on people and their mindsets as well as on customer satisfaction since these factors contribute significantly to the success of projects [61]. Based on the agile values, principles and practices, the agile methods are build upon and assemble the underlying principles [61]. These agile methods are commonly lightweight processes that actively involve users to create, prioritize and verify requirements, use short iterative cycles, and rely on the tacit knowledge of a team as opposed to documentation [13].

2.2.2. Scrum

One of the most popular agile frameworks is Scrum; according to the VersionOne survey 2019, 72% of the respondents stated they practice Scrum or a hybrid that includes Scrum [73]. Scrum was developed by Ken Schwaber and Jeff Sutherland and presented at the OOPSLA Conference for the first time in 1995. Together, they run the Scrum Guide [65], a manual that is public and continuously updated. According to this, Scrum is defined as "a framework within which people can address complex adaptive problems, while productively and creatively delivering products of the highest possible value" [65]. This is illustrated in Figure 2.2.

The Scrum framework is based on several fundamental principles, values, and practices. The three main cornerstones are transparency, inspection, and adaptation [65]. This clarifies that Scrum is not a standardized process to be followed step-by-step, but rather a framework in which the development teams decide what they do and how they obtain the result [75]. The practices of Scrum are anchored in specific roles, activities, artifacts, and corresponding rules. These principles link the roles, events, and artifacts and regulate the connections and interactions between them [65].

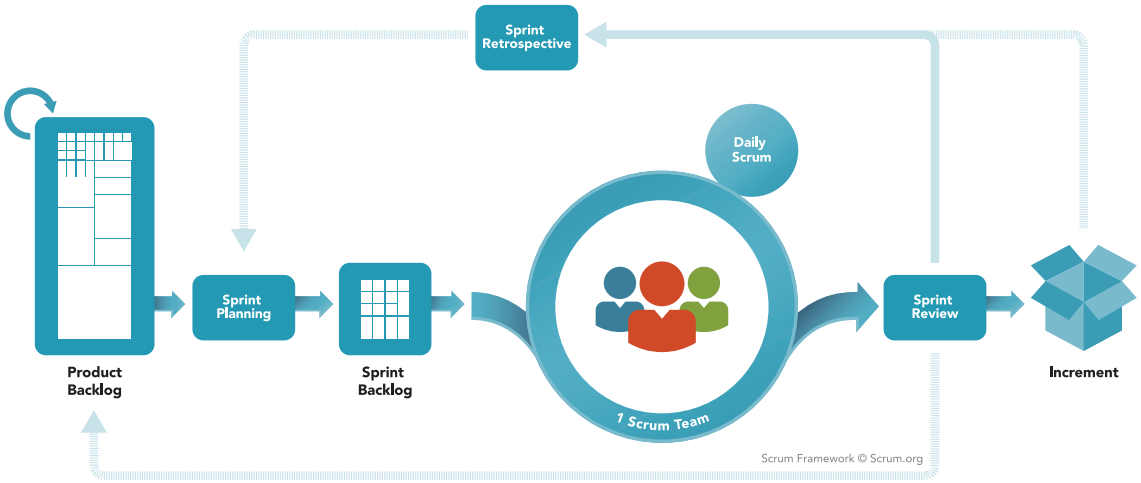

Figure 2.2.: Scrum framework [66]

The three artifacts are the *product backlog*, the *sprint backlog*, and the *increment*. The product backlog lists all features, functions, requirements, enhancements, and corrections that represent the changes made to the product in future versions [65]. Additionally, the product backlog is valid for the duration of the entire project. In contrast, the sprint backlog only exists for one sprint [62]. Furthermore, the sprint backlog consists of the product backlog items and a plan for the delivery of the product increment and the realization of the *sprint goal* [65]. It is the result of all sprint backlog items completed in the current sprint and the value of the increments of all previous sprints. It must always be ensured that a useful version of the working product is available in every phase and at any time. Hence, the daily sprint is vital to aid the development team in coping with the rapid, flexible workflow within a sprint [57].

The *scrum team* consists of three essential roles for the Scrum framework: the *product owner*, the *scrum master*, and the *development team*. Ideally, the Scrum framework consists of three to nine developers. Several scrum teams can exist within a scrum team development environment; it is also possible to introduce additional roles, but these are not essential [57]. The product owner is responsible for representing everyone's concerns and for managing the product backlog, i.e., that the most valuable functionality is first produced and then built upon [62]. The scrum master is accountable for the scrum process, for ensuring that the agile values and principles are lived and that everyone obeys the rules and practices of Scrum [57, 62]. The development team is responsible for completing the increment within a sprint. The development teams are self-managing, self-organizing, and cross-functional, so they are in charge of determining how the product backlog can be transformed into an increment within an iteration [62].

"The heart of Scrum lies in the iteration" [62]. This iteration is called *sprint*, which is time-boxed and usually lasts a maximum of one month. Each of the sprints is initiated by a

sprint planning, which lasts at most eight hours and aims to determine a plan with the work to be done for the next sprint. The plan, the so-called *sprint backlog*, is created collaboratively by the scrum team and based on the product backlog [62, 65]. Additionally, every morning during the sprint cycle, there are *daily scrums*, which is an inspect-and-adapt activity and lasts a maximum of 15 minutes. The schedule is based on three questions that each team member requests: What has been achieved in the last 24 hours? What are the goals until the next daily? Are there are any obstacles? [62, 65]. At the end of a sprint, the *sprint review* and *sprint retrospective*, both informal meetings, are held. The sprint review is used to inspect the sprint goal or the increment. The scrum team also receives feedback from customers and stakeholders. The results are product improvements, such as new or changed requirements in the form of product backlog entries. The time frame is set to a maximum of four hours [65, 75]. In contrast, the sprint retrospective, led by the scrum master, analyzes the sprint and the teamwork itself. The result is improvement measures for the process, which are implemented during the next sprint [62, 75]. The sprint retrospective lasts at most three hours and takes place after the sprint review and before the next sprint planning [65].

2.3. Large-scale agile development

The application of agile methods and practices was initially developed for small, self-organizing, and co-located teams [1, 13, 21]. Nevertheless, due to several proven success stories, large companies are increasingly interested in the implementation of agile methods. However, the application in large-scale projects is much more complicated, and in the majority of cases, does not run seamlessly [13, 21]. Thus, companies are often confronted with challenges and problems, such as cross-team coordination and communication [19, 28].

Although the empirical literature already addresses issues such as challenges and success factors in the large-scale agile development, there is a lack of a consistent understanding of the interpretation and terminology of large-scale agility [21, 56]. However, this is of enormous relevance and indispensable for further research in this field [51]. There are already several approaches by researchers describing agility on a large scale, most of which address size metrics such as the number of developers, team size, line of codes, or project budget [20, 21]. Dikert et al. [20], for example, define large-scale agile development as a project size that comprises at least six teams and more than 50 people. Based on these findings and to counteract the definition issue, Dingsøyr et al. [21] proposes a taxonomy that defines *large-scale* in terms of agility as two to nine teams, with each team comprising seven plus/minus two people. Additionally, they describe projects with ten or more teams as *very large-scale*. The distinction of the definitions depends on the extent of the additionally required coordination of the teams [21]. A different interpretation of large-scale agile development found in the literature is based on the project scope, i.e., how far-reaching the application of agile practices and methods is in the enterprise [23, 27, 51]. Fuchs et al. [27] define the levels as follows: "a) the use of agile methods in large firms, b) the

application of agile methods in large projects or large teams, c) the usage of agile methods in large multi-team settings, and d) the employment of agile practices and principles in firms as a whole" [27]. In sum, our understanding of agile development on a large scale is the application of agile methods and practices in a business environment that involves large projects or teams, multi-team settings, or the entire enterprise and at least six teams consisting of 50 or more people.

2.3.1. Scaled Agile Framework – SAFe

The Scaled Agile Framework (SAFe) is the most commonly used scaling framework and is mainly based on the approaches of agile development, lean product development, an systems thinking [73]. It was released in 2011 by Dean Leffingwell and is by currently version 5.0. The framework offers several configurations, including Essential SAFe, Portfolio SAFe, Large Solution SAFe, and Full SAFe. These differ in the scaling factor, i.e., the planned scope of the implementation of agile practices. Most of the configurations build on each other, which allows an individual adaptation of the framework to the needs of the enterprise [39]. The choice of setting is usually based on the number of employees or teams and can range from 50 to several thousand people. SAFe Essential is the starting point for implementing agile practices on a large scale and forms the basis for all other configurations. In contrast, Full SAFe is the most comprehensive and includes all the different setups (see Figure 2.3) [39].

The configurations also differ in the composition of various organizational levels, namely team, program, large solution, and portfolio level. Each layer integrates agile and lean practices, manages its activities, and is coordinated with the other layers. The team level, the basis, is composed of individual agile teams, consisting of a scrum master, product owner, and the development team, similar to the Scrum framework. If required, additional company-specific roles can be added [39]. However, compared to Scrum, the iteration cadence ('sprint'), only takes two weeks. The teams' applied agile practices are primarily based on Kanban, Extreme Programming, or Scrum to improve performance [59]. The Essential SAFe is made up of the program level, team level, and foundation layer. Moreover, the team layer and the program layer together form the *agile release train (ART)*. Each ART is linked to a particular *value stream*, representing the intended objective. The ART generally consists of five to twelve teams that develop and deliver incremental cadence-based solutions within a *program increment (PI)*. The PI cadence lasts between eight and twelve weeks [39]. The goal is to create a shared vision and mission within the ART [59]. Further roles such as the *product management* or *release train engineer (RTE)* are introduced. The former works together with the PO's and is not only responsible for implementing the customer requirements in the *program backlog* but also for prioritizing features within an ART. The RTE facilitates the processes within an ART and is the chief scrum master. Moreover, they are responsible for minimizing obstacles, balancing risk, and promote continuous improvement. The Portfolio SAFe configuration has an additional fourth level, namely the portfolio level. This forms the top level and corresponds directly with the

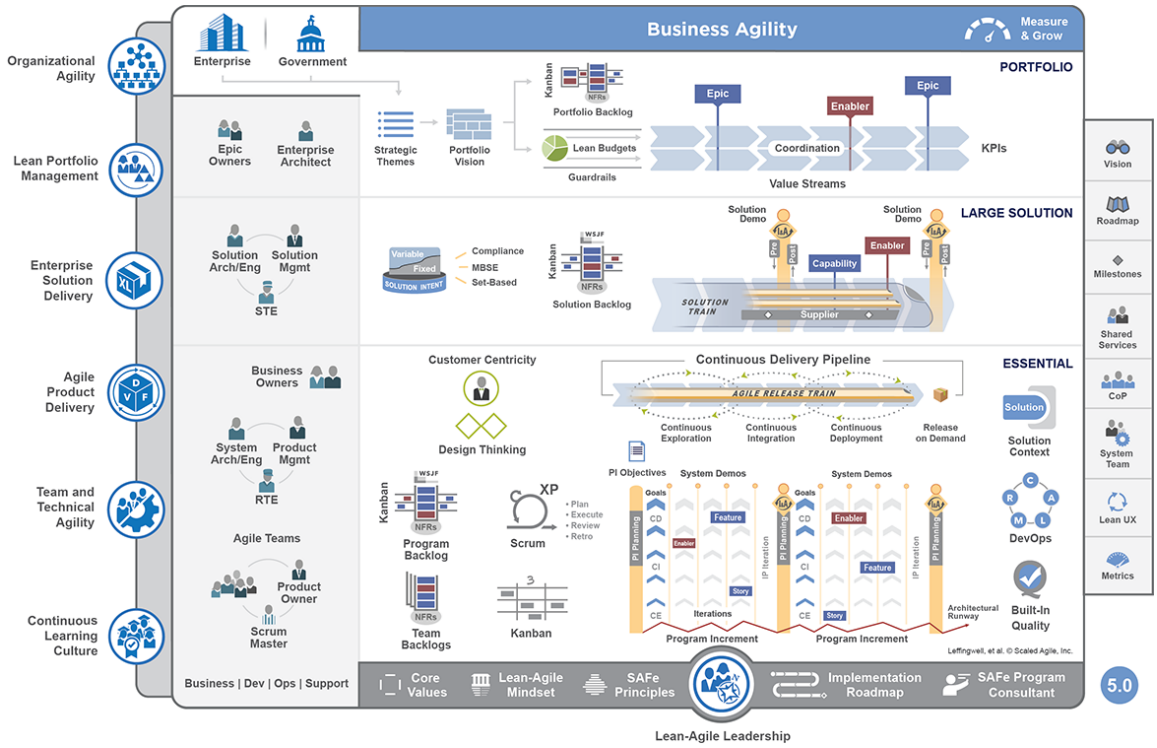

Figure 2.3.: Big picture of portfolio level SAFe (Full SAFe) [60]

program level or, if available, with the large solution level. The portfolio level differs from the other levels in that its function is also to align the corporate strategy with the execution of the portfolio. This is done by coordinating and optimizing one or more value streams. Additionally, this level manages investment intentions with budget and targets (*epics*). The epics and visions are then forwarded to the program level, where they are broken down and scheduled on the corresponding ARTs. Another optional level is the large solution layer. This is part of the Large Solution SAFe configuration and is comes between the program and portfolio level. However, it is usually only required for the development of extremely large and complex systems without taking the portfolio level into account. The Full SAFe configuration includes all levels (team, program, large solution, and portfolio) and the foundation layer [39]. This is the most sophisticated version and used primarily for the development of integrated solutions with multiple products and thousands of employees [59].

The SAFe framework is also anchored in specific values and principles. The four core values are *code quality*, *alignment*, *program execution*, and *transparency* [44]. These values are supported by the following ten principles [39]:

1. "Take an economic view"

2. "Apply systems thinking"
3. "Assume variability; preserve options"
4. "Build incrementally with fast, integrated learning cycles"
5. "Base milestones on objective evaluation of working systems"
6. "Visualize and limit WIP, reduce batch sizes, and manage queue lengths"
7. "Apply cadence, synchronize with cross-domain planning"
8. "Unlock the intrinsic motivation of knowledge workers"
9. "Decentralize decision-making"
10. "Organize around value"

2.3.2. Large-Scale Scrum – LeSS

The Large-Scale Scrum (LeSS) was published by Larman and Vodde [36] in 2008 and includes two scrum-based frameworks: *LeSS* and *LeSS Huge*. These differ mainly in the number of teams; LeSS consists of two to eight teams, while LeSS Huge consists of at least eight teams, and coordinates several thousand people [36]. Accordingly, the authors generally define them as follows: "LeSS is Scrum, applied to many teams working together on a product" [36]. However, both frameworks have some standard features, such as only one product owner, one product backlog, and one increment [36]. The transition from Scrum to LeSS attempts to solve the problem of global end-to-end focus by shifting the teams' attention to the whole product and not just to their task [37]. Therefore, it is designed for cross-component, end-to-end feature teams.

LeSS: The main difference between LeSS and the Scrum framework is the coordination and planning of sprint meetings [37]. Accordingly, sprint planning is divided into *sprint planning one* and *sprint planning two*. The first is the same for all teams; the product owner, and either team representatives or the entire team are participating. During the meeting, the product backlog items to be completed by the next sprint are collectively assigned to the teams. However, sprint planning two is implemented separately for each team. Alternatively, multiple teams can perform the *multi-team sprint planning two* if their items are closely coordinated [36]. At the end of the sprint, is a sprint review and a team retrospective, similar to Scrum. New in LeSS, however, is the *overall retrospective* in which the PO, the scrum master, and the team representative participate [36]. Furthermore, the sprint review differs slightly from the Scrum approach as it is a single meeting for all agile teams. Another decisive factor in the LeSS framework is that the teams are *feature teams*, i.e., "true cross-functional and cross-component full-stack teams" [36], consisting of three to nine people. The roles, artifacts, and meetings relevant for the LeSS framework are depicted in Figure 2.4.

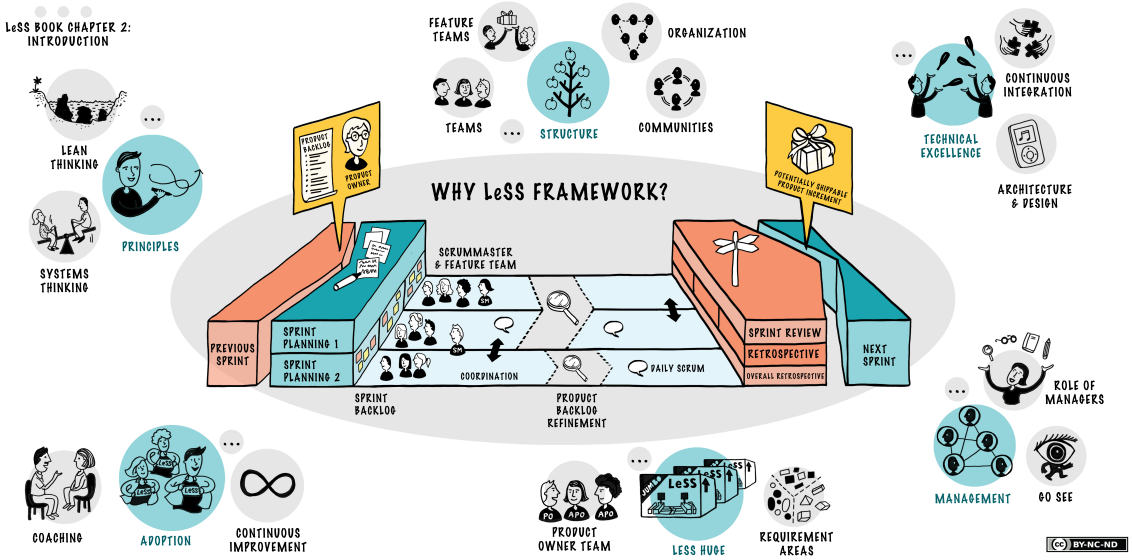

Figure 2.4.: Large-Scale Scrum by [6]

LeSS Huge: Basically, all LeSS rules also apply to LeSS Huge, unless otherwise stated, i.e., there are still sprint synchronizations and a common product backlog. However, a significant difference is the introduction of scaling elements to allow for proper coordination despite a large number of developers. This is realized by a third hierarchical level called the *requirement area (RA)* [36]. The RAs are usually divided around "main areas of customer concerns" [36]. In addition to this, a new role is introduced, the *area product owner (APO)* responsible for both the *area backlog* and the associated RA. Four to eight *area feature teams* are also assigned to the APO. This resembles a "small" LeSS framework. Additionally, there is an overall responsible PO who, together with the APOs, forms the *product owner team*. The PO's focus is mainly on the entire product development and optimization but they are also accountable for the assignment of the APOs and the division of the product into requirement areas [36]. Furthermore, the LeSS framework includes some principles that define it, and adherence to those is fundamental to its successful implementation, an overview is given in [7].

2.3.3. Spotify Model

Spotify created its own new agile working approach in their software development after the organization had grown into multiple teams, and the Scrum approach was no longer viable [35]. In 2012, Kniberg and Ivarsson [31] published this new approach called Spotify Model for the first time. The unique thing about the Spotify Model is that although the company has scaled up and is operating with 30 teams across three different cities, it retained an agile mindset. This agile engineering culture is one of the significant success factors of

Spotify [35]. However, as Spotify is a growing organization, and its environment is always changing, the model will also change, and adjustments will be necessary [31]. Therefore, the aim is to view the approach as a journey in progress and not as a completed journey [35]. Figure 2.5 gives an overview of the layout and structures as well as the respective roles of the Spotify Model [31].

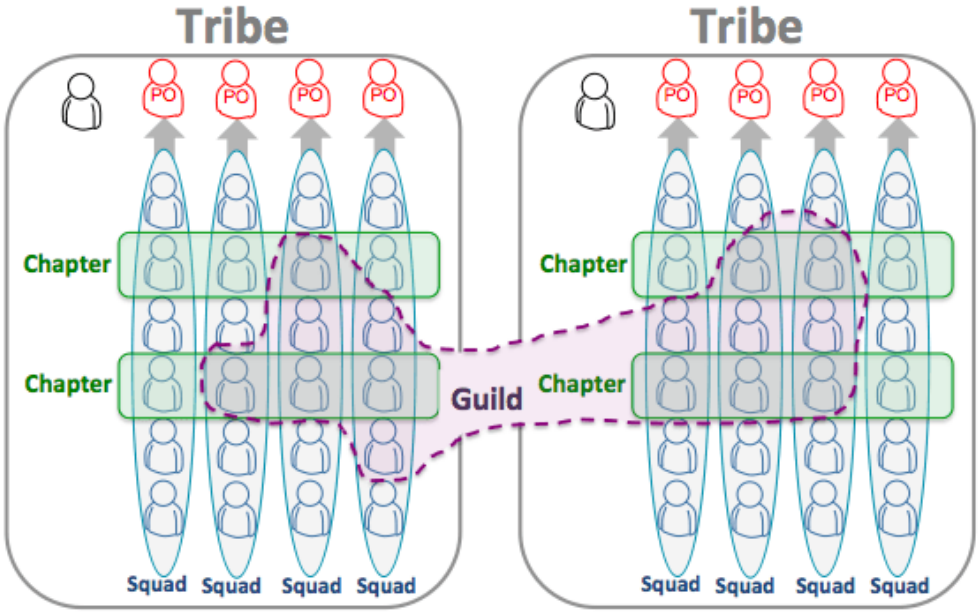

Figure 2.5.: The Spotify Model by [31]

The basic building block of development in the Spotify Model is called *squad* and is comparable to a scrum team. It is a small cross-functional self-organizing team, which usually consists of less than eight people. squads are autonomous, which means that each squad can decide what and how to build and work together while doing it [35]. Therefore, this little standardization implies that it depends on each individual squad, whether they are using scrum sprints, Kanban, or a mixed approach, etc. As each squad has its mission and keeps a part of the product for quite some time, they can genuinely become specialists in that area. In addition to the opportunity to work with an agile coach to further develop and improve the way of working, the squad teams can use 10% of working time for "hack days". The latter can lead to significant product innovations [31]. Every squad has its product owner, who is responsible for prioritizing the tasks of the team but does not decide how they are carried out [31].

Due to a large number of squads, they are grouped into *tribes*, a lightweight metric [35]. Tribes are a group of several squads working in related fields. Usually, these comprise less than 100 people, with a tribe lead in charge of creating the most appropriate environment for the squads within that tribe. Each person is a member of both a squad and a chapter

[31]. The squad is the primary dimension, focusing, for instance, on product delivery and quality. At the same time, the *chapter*, which consists of people with similar skills, is an area of expertise such as quality support, agile coaching, or web development within the same tribe. The chapter lead, the former line manager, coaches and mentors every squad member [35]. A *guild* is a lightweight "community of interest" where people from across the entire organization assemble and exchange knowledge in a specific area, such as governance, web development or continuous delivery. Anyone can join or leave a guild at any time. Guilds commonly use informal communication methods [35]. Since most squads are quite independent, there is usually no need for coordination meetings. Therefore, practices like Scrum of Scrums from the scrum approach, which can be considered as synchronization meetings, take place in the Spotify Model only "on-demand" [31]. Nonetheless, the tribes have regular informal meetings. At these meetings, they give an update on their current work and achievements. This encourages a learning effect on the other tribe members [31]. In summary, the Spotify Model is very well suited for product development with multiple teams. Compared to other agile frameworks, this approach has fewer formalities and advocates more decision making power for autonomous teams. By providing different types of communities of interest or practice that are established across teams, learning and coordination are facilitated [22]. However, since, as stated above, there are no architecture and implementation guidelines, it is a model that is continuously evolving and adapting to needs.

2.3.4. Overview of other scaling agile frameworks

In the previous chapters, the agile method Scrum and the three scaled-agile practices SAFe, LeSS, and the Spotify Model were introduced, as these are the most common agile practices in our case companies. However, there exist several other frameworks and guidelines that support large-scale agile development; for example, the Disciplined Agile Delivery (DAD) process decision framework, which is a hybrid approach that extends Scrum with methods from Extreme Programming, Kanban, Lean Software Development, and multiple other methods [4]. The concept of Nexus [63] is similar; it is based on Scrum with the focus on the dependencies and interoperations between the scrum teams. Additional well-known frameworks are RAGE [3], which is likewise a hybrid approach, or Scrum of Scrums [68]. A thorough overview is given in [3, 71].

2.4. Large-scale agile transformation

2.4.1. Definition

The implementation of agile methods on a large scale is not limited to the software development area of companies. The success of agile applications requires dynamic and fast interaction with other units that form the customer-oriented part of the business, such as

HR or Operations [9, 20, 27, 46]. For this reason, companies strive for a broader adaptation of agile methods beyond software development [46]. Moe and Mikalsen [46] refer to these efforts as large-scale agile transformations which they consider to be a special kind of organizational change that originates in the software development units. A similar definition is provided by Barrocca et al. [9]. Furthermore, they divide the research in the field of large-scale agile transformations into three areas: "a) challenges and success factors in the transformation process, b) changes in roles and practices that occur during such transformations, and c) models for understanding agile transformations" [9]. However, they criticize that while there are many views on agile transformations, there is often a missing underlying theory [9]. Another understanding of large-scale agile transformations is the "switch from a different development approach or work organization concept to agile methods" [27]. This can comprise, for example, a step-by-step approach where an agile pilot is scaled up to a large environment or a one-time big bang transition to agile methods in a large setting [27]. In our work, we adopt the latter definition in the context of large-scale agile transformations, the characteristics from our large-scale agile development definition (see Section 2.3) remain valid.

2.4.2. Transformation approaches

In order to obtain a more profound insight into the procedure of the barely studied field of large-scale agile transformation processes, it is necessary to investigate it by means of an underlying theory. First, to provide clear definitions of possible large-scale agile transformation approaches and, thus, to counteract the criticism of the lack of a theoretical foundation in literature and practice in this research field [9, 21]. Second, to create a solid basis for further research, and third, to help practitioners to find a suitable transformation strategy, especially concerning the aspects described in connection with the work system (see Section 2.1.2); since this is crucial for the success of the implementation of organizational change [40]. This is evident from the following statement by Eason [25]:

> *"If the process is effective it will end with a technical system able to support the work to be done, a social system that has adjusted to exploit the technical system and a population of users able and willing to use the technical system"*.

For this purpose, he identified five broadly diversified transformation approaches in the field of information systems: "The big bang, parallel running, phased introduction, trails and dissemination, and incremental evolution" [25]. However, there are more approaches, e.g., process line and hybrid strategies [40], or the factory approach [27, 69]. These strategies are not mutually exclusive, and often a mix of several strategies is used in practice [25]. In the following, we will discuss these strategies in the light of the large-scale agile transformation approaches we identified in the literature (see Figure 2.6).

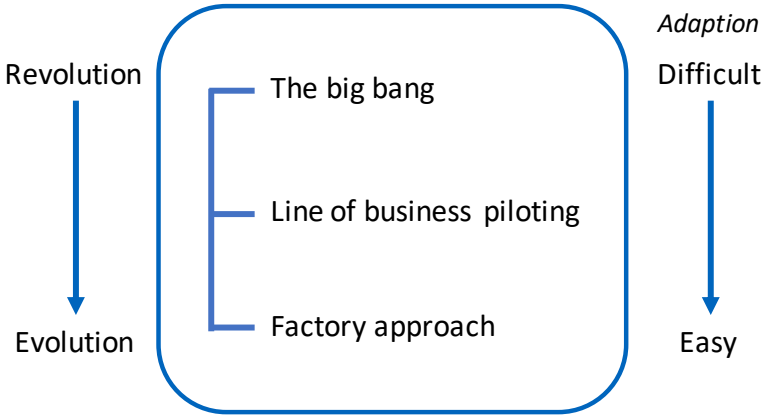

Figure 2.6.: Implementation strategies based on [25]

The big bang (full-scale approach)

In an agile environment, in contrast to installing systems in IS, such as ERP systems, the implementation of a big bang transformation strategy does not happen all at once, with the new system going live and the old system shut down simultaneously [25, 26, 40]. Instead, the establishment of an enterprise-wide agile environment occurs within a certain time, i.e., the roll-out of agile practices is implemented in a very tight time frame [26]. As a rule, comprehensive and careful preparation and planning before implementation are crucial, on which success ultimately depends [25, 40]. However, this approach comes at the expense of regular business, since, in general, not everything will work smoothly right from the very beginning. It can take weeks or months until a comparable or higher performance can be achieved again. Although the aim is often to minimize resources, more resources are needed initially, for example, for change management and technical staff and trainers [25].

Within the big bang strategy, there are different variants: the mini big bang, the multi big bang, and the mega big bang. These differ by division into smaller sections, geographical locations, which are centrally organized, and a giant big bang according to the "do or die" maxim [40]. However, the big bang approach bears a relatively high risk of failure compared to other transformation strategies. In general, it can be said that this strategy is more suitable for smaller companies than for complex change processes [25, 40], or for companies with independent units, modular architecture, and agile culture [2]. Besides this, there are some disadvantages, including a substantial cultural change and a risky, long-term transformation with legacy architecture, culture, and structure [2], as well as the potentially severe consequences of implementation failure [26, 40]. In contrast, there are also some advantages, like the avoidance of complex integration issues, a good concept for rapid implementation, and the elimination of decisions regarding sequencing [40]. Additionally, this makes it possible to avoid organizational dissonance and to meet the desire for decisive action [26]. A key argument for this approach is also the "critical mass argument" [25].

Figure 2.7 shows how a full-scale big bang approach might look.

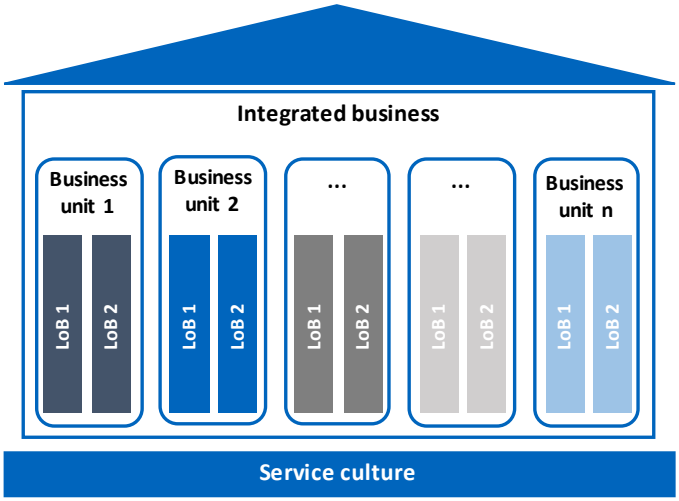

Figure 2.7.: Full-scale big bang approach based on [2]

Line of business piloting

The process line strategy splits the implementation approach to manage similar or parallel business processes or product lines [40]. The changeover is first carried out in selected business lines or processes. The approach often consists of a sequential or progressive implementation over a certain period [2, 25, 27, 34, 40]. The procedure's advantage is that the personnel specialized in the change can concentrate on a specific area or some of the people; this allows a more even distribution of resources [25]. Other positive features are that this strategy offers a certain degree of flexibility and that a successful partial implementation of the system can already make a positive contribution to the overall project, as initial successes strengthen the organization's confidence in the new agile way of working [40]. Additionally, it enables the units with urgent agile needs [2]. The gradual or progressive implementation of agile practices for different business lines or units is best achieved when users in various business lines or areas should use similar agile methods but can use them relatively independently of each other. It is common practice to form an implementation or transformation team that moves from business line to business line and helps the teams and individuals adopt the new agile practices and trains the users [40]. Nevertheless, this strategy has some disadvantages, such as a higher time expenditure for implementation [40] or the risk of increasing heterogeneity, e.g., different technology stacks [2]. Other difficulties are the loss of synergies and shared capabilities [2]. Figure 2.8 illustrates how a possible process line transition within a company could look like.

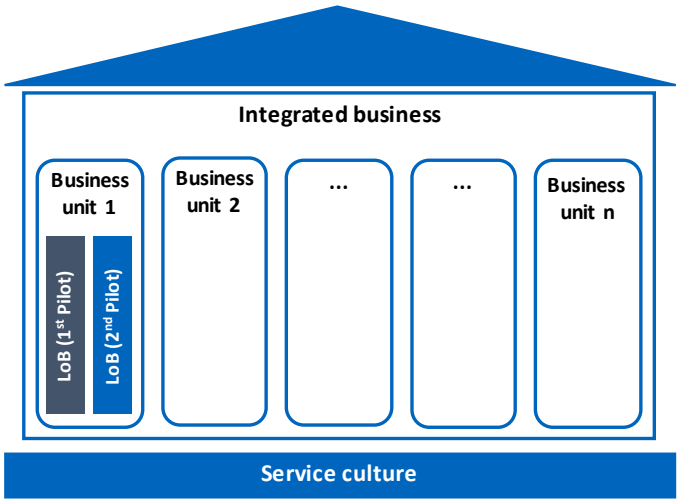

Figure 2.8.: Line of business piloting approach based on [2]

Factory approach

Using this strategy is a good way to start the implementation with a trial or boot camp since many problems usually occur during a transformation [25]. More specifically, it is a small-scale implementation trial with smaller teams or individuals trained in agile working methods over a long time in a separate location detached from their original function and department. They learn to work cross-functionally and are enabled to take the initiative to become autonomous teams [27, 69]. This system or factory approach is ideally used for live work [25]. The aim is to test the system or agile practices and methods to be implemented on a broader basis. The factory approach strategy offers the possibility to identify problems arising from the interaction between the technical and social systems, e.g., the type of training required. Once most of the issues have been identified and solved, it is often assumed that large-scale implementation is feasible without too many difficulties [25]. Furthermore, such an agile boot camp will increase the company-wide interest in agile methods [27]. However, a shortcoming of this factory approach is that the solution methods do not apply to all groups in the same way [25] and that the proper coordination and strategy makes it very time-consuming [2]. Other potential shortcomings are, first, the perception of a two-tier society within the company, as not every employee can become part of this boot camp. Second, it can complicate the organization's social structures, as team members and entire teams are moved to a isolated location, which impedes communication with employees who were not involved in this special agile training [27]. The visualization can be seen in Figure 2.9.

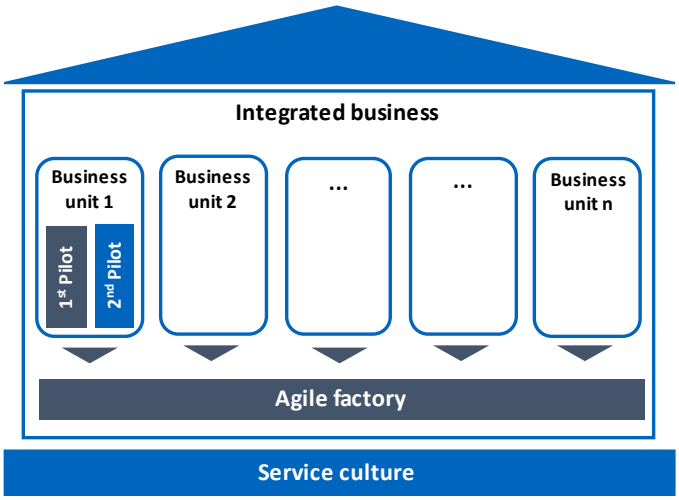

Figure 2.9.: Factory approach based on [2]

There are several transition strategies when implementing, e.g., ERP systems, although most of them are variants of the four basic types [25, 40]. The same applies to the adaptation of agile practices, where often not single approaches, but a mixture of variants is used [27, 49].

3. Related work

The chapter summarizes the existing research in the field of large-scale agile transformations, which justify the importance of further studies in this area. Accordingly, empirical studies that focus on large-scale agile transformation processes (see Section 3.1) and describe the classifications of challenges and success factors (see Section 3.2) are presented.

3.1. Related work on large-scale agile transformations

Fuchs et al. (2018)

Fuchs et al. [27] conduct two in-depth case studies to investigate large-scale transformation processes with the help of socio-technical systems theory. They do it on the one hand, to expand the rather scarce empirical literature on the challenges and the associated coping and scaling measures of large-scale agile transformations through relevant theoretical findings and, on the other hand, to provide managers with guidance on how to manage agile transformations in the course of digital transformation [27]. Fuchs et al. [27] discovered that companies proceeded step-by-step in the transition. Thus, the large-scale agile transformation process can be represented in four phases. Consequently, the overall process of these transformations consists of several agile waves. Fuchs et al. [27] interpret a large-scale transformation as episodic, socio-technical change, which can be represented by a sequence of transformation phases (see Figure 3.1). These phases comprise two periods consisting of a radical change, i.e., a revolutionary period and an incremental change. The latter occurs up to the point where one or more obstacles to large-scale agile transformation appear, which triggers the need for radical change. Consequently, the alternating periods of radical and incremental change are necessary to evaluate and refine the organizational approach used in the agile transformation process [27]. Furthermore, Fuchs et al. [27] were able to derive three main barriers in their study: "a) the coordination of different organizational worlds, b) the difficult selection of the right people, and c) the suitability of agile methods" [27].

Paasivaara et al. (2018)

Paasivaara et al. [49] present a thorough single case study on a large-scale agile transformation process in Ericsson's R&D organization. The goal of introducing agile practices in-the-large was continuous feature delivery for the new XaaS platform and the associated

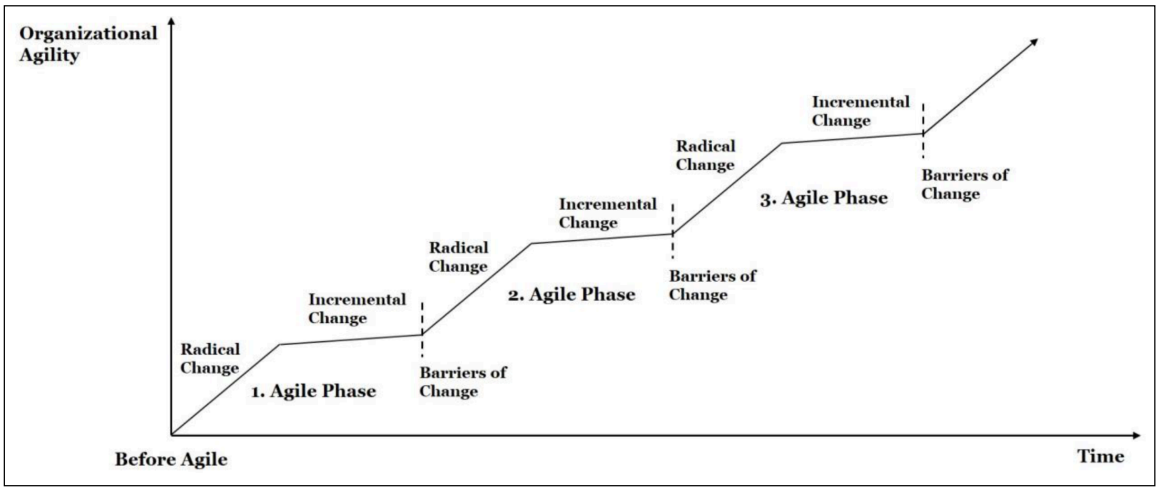

Figure 3.1.: Large-scale agile transformation process according to [27]

set of services. The three motivators for an agile transformation were alignment with the corporate strategy, dissatisfaction with the prevailing working methods, and the necessity for faster and continuous end-to-end deployment of functions [49]. Moreover, Paasivaara et al. [49] identified four phases of the agile transformation at Ericsson [49]:

1. "Knowledge transfer and component-based teams"
2. "Introducing agile"
3. "Finding common ground through value workshops"
4. "Towards continuous integration and deployment"

Likewise, they assign the introduction of agility to four phases. The phases describe how today's agile team structure developed from the initial organizational structure [49]:

1. "Building a pilot cross-functional agile team"
2. "Full-scale roll-out of cross-component, cross-functional agile teams"
3. "Creating a competence pool providing team members to cross-component teams according to the needs of each feature"
4. "Cross-component, cross-functional teams specializing on specific business flows"

These are particularly relevant for this thesis. Besides identifying challenges such as *resistance to change*, *lack of coaching and training*, and *challenges in defining the role of the product owner*, to name just a few, they derive four lessons learned [49]. Of particular interest is the fact that Ericsson chose a step-by-step approach, as this was the only way to ensure

continuous delivery of features despite change [49].

Gerster et al. (2018)

Gerster et al. [28] investigate in their study agility at organizations and their challenges and implications when adopting it. Therefore, they conducted an explorative case study with ten global companies and used the socio-technical systems theory to examine changes in an organizational context. Thus, they show that introducing agile practices has extensive consequences for products, processes, technology, people, and structures.

The *coexisting of agile and non-agile units* and *resolving resource conflicts between products* are two governance aspects affected by the implementation of agile practices in the structural dimension. The former, for example, and therefore, foreseeable conflicts can be addressed by reducing interfaces between agile and non-agile units [28]. In the task dimension, Gerster et al. [28] identified *product definition*, and *product portfolio* as main affected issues regarding products. In terms of product definition, a focus shift towards products and outcome-orientation is observable. Concerning the product portfolio, they observe that the introduction of agile practices implies more vigorous attention to the business value as well as to customer journeys. Furthermore, in terms of processes, they identified *budgeting*, *sourcing*, and *controlling* as main affected issues. The former, for example, requires a shift to product-oriented budgeting [28]. On the technology level, they identified a high impact on *IT-Architecture* as well as on *software development* and *software tools*. Due to short iterations and continuous planning, a stable technology stack is essential [28] *Job-profiles and roles*, *performance appraisal and compensation mechanisms*, and *corporate culture* are affected aspects in the actor dimension. The resulting de-hierarchization requires the initiative and self-organization of the employees, simultaneously also creates new job roles. Additionally, an appropriate corporate culture that promotes an agile transformation becomes essential [28].

Fry and Greene (2007)

Fry and Greene [26] describe in their experience report how Salesforce, an IT company, carried out an agile transformation in the R&D area with 200 employees within three months. The motivation for the transition from a waterfall-based process to an agile approach was, among other issues, the late receipt of feedback on features at the end of the release cycle or declining productivity as the team grew [26]. As a result, Salesforce chose a big bang approach for adopting agile practices. The main drivers that led the company to opt for a big bang approach rather than an incremental one were organizational dissonance and the willingness to act decisively.

However, the company benefited from an already existing test system, a suitable software model, and the planned merger of the R&D organization, which are prerequisites that significantly facilitated the transition. The implementation was driven by a cross-functional scrum team that was responsible for the introduction and already had experience with

agile methods. Additionally, the majority of the people had to pass the Scrum certificate. There were also training sessions for the teams as well as internal wiki-based websites. Fry and Greene [26] describe as initial successes, for example, *focus on team throughput rather than individual productivity*, *defined organizational roles*, *automation team focused on build speed & flexibility*, or *potentially release-able product every 30 days*. Furthermore, they name the following as the most important milestones of the introduction [26]:

1) "the management's commitment to change;"
2) "the formation of a dedicated roll-out team to facilitate change;"
3) "the focus on principles rather than mechanics;"
4) "the early focus on automation and continuous integration;"
5) "providing radical transparency, and"
6) "the use of external agile training and coaching".

Despite the successful agile transformation, they learned some lessons as well, such as *involve more individual contributors early*, *train product owners earlier and with more intensity*, or *get outside coaching earlier*, to name a few [26].

3.2. Related work on challenges and success factors in large-scale agile development

Dikert et al. (2016)

In their study, Dikert et al. [20] present a systematic literature review of industrial large-scale agile transformations to identify challenges and success factors in these transitions. To this end, they analyze 52 publications, 46 of which are industrial experience reports, and only six remain research papers. In total, they identify nine categories for challenges, some of them are *resistance to change*, *integration of non-development functions*, and *lack of investment* [20]. They can also identify eleven success factors categories such as *selection and adaptation of the agile approach*, *management support*, *training and coaching*, as well as *mindset and direction* [20]. Moreover, since there is a lack of reliable research evidence, the success factors and challenges are perceived and explained as necessary by practitioners

Uludag et al. (2018)

Based on the work of Dikert et al. [20], Uludag et al. [70] present a secondary study on challenges in large-scale agile development. Furthermore, they focus on challenges that are directly related to stakeholders; they consolidate 14 stakeholder roles. Uludag et al. [70]

introduce the concept of large-scale agile patterns to provide best practices for stakeholders' recurring difficulties and initiatives in implementing agile practices on a large scale. In total, they identified 79 challenges among 41 newly emerging ones, and the remaining 38 are strengthened by large-scale agile development. These challenges are clustered in eleven groups. Furthermore, they identified several generalizable findings regarding stakeholders or program-related difficulties, for example, *scaling agile development entails new communication and coordination challenges* [70].

Conboy and Carroll (2019)

In comparison to Dikert et al. [20] and Uludag et al. [70], Conboy and Carroll [19] present challenges and recommendations related to the implementation of large-scale agile frameworks, such as Scrum at Scale, the Spotify Model, Large-Scale Scrum, Nexus and other mixed or adapted large-scale agile frameworks. They examined 13 agile transformation cases over more than a decade and identified nine challenges and corresponding recommendations to mitigate each one. Figure 3.2 provides an overview of the phases that organizations have gone through in adapting agile practices on a large scale. Conboy and Carroll [19] identified the following difficulties with the most significant impact: *Defining concepts and terms, comparing and contrasting frameworks, readiness and appetite for change, balancing organizational structure and frameworks, top-down versus bottom-up implementation, overemphasis on 100% framework adherence over value, lack of evidence-based use, maintaining developer autonomy, misalignment between customer processes and frameworks* [19].

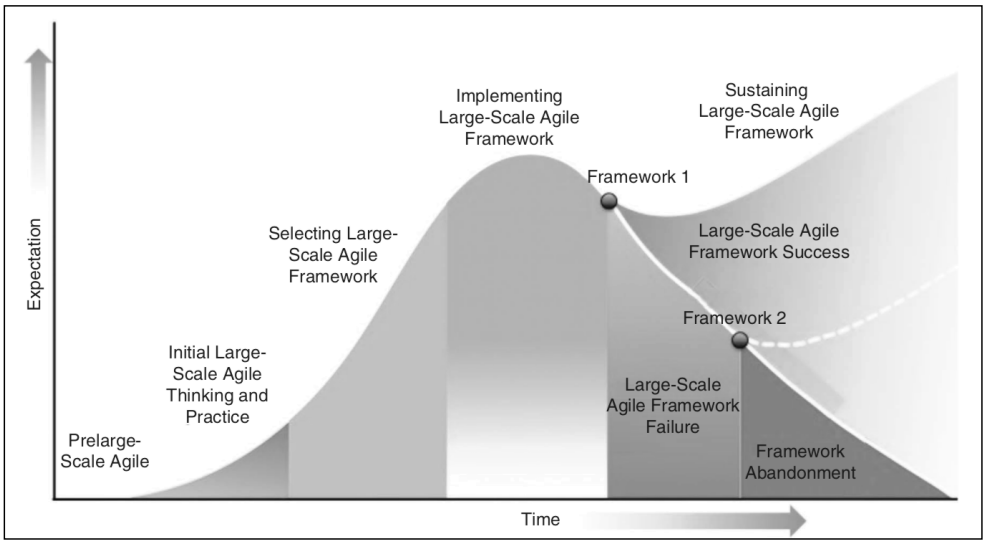

Figure 3.2.: The adoption of large-scale agile frameworks according to [19]

Kalenda (2018)

Kalenda et al. [30] aim to collect more evidence about impact factors during an agile scaling process. Therefore, they follow a twofold approach in their study: In a first step, they identify success factors and challenges as well as scaling practices used by large enterprises employing a literature review. In the second step, they conduct an action research study based on their results from the literature research. It took place during a process of scaling agile methods within a software company to derive challenges, success factors, and specific scaling practices. Kalenda et al. [30] discover that the results of the case study are similar to those from the literature. Within the case company, they determine four challenges: *resistance to change*, *quality assurance issues*, *integrating the previous and non-agile parts of the organization*, and *too fast roll-out*. They also identify four success factors, namely *unification of view and values*, *executive sponsorship/management support*, *company culture*, and *prior agile and lean experience* [30].

4. Case study

The following chapter discusses the results of the embedded multiple-case study. First, the case study design is presented (see Section 4.1). Next, an overview of the case organizations (see Section 4.2), as well as their motivation for undergoing a large-scale agile transformation, is given (see Section 4.3). This is followed by a description of the used transformation approaches (see Section 4.4) and a summary of the derived findings (see Section 4.5). Subsequently, the implications of the agile transformation are analyzed and clustered using the four dimensions of the socio-technical systems theory (see Section 4.6). Finally, the resulting challenges (see Section 4.7) and success factors (see Section 4.8) are derived. Figure 4.1 illustrates the framework and structure of the case study.

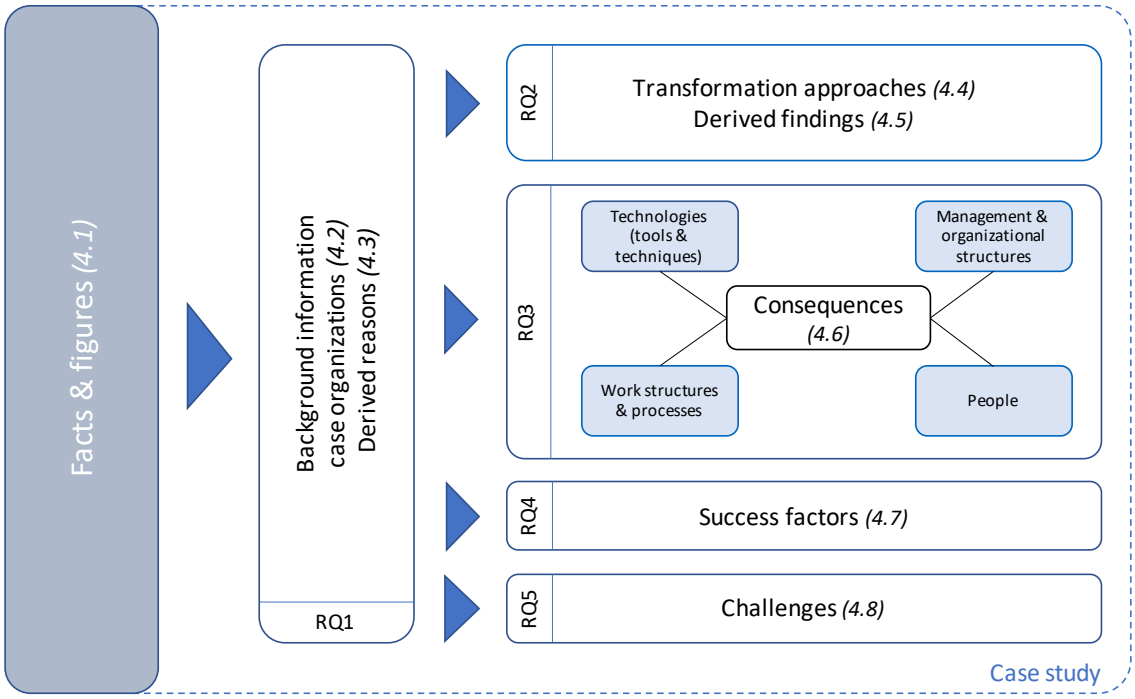

Figure 4.1.: Overview case study structure

4.1. Case study design

Throughout the thesis, the enterprises are named *case organizations* and abbreviated with *InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2,* and *TechServCo*. Since the research questions are guided and driven by a practical problem, case study research is applied, as it provides an in-depth overview of real-life situations and contemporary phenomena [76]. The layout of the explorative multiple-case study is based on the guidelines according to Runenson and Höst [58].

Case study design and planning

The research is based on the embedded multiple-case study design, since several units of analysis are examined in some of the six case organizations mentioned above. This allows for a cross-case analysis [76]. Additionally, the cases were selected from various sectors, including insurance, retail, automotive, technology and electrical engineering, as well as industrial goods and services, to avoid a possible bias of the industries [55, 76]. We focused on selecting companies that have been undergoing a large-scale agile transformation for at least one year to gain deep insights into the transformation approach and the advantages and disadvantages. In Table 4.1 an overview of the case companies and interviews is presented.

Data collection

We applied the first-degree technique for data collection, as personal interviews in exploratory research allow detailed discussions [41]. The interviews were semi-structural. Therefore, the questionnaire contains a combination of predefined open and closed questions that resemble more the form of a guided discussion rather than a structured sequence of questions [58, 76]. This type of questioning allows for improvisation and exploration of the objects examined. It enables the interviewees to speak openly, and thus, sharing their insights, personal views, and interpretations [55, 76]. A total of 16 interviews were carried out between November 2019 and February 2020. The interviews lasted between 40-90 minutes and were conducted mainly in face-to-face meetings, or if not possible, via Skype meetings (see Table 4.2). In order to reduce the bias created by using one researcher only, two to three researchers were always present in the interviews [58]. For evidence reasons, at least two persons per company or department were interviewed. The questionnaire of the semi-structured interviews can be found in Appendix A.1.

Data analysis

The qualitative data analysis was conducted according to Miles et al. [45]. For this, we used

Industry and abbreviation of case organization	Headquarters location	Company size [employees]	No. of interviewees	Position of interviewees
Global insurance company ("InsureCo")	Europe	150,000+	2	Head of customer processes and digital services; agile master
Consumer retail company ("RetailCo")	Europe	50,000+	2	Chapter lead data engineering; senior agile coach
Global powerhouse focusing on technology and electrical engineering ("TechElecCo")	Europe	400,000+	3	Platform software architect; head of software development; head of agile transformation
Car manufacturer ("CarCo1")	Europe	150,000+	5	Project manager (agile coach & scrum master); IT specialist; change transformation manager; transformation agent; area product owner
Car manufacturer ("CarCo2")	Europe	50,000+	2	Change leader of engineering & team director of functional systems; director & transformation leader of the vehicle stream
Global supplier of technology and services ("TechServCo")	Europe	400,000+	2	Team leader; agile master

Table 4.1.: Overview and specifics of case organizations and conducted interviews

the data analysis software MaxQDA 2018®[1]. The recorded interviews were transcribed and then coded. To get a first understanding of the cases, deductive coding related to our research questions was used.

[1]https://www.maxqda.de

ID	Case organization	Role	Alias	Years of experience with agility	Level of experience with agility	Duration [in min.]
I1	InsureCo	Head of customer processes and digital services	HCPDS	16-20 years	Expert	61
I2	InsureCo	Agile master	AM1	5-6 years	Advanced	59
I3	RetailCo	Senior agile coach	SAC	12 years	Advanced to expert	55
I4	RetailCo	Chapter lead data engineering	CL	8 years	Expert	67
I5	TechElecCo	Platform software architect	PSA	10-11 years	Advanced	51
I6	TechElecCo	Head of agile transformation	HAT	11 years	Advanced to expert	57
I7	TechElecCo	Head of software development	HSD	19 years	Expert	84
I8	CarCo1	Project manager (agile coach & scrum master	PM	15 years	Expert	44
I9	CarCo1	IT specialist (scrum master)	ITS	2 years	Advanced	67
I10	CarCo1	Area product owner	APO	3-4 years	Advanced	59
I11	CarCo1	Change transformation manager	CTM	7 years	Advanced	76
I12	CarCo1	Transformation agent	TA	4 years	Advanced to expert	43
I13	CarCo2	Change leader & team director	CLTD	9 years	Advanced	64
I14	CarCo2	Transformation leader & director	TLD	23 years	Advanced	65
I15	TechServCo	Team leader	TL	11 years	Expert	65
I16	TechServCo	Agile master	AM2	5-6 years	Advanced to expert	71

Table 4.2.: Interview partner and details of interviews

4.2. Case descriptions

This section provides a brief description with relevant information about each case organization, including their motivation and goals for a large-scale agile transformation. Thus, the first research question is covered here. Figure 4.2 visualizes the structure of the case descriptions.

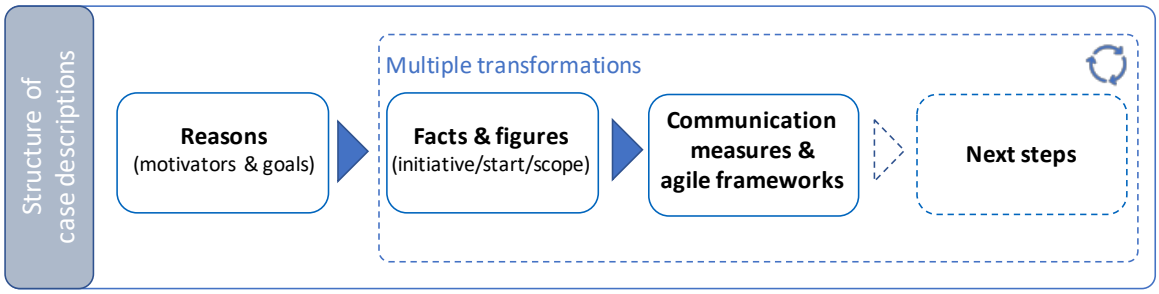

Figure 4.2.: Structure of case descriptions

InsureCo

InsureCo's rationale for a large-scale agile transformation in the German market was to secure its competitiveness and market share, especially during a time when the financial and insurance sectors are undergoing a turnaround with the emergence of new business models and an increasing number of start-ups. This led to several goals that needed to be achieved. For instance, the transformation should enable the company to react more quickly to market changes and needs and to develop and launch products faster. Another goal was the reduction of "waste", meaning developments that nobody needs in the end (I1, HCPDS).

After the first transformation had failed for various reasons in 2007, InsureCo decided to start another attempt at a large-scale agile transformation in 2016. It was initiated from the top-down but implemented from the bottom-up and started in Germany's IT development department, which had about 2,000-3,000 employees. Since "the heart of this agile transformation is information technology" (I1, HCPDS), and IT runs through the entire company, every area of the enterprise was affected. The first step was an initial pilot phase with only a few teams who received intensive training, isolated and off-site. After that, special locations, so-called agile training centers (ATCs), were established. In ATCs, employees worked together in co-located teams cross-functionally, detached from their original tasks and obligations. At that time, the ATC had 200 employees split into 20 agile teams. Since mid-2019, about 1,000 to 2,000 employees had been working with agile methods inside and outside the ATC. Extensive company-wide communication measures and agile methods/frameworks based on various standards were introduced to support and establish agility. A step-by-step approach followed according to the trial and error principle, resulting in a

tailor-made framework that consisted of various elements of SAFe, LeSS, and the Spotify Model as well as individual experience.

RetailCo

In the case of RetailCo, the reasons for the transformation included the need to adapt the business model to changing market conditions more reactively and efficiently, the internal complexity due to redundancies in the areas of responsibility, and very high costs. This led to the goals, increased speed of adaptation and reaction to market changes and customer needs. Furthermore, more employee commitment, thus reducing complexity within the organization, a long-term cost reduction, and faster time-to-market in the IT product development.

The large-scale agile transformation was driven strongly top-down from c-level and started at the end of 2017. The transition was structured in three waves to complete it as quickly as possible. The first wave and thus, the start of the transformation began in the IT department as well as in the responsible business units to ensure business-based product responsibility. There were 93 teams, each consisting of seven to eight employees. In the second wave, the business departments, e.g., HR, Controlling, etc., were reorganized so that all people working on the business side also became agile. In the last wave, the country units were transformed. In addition, an agile coaching department was established to support the overall process. The main objective was to create a centrally controlled, product-led organization.

Furthermore, extensive company-wide communication measures and agile methods/ frameworks based on various standards were introduced to facilitate and establish agility. Therefore, SAFe, LeSS, and Scrum of Scrums were used for this purpose. With the implementation mostly completed, RetailCo was at that time in the inspection and adaptation phase.

TechElecCo

The unit of analysis is a subsidiary of TechElecCo, which employs over 50,000 people worldwide. Two large-scale agile transformations within this unit of analysis were investigated, but they were not mutually exclusive; they were connected or overlapped. In the following, we speak, therefore, of transformation A and transformation B. The drivers and triggers for a transformation were similar in both examples. They can be summarized as ensuring market leadership by being open to new business models and being able to react quickly to market requirements and thus remain competitive. This led to the following objectives: faster, better, and smarter ways of product development, quality improvement, e.g., through earlier feedback, coping with complexity, and improved productivity and efficient utilization of resources.

Transformation A was a large-scale agile transformation at department-level, the so-called software development department, subordinated to the R&D department. It was one of

the first agile movements within the TechElecCo, initiated from the top-down, and started with the first pilot project in 2008. The broader roll-out followed in 2010/2011, and since 2014/2015, this transformation has been completed from a project perspective. By the end of 2019, 30-40 scrum teams consisted of 250 people. The used agile method/framework was Scrum of Scrums, as neither the SAFe nor the LeSS, or other common approaches existed at that time.

However, the question was how to promote this to gain utility for the whole organization and not just parts of it. Therefore, transformation B started at the end of 2017, focusing on product definition and the R&D units. It started from the headquarters, in this case, Germany, with some business units and divisions, and the aim was to spread it further. The procedure can be roughly divided into three steps: first, to show people the benefits of a large-scale agile transformation within an organization and how they can benefit from it in their daily business. In addition, the values and principles behind them are to be conveyed, thus raising employees' understanding of these issues. Second, to begin the transformation, including experimenting with team-of-team approaches and starting the first ART. Thirdly, implementing the change on a large-scale and merging the ARTs into more broad solutions. Another task is the parallel improvement and dissemination within the organization.

In addition to a central unit that supported the business units during the transformation, extensive company-wide communication measures, and agile methods/frameworks based on various standards were introduced to facilitate and establish agility. SAFe, LeSS, Scrum of Scrums, and Nexus were used to that end, although the use of SAFe was recommended. At the end of 2019, there were 15 business units, of which about eight had already started the transformation. Moreover, 700 to 800 people were already working in an agile environment, but twice as many have received training.

CarCo1

Several large-scale agile transformations were studied at CarCo1 in different departments and divisions. In the following, these transformations are denoted from C-G. The reasons for the changes were very similar throughout the company. Competitiveness was at the top of the list; especially in the automotive industry, it is essential to adapt to volatile markets and to develop new business models accordingly. Another driver was a sharper customer focus, for example, through higher quality and increased stability. However, there were also internal factors such as the handling of complexity and end-to-end responsibility. Speed, in the sense of faster reaction to changes in requirements, more rapid product development, and quicker market introduction as well as lower costs, were the intended goals. We decided to describe the transformation F as it seems most interesting to us in the further course of the thesis. The remaining transitions are only briefly explained based on their essential characteristics.

Transformation C started in 2016 and involved a sub-department of the Digital Products department, which had about 1,000 employees. One hundred people across 14-20 teams were affected, with 60-70 people from that sub-department, and the remaining people

were affected through their cross-functional work. According to the interviewee, the hope was to make a big step in the transition by mid-2020. The transformation approach can be described as parallel sequential piloting of several teams, with the pilot phase lasting about six months. The goal was a continuous roll-out, not a big bang. The initiative was top-down, and it was initially recommended to use LeSS as a framework, although it was heavily modified, e.g., by introducing new roles. The next steps are to further shape the teams, define the product more deeply, and map the product within the teams.

The following two transformations, D and E, were part of the same initiative under the slogan "100% agile" of the former CIO. However, each division was responsible for its implementation. In particular, the departments dealing with product development were part of this movement. Even if it was one initiative, we consider them as independent transformations; since, as already mentioned, each business unit was responsible for its change, and no uniform concept existed.

In transformation D, the initial preparations began in 2017, and the implementation started in 2018. The large-scale agile transformation in the IT department included about 2,000 employees. Even within the department, the approach was not a big bang but rather a parallel line of business piloting, i.e., the line managers were in some way responsible for implementing it in their area of responsibility.

Transformation E also started in 2017 with the initial plan to have the implementation completed by 2019. However, due to a change at the management level in 2018, as described above, it was accompanied by a significant reorganization. The department comprised around 4,000 people, of which half of the people should end up working with agile methods, most of whom were developers. To support and establish agility, extensive company-wide communication measures were offered, such as meetings, events, and forums. Additionally, agile methods and frameworks were introduced, including LeSS and Scrum of Scrums. Due to the management change, a strong movement back to the classic V-Model (cf. [8]) could be observed. At the beginning of 2020, there were still between 250 and 300 people working in an agile way. Due to the mentioned management change, it is difficult to predict what the next steps in this initiative and, therefore, of transformation D and E will be.

Transformation F did not involve one specific division or business unit, but is rather a virtual construct called Innovation Hub in the further course of the thesis. It was composed of various business lines. Transformation G is a business line that was part of this Innovation Hub. The development of this merger began in mid-2019 and involved around 3,000 employees. The Innovation Hub attempted to combine cross-functional and end-to-end work within the organization, i.e., to generate a value stream that ranges from requirements definition to the end-user/product. In terms of agility, the aim was to create a centralized solution instead of individual, uncoordinated initiatives, following several changes in upper management. This decision was also supported by the fact that best practices already existed in some business lines. In addition to this, extensive communication measures and agile methods/frameworks based on various standards were introduced to facilitate and establish agility. For the Innovation Hub, there was not just one solution, since the business lines involved had already established their agile methods. Still, it was intended to make

sure that "everything fits under one roof" (I11, CTM). Nevertheless, the SAFe model was chosen as a potential framework, but with the idea of picking out individual elements.

CarCo2

The lack of speed and quality needed to manage the transition to new business models that support products and services presented some reasons for a large-scale agile transformation at CarCo2. Another cause was the demand for flat hierarchies that enable change to meet tomorrow's challenges that the company will face, such as software-driven innovation. This resulted in the following goals: faster responsiveness and time-to-market to drive future innovations, and thus, become an innovation-based organization, as well as achieving customer satisfaction and ensuring profitable growth. The transformation started in the summer of 2017 and was strongly driven from the top-down and involved the entire R&D department with about 8,000 employees. Before the actual start of the transformation and the decision to conduct it strictly according to the SAFe roadmap, there were a few pilot projects. However, these were discontinued, and they went to "live implementation without callbacks" (I13, CLTD). The core transformation team, consisting of 80-100 people, supported the individual business units within R&D. At that time, 700 teams were working in an agile mode. The implementation phase should be formally completed by the end of 2019.

TechServCo

The large-scale agile transformation at TechServCo was more an IT product-related transformation than a transformation on a company or business unit level. Although several initiatives had started within the case organization, they were not centralized, and each followed an individual approach. In the following, the unit of analysis is, therefore, the IT product-related transformation mentioned above. Reasons for this transformation included mainly the handling of the growing complexity of a large and important software product, by the distribution of responsibility to different teams, as well as dealing with increasing team size. This would not be possible with the conventional "waterfall" approach. This resulted in the following goals: improving efficiency and increasing customer satisfaction, on-time delivery, faster development, and reduction of maintenance costs. In 2014, this project switched from a non-agile approach to an agile approach with Scrum. To handle the ever-growing team size, a first scaling-up initiative was launched from 2016 to 2017. It was implemented according to the LeSS framework. Due to stringent adherence to the LeSS handbook, this transformation attempt failed after nine months. Internally, they named this phenomenon of failure "agile fundamentalism" (I15, TL), illustrating that adaptations are necessary. However, after learning from the mistakes, in a second try in 2018, the right changes were made, resulting in a successful transformation trial. Despite the effort to keep the agile teams separated from the company's traditional development endeavors, there were still hierarchical structures and regulations. Although the management gave this ini-

tiative the necessary freedom due to its success, it tended to be driven from the bottom-up. To support and establish agility, agile methods/frameworks based on different standards have been introduced. Among others, elements from LeSS, Scrum at Scale, Spotify Model, and completely self-invented ones were used. At that time, the transformation was in the adapting phase. In addition to this, since early 2020, a merging of two agile product teams to a big product team with 80 people and approximately seven teams has started.

4.3. Summary reasons

In addition to the drivers and triggers that led to the decision for a large-scale agile transformation, the interview partners were asked about the objectives they are striving for through this change. These were already addressed in the respective case description. However, in order to draw a well-founded conclusion and answer for the first research question, they will be compared again. A list of the mentioned goals is given in Table 4.3. The indicated frequencies show that the different case organizations partly pursue the same or similar aims. Most respondents indicated that the reasons or drivers and triggers for a change largely overlap with the goals that such a transformation aims to achieve. Therefore, both triggers and drivers, as well as goals, are considered as reasons in the following comparison.

Each case organization cited both *changing markets and needs* and *speed* as reasons for undergoing a large-scale agile transformation (InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2, TechServCo). More specifically, speed was mentioned in 67% of the cases in connection with "faster responsiveness" and "faster product development" (InsureCo, RetailCo, TechElecCo, CarCo1). "Time-to-market" and "delivery on time" were also reported in connection with speed (CarCo1, TechServCo). Five out of six companies explicitly named *competitiveness* in the market as goal (InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2), which in turn is also closely linked to the driver *changing business models*, which 67% of the case organizations stated (InsureCo, RetailCo, CarCo1, CarCo2). *Handling/coping with complexity* and *efficiency* were also listed by four companies (RetailCo, TechElecCo, CarCo1, TechServCo). Whereas *customer satisfaction* and *higher quality* were only considered by 50% (TechElecCo, CarCo1, CarCo2, TechServCo). The remaining reasons were mentioned by at most two companies and are, therefore, not explained in detail; they can be seen in Table 4.3.

Reasons	Number of case organizations
Changing markets and needs	6
Speed	6
Competitiveness	5
Changing business models	4
Handling/coping with complexity	4
Efficiency	4
Commitment and empowerment of people	3
Higher quality	3
Customer satisfaction	3
Digitalization/innovation	2
Reduction of costs	2
Better planning and results	2
Reduction of "waste"	1
State of the art technology	1
Earlier feedback	1
Better working conditions	1
End-to-end responsibility	1
Lean portfolio management	1
Need for scaling up	1

Table 4.3.: Reasons for large-scale agile transformations

4.4. Transformation approaches

The following section aims to address the second research question. Consequently, the large-scale agile transformation approaches in the enterprises are described in more detail in order to provide more in-depth insight and understanding of the procedure.

InsureCo

The implementation process of the large-scale agile transformation at InsureCo was not limited to a single approach but allowed plenty of room and opportunities to try out different strategies. The decision to do so was mainly based on the fact that there was not one single approach that fitted all the different teams and products that existed within InsureCo (I1, HCPDS). Primarily, the foundation of agile training centers (ATCs), and elements of the Spotify Model within agile centers (ACs) could be identified. The basic idea behind the ATCs was to take the employees out of the traditional line organization and to put them into an experimental environment to learn and internalize agile principles and values, as well as agile work structures and methods. Afterward, the people returned to the organization or special ACs in the two headquarters in Germany. They were integrated into

a tribe of several agile product teams to practice and spread this agile way of thinking (I1, HCPDS; I2, AM1). A virtual corporate structure was set up as a result. The line organization was, thus, still the same as before, with the same smaller and larger departments. However, as previously described, an attempt was made to take employees out of these departments to have them work in cross-functional teams. Thus, the employees still belonged to their old departments, but it was possible to build up these agile teams quickly. However, it had the drawback that almost every single employee within a team had a different supervisor, which sometimes led to an inevitable conflict of goals and responsibilities. Nevertheless, the line structure of the organization will only be changed when more experience is gained, and when it is clear how it should look in the future (I2, AM1). In general, the transformation process was characterized by small steps. In the last two and a half years, it had proven to be successful in taking one step and seeing if it works, and if it does, to continue with this approach or to try something else, if the approach was not successful (I2, AM1).

The initiative and the high-level idea for a transformation within InsureCo originated from the CIO and was, therefore, top-down driven and received firm support from the top management. However, a plan for the actual implementation was developed by the employees in the first two agile teams, such as how to assemble the teams and under which conditions they are supposed to work (I1, HCPDS; I2, AM1).

In 2016, at the very beginning, there were two teams, each consisting of ten to twelve persons who underwent intensive training for three to four months. One team was sent to an external agile coaching company, which was completely isolated without any ties to InsureCo. There the training was held according to the principle of job shadowing, i.e., each InsureCo employee was assigned to an agent of the external contractor who coached and supervised them. The team was, thus, introduced to agile thinking and, at the same time, developed the new product together with them (I1, HCPDS; I2, AM1). The other team underwent the same procedure and also had very intensive training, but on-site (I2, AM1). After that, the agile training center was set up, and other teams were sent to it and underwent a phase of agile training. It begins with a boot camp, starting with their first MVP[2] in a hundred-day cycle. However, this did not involve job shadowing but rather assigning individual agile trainers or masters to support the teams (I2, AM1). After completing this training cycle, employees left the agile training center and moved to the agile center, where they continued to build and maintain the product they had developed (I1, HCPDS). The groups' size was ten to twelve persons, and the planned training duration was between three and six months. At the end of 2019, about 1,000 to 2,000 employees were working with agile methods inside and outside the ATC, of which the ATC had 200 employees split into 20 agile teams (I1, HCPDS; I2, AM1).

Extensive company-wide communication measures were put into place to ensure that everyone received a minimum, right amount of information and had the opportunity to contribute (I1, HCPDS). Some general formats included newsletters or webcasts to which every employee from the entire IT development department was invited and in which

[2]https://www.agilealliance.org/glossary/mvp/

necessary information was disseminated. Besides that, town hall meetings were used to inform employees about the agile approaches, what had been achieved so far, and the plans for the near future (I1, HCPDS; I2, AM1). There were also some more specific formats, such as web-based training or the agile breakfast. In the latter, anyone interested in agile methods could take part in it and received a very detailed introduction to agile methods as well as built up personal connections. Moreover, there was a team within the ATC that acted as an "ambassador of agility" (I1, HCPDS). It offered coaching support inside and outside the agile training center. Along with these communication measures, agile methods, and frameworks based on various standards were also introduced. Here, InsureCo had looked at multiple scaling methods. The result was a tailor-made framework that consisted of various elements of the frameworks SAFe, LeSS, and the Spotify Model as well as individual experience (I1, HCPDS; I2, AM1). At that time, the ATC's focus was on IT product development; therefore, almost all agile teams delivered software. The next steps are to find out how the agile idea can be scaled to the rest of the staff in this IT product development and to find possibilities to transfer it to other departments as Finance, HR, etc. (I1, HCPDS; I2, AM1).

By then, the first results could be recorded, such as a shorter time-to-market with the right and successful products and higher quality in terms of fewer bugs the teams have to fix. Another notable success is that people are happier and, therefore, more motivated (I2, AM1). Interviewees were also asked what they would have done differently in retrospect. One point was to involve colleagues much more at an earlier stage, for example from HR, in order to create role descriptions more easily and quickly and, thus, give employees a much better orientation (I2, AM1). The other interviewee stated:

> *"I would have scaled, I would have taken it to the whole organization a lot faster. We were very careful and cautious, and now I think we could have done it a lot faster"* (I1, HCPDS).

One reason for choosing this mixed approach and not a big bang strategy (see Section 4.4) was the excessive risk of failure and the consequences for the company and its customers. Furthermore, at that time, the current market conditions did not make this a mandatory requirement. In fact,

> *"it is more that the market conditions are very focused on providing a very stable environment because especially the finance industry [...] is very unsure, volatile, a lot is going on in the world, and therefore, we as an insurance company need to provide a safety network, a safety zone that people can rely on, and I think this is a powerful motivator for us not to throw everything away, but rather to take small steps and know what we are doing"* (I2, AM1).

RetailCo

One of the main reasons for the transformation was the financial situation of RetailCo and, thus, the need to establish a new business model. Therefore, the urgency for a

transformation was very high, and everyone understood why a change was inevitable (I4, CL). A lot of experiments with agile working methods had already been carried out successfully; accordingly, there already were departments that worked agilely, and there was also a successful Customer Relationship Management project at the company level, which can be considered as a proof-of-concept. This demonstrated to the executive board that agility is a concept that works (I3, SAC; I4, CL). At the beginning of the transformation, a well-known consulting firm was commissioned to manage the agile transformation for the first six months. After the initial CTO of RetailCo left, an interim CTO was provided by the consulting firm for that period. Besides the on-boarding of the transformation, they were responsible for finding a successor CTO for the company (I3, SAC).

In the first step, a group was selected, a so-called agile coaching department, to support the transformation. People from different levels and areas were involved, such as senior managers, VPs of technology, and existing agile coaches within the organization. Initially, this department could be divided into two parts: the management part, which drove the transformation, and the agile coaching part. However, the management part was dissolved after the teams were set up (I3, SAC). At the beginning of 2020, the remaining part consisted of 60 agile coaches (I4, CL). It was a prerequisite, as internal recruitment, to have a group of people that supports the whole process in addition to the external assistance (I3, SAC). As previously described in Section 4.2, the transformation was done in waves. The overarching goal of this large-scale agile transformation was to create a centrally managed, product-driven organization with a multi-channel business model. Hence, it was a complete restructuring. According to one of the chapter leads, it was

> *"[...] a full-scale transformation, as it affected the entire company, the IT, the business units, and departments. It also affected the countries; it affected the way we develop software, how we do requirements engineering, how we manage our deliveries, and how we respond to changes in the market, how we work as an organization. What culture and values we have, what processes we have, what technologies we use. It has influenced everything; thus, the only possible solution, is a full-scale transformation"* (I4, CL).

The first wave started in the IT department as well as in the responsible business units. Therefore, especially in this area, agility, the concept of agile working, and the desired outcome of being agile were not entirely new for most people. The time frame for this first milestone was one year (I4, CL). The implementation within the IT department was also structured in waves, from wave 0 to wave x, where three to four teams were transformed in each wave. Each team, in turn, consisted of a scrum master, a product owner, and a development team. In addition to this, each of these roles had to participate in specialized one-day trainings; for example, the scrum masters had a one-day scrum master training. Additionally, there were one or two-day trainings for the whole team to clarify the roles and the way of working. Afterward, the teams started with the agile way of working. Each group also had two senior agile coaches to support them during the six-week intensive care phase. Once this was completed or implemented, the next wave began (I3, SAC). The selection and decision about which teams are transformed in which wave was made by

the management part of the transformation team. However, this did not take place behind closed doors, it was carried out in public, so everyone could inform themselves about the current status, participate, and ask questions. Basically, the order was that the first identified were those teams that were already working agilely, starting with some mature teams and then continuing with less mature ones; thus, the teams that had never heard of agility were trained in the last wave (I3, SAC). In addition to this training and support, there were also change agents of sorts and other agile coaches in the company that could be contacted (I4, CL).

Nonetheless, there were, of course, several internal employees who were interested in becoming agile coaches. Thus, mentoring programs, job shadowing, or the method of coaching couples, i.e., a senior agile coach working together with a less experienced coach, to achieve a knowledge transfer, were offered (I3, SAC). There was no company-wide plan or guidelines for the use of agile methods and frameworks, as the goal was to avoid forcing a scaled agile framework; instead, it should be possible to choose them as needed. The blueprint that existed was rather an eclectic framework, combining agile methods or approaches such as LeSS, SAFe, Scrum of Scrums, etc. (I3, SAC; I4, CL).

In summary, the first transformation phase included the harmonization of the location of Germany, and thus the headquarters. Therefore, many local optimizations were taking place. While these optimizations included reducing the IT department's staff by more than half, at that time the current number of agile teams was 93, consisting of seven to eight employees (I3, SAC; I4, CL). In the second wave, the business departments, e.g., HR, Controlling, etc. were reorganized so that all people working on the business side became agile. Finally, in the third wave, the solutions that were centrally developed and created in Germany are rolled out to the federal states. The aim is to have a global agile coaching department that is responsible for all countries.

Even though, from an organizational point of view, the agile product organization was already implemented, the organization was defined, and "a high-level principle-based framework on how to steer the organization and how to align the different product teams" (I3, SAC) was in place, there were still some gaps. These included, for example, topics and processes that affect multiple product teams, such as the management of the portfolio level. Consequently, there was still a lot of work to be done in terms of the scope of the framework (I3, SAC; I4, CL). Another existing problem was that the product teams were assigned to the products. The perfect way would be to have delivery teams, i.e., teams with skills to do everything, according to the idea "bring the work to the teams and not the other way around" (I3, SAC). Nevertheless, it is ultimately about mindset. A change leader stated:

> *"You have to educate people and people should start to take ownership of what they are doing; this is the biggest change. We had a classical organization where people are just waiting for their next task, and from the next day on, they should be self-driven, self-organized. I think this takes a lot of time"* (I4, CL).

A feedback culture, more and open communication as well as more proactive employees were, in addition to building Communities of Practice for information and knowledge

sharing, successes that were already visible (I3, SAC).

RetailCo had chosen a full-scale approach coupled with a line of business piloting strategy. The idea of the transformation was to make the change as fast as possible, as the company needed to react quickly to the current situation and also to difficulties in the market. This was also the reason for an external interim CTO, who was provided by the consulting firm. It was, therefore, an external company that was brought on board to drive the change forward or at least to start it and then give the organization the time to move on (I3, SAC).

TechElecCo

As previously mentioned, two large-scale agile transformations were investigated. Therefore, both are described in the following.

Transformation A

The large-scale agile transformation A took place at the department level, in the so-called software development department. It consisted of 250 employees and subordinated to the R&D department. It was one of the first agile transitions within the company and can, therefore, be considered a pioneer. Later initiatives benefited above all from their lessons learned. In addition to this, the software department also actively shared its knowledge and information (I5, PSA).

In the beginning, there was a core team consisting of five to six people that dealt with how to best and most appropriately implement the agile way of working. Consequently, piloting was the chosen method, and it began with two pilots. Before the final roll-out took place in 2010/2011, which was compulsory for the entire department, the selection of the teams to be transformed was based more or less on the concept of voluntary participation. However, the core team was also concerned with defining how products can be released in the new working mode in the future to ensure that this working mode does not conflict with the quality-related processes (I5, PSA). Another measure besides the piloting was the so-called "champions program," after the "train the trainer" maxim. Thus, first, the identified key persons were trained, who then acted as multipliers in the teams. In general, the integration of the employees also took place by obliging them to complete the Scrum certificate as well as several workshops. Additionally, external consultants were hired for support. In the further course of the project, the work was continued with one consultant, who initially mainly supported the collaboration on-site, but later on, only came for regular visits until the partnership came to an end around 2015. Since, at that time, there were very few frameworks based on different standards in literature and practice, the Scrum of Scrums approach was chosen. One team leader was responsible for several scrum teams. From a project perspective, the transformation was already completed four to five years ago, i.e., all teams were on board at the time, the work was planned in backlogs, and all related software development processes were adapted. Since then, it has been more about continuous optimization. By the end of 2019, there were about 30-40 agile teams (I5, PSA).

The interviewee was also asked what successes were achieved. One point which was mentioned was that overtime and working on weekends decreased; thus, the working methods became more effective and efficient. Furthermore, the interviewee added "predictability, so it is now at least to some extent possible to foresee what we will deliver in the next release" (I5, PSA). The third success factor was speed, faster delivery of products, among other things, through more transparency in the development process (I5, PSA).

The main reason for this piloting strategy was to ensure that the approach and the agile concept fit into the processes, tools, and way of working. For example, good traceability was essential for regulatory purposes, i.e., from what is to be done to what has actually been done. Thus, the idea was to start with pilots and then to expand it over time to more and more teams (I5, PSA).

The next step is to combine and integrate the agile working with several elements from the flow and lean principles. The realization is supposed to be such that the high-level planning will be more in this lean and flowing style, and that it will be broken down in the backlogs of the teams that work in an agile way (I5, PSA).

Transformation B

As already described in Section 4.2 and as transformation A also indicates, there had been agile initiatives within the R&D department for a very long time. However, the goal was to promote them in such a way that they could benefit the entire department or company and to pursue a uniform concept. A consistent concept in the sense that, on the one hand, the challenges that arise from the interaction of agile and non-agile teams are solved and, on the other hand, a common agile approach based on the SAFe strategy is pursued (I6, HAT). Through the individual initiatives, many different agile frameworks such as Scrum of Scrums, LeSS, Nexus, or SAFe were used, and these needed to be streamlined (I5, PSA). The initiative was driven by people from senior management who were very convinced of the concept, so there was a strong management buy-in. As a result, the large-scale agile transformation B was launched in late 2017 (I6, HAT).

The strategy was to start with a few business units and departments at the German headquarters and to spread the movement further from there. The transformation approach followed a line of business piloting. Accordingly, the idea was to begin with one pilot in each business unit, of which there were 15 in total. This starting point did not mean agile practices at the team level, but rather on a scale, i.e., in teams of teams. It was, of course, assumed that initial agile experiences had already been gathered. In general, it is challenging to practice or introduce agile at scale if the teams or employees have no experience. There was no fixed order in which the starting points of the respective business units were defined; instead, the approach was to be understood as an offer. Thus, the aim was not to force individuals and teams to do so but to win their willingness to join the change (I6, HAT). However, in the end, several pilots ran parallel to one another, and these were then expanded.

Consequently, if interest was shown, the respective units were supported by the core

transformation team as well as by internal and external coaches. The core transformation team consisted of two to three people and acted as a central and guiding unit within the transition. The external coaches, who came from outside, were assigned to the business units and, by then, made up the majority of the supporters and were primarily responsible for coaching. In addition to this, there were other internal coaches who will be the main focus in the future, so that they can ultimately be used instead of the external coaches and will gradually replace them. These coaches acted as multipliers within the business units, similar to those described in transformation A. Since these multipliers needed to have a deeper understanding and knowledge of the agile transition, it was essential to provide them with continuous training to enable them to expand their experience and expertise. In most cases, they did this on their initiative, for example, by studying books, participating in external training and conferences, as well as in internal training (I6, HAT).

At the end of 2019, about eight business lines were transforming, and 700-800 of about 1,300 trained people were actively participating or were involved. In the first year of the change, the main focus was on providing a basic understanding of the values, principles, and benefits of a large-scale agile transformation. In the second year, the goal was to start at least five ARTs using the approaches, actions, and methods described above, which was even exceeded. In the final step, which was also the current status by then, the expansion to other business areas and regions was planned. Additionally, another issue was to look a bit deeper into each transformation and try to refocus on the principles. Furthermore, once people have gained more experience with the work, the plan was to extend it to other people within the organization (I6, HAT). There were already teams in Marketing and Communication with agile practices, but these were not developed teams working in agile mode. Also, there were discussions in the HR department about how to change and support the new way of working (I5, PSA; I6, HAT).

CarCo1

The Innovation Hub is a virtual construct within CarCo1. It was still in the process of being set up and comprises business lines or departments which usually have between 25 and 300 employees. However, the overarching aim was not to create 100% agility, but rather to establish end-to-end responsibility and to promote and facilitate cross-functional cooperation (I11, CTM). Thus, it makes little sense to implement agile working in areas where it does not add value (I10, APO; I11, CTM). Furthermore, besides this change, the system must still be fully operational to keep the day-to-day business running and, thus, ensure competitiveness. One task will, therefore, be how to design the interfaces between the agile world and the "waterfall" world. These must be clearly defined in order to enable smooth transfer points (I11, CTM).

The establishment and launch of the Innovation Hub could be considered more or less a big bang. However, this also exerted pressure, since, as the interviewee stated, "now we have to run almost faster than we are able to at the moment" (I11, CTM). Even before introducing this virtual construct, there were already successful agile transformations

within the business lines, which could be regarded as best practices. According to this, the experience and agile level within the Innovation Hub were very different and varied from no experience with agility to well developed and implemented agile working methods (I11, CTM). The latter group was, therefore, "a big banner" concerning the Innovation Hub.

However, it was not possible to use one of these best practice approaches as a strategy and roll it out uniformly for all, because what works for IT, for example, is not immediately applicable to the procurement. The approach was, therefore, twofold; one was to use multipliers to transform smaller units so that they could use their knowledge to put it into orbit somehow, and the other one was to implement pilots, to create success stories to show how this company will be built in the near future. This applied to various aspects, both in terms of product development and how to work together cross-functionally (I11, CTM).

The implementation approach could be seen as a multi-layered strategy: external coaches were hired to join the team, as only 50 change managers were available internally, which was far too few for 3,000 people, and agile masters, who did a lot of development within the teams, also supported in the implementation. A second part of the multi-layered strategy was town hall meetings, many role plays, and workshops, e.g., games for approaching the roles, product vision, product owner, and role workshops. Last but not least, new people with varied experience were hired, in a way, to buy expertise, because, in the past, the primary prerequisite when hiring new employees was engineering experience. Nowadays, especially in this context, the right mix is needed to get all the answers somehow. In addition to the strategy measures, many people were very interested in striving for new ways of thinking; therefore, they educated themselves, e.g., by reading a lot and participating in self-initiated meetings (I11, CTM). When asked what obstacles exist, one interviewee replied as follows:

> *"The biggest barrier is how to get the operational day to day work under one head with what you want to achieve. One thing that comes from the agile thinking method is prioritize, focus, do WIP (Work in Progress) limits. This is hugely important to get some time to think ahead"* (I11, CTM).

The next steps are to start more pilots, which will serve as examples to reach a critical mass and to involve the management more.

CarCo2

In order to address the issues mentioned in Section 4.2, management at CarCo2 had decided to make the entire R&D department and the related product development process agile. After the first pilots in the electric area turned out to be a mess, management decided to carry out the large-scale agile transformation according to the SAFe Implementation Roadmap[3] (see Figure 4.3) (I13 CLTD; I14, TLD). Therefore, the pilots were abandoned, and

[3]https://www.scaledagileframework.com/implementation-roadmap/

a change was made directly to a live implementation according to that framework without callbacks (I13, CLTD).

Before the actual launch, external consultants were hired to jointly develop a concept of how the SAFe framework could most suitably be adapted. Thus, the first step was the establishment of a core transformation team structured according to the hub-and-spoke model consisting of representatives from all units of the R&D department. The leader of this core team had already carried out three to four large-scale agile transformations at a big telecommunications company and, therefore, had considerable experience in this field, which was beneficial for CarCo2 and the change (I13 CLTD; I14, TLD). In parallel, a three-hour training session was developed for all leaders to explain the reasons for the transformation, what SAFe is, and how it is used and applied. In turn, these leaders passed on the information to their teams and engineers (I13 CLTD; I14, TLD). In addition to this, there were open demos in which every employee could participate and which helped to "expand the information propaganda" (I14, TLD). Accordingly, it was ensured that employees were always informed and made aware of future expectations. Furthermore, a whole range of other training were developed and compiled. The aim was to combine invitation-based implementation with training on different levels. Various communication channels were used to provide dialogue material, such as the intranet, e-mails, or directly through the change leaders. In this way, the employees were informed about the next steps and initial successes through regular updates. As a result, a vision was conveyed, and an alignment was achieved (I13, CLTD). The next step was to identify Agile Release Trains once the first steps of the implementation had been taken, explaining the reasons for the change and reaching a critical mass of informed and dedicated people required for the effective implementation of SAFe. Since the implementation was to start on a small scale, suitable ARTs were identified in the areas where initial activities were to begin. Although a lot of employees had been trained by then, the focus was on starting with people who were very interested in the transformation, since they could act as forerunners in their areas (I13 CLTD; I14, TLD).

In order to effectively shift into the next higher gear of transformation after the small-scale initial start, more and more ARTs and product streams were launched. The plan was to start with one team per division in each product stream. In addition to this, external consultants were hired as teachers to train, support, and guide the people and to serve as "catalysts" at the beginning of the transformation. The goal was to have one consultant per identified ART, which consisted of 50-175 employees, to support the ART management team, both the department head and the product manager (I13, CLTD). After a certain level was reached, the system was kicked-off with the aim of transforming all areas of R&D by the end of 2019. At that time, about 700 teams were already working in an agile way.

The next steps are to practice and adapt, as well as to improve the approach. A major goal will be to get more flows and fewer dependencies (I13 CLTD; I14, TLD). Although the implementation was not yet complete, the first recorded successes were "much better cooperation," as well as the ability to show trust transparently (I14, TLD). Furthermore, individual and team performance was discussed more openly. The other interviewee mentioned that,

from the start of the product development, a much higher quality was achieved (I13, CLTD).

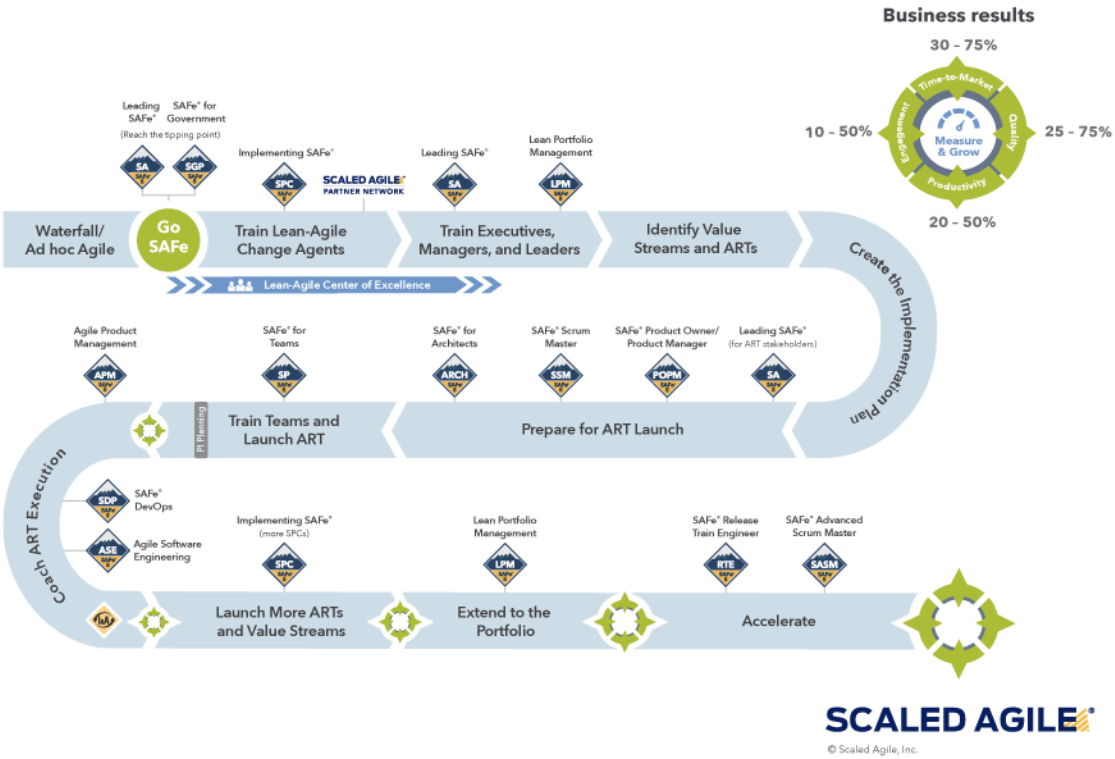

Figure 4.3.: SAFe Implementation Roadmap [59]

TechServCo

In the company TechServCo, it was a product-related large-scale agile transformation rather than a change at the company or department level. The project situation was described as follows: "We have multiple products in one platform and multiple customers with multiple projects running in one agile project" (I15, TL).

As already outlined in Section 4.2, the first touch point with agility was in 2014, when the project moved to a classic agile approach with Scrum. However, the team grew continuously due to the increasing demand from customers; therefore, the traditional agile approach was not feasible anymore. Thus, it was decided to scale up in 2016. An attempt was made to implement this with the help of an external coach, training, and workshops for employees and the LeSS model (I15, TL; I16, AM2). The problem was that everything was adapted according to the LeSS manual, like a perfect reproduction, without questioning if everything was necessary for the project or not (I16, AM2). Exactly this led to a severe failure later on (I16, AM2). Nonetheless, both respondents said that this was where the

actual transformation began and that the failure was necessary to understand the problem and draw the consequences. For example, they stated, "we had quite a strong learning curve" (I16, AM2) or, "we managed to understand how to implement this in a working pattern for our circumstances" (I15, TL).

After nine months, a task force was introduced, which was the complete opposite of the agile working philosophy. However, the introduction of the task force mode was necessary to secure the most important milestones of 2017 somehow, i.e., to be able to deliver the most critical issues of the year and to survive in the remaining three months. The key learnings of the project that were taken along were to use the LeSS framework only as a skeleton, to give all persons in the project the same decision rights is not reasonable, and that outside of this agile project, a lot is characterized by hierarchical structures, both within the company and at the customers (I15, TL).

In 2018, the second attempt started, but this time with a very experienced team that adapted itself continuously. An essential condition or directive was that whatever was done as a team, the team always had to generate business value (I15, TL). This transition was a mix of a top-down, more or less from middle management, and a bottom-up initiative, which was the conclusion that helped to achieve the best results. Therefore, there were some boundaries, but also a lot of freedom of choice, but as mentioned before, this agile approach will only be supported as long as it generates business value (I15, Tl; I16, AM2).

Two internal coaches supported the transformation project on a part-time basis, and one external coach worked on the project full-time (I15, TL). The agile development teams were not co-located since the employees were from various countries and business units and still subordinated to hierarchical structures, even if they spent 100% of their working time on the agile project. Although the used agile framework was based on LeSS, some elements were adapted from the Spotify Model or were entirely invented by the developers (I15, TL; I16, AM2). One of the interviewees explained as a reason for the project success:

> *"Our main differentiation to other projects is that we have some mindset, it is the social aspect in our projects, so everybody loves to work in this project. Everybody identifies with this project somehow, and we devote a lot of time to creating this environment"* (I15, TL).

The official expectation of the project was to implement the whole thing from a technical perspective within two months, e.g., to define the meetings, the material, and the roles. After that, the adaptation phase started, which was by then the current status. Since the beginning of 2020, two agile product teams are merged into one large product team with 80 people and about seven teams (I15, TL; I16, AM2). Another essential step will be, despite the actual adequate operational performance, to develop a vision for the product and to ensure the long-term success of this change (I16, AM2). The interviewees were also asked about the first discernible successes. In this context, team satisfaction was mentioned in the sense of a stronger team feeling and a more definite identification of the employees with the product they are creating, which in turn leads to a high motivation for the entire project. Other success factors included receiving more responsibility, and therefore, also having

more freedom (I16, AM2).

4.5. Derived findings of the large-scale agile transformation processes

Additionally, the interviewees were asked what advantages and disadvantages they observed in their chosen transformation approach. In the following, these identified aspects are explained and compared to the information above based on the following topics: *initiation, advantages and disadvantages, transformation scale, used scaling framework, and status quo*. Tables 4.4, 4.5, and 4.6 summarize the organizations studied and their large-scale agile transformations.

Initiation: At InsureCo, RetailCo, TechElecCo, and CarCo2 the transformation was driven from the top-down and had strong management buy-in from the c-level, which is also cited by all of them as one of the main success factors for a change within an organization (I1, HCPDS; I2, AM1; I3, SAC; I4, CL; I6, HAT; I13, CLTD; I14, TLD). Although the initiative of transformation D and E at CarCo1 was steered from the top-down, the necessary support of upper management was missing after the CTO changed, which even led to a standstill (I8, PM; I9, ITS). However, the new initiative, the establishment of the Innovation Hub, was initiated from the top-down and received management support; without this assistance, the project would not be viable (I10, APO; I11, CTM). The transformation at TechServCo can be placed between a bottom-up and a top-down movement (I15, TL). One of the interviewees described it as follows:

> *"It was a mix. [...] We had some boundaries, but also a lot of freedom to make decisions. This is where we had the support from the top part, and from the bottom, we involved the team quite heavily"* (I16, AM2).

Advantages and disadvantages: For RetailCo, in particular, speed was the decisive argument for a very rapid transformation and realignment of the entire organization (I3, SAC; I4, CL). At InsureCo, precisely, this positive aspect of a full-scale transformation, namely speed, was considered a significant shortcoming. It was stated that a previously defined implementation approach and scope would have ultimately provided more structure and caused less chaos (I2, AM1). However, InsureCo was in a safe and leading position in the market and, therefore, unlike RetailCo, there was no need or pressure to carry out a transformation as quickly as possible due to the financial situation and an outdated business model (I2, AM1; I3, SAC; I4, CL).

Furthermore, InsureCo is a security-oriented company which is reflected in its structure and processes. The risk of something not working during or after the change was, therefore, too significant. This is why it was essential, as one of the interviewees stated, "not to throw everything over, but only making small steps, really knowing what we are doing actually"

(I2, AM1). Also, this step-by-step approach allowed "learning by doing", which made it possible to adapt the approach along the way to find a suitable solution for the company (I2, AM1). Moreover, this strategy was facilitated and supported mainly by the ATCs. There, the opportunity existed, in addition to the training in agile working methods, to try out ideas without governance, other technical regulations, and the risk of damaging the main business (I1, HCPDS). With the pilot procedure at CarCo1, "avoiding major problems if something goes wrong" and "the cost of failure is lower" were likewise cited as benefits (I10, APO). In this context, a further advantage was also described, namely the ability to decide more flexibly, and in line with current circumstances, which team is particularly suitable as a pilot project. This was evident from the following statement:

> *"Even initially you know which kind of product you can more easily cut out of the entire system and try to develop in another way or which kind of product actually benefits from that way of working more, because you do have uncertainty regarding requirements. I think that was a key driver in terms of deciding which kinds of pilots you want to have [. . .]"* (I10, APO).

At CarCo2, as at RetailCo, speed was cited as an advantage of their big bang approach for the introduction of their agile concept. Furthermore, one respondent stated:

> *"With piloting, we would have had to run the pilot for several years before we could see results, and then that is not agile if you have to wait. It was an advantage for us to make a big bang, even if it caused a lot of frustration in the organization"* (I13, CLTD).

One CarCo1 respondent also explained that the big bang strategy would have eliminated the disadvantage of dealing with people who do not work in an agile environment, which made many processes more challenging (I12, TA). However, a roll-out that takes place too fast can cause difficulties, for example, insufficient coaching capacity of the central transformation team, illustrated by the following statement:

> *"[...] we are not able to be everywhere at any time, and this is difficult because people sometimes need more support, and sometimes they need less, and this is something we cannot always manage [...]"* (I5, PSA).

This, in turn, can lead to an agile cargo cult[4] problem, since understanding and internalizing the agile principles is one of the essential aspects of agility (I6, HAT).

Nevertheless, the full-scale approach scores points over the ATC and line of business piloting strategy by avoiding "living in two worlds"; the agile versus the non-agile world. At InsureCo, for example, the challenge was that almost every single employee within a team had a different supervisor, which sometimes led to a particular conflict of objectives and responsibilities (I1, HCPDS; I2, AM1). Comparable problems were cited at CarCo1

[4]Teams or people understand what their tasks are and how to carry them out, but not why they are doing it; thus to be agile and not just to pretend to be it. Agile is not about a specific set of titles and rituals, but rather about developing an agile way of thinking [44].

regarding the piloting approach within the business lines. Thus, the problem was described as follows:

> *"You are still [...] a smaller fraction which tries to adopt new methods, and you always get to the systemic boundaries of having an organization that is still used to the old processes, which, of course, leads to friction"* (I10, APO).

Likewise, in this context and comparable to InsureCo, CarCo1 referred to the hierarchical structures that still existed. Agile working methods are impaired if employees are disturbed by superiors from the departmental or management level entrusting them with tasks related to other topics. Consequently, it also led to a significant increase in workload (I8, PM; I13, CLTD). TechElecCo saw a considerable advantage of its parallel line of business piloting approach in the fact that participation in the agile transformation is voluntary. Thus, the benefit was that it integrated people who are willing to get involved (I6, HAT). The multiplier or champions strategy strongly supported this approach (I5, PSA; I6, HAT). In the long term, however, all business lines must participate in the change (I6, HAT). Similarly, TechServCo also benefited from the fact that its approach ensured that only motivated employees participate in its project-related transformation (I15, TL). Regarding the Innovation Hub, the piloting strategy and as well the associated multiplier effects were considered a significant advantage. The virtual construct also took advantage of the fact that some departments were already in an agile world and have gained experience (I13, CLTD).

An agile senior coach at RetailCo also said that the transition "had a huge effect on many people in the company. Some people were thrilled, but many people were very emotional about it, too" (I3, SAC). The latter makes it clear that in addition to the positive aspects of change, there are also negative consequences, especially for employees. The change created a lot of confusion, and the feeling of being lost because often, the understanding of new working methods is missing, or roles are not clearly defined or simply no longer exist. A company must also expect that employees will leave, especially in the case of transformations of this size. This was also a drawback in the cases of RetailCo, TechElecCo, CarCo1, and CarCo2 (I3, SAC; I4, CL; I6, HAT; I8, PM; I9, ITS; 13, CLTD; I14, TLD). It was further stated that in some cases agility is more natural for younger employees; "older ones are struggling with it and may feel uncomfortable" (I9, ITS). However, a similar phenomenon was also observed within InsureCo at the beginning. The step-by-step approach, based on the principle of trial and error, caused uncertainty among many employees, as no concrete answers could be given concerning what to expect, what the next steps would be, or what the roles would be (I2, AM1).

Transformation scale: Regarding which parts of the organization were affected by the large-scale agile transformation, respondents from RetailCo, InsureCo, TechElecCo, CarCo1, and CarCo2 stated that almost everyone in the organization was impacted (I1, HCPDS; I3, SAC; I4, CL; I6, HAT; I8, PM; I9, ITS; I10, APO; I11, CTM; I12, TA; I13, CLTD; I14, TLD). This was not the case at TechServCo. Although employees from different departments

worldwide were part of this virtual construct, the transformation refers only to a specific product (I15, TL; I16, AM2).

Used scaling framework: RetailCo, InsureCo, and TechServCo did not follow a specific agile framework; instead, all three used an eclectic variant with elements from common scaled agile methods (I1, HCPDS; I2, AM1; I3, SAC; I4, CL; I15, TL; I16, AM2). In contrast, CarCo2 opted for the SAFe Implementation Roadmap, and thus, focused on a single framework, albeit making necessary adaptations (I13, CLTD; I14, TLD). At TechElecCo, it is twofold; therefore, Scrum of Scrums was used in transformation A because, at that time, no other common approaches existed (I5, PSA). In transformation B, however, the application of SAFe is recommended, but other known agile frameworks were also used (I6, HAT). The same procedure was applied in transformation F (I11, CTM; CarCo1). While transformations C and E (CarCo1) primarily adopted a modified LeSS framework (I12, TA; I8, PM).

Status quo: From an organizational perspective, the agile transformation at RetailCo was completed at the end of 2019. However, there are still some gaps that need to be closed, as well as ongoing optimization and adaptation (I3, SAC; I4, CL). The same applies to transformation A at TechElecCo, where the change from a project perspective was completed since 2015. Still, there have recently been efforts to align high-level planning more closely with "flow lean" principles (I5, PSA). It is similar to the product-related agile transformation at TechServCo, with the entire team operating in an agile way. However, a merger of two large-scale agile teams has been taking place since January 2020 (I15, TL; I16, AM2). CarCo2 aimed to transform all areas of R&D by the end of 2019 and then proceed with the adaptation and optimization phase (I13, CLTD; I14, TLD). Meanwhile, InsureCo was in the middle of the agile transformation. They began the mobilization for all products and IT systems at the beginning of 2019. By now, 30-60% of the IT department employees work with agile methods (I1, HCPDS; InsureCo). Transformation C at CarCo1 and transformation B at TechElecCo were as well at equal stages (I6, HAT; I12, TA). In the latter case, it was based on voluntary participation in the change. At that time, about half of all 15 business lines were in the implementation phase (I6, HAT). Of all the transitions described, transformation F and G at CarCo1 were in their most recent stage and were launched in mid-2019; the Innovation Hub was still under development (I10, APO; I11, CTM). The transformations D and E (CarCo1) were put on hold for an indefinite time (I8, PM; I9, ITS).

	InsureCo	**RetailCo**
Transformation begin	Beginning of 2016	End of 2017
Reasons for the transformation	Changing markets and needs; changing business models; speed; competitiveness; commitment and empowerment of people; reduction of "waste"; state of the art technology	Changing markets and needs; changing business models; speed; commitment and empowerment of people; handling/coping with complexity; efficiency
Initiation	Top-down: driven by upper management	Top-down: driven by upper management
Transformation approach	Factory approach: ATCs as dedicated co-locations; piloting; ACs in line organization	Full-scale transformation; line of business piloting; agile coaching department
Approach advantages	"Learning by doing": step-by-step trial and error approach	Speed: rapid transformation and realignment of entire enterprise; homogeneous structure: no dependency problems or difficulties with existing hierarchical structures
Approach disadvantages	Lack of speed; living in two worlds: still hierarchical structures; lack of a coherent structure	Risk of failure; loss of employees;
Used scaling framework	Tailored framework with single elements from SAFe, LeSS and Spotify Model	SAFe; LeSS; Scrum of Scrums
Transformation scale	Enterprise-wide transformation	Enterprise-wide transformation
Status-Quo	In the middle of the agile transformation since the beginning of 2019	Implementation phase finished since the end of 2019; currently in the optimization and adaption phase

Table 4.4.: Overview of the case organizations (1/3)

	TechElecCo	CarCo1
Transformation begin	Transformation A: beginning of 2009; transformation B: end of 2017	Transformation C: 2016; transformation D&E: 2017; transformation F&G: mid of 2019 (Innovation Hub)
Reasons for the transformation	Changing markets and needs; speed; handling/coping with complexity; efficiency; higher quality; earlier feedback; better working conditions;	Changing markets and needs; changing business models; speed; competitiveness; handling/coping with complexity; efficiency; higher quality; customer satisfaction; digitalization/innovation; reduction of costs; better planning results; end-to-end responsibility; lean portfolio management
Initiation	Top-down: driven by upper management	Top-down: driven by upper management
Transformation approach	Transformation A: full-scale division-wide transformation with mini big bang; pilots in the beginning; multipliers; transformation B: parallel line of business piloting; multipliers	Transformation C-E: parallel line of business piloting; driven by the CIO; transformation F&G: Innovation Hub with parallel line of business piloting; mini-big bang start;
Approach advantages	Motivated employees: voluntary participation	Less consequences in case of a failure; flexibility to choose right pilot projects; Innovation Hub: more streamlined and shared responsibility
Approach disadvantages	Lack of coaching capacity: too fast roll-out	Living in two worlds: still hierarchical structures and dependencies to non-agile units
Used scaling framework	SAFe; LeSS; Nexus; Scrum of Scrums	SAFe; LeSS; Scaled Scrum
Transformation scale	Subsidiary-wide transformation	Enterprise-wide transformation
Status-Quo	Transformation A: since 2014/15 finished from a project perspective; transformation B: in the middle of the implementation phase	Transformation C: in the middle of the implementation phase; transformation D&E: sustained large-scale agile transformation; transformation F&G: at the beginning of the set-up of the Innovation Hub

Table 4.5.: Overview of the case organizations (2/3)

	CarCo2	TechServCo
Transformation begin	Mid of 2017	Beginning of 2017
Reasons for the transformation	Changing markets and needs; changing business models; speed; competitiveness; higher quality; customer satisfaction; digitalization/innovation	Changing markets and needs; speed; commitment and empowerment of people; handling/coping with complexity; efficiency; customer satisfaction; reduction of costs; better planning results; need for scaling up
Initiation	Top-down: driven by upper management	Mix bottom-up and top-down (driven by middle management)
Transformation approach	Full-scale division-wide transformation with mini big bang; pilots in the beginning	Steered by expanding IT product; continuous growing team-size; mini big bang
Approach advantages	Speed: big bang roll-out homogeneous structure: no dependency problems	Motivated employees; experience with agility: agile working methods were already practiced before the scale-up
Approach disadvantages	Interrupted information flows	Time consuming adaptions
Used scaling framework	SAFe	Tailored framework with single elements from LeSS, Scrum at Scale, Spotify Model, and self-invented ones
Transformation scale	Enterprise-wide transformation	IT product-related transformation
Status-Quo	Implementation phase should be formally completed by the end of 2019	Merging two large-scale agile teams at the beginning of 2020

Table 4.6.: Overview of the case organizations (3/3)

4.6. Consequences

This section focuses on the third research question, the consequences resulting from the agile transformation. Figure 4.4 gives an overview of the designated areas affected by the introduction of agile practices within enterprises. They have been aligned with the four dimensions of STS systems theory in order to derive these impacts.

Impact of agile practices on management and organizational structures

The consequences of agile practices on the organizational structure led to the following aspects:

(1) *De-hierarchization* (RetailCo, TechElecCo, CarCo1, CarCo2): Especially in the area of organizational structures, it becomes clear that the extent of change depends on the scope of the transformation. Thus, the most significant change has been observed at RetailCo due to the full-scale approach and, therefore, the restructuring of the entire company. Consequently, a clear de-hierarchization is discernible. Several initiatives supported this; for example, there were open-door architecture days in which anyone interested could participate, making it possible for both management and developers to attend the same meeting (RetailCo). However, flatter hierarchies also implied that specific roles or layers, such as middle management, were no longer required, which in turn posed a challenge (RetailCo, TechElecCo, CarCo1, CarCo2). Furthermore, this de-hierarchization resulted in a splitting of responsibilities; in the case of RetailCo, there were no longer any steering functions that bore full responsibility. Here, the structure of a steering triangle was established: This consists of a business function responsible for value contribution, an engineering function accountable for quality and technology, and a flow function, a person from the agile department who is responsible for the way things work.

(2) *Implementation of new roles* (InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2): The majority of case organizations stated that no real change in the organizational structure was apparent, or at least only in the part of the company that was actively transforming (InsureCo, TechElecCo, CarCo1, CarCo2). Nevertheless, in these areas, the introduction of a new agile setup took place, i.e., the introduction of new roles such as product owners, agile masters, etc. (InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2).

(3) *New arrangement of departments* (CarCo1): Some departments or areas had a high degree of redundancy. This led to conflicts that were related to the same resources, which was significantly improved by the establishment of the Innovation Hub since a completely new structure and arrangement of departments was created (CarCo1).

(4) *Coexistence of agile vs. non-agile* (InsureCo): A negative aspect associated with the agile

transformation is living in two worlds, the agile vs. non-agile world, especially seen in the factory approach taken by InsureCo. One interviewee stated that

> *"right now we are basically living in a matrix between the strictly hierarchical and functional structures and our new agile world with almost no hierarchies, with far more self-organized teams, but right now every employee lives in both worlds"* (I1, HCPDS; InsureCo).

Impact of agile practices on people

Employees play a significant role, especially in change management [61]. For this reason, the interviewees were asked to identify differences in people due to the transformation.

(1) *Attitude towards transformation* (InsureCo, RetailCo, CarCo1): Contradictory attitudes and opinions were observed regarding the agile transformation. At InsureCo, for example, after an initial sharp separation between the agile and non-agile world, a strong drive towards agility was seen. People across the company were enthusiastic about joining agile teams and about trying out these new approaches. Some employees even supported the transition and agile working methods by promoting and encouraging them (InsureCo, RetailCo). However, there was also skepticism. Some of the workers were afraid and worried because they were not sure what to expect, and transformations always involve changes in various aspects (InsureCo). Furthermore, people, especially from domains where agile working is not the standard or possible, such as the SAP area, did not consider it useful or necessary (RetailCo). This skepticism also occurred when the essential mindset was not given or lived on all enterprise levels (CarCo1). In some cases, organizations even had to accept that employees left the company since they could not identify themselves with the agile attitude and way of working (RetailCo, CarCo1).

(2) *Employee satisfaction* (InsureCo, RetailCo, TechElecCo, CarCo1, TechServCo): Five companies reported that they could see that employees were more satisfied and happier. This observation was made, especially among younger employees; therefore, the agile way of working also represented a particular attractiveness of work (CarCo1, TechServCo). At TechElecCo, a significant decrease in overtime was recorded, as the work could be done during regular working hours, and notably, the developers were less stressed. Other reasons for higher employee contentment were a better working environment and work mentality (InsureCo, CarCo1). Thus, through co-location and cross-functional working, it was possible to have face-to-face conversations instead of countless e-mails and calls (CarCo1). Another point that was mentioned by half of the case organizations was that employees appreciated and enjoyed having more responsibility and ownership and, therefore, more freedom to contribute new ideas and approaches (RetailCo, CarCo1, TechServCo).

(3) *Feedback culture* (CarCo1, TechServCo): In general, it was observed that people were

more open to giving feedback, whether it was about future plans or external communication. Additionally, at the team level, constructive critical issues were now immediately addressed. This, in turn, led to a more open culture and promoted and strengthened collaboration (CarCo1, TechServCo).

Impact of agile practices on working structures and processes

The task dimension covers the steps within the organization that serve to produce goods or services [38]. According to this, we asked the interviewees about changes in work structures and processes to be able to draw conclusions. It is discernible that, especially, the agile principles, which are explained in Section 2.2.1, have a strong influence.

(1) *Communication* (InsureCo, RetailCo, TechElecCo, CarCo1): Almost all companies stated that cross-functional work and co-location were changes in the course of the agile transformation concerning work structures and processes. Both are also issues which are part of the principles of the Agile Manifesto (see Section 2.2.1). Especially, with co-location it is intended to help solve or simplify communication and understanding problems. Many employees noticed that cross-functional working brought several advantages; for example, this type of collaboration enabled faster development and, thus, the delivery of products (InsureCo, RetailCo, TechElecCo, CarCo1). However, this was not always possible, for instance, in the case of TechServCo, when the agile transformation involved business units and departments across several countries. Other positive effects mentioned, were first, that the use of agile tools led to a reduction of paperwork, and second, shorter communication streams were achieved (CarCo1). Additionally, co-location and cross-functional working resulted in a decrease in e-mails and calls (InsureCo). Likewise, this was also observed through PI planning, a concept from the SAFe framework (see Section 2.3.1), which takes place face-to-face (CarCo1). A further aspect was transparency: through documentation and the use of agile methods such as Kanban boards or sprint backlogs, everyone affected could see the current status (TechElecCo, CarCo1).

(2) *Self-organization* (RetailCo, TechElecCo): Self-organization was also named as an aspect and can be found in the principles of the Agile Manifesto (see Section 2.2.1). Many things were divided up on a more granular level and were then distributed among the teams. Accordingly, specific roles, such as the project or line manager, were no longer necessary; since the team organized and coordinated itself and was therefore responsible for its contribution to the overall solution (RetailCo, TechElecCo).

(3) *Flexibility* (RetailCo): The use of agile methods enabled a faster reorientation, both in the case of changing market conditions and the corresponding need to realign the business model, as well as in the implementation process at iteration level (RetailCo).

(4) *Less upfront planning* (InsureCo, RetailCo): The time-consuming process of creating a project plan with goals and required resources up to the budget application before

the project even starts was eliminated. It was even described as "it was a blocking process and difficult" (I3, SAC; RetailCo). After the restructuring, the budget was already distributed, and the focus was more on how the goals could be achieved with the help of the product teams (RetailCo). At InsureCo, it was also observed that the need to plan ahead was reduced, and employees began to change the way the work was done. Before the agile transformation, it was essential to specify large functional requirement documents fully and to consider all eventualities before anything began. Agile thinking led to a change in the sense of just starting and finding solutions when problems occur and then addressing them on an iterative basis (InsureCo).

Impact of agile practices on technology

Agility is mainly used in software development, where it has its roots. In our multi-case study, the introduction of software tools, as well as the use of microservice architecture, were mentioned as consequences of the establishment of agile practices in the technology dimension.

(1) *Software tools* (InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2, TechServCo): All case organizations named the introduction and use of software products as a consequence of agile practices. Examples of products mentioned were Jira for product definition, Confluence for documentation, TFS for performance measurement, and New Relic for monitoring.

(2) *Micro-services architecture* (InsureCo, RetailCo): Two of the companies stated that they were moving away from monolithic applications towards cloud-based solutions and the adoption of the microservices approach. While this concept is considered a general industry trend, it is particularly suitable in the context of agility, as "agility is the natural habitat for these technologies to live in" (I1, HCPDS; InsureCo).

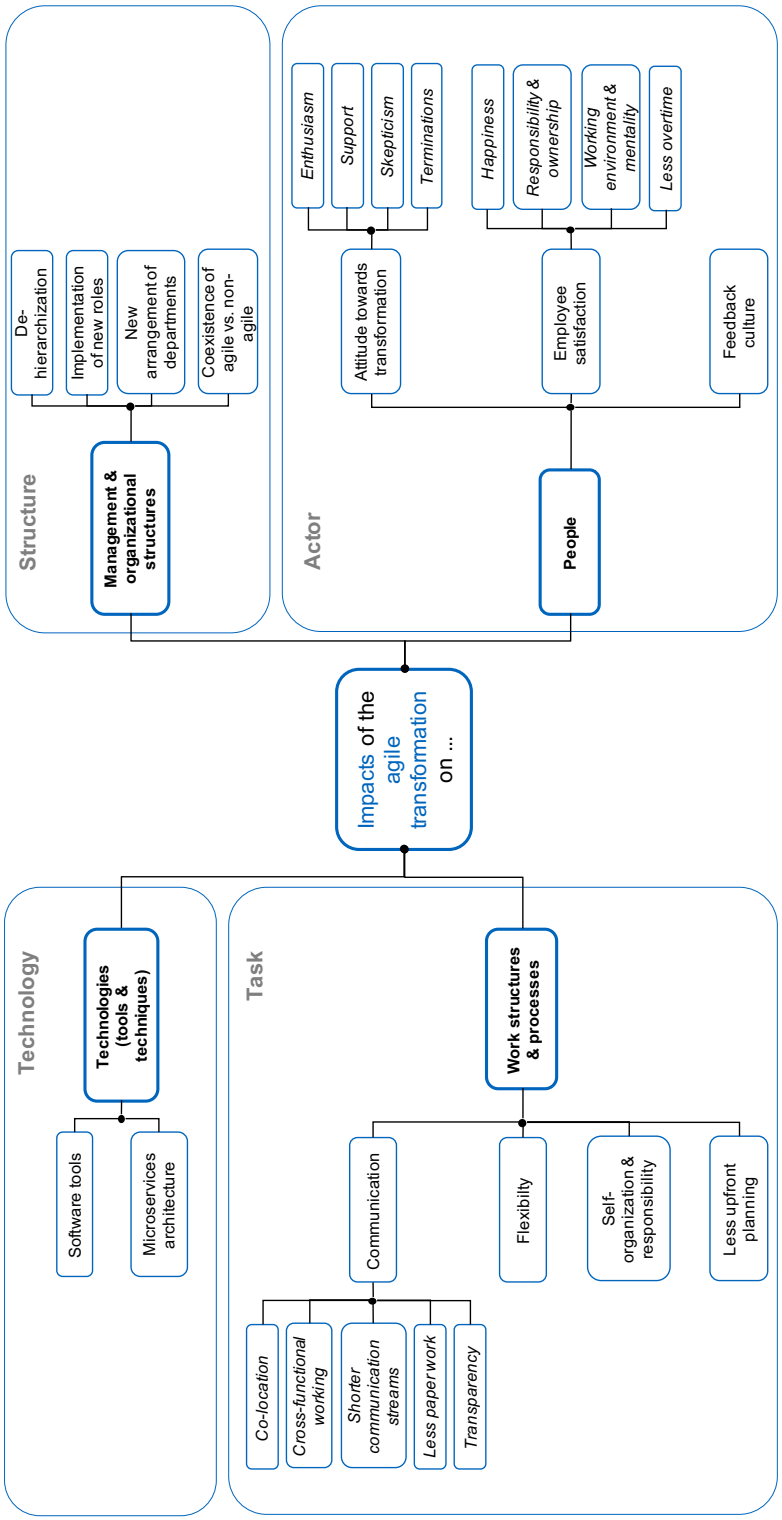

Figure 4.4.: Overview of dimensions impacted by the large-scale agile transformation at the case organizations

4.7. Challenges

Any change entails new challenges; in a large-scale agile transformation, nothing happens without friction. To get an insight into the difficulties our case companies face, we asked respondents about challenges, especially what they consider to be severe and far-reaching. In the following analysis, we took into account the problems that were explicitly identified by the interviewees. Accordingly, the fourth research question is addressed below. In total, we were able to identify ten categories, which are listed in Table 4.7.

Missing role definition (RetailCo, TechElecCo, CarCo1, CarCo2, TechServCo): The most frequently mentioned category of challenges is the lack of role definitions, at 83%. An interviewee reported that product owners and scrum masters did not initially act according to their roles, which was a problem for the team development (TechElecCo). Role conflicts were also an issue, e.g., when employees questioned these new roles of PO's or scrum master's, often due to the lack of understanding of agile working methods (CarCo1). Role ambiguities were identified at TechElecCo, especially during the major implementation phase. It was reported that it took a while to clarify the expectations of the roles and what their responsibilities were. The recruitment of suitable people for the PO roles was another aspect that was cited (TechServCo). An additional issue that was raised was that due to the de-hierarchization and the associated abolition of specific functions, those affected persons had problems finding "their new identity within the company" (I3, SAC; RetailCo). In some cases, this led to them leaving the company (RetailCo).

The misalignment of roles was also described as a challenge. Sometimes, after a certain time, it was found that people in some areas had the wrong positions. The reason for this was that many people did not know the exact areas of responsibility and competencies of these roles and where they could fit in best and contribute the most. Subsequently, an attempt was made to support them in finding a more suitable position (CarCo2). Another problem that was pointed out was "to press a new way of working into an old corset" (I8, PM; CarCo1). The tendency was to transfer the previous hierarchical roles one-to-one to those in the agile world, e.g., a department head was equivalent to a PO, a scrum master was comparable to a group leader, etc. However, this was not effective because it deprived the feature teams of their freedom of decision (CarCo1).

Change resistance (RetailCo, TechElecCo, CarCo1, CarCo2): Management resistance can be considered twofold: upper management resistance on the one hand and middle management resistance on the other. Intermediate management resistance occurred most often because these are the people who lose the most as their roles sooner or later become dispensable, due to the de-hierarchization in an agile transformation (RetailCo, TechElecCo, CarCo1, CarCo2). Upper management resistance occurred mainly when several managers of the board were involved (TechElecCo). One respondent cited as a potential threat that

"the generally good idea, which is also perceived as the working method of the future, is

> *being kept small by management that has not moved towards an adequate agile working style"* (I10, APO; CarCo1).

As a result, employees lost confidence in the change and its intended goals because the agile way of working was not lived (CarCo1).

Often demand or even urgency are needed as reasons for the willingness and acceptance of the change (RetailCo, TechElecCo). Nevertheless, it will be the case that not everyone will be open to change, and some employees will never adapt to the new way of working. This is illustrated by the statement of a respondent at CarCo2:

> *"We have about 10% of early adopters, 40% agree with it, and 40% are waiting for the first half to succeed before they follow; the last 10% will be against the transformation"* (I13, CLTD).

It was also reported that employees were often not only against these transformations but even worked against them and were so-called "blockers" (RetailCo, TechElecCo). The main challenge was to convince precisely these employees (TechElecCo).

Agile approach (RetailCo, CarCo1, CarCo2, TechServCo): The agile approach is another category that raised some problems. At TechServCo, the LeSS framework was implemented strictly according to the manual. It was not adapted to the company's requirements, which ultimately led to the termination of the transformation and to the second transformation attempt. Another aspect was that the establishment of the Innovation Hub raised the question of how to coordinate and align all departments, especially those already using different agile methods (CarCo1). The interrupted information flows at CarCo2 were a consequence of the implementation of agile methods. A respondent described the reason as follows: "We never solved the root cause that we tried to run an old way of running a project with a new development system" (I14, TLD). Another hurdle was the steering of the portfolio level due to the maturity degree of the agile teams. Since the teams did not have sufficient agile experience, it made it challenging to coordinate cross-team processes or new functions (RetailCo).

Living in two worlds (InsureCo, TechElecCo, CarCo1): A challenge that arose explicitly in connection with the factory approach was the persisting hierarchical line structure of the organization outside this construct. When people wanted to work in the new agile roles, this often led to conflicts with the superiors in their departments, for instance, because it was not obvious who would take over their primary jobs (InsureCo). A similar problem was described at CarCo1, where PO's were asked to do tasks for the management level, which was still working in the "waterfall" model, but which disturbed the agile way of working. Especially in manufacturing companies, the cooperation with external contractors and suppliers was a challenge. On the one hand, getting them on board, since they are distributed around the world, and on the other hand, because suppliers, for example, need planning security and require specifications several years in advance, which makes agile

working methods almost impossible (CarCo1). Additionally, the lack of confirmation of target agreements led to a loss of trust among dependent non-agile departments (CarCo1). Convincing stakeholders to set requirements in backlog mode was also mentioned as a challenge, as they were still working in a planned-based hierarchical way (TechElecCo).

Communication (InsureCo, RetailCo, TechElecCo): Communication can be seen in two ways: involving employees in general and involving management and stakeholders. A respondent at InsureCo stated that a lot of issues were going on, primarily due to a large number of employees. Therefore, it was very challenging to get everyone involved and informed, as sending e-mails or having technical platforms as mediums for communication might not be sufficient to make people aware and understanding about the goals intended to achieve with the agile approach (InsureCo). Another consideration was to involve the employees more closely to give them a feeling of psychological security (RetailCo). Stakeholder or management involvement was mentioned as another challenge (RetailCo, InsureCo). At RetailCo, for instance, the stakeholders did not feel involved, and therefore, tried to assign tasks to the teams, thereby hindering the agile way of working. The solution was to offer training to get them more involved (RetailCo).

Change in management (RetailCo, TechElecCo, CarCo1): In half of the case companies management change was named as a significant challenge. In the case of CarCo1, this led to an initial halt in the transformations D and E; even a return to old structures, patterns, and ways of working was observed. TechElecCo also had to deal with the fact that one of the top managers who initiated and strongly supported the transformation left the company. The numerous c-level manager changes at RetailCo also brought its difficulties.

Lack of resources (RetailCo, TechElecCo, CarCo1): The lack of resources was observed in several ways: firstly, that the transformation team was too small to meet the need for sufficient coaching to prevent problems like agile cargo cult (TechElecCo). Secondly, that agile coaches had to supervise several teams, making it impossible to focus on everything (RetailCo). Thirdly, the lack of personnel within the groups (CarCo1).

Mindset (TechElecCo, CarCo1, CarCo2): A critical issue was that people did not live the agile mindset. They may have worked in an agile way, but they did neither understand the meaning of agility nor internalize the values and principles (TechElecCo, CarCo2). Another problem was that many people followed a career thinking, meaning they are focused on things like job position, salary, incentives, etc. However, this career thinking is in contrast to the agile way of working, as in feature teams, for example, all people are equal, and many people did not like that which led to difficulties (CarCo1).

Goal-orientation (CarCo2, TechServCo): The missing definitions of the present and the future state created an undefined gap that needed to be filled. In particular, this definition would have been necessary to help people understand the intentions and goals behind the

transformation and their possible role in the transition (CarCo2). Additionally, at TechServCo's product-specific transformation, it was pointed to a lack of vision, and thus, to a missing long-term picture of where the product should go. On the one hand, this vision would have allowed better use of the time remaining, and on the other hand, it was noted that "when we have a vision, we have a much better tool to decide, for example, that one user story is more necessary than another one" (I16, AM2).

Regulatory requirements (InsureCo): Depending on the sector of the company, regulatory changes can influence the transformation and were, therefore, identified as challenges. For instance, legislative changes require changes to the legal framework. The authorities are setting fixed deadlines with enormous reporting requirements, and if these deadlines are not met, this could otherwise lead to horrendous penalties. Changes in the insurance sector were already in the pipeline, "if this hits us, it will delay the whole agile transformation" (I1, HCPDS).

Challenges	Case organization	No. of cases
Missing role definitions	**RetailCo, TechElecCo, CarCo1, CarCo2, TechServCo**	**5 (83%)**
Conflict of roles (PO and scrum master)	RetailCo, TechElecCo, CarCo1, TechServCo	4 (67%)
Misalignment of roles	CarCo1, CarCo2	2 (33%)
Change resistance	**RetailCo, TechElecCo, CarCo1, CarCo2**	**4 (67%)**
Management resistance	RetailCo, CarCo1, CarCo2	3 (50%)
Employee resistance	RetailCo, TechElecCo, CarCo2	3 (50%)
Agile approach	**RetailCo, CarCo1, CarCo2, TechServCo**	**4 (67%)**
Poor customization	TechServCo	1 (17%)
Alignment of different approaches	CarCo1	1 (17%)
Broken information flow	CarCo2	1 (17%)
Steering at portfolio level	RetailCo	1 (17%)
Living in two worlds	**InsureCo, TechElecCo, CarCo1**	**3 (50%)**
Hierarchical structures	InsureCo, CarCo1	2 (33%)
Dependencies to non-agile units	TechElecCo, CarCo1	2 (33%)
Working with external contractors	CarCo1	1 (17%)
Communication	**InsureCo, RetailCo, TechElecCo**	**3 (50%)**
Involving people	InsureCo, RetailCo	2 (33%)
Including stakeholders	RetailCo, TechElecCo	2 (33%)
Management change	**RetailCo, TechElecCo, Carco1**	**3 (50%)**
Lack of resources	**RetailCo, TechElecCo, CarCo1**	**3 (50%)**
Mindset	**TechElecCo, CarCo1, CarCo2**	**3 (50%)**
"Cargo cult agile"	TechElecCo, CarCo2	2 (33%)
Career thinking	CarCo1	1 (17%)
Goal-orientation	**CarCo2, TechServCo**	**2 (33%)**
Definition of current and target state	CarCo2	1 (17%)
Lacking vision	TechServCo	1 (17%)
Regulatory requirements	**InsureCo**	**1 (17%)**

Table 4.7.: Identified challenges

4.8. Success factors

The following section deals with the fifth and last research question, which is about the success factors for a transition. We asked the interviewees to name three success factors that, in their opinion, are important for a successful large-scale agile transformation. Some of the interviewees stated more than three factors or explicitly mentioned additional issues in the interview. We decided to document them nevertheless. In total, we identified seven categories. These are summarized in Table 4.8 and discussed in more detail below.

Success factors	Case organization	No. of cases
Commitment for transformation	**InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2, TechServCo**	**6 (100%)**
Management buy-in	InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2	5 (83%)
People buy-in	RetailCo, TechElecCo, CarCo1, TechServCo	4 (67%)
Leadership, attitude, and clear guidelines	**InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2, TechServCo**	**6 (100%)**
Goal-orientation	InsureCo, RetailCo, TechElecCo, CarCo2	4 (67%)
Agile mindset	InsureCo, TechElecCo, TechServCo	3 (50%)
Common vision	InsureCo, TechElecCo	2 (33%)
Common understanding	CarCo1	1 (17%)
Company culture	CarCo1	1 (17%)
Involvement of people	**RetailCo, TechElecCo, CarCo1, CarCo2, TechServCo**	**5 (83%)**
Start with multipliers/supporters	RetailCo, TechElecCo, CarCo1, TechServCo	4 (67%)
Reach critical mass	CarCo2	1 (17%)
Training and coaching	**InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2**	**5 (83%)**
Proper and thorough coaching	InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2	5 (83%)
Have enough coaching capacity	TechElecCo	1 (17%)
Motivation for self-training	CarCo1	1 (17%)
Open communication	**InsureCo, RetailCo, TechElecCo, CarCo1**	**4 (67%)**
Ensure transparency and information flow	RetailCo, CarCo1	2 (33%)
Show success and quick wins	InsureCo,	1 (17%)
Define roles and expectations	TechElecCo	1 (17%)
Agile approach	**CarCo2, TechServCo**	**2 (33%)**
Choose right framework	CarCo2	1 (17%)
Customize/make adaptions	TechServCo	1 (17%)
Demand for change	**RetailCo, TechServCo**	**2 (33%)**

Table 4.8.: Identified success factors

Commitment for transformation (InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2, TechServCo): Commitment for transformation was mentioned as a success factor in each of the companies. A further distinction was made between top management buy-in (InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2, TechServCo) and people buy-in (RetailCo, TechElecCo, CarCo1, TechServCo). Many people said that the support of top management

is indispensable and necessary, especially for large-scale agile transformations (RetailCo, InsureCo, TechElecCo, CarCo1, CarCo2, TechServCo). "If management is not living this, then the others will not follow" (I9, ITS; CarCo1). Accordingly, the management level has a certain role model function and the task of convincing employees to actively participate in the transformation. Additionally, upper management support is needed to ensure that if obstacles arise, employees do not fall back into old ways of working; thus, management tries to remove these impediments (InsureCo, CarCo2). This was reflected among others in the following statements:

> *"I think it would not work without this, because top managers essentially drive the whole initiative further and support this in the teams and get many obstacles out of the way so that we actually can work in an agile way"* (I2, AM1; InsureCo), and
>
> *"you need the support of top management, and they must ensure that we will not fall back and go back to the old ways when it starts to be difficult and troublesome"* (I13, CLTD; CarCo2).

Nevertheless, besides upper management buy-in, the support of the employees is needed; otherwise, change cannot be implemented (RetailCo, TechElecCo, CarCo1, TechServCo). "Top management must want it and support it unconditionally, and so must the employees" (I8, PM; CarCo1), "if you don't have people who are really driving it, then it will die sooner or later" (I16, AM2; TechServCo), and "this needs to be there, the level of commitment needs to be on all levels" (I10, APO; CarCo1). These responses of the interviewees emphasize that issue.

Leadership, attitude, and clear guidelines (InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2, TechServCo): The attitude towards change and the communication of the intended objectives, as well as a shared understanding and a clear vision and culture were also mentioned as critical factors. An essential aspect in this context is goal-orientation. Companies need to be aware of their expectations and goals behind the transformation and communicate this clearly (InsureCo, RetailCo, TechElecCo, CarCo2). Starting an agile transformation only because other companies are doing so is not very goal-oriented, as it is not clear what exactly is supposed to be improved (InsureCo). This also becomes obvious from the following statement: "[...] goal-orientation is very important, so that you have something that you want to achieve with agility rather than just trying to do agility itself" (I2, AM1; InsureCo). Additionally, it is crucial to have a shared vision to overcome challenges such as "departmental egoism" (I1, HCPDS; InsureCo). A significant step in this direction is the introduction of an agile way of thinking (InsureCo). Especially in the context of multipliers, as their task is to live and spread the agile mindset and the vision behind the change in the respective departments (TechElecCo, TechServCo). It was also stated that it is vital that the corporate culture is designed for an agile transition (CarCo1).

Involve people (RetailCo, TechElecCo, CarCo1, CarCo2, TechServCo): It is important that employees are actively involved in achieving a change in the enterprise. Therefore, as

already noted, key people acting as supporters and multipliers constitute a significant success factor (RetailCo, TechElecCo, CarCo1, TechServCo). This is evident from statements such as: "You don not only need your group of people; you need key players who support this" (I3, SAC; RetailCo), or that it is crucial "to find the right people with the right mindset and empower them with the right tools to promote this type of thinking and acting into the teams" (I16, AM2; TechServCo). One respondent also made the following point: "You need a critical mass of people understanding what you want to achieve and who are able to help other understanding, help them design it" (I4, CL; RetailCo).

Training and coaching (InsureCo, RetailCo, TechElecCo, CarCo1, CarCo2): Training and coaching are especially essential to support the employees, but also to spread the agile methods within the organization (TechElecCo, CarCo1, CarCo2). Therefore, it is decisive in this context to have enough coaching capacity to provide the necessary support (TechElecCo). Another critical point is to bring in

> *"coaching at a very early point because they [coaches] know how people react if they are faced with challenges. Of course, you cannot predict everything, but you can protect management and the people from pitfalls you already know"* (I11, CTM; CarCo1).

Furthermore, enterprises should have coaches in place, since

> *"people are not agile per definition, it requires the input of effort every day for a long period to change a classical team into an agile one or to change mindsets"* (I4, CL; RetailCo).

However, it is also essential that in addition to compulsory and offered training, people are motivated to train and educate themselves (CarCo1).

Open communication (InsureCo, RetailCo, TechElecCo, CarCo1): A transparent and continuous communication approach is essential since this is a prerequisite for convincing employees and receiving their support (RetailCo, CarCo1). Additionally, it was stated to show success and quick wins. Therefore, it is crucial to have "the ability that you actually can prove that what you are doing is successful and not in the long run but small steps" (I2, AM1; InsureCo). For example, after a few months, InsureCo was able to show that better software was delivered and that the products also had added value for the customer and the company. Precisely, "this success builds up the basis on which we could increasingly expand the agile transformation" (I2, AM1; InsureCo). Moreover, it is necessary to define and communicate future roles and expectations in advance (TechElecCo).

Agile approach (CarCo2, TechServCo): Another success factor is, for instance, for CarCo2, the choice of the right transformation approach and framework. They decided to use the SAFe Implementation Roadmap and have been successful with it so far (CarCo2). TechServCo learned from its mistakes in the first failed transformation attempt, and the

respondents cite customizing and making adoptions to the chosen agile transformation approach as a critical issue. It was further stated: "This was one of the major insights into 2018 and 2019, that you need to invest some time to sharpen your tools" (I16, AM2; TechServCo).

Demand for change (RetailCo, TechServCo): A further success factor is a demand for change. It is based on the observation that when people have this sense of urgency, they realize that they need to change (RetailCo, TechServCo). This becomes clear from the following statement:

> *"Let's say you have a lot of people who are more or less satisfied with the current situation and then someone comes along and says, 'here is this new fancy framework xyz, and we need to use it', then most probably it won't work. You need to have a demand to change something, which is putting you out of your comfort zone. This was the main trigger for us as well as a success factor: IT and a demand for adaption"* (I16, AM2; TechServCo).

5. Discussion

This chapter summarizes and discusses the key findings of the multiple-case study by means of the research questions (see Section 5.1). Followed by a discussion about the limitations of this master's thesis (see Section 5.2).

5.1. Key findings

This thesis aims to investigate the large-scale agile transformation processes employing a multiple-case study with large traditional companies, thus, answering the research questions that have been raised.

> **Research question 1:** What are reasons for large organizations to undergo agile transformations?

In literature, the key motivation for agile transformations, especially within software development companies, is to shorten the time-to-market and to maintain or improve competitiveness [49]. Nevertheless, well-established traditional organizations adopt scaled agile practices as well, but compared to start-ups or native-digital companies, many challenges arise [28]. Therefore, we asked the case organizations, that were not born-digitally, about their motivation and reasons for undergoing such a transformation, even if it causes difficulties [20] (see Section 4.2).

Most respondents indicated that the reasons for change largely overlap with the goals that such change is intended to achieve. Therefore, in our analysis, both the triggers and drivers, as well as the goals, were considered as reasons. Overlaps of reasons and benefits of agile adaptation can also be found in the State of Agile survey 2019 [73], which provides a solid overview of the practice. We identified 19 reasons that made traditional companies opt for large-scale agile transformations (see Table 4.3). Nine of these were named by at least half of the organizations, and therefore, we are discussing them in more detail. All of the case companies cited *changing markets and needs*, and *speed* as reasons for undertaking a large-scale agile transformation. More specifically, speed was mentioned in 67% of cases in connection with "faster responsiveness" and "faster product development" and in 33% of cases in connection with "time-to-market" and "on-time delivery". These two reasons – changing markets and needs, and speed – were also mentioned as the most frequent motivators for the adaptation of agility in the State of Agile survey 2019 [73]. *Competitiveness* and *handling/coping with complexity* were cited as reasons by 67% of the surveyed companies.

However, the State of Agile survey 2019 [73] did not reveal these or similar reasons. One explanation could be that the survey probably used predefined response options, thereby narrowing down the responses to them while our reasons were derived from the data and were not limited to predefined options [20]. The same applies to the identified external factor *customer satisfaction* and the internal factor *commitment and empowerment of people*, which were cited by 50% as reasons for agile transformations. The share of respondents who stated *efficiency* and *higher quality* is comparable to that of the survey on the State of Agile survey 2019 [73].

> **Research question 2:** What transformation approaches exist to perform large-scale agile transformations?

Our multi-case study enabled us to analyze the large-scale transformation processes and subsequent implementation approaches of the various case companies (see Section 2.4.2). Although there are initial studies in the literature that provide insights into transformation approaches, there is an urgent need for research in this area [26, 28, 49, 69]. Based on the transformation strategies in Section 2.4.2, we can, therefore, derive the transformation approaches used by the respective companies. All three transformation strategies described – full-scale approach, line of business piloting, and factory approach – appeared in a modified form. Accordingly, the transformation approaches revealed similar essential characteristics of the outlined strategies. A decisive aspect is that in almost all cases, the initiative was steered from the top down. However, some of the units within the companies already had experience with agile practices on a small scale. In almost all transformation approaches, pilot tests were started at the beginning. These vary from one or two teams to pilots that were carried out in each of the individual business units.

The large-scale transformation approaches can be summarized as follows: RetailCo used an sequential LoB piloting approach that ended in a company-wide, full-scale transformation; thus, the most significant agile change of all transition approaches examined was identified. Certain similarities were observed between CarCo2 and transformation A (TechElecCo), where both started with a pilot test, but quickly moved on to a mini big bang, i.e., a full-scale division-wide transformation. Paasivaara et al. [49] report a similar approach in their research study at Ericsson. TechServCo's transition strategy is difficult to classify since it is a product-related agile transformation, and team size depends on demand. Another reason is that the teams were already using agile working methods, and it was more of a scaling-up process. Nevertheless, we were able to identify a mini big bang approach. In transformation B (TechElecCo) and at CarCo1, some form of parallel LoB piloting approach could be identified, although parallel pilot tests were carried out in the different business lines. The aim is to gradually expand it until a full-scale transformation is achieved in the respective division. In the case of transformation B, this took place without a time limit and at the discretion of the individual business lines. In contrast to CarCo1, where a mini big bang was observed, the pilot tests in the respective business units began parallel to the establishment of the Innovation Hub. We identified a significantly different approach

at InsureCo. According to this, agile training centers were set up and thus they can be seen as a factory approach. Each of the approaches has its advantages and disadvantages and depends on the companies' situation and their intended goals behind it. Furthermore, the company's industrial sector also plays an important role, e.g., due to governmental regulations or the degree of dependence on stakeholders or external entities. While there are several other transition strategies, most of them are variants of the basic types described in Section 2.4.2 [40].

Research question 3: What consequences do organizations face?

As described above, while several studies examine agility in its initial context, namely the software development area, there is a lack of empirical research on the impact of the introduction of agile practices in traditional companies and the consequences that agile transformation may imply. Therefore, we investigated the impacts of introducing agile practices within our case companies' working systems. For our analysis, we used the STS theory as a guideline to categorize the identified consequences according to the four dimensions – management and organizational structures, people, work structures and processes, and technology.

The overall outcome is that those large-scale agile transformations, regardless of whether they take place at the departmental level or are full-scale, impact the entire organization. Thus, we can confirm this observation of Gerster et al. [28]. This also becomes obvious from the derived aspects of the dimension management and organizational structures. Almost all companies mentioned *de-hierarchization* and *implementation of new roles*, which affect the whole company. The latter, as well as the *coexistence of agile vs. non-agile* units, align with findings in the literature [28]. Agile change has the most considerable influence on the people dimension, which again illustrates the importance of people in a change process as well as in agile methods. 83% of the enterprises mentioned that the introduction of agile practices resulted in higher employee satisfaction. However, the attitudes towards an agile transformation varied. On the one hand, some employees encouraged and supported the change, while on the other hand, other employees did not. The latter was often seen at the middle management level in particular. In the dimension processes and working structures, the impacts were often mentioned as objectives and prerequisites aimed at introducing agile practices, such as self-organized teams, flexibility, etc. The most significant impact was observed in the category *communication*. Very little or no influence was found in the technology dimension since the continuous introduction of new techniques and software programs already took place before the agile transformation. Nevertheless, all companies stated that the introduction and use of standardized agile tools for software development that facilitate and support their agile way of working were part of this process. The results from the case study of Gerster et al. [28] support this finding.

Research question 4: What challenges are associated with large-scale agile transformations?

We compared our identified challenges with the classifications of challenges in published studies [19, 20, 30, 49, 70, 73], not only to allow easy comparison with the literature, but also to indicate new challenges. In total, we identified 20 difficulties, which we clustered in ten categories, as presented in Table 4.7.

At least half of all case companies faced the following challenges: *role conflict (PO and scrum master)*, *management resistance*, *employee resistance*, *management change* and *lack of resources*. According to our evaluation in Section 4.7, we were able to verify twelve challenges and identify eight new ones. Among them *misalignment of roles*, *broken information flow*, *steering portfolio level*, *working with external contractors*, *management change*, and *definition of current and target state*. Particularly notable are *misalignment of roles* (33%) and *management change* (50%). The reasons for the misalignment of roles are: First, many people did not fully understand the exact responsibilities and competencies of the functions, and therefore, did not know which position and area of responsibility seemed appropriate. The lack of a clear definition of roles also contributes to this situation. Second, there was a tendency to transfer the previous hierarchical roles one-to-one to the agile world, which can never be successful in the long run. C-level management change was mentioned by 50% of the case organizations but had varying degrees of impact on large-scale agile transformation processes. This depends mainly on how high the agile maturity level is and how much it was driven from the top-down by the former manager. However, this can result in a stop of the agile transformation, as revealed in the case of CarCo1 (see Section 4.2). In this context, it would be interesting to further investigate the impact of management changes on large-scale agile transformations.

> **Research question 5:** What success factors are associated with large-scale agile transformations?

Since the success factors are often derived from the challenges and barriers that arose, similarities or overlaps are often evident. Section 4.8 explains the analysis of the success factors deduced from our case study. We identified 18 success factors which we grouped into seven categories, as presented in Table 4.8. We also compared them with those from the existing literature and could verify ten existing factors and identify eight new ones [19, 20, 30, 73]. These eight new success factors are *goal-orientation*, *common vision*, *reach critical mass*, *have enough coaching capacity*, *motivation for self-training*, *define roles and expectations*, *choose right framework*, and *demand for change*. Almost all of these new factors are strongly related to the employees, how to best integrate them, and how to facilitate the adaptation of agile practices. Accordingly, it illustrates how important people are in a large-scale agile transformation and that they are one of the primary drivers of success. This is consistent with one of the central principles of the agile approach, the focus on people [44].

At least two-thirds of the companies surveyed cited *management buy-in*, *people buy-in*, *goal-orientation*, *start with multipliers/supporters*, and p*roper and thorough coaching* as factors. Except *goal-orientation* (67%), all of them were already identified in the existing literature.

Nevertheless, goal-orientation is crucial in an agile transformation to give people a clear direction and not lose focus during the change.

5.2. Limitations

The trustworthiness of the results in a scientific paper is reflected in its validity; therefore, the master's thesis's threats and limitations are discussed in the following section. First of all, a general restriction is the limited research time frame of the thesis. Therefore, the latter does not allow us to analyze all large-scale agile transformations after a completed implementation phase, i.e. when all case firms are already in their adaptation and optimization phase. In order to ensure the validity of the case study part (see Chapter 4), possible threats are discussed below using the assessment scheme of Runeson and Höst [58]. Accordingly, four aspects of validity are distinguished here:

Construct validity: This issue reflects to what extent the operational measures that are studied correspond to what the researchers have in mind and what is analyzed according to the research questions [58]. To counter this threat, we conducted semi-structured interviews with several interest groups with different backgrounds.

Internal validity: This validity is important when causal relationships are investigated [58]. Since the research of the master's thesis does not aim at establishing causal relationships, threats to internal validity are not discussed here.

External validity: This aspect deals with the extent to which the results can be generalized and to what extent they are of interest to people outside the case study [58]. This work aims to make an analytical generalization by describing the cases in detail. In particular, the embedded multiple case study provides empirical insights into the rationale and approaches of large-scale agile transformations. Furthermore, it sheds light on the impacts, challenges, and success factors. The obtained findings should be considered as valuable insights for other organizations facing similar transformations and challenges as the case organizations.

Reliability: This aspect refers to the consistency of the work, i.e., the extent to which data and analysis depend on the individual researcher and whether repeated performance leads to the same results [58]. One countermeasure taken to prevent this threat was the creation of a case study protocol that consists of notes and documents such as interview guidelines and audio recordings. Furthermore, the multiple case study was designed in such a way that the number of interviews, both in general and within an organization, allowed for data and observation triangulation. Nevertheless, limitations must also be addressed here. For example, the study is based on interviews and thus relies on subjective opinions; therefore, conducting this study again with other organizations does not guarantee the same results. This is because other organizations have a different level of agile maturity, as well

as different employees with different cultures and mindsets. Especially concerning agile transformation approaches, it can be stated that many companies use individual strategies and methods.

6. Conclusion and future work

This last chapter gives a summary of the research results of the master's thesis in Section 6.1 and a short outlook on future work in Section 6.2.

6.1. Summary

Although the use of agile practices was initially designed for projects with small, single, co-located teams [13], there is a clear trend that more and more large traditional companies are taking advantage of the benefits of agile development [73]. Companies are trying to cope with the challenges posed by the emergence of a digital era and the resulting volatile market environments. These include shorter time-to-market cycles, continually changing customer needs, and new technological advances [43, 54].

However, the adoption of agile practices in-the-large often leads to challenges and problems because, as already mentioned, the methods are not designed for large projects. Although there exist some approaches and agile scaling frameworks to deal with that issue (see Section 2.3), they are not a universal solution and need to be adapted to the company's specific needs [33]. This highlights the demand for research in this area. However, currently, there is little empirical research on how companies can manage a large-scale agile transformation, especially concerning the approach to adapt and implement agile in large. As described in Chapter 3, previous studies identified a variety of challenges [19, 20, 70]. For example: *agile difficult to implement, integrating non-development functions, change resistance,* and *requirements engineering challenges* [20, 70]. Success factors were also identified, for instance, the most crucial success factor categories were *management support, choosing and customizing the agile model, training and coaching*, and *mindset and alignment* [19, 20].

We followed the call for further research in the field of large-scale agile transformations and contributed to closing this research gap through our multiple-case study. Through this research, we identified 19 reasons that made large enterprises opt for a large-scale agile transformation. The top three reasons are *changing markets and needs*, *speed*, and *competitiveness*. It is worth mentioning that 50% of the case organizations cited *commitment and empowerment of people* as a reason, which puts a spotlight on the people in such a transformation. This is consistent with the general belief that humans are the decisive force in the deployment of agility [10]. In the studies of Paasivaara et al. [49], Fuchs et al. [27] and Gerster et al. [28] the transformation approaches are briefly described. They observe that the respective companies have chosen a step-by-step approach for the implementation. Through our study, we were able to identify several transformation approaches. Many of

them show characteristics and similarities to the strategies described in Section 2.4.2, but often mixed forms are used. In almost all cases, the initiative was driven from the top-down. We observed two approaches that were popular among companies when adapting large-scale agile transformations. First, the parallel line of business piloting strategy, both within a large department and across departments. Second, the full-scale approach, within a department, and also in a product-specific and company-wide transformation. Another transformation approach that we identified is the factory approach, which focuses mainly on the employees' education and training.

Furthermore, we examined the impact of such a large-scale agile transformation on the work system. Most of the effects were in the dimensions people, work structures and processes, management and organizational structures, and less in the technology dimension. We noticed that there were several positive consequences in terms of employees, such as *employee satisfaction* or the *attitude towards a transformation*, as well as a better *feedback culture*. But not everything changed for the better; a negative consequence was the *coexistence of agile and non-agile* units. Every change, especially on a large scale, brings along difficulties. We identified 20 individual challenges, which we grouped into ten categories. Most of them, we could confirm with those already observed in the literature [19, 20, 30, 49, 70, 73]. Nevertheless, we also identified new challenges, especially *management change* and *regulatory requirements*. As success factors, we classified 18 individual ones and clustered them into seven categories. They also correspond, to a large extent, with the findings in the literature [19, 20, 30, 73]. Almost all companies named *commitment for transformation*, *leadership, attitude, and clear guidelines*, the *involvement of people*, and *training and coaching* as essential success factors. This highlights how important people are in a large-scale agile transformation and that they contribute significantly to the success of the change.

6.2. Future work

Most of the investigated transformations are still in the middle of the implementation phase or at the beginning of the optimization and adaptation phase. Accordingly, the case organizations will remain in a transformation process for a longer time. Therefore, we plan long-term studies on the approach and implementation of agile transformations, as additional investigations can be valuable. Our main objective is to gain a more in-depth insight into the case organizations' different transformation approaches and to identify further advantages and disadvantages. Moreover, we want to investigate in more depth what effects such agile organizational changes have. Although there is already a vast amount of literature on challenges and success factors in such transformations [19, 20, 30, 49, 70, 73], more research should be conducted on external factors and influences, such as regulatory requirements. In general, research on large-scale agile transformations is scarce. Thus, there is an urgent need for conducting additional case studies in that field [20], since the topic is increasingly important, especially for large companies moving to an agile environment. Paasivaara et al. [49] point out in their case study that it would be of interest

to investigate the adaptation of an agile approach to different types of large organizations. We followed their call, and for future research, we encourage other researchers to continue identifying and studying other large-scale agile transformation approaches to make them measurable and comparable.

A. Appendix

A.1. Semi-structured case interviews

Section: General information

1. How many years have you been working in your current position?
2. Could you name your current position and main responsibilities within your company?
3. How many years of experience do you have with the topic of "Agility"?
4. How would you rate your experience in the topic of "Agility"? (No experience, Beginner, Advanced, Expert)

Section: Background information

1. What do you understand by "large-scale agile transformation"?
2. When did you start the large-scale agile transformation?
3. What is/was the planned time frame for implementing the large-scale agile transformation? Has the timetable been met/can it still be met?
4. What goals are expected or were achieved by the large-scale agile transformation?
5. What were/are the triggers/drivers that initiated the large-scale agile transformation?
6. Which general conditions were defined, or which prerequisites had to be met before starting the large-scale agile transformation?
7. How many people/agile teams/departments were/are affected by the large-scale agile transformation?

Section: Transformation approach

1. How was the large-scale agile transformation initiated (i.e., top-down or bottom-up)?
2. How and to what extent were/are employees involved in the large-scale agile transformation?

3. Did you consider any (single or multiple) established approaches for your large-scale agile transformation, e.g., factory approach, line of business piloting, full-scale transformation, etc.?
   a) Could you identify any advantages regarding this approach?
   b) Could you identify any disadvantages regarding this approach?
   c) How do/did you proceed with the implementation of the approaches (e.g., piloting, coaching, big bang, etc.)?
4. Why have you chosen this/these approach(es)?
5. What are the main factors/characteristics that are particularly important for you in a large-scale agile transformation (e.g., time, cost, employee participation, etc.)?
6. What frameworks (single or multiple) have been used for undertaking the large-scale agile transformation, e.g., scaling frameworks like SAFe or LeSS, or transition frameworks like ETF, etc.?
7. Can you briefly describe the (planned) time schedule and the different phases of your large-scale agile transformation as well as the key milestones?
8. How many agile experts are/were in the project team for the large-scale agile transformation?

Section: Ex-post view

1. Do you see any differences comparing the company's situation before and after the large-scale agile transformation?
   a) How did people respond?
   b) How did work structures change?
   c) How did the used technologies change?
   d) How did organizational structures respond?
2. Which benefits/successes were realized after the large-scale agile transformation?
3. In your opinion, which factors are necessary to execute the agile large-scale agile transformations successfully?
4. What were the challenges you encountered so far during the large-scale agile transformation?

Section: Ex-post view

1. What will be the next steps of the large-scale agile transformation?
2. If you were to realize the large-scale transformation again, what aspects would you do differently?
3. Which future challenges of the large-scale transformation do you see for the organization?
4. Are there any barriers that need to be resolved before the large-scale agile transformation can proceed?

Section: Ex-post view

1. What are your expectations regarding our further analysis?
2. Do you have any further comments or open points?

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