

Experienced Challenges of Adopting Agile Scaling Frameworks

Irina Safonova*, Maria Paasivaara*[†], Casper Lassenius^{†‡}, Ömer Uludağ[§] and Abheeshta Putta[†]

*LUT University

Lahti, Finland

Email: [firstname].[lastname]@lut.fi

[†]Aalto University

Espoo, Finland

Email: [firstname].[lastname]@aalto.fi

[‡]Simula Metropolitan Center for Digital Engineering

Oslo, Norway

Email: casper@simula.no

[§]Technische Universität München

München, Germany

Email: oemer.uludag@tum.de

Abstract—Background: The adoption of agile scaling frameworks has become increasingly prevalent in the software industry as organizations seek to extend the use of agile to large and complex projects. The frameworks claim to provide the necessary structure and guidance for scaling agile practices across multiple teams and domains. Despite their growing popularity, the challenges of adopting the frameworks are poorly understood. **Aims:** In this study, we analyze the experienced challenges related to adopting agile scaling frameworks to understand whether they are different for the different frameworks or between industries or roles within the adopting organization.

Method: We conducted a survey targeting software practitioners with experience adopting agile scaling frameworks. We received 204 valid responses, representing ten frameworks adopted in 26 countries and six continents.

Results: The most salient challenge, regardless of scaling framework, industry, or role, was organizational politics. Across frameworks, the challenge of forming agile teams emerged as the second most significant and change resistance as the third. We found significant differences in the challenges experienced by organizations based on their chosen framework and significant differences in the challenges between different industries and organizational roles, highlighting the importance of context when adopting agile scaling frameworks.

Conclusions: This study provides the first quantitative assessment of the challenges of adopting specific agile scaling frameworks in various contexts. By comparing the challenges associated with different frameworks, industries, and organizational roles, other organizations can better understand the most significant obstacles they may face and improve their framework fit to mitigate them. Future studies could build on these findings to provide additional insights and recommendations for organizations seeking to adopt agile scaling frameworks, including identifying strategies for overcoming common challenges and improving the overall effectiveness of these frameworks in a diverse range of contexts.

Index Terms—Agile software development, agile scaling frameworks, adoption challenges

I. INTRODUCTION

Agile software development methodologies have become widely adopted in the software industry since the beginning of the 21st century [1], [2]. They have garnered significant attention from scholars and industry professionals alike [3]. Initially designed for small, co-located, self-organizing teams working closely with customers in short iterations, methodologies like Extreme Programming (XP) and Scrum have seen success in smaller organizations and projects [1]. This has led to a growing number of software practitioners implementing agile methods in larger projects and organizations [4]. This, however, is far from the "sweet spot" of such methods [5], and scaling the methods to such contexts creates a broad set of challenges that need to be addressed.

To address the challenges of adopting agile methods in larger organizations and projects, proponents of agile methodologies and practitioners with experience in scaling agile have introduced various agile scaling frameworks to work as template solutions [6]. These include Large Scale Scrum (LeSS) [7], the Scaled Agile Framework (SAFe) [8], Disciplined Agile Delivery [9], Scrum at Scale (Scrum@Scale) [10], and, perhaps somewhat controversially, the Spotify Model [11]. As large organizations increasingly feel the pressure to become more agile, adopting such frameworks has become popular in the industry since they offer ready-made solutions for scaling agile methodologies [6], [12], [13]. A systematic mapping study [14] recognized the topic of agile scaling frameworks as one important research stream in large-scale agile development. The number of scaling frameworks has grown, e.g., a structured literature review [15] identified twenty different agile scaling frameworks.

The interest in adopting agile scaling frameworks is not limited to practical applications [13]; there is also a rising

academic interest in studying the implementation of these frameworks in large organizations, with the goal of providing valuable insights to support the agile adoption processes in companies [6].

The current literature on challenges in adopting agile scaling frameworks identified the following general challenges: (i) change resistance [16]–[20], (ii) team coordination and integration [16]–[21], (iii) agile implementation related challenges [16], [18], [20]–[23], (iv) organizational politics [16], [17], [19]–[21], and (iv) establishing an agile mindset [16], [17], [19], [20], [23], among others.

Only a few studies have focused specifically on reporting challenges with agile scaling frameworks [16], [21], [22]. The challenges reported by them are similar or overlap with those identified in other studies on large-scale agile adoption in general. However, to our knowledge, no other studies have looked into whether the challenges differ across different frameworks.

Although there is an expanding body of knowledge on agile scaling frameworks, the current literature does not adequately explore the challenges companies encounter when selecting and adopting a specific framework. In particular, it is unknown whether the challenges differ depending on the selected framework or whether different industries experience different challenges. A good understanding of this could provide valuable information for companies in selecting a framework that would fit best to their context. Companies should also know the challenges they will likely face while adopting a particular framework.

We begin to address these gaps in the literature by presenting our findings on the challenges organizations face adopting agile scaling frameworks based on a worldwide survey of industry practitioners. We aim to answer the following four research questions (RQs):

- RQ1: *What challenges do practitioners experience when adopting agile scaling frameworks?*
- RQ2: *How do the challenges differ across different frameworks?*
- RQ3: *How do the challenges differ across different industries?*
- RQ4: *How do the challenges differ between organizational roles?*

The structure of the paper is as follows. In Section II, we describe the background and related work. In Section III, we portray the procedure of our survey. In Section, IV, we present our outcomes, provide a discussion of our findings, and discuss the limitations of our study. We conclude our paper with a summary of the results and remarks on future research in Section V.

II. BACKGROUND AND RELATED WORK

Several scaling frameworks have emerged recently [15]. Even though adopting a scaling framework is expected to bring many benefits to the company, the adoption also introduces new challenges that organizations must overcome [16], [24]. Organizations must navigate complex systems, adapt to

changes in culture and leadership, and manage the inevitable tensions between agility and traditional project management practices. Two significant challenges emerge when applying agile methods to larger companies or projects. The first obstacle is the *added complexity factors* with larger teams, geographical dispersion, and formal governance structures. These factors make it difficult to achieve the optimal conditions that small, co-located teams with easy access to both users and business experts and non-life-critical software development represent [5]. The second challenge lies in the *lack of guidance* provided by agile methods to address these complexity factors [25]. The literature on challenges associated with different agile scaling frameworks is very limited. Especially, comparisons between the challenges that different frameworks introduce are missing.

The challenges related to adopting the Scaled Agile Framework (SAFe), the most used scaling framework according to some surveys (e.g., Digital.ai [13]), has been studied in a few papers. Putta et al. [24] identified 15 SAFe adoption challenges, including resistance to change, moving away from agile, and controversies within the framework. Laanti [22] reported that the most common challenges of SAFe adoption were an old mindset and culture, the model needing to have a good fit with the organization, and needing more fluency when using the model. Gustavsson et al. [26] noted that the lack of productivity, focus, and efficiency were the most common drawbacks of SAFe adoption. Salikhov et al. [23] found that the drawbacks of SAFe adoption included requiring more resources, a complex structure, a lack of autonomy, and decreased productivity. Thus, the SAFe adoption-related challenges seem somewhat different in different studies.

Conboy et al. [17] reported the results of a research collaboration that identified nine significant challenges related to adopting Scaled Agile Framework (SAFe), Scrum at Scale (S@S), Spotify, Large-Scale Scrum (LeSS), Nexus, and other mixed or customized large-scale agile frameworks. The paper identified the following challenges associated with implementing large-scale agile frameworks: (i) defining concepts and terms, (ii) comparing and contrasting frameworks, (iii) readiness and appetite for change, (iv) balancing organizational structure and frameworks, (v) coordinating work across teams, (vi) managing dependencies, (vii) scaling ceremonies and events, (viii) tracking and reporting progress, and (ix) cultivating an agile mindset and culture. They should be considered by organizations aspiring to pursue a large-scale agile strategy. The study does not provide a direct comparison of how the identified challenges differ between various large-scale agile frameworks. However, the paper states that the challenges and recommendations were identified based on 13 agile transformation cases over 15 years.

Dikert et al. [18] conducted a systematic literature review and described 35 challenges faced by large-scale organizations in the adoption of agile scaling frameworks, including change resistance, lack of investment, agile difficult to implement, and coordination challenges in multi-team environments. This study did not take different scaling frameworks into account.

Kalenda et al. [21] discussed two frameworks, SAFe and LeSS, and identified challenges such as resistance to change, quality assurance issues, integrating the previous and non-agile parts of an organization, and agile difficult to implement. However, the paper does not provide a comparative analysis between different frameworks or challenges.

Additionally, some non-scientific articles reported on the challenges of adopting agile scaling frameworks. Denning [27] identified five challenges faced by agile adoption in general, which were related to the correct definition of agile, getting top management buy-in, concern that some of the scaling frameworks (name of the specific frameworks were not provided) can be troublesome as they follow ideas that are not related to agile, and top-down processes that contradict true agile principles. Finally, they mention the need for progress in research, an in-depth understanding of different methods, and a lack of professional coaches. The article states that unless these challenges are met, the eventual spread of agile could be delayed by years or even decades.

Miller [28] discussed challenges and problems specific to agile projects, such as communication issues, managing day-to-day operations, gaining buy-in from stakeholders, changing culture and mindset, and gaining experience in adopting agile methods from the project management perspective. The article stated that, although some challenges may be unique to specific projects or organizations, there would be a need for general guidance to address common problems in agile projects.

However, a comprehensive literature review on challenges faced while adopting different agile scaling frameworks in different industries and challenges faced by different organizational roles is not readily available.

III. RESEARCH METHODOLOGY

In this section, we present the survey design, data collection, and data analysis.

A. Survey Design

We collected data using a questionnaire¹ consisting of an introduction and four parts. In the introduction, we explained the research goal and the intended respondents, i.e., practitioners with experience in agile transformations. In the first part, we collected organizational background information, e.g., data on the development process before the transformation. The next three parts asked the respondents about the reasons, challenges, and expected and realized benefits related to a single transformation they had had experience with. We asked the items using a five-point Likert scale, prompting the respondents to indicate their agreement with statements based on previous studies, including [15], [29], [30]. To allow the respondents to add items that might be missing from previous research and to help limit the anchoring effect, we had write-in sections related to all major items. The last part of the survey collected background information on the respondents,

including their role in the organization and the geographic location of the organization.

We validated the questionnaire in several stages. First, all authors reviewed and discussed the instrument. As a second step, we invited comments from an academic expert on large-scale agile. Third, two senior researchers experienced in survey design reviewed our instrument, helping to ensure that it adhered to good survey research guidelines. As a last step, an experienced practitioner reviewed the questionnaire. All stages led to various improvements in the formulation of the questions. After improving the instrument based on the feedback, we piloted it using three respondents representative of our intended audience.

B. Data Collection

The target audience for our survey included software professionals with experience in adopting agile scaling frameworks. We were interested in people in various roles, e.g., managers, agile coaches, Product Owners, and developers. As common in empirical software engineering, we ruled random sampling infeasible for our purposes and relied on non-probabilistic convenience sampling, ending up with “*getting responses from the individuals who are willing and are available*” [31].

To reach our target population, we promoted our survey at international agile conferences, agile meetup groups, social media groups, and using our personal networks.

We promoted the survey at three international conferences that have high attendance of agile practitioners: the 20th International Conference on Agile Software Development (XP 2019)², the 14th International Conference on Global Software Engineering (ICGSE 2019)³, and the Agile 2019⁴. The data was collected using the LimeSurvey⁵ tool between May and September 2019.

In June 2019, we posted the survey link in the LinkedIn group “*Lean and Agile Software Development*”⁶, which is a large online community, consisting of Lean and Agile practitioners, and, at the time, with more than 157.000 members from all over the world.

We also promoted the survey in two agile meetups. Meetups are informal gatherings in which practitioners share their experiences, ideas, and knowledge on a topic of joint interest, in this case, agile software development. One Meetup was held in Helsinki, Finland, in August 2019 with 32 participants, and one in Copenhagen, Denmark, in June 2019 with 30 participants.

Finally, we approached agile professionals from different organizations worldwide via email, LinkedIn, and other social media channels, asking them to complete the survey. We approached our personal contacts by email and asked them to snowball, i.e., send to colleagues they thought could provide answers to the questionnaire in addition to themselves.

²<https://www.agilealliance.org/xp2019/>, last accessed on: 02-05-2023.

³<https://conf.researchr.org/home/icgse-2019>, last accessed on: 02-05-2023.

⁴<https://www.agilealliance.org/agile2019/>, last accessed on: 02-05-2023.

⁵<https://www.limesurvey.org/>

⁶<https://www.linkedin.com/groups/37631>, last accessed on: 02-05-2023.

¹Available at <https://figshare.com/s/abd8810840a3fe514db6>

We promoted the survey only in events where the majority of participants were agile practitioners and made it very clear in our promotion and in the survey introduction that the survey was only aimed at practitioners that had experienced a large-scale agile transformation in their organization.

C. Data Analysis

We received 4044 responses, of which 204 were complete and valid. The small number of complete answers compared to the total is because many respondents started the survey but did not finish it. We were conservative and decided only to include complete responses, i.e., where the respondent had answered the full survey. We imported the data into SPSS Statistics⁷ software for analysis.

Descriptive Statistics. We started the data analysis by running basic descriptive statistics to get an overview of the data and insights on how to proceed with inferential statistics. For this paper, we focused on challenges faced in adopting agile scaling frameworks and the differences between different frameworks, industries, and organizational roles.

Inferential Statistics. We tested for normality using the *Kolmogorov-Smirnov test* [32], which showed that the data was not normally distributed. Thus, we needed to use non-parametric tests to perform inferential statistics. We used the *Kruskal-Wallis H test* [33] to compare the differences between more than two independent groups, e.g., primary framework, industry sector, and roles when the dependent variable is either ordinal or interval/ratio.

The *Kruskal-Wallis H test* only finds if there are statistical differences between several independent groups (e.g., SAFe, LeSS, Spotify, different industries, and different organizational roles). To find the statistically significant difference between the two independent groups, we conducted a posthoc analysis consisting of pair-wise comparisons between the individual frameworks (e.g., SAFe and LeSS), industries (e.g., Finance, Automotive), and organizational roles (e.g., Project Management, Development Perspective) using the *Mann-Whitney U* [33] test, which is used to identify the statistically significant differences between two independent groups.

Qualitative Analysis. We coded the data for the open-ended question, *other challenges* according to the guidelines in [34]. We started by open coding, which included breaking down the data into meaningful labels. After that, we grouped the open codes into axial codes based on their similarities and differences.

Data Availability. The dataset for this publication is available at doi:10.5281/zenodo.8126320 [35].

IV. RESULTS AND DISCUSSION

In this section, we present and discuss our results. We start by giving an overview of the demographics of the survey respondents, after which we answer our four research questions.

⁷<https://www.ibm.com/products/spss-statistics>, last accessed on: 04-29-2023.

A. Overview of contextual information

We received 204 complete and valid responses. The respondents were located across all continents, with the highest number of respondents coming from the USA (22.1%), Germany (19.6%), and Denmark (5.9%). The high number of respondents from these locations is partly due to our sampling process, as we recruited participants from the conferences that took place in the US and Canada, as well as through personal networks of the authors, part of whom were located in these countries. Most respondents were located in North America and Europe, which aligns well with the respondent distribution of the State of Agile Survey [13] and the use of agile methods in general.

Our results show that SAFe is the most adopted primary framework (49%) among the survey participants, followed by LeSS (13.7%) and internally created methods (5.9%). For most respondents, the duration of usage of a scaling framework in their organization was only 1–2 years before answering the survey (41.2%), while one-third (33.3%) had used a scaling framework for 3–5 years, and only a small part had used a scaling framework over five years (10.8%) or under one year (14.7%).

Most respondents had globally distributed teams in their organization (82.2%). Slightly over one-third of organizations of the respondents had 10–50 agile teams (36.8%), one-third had 1–9 teams (34.3%), and a bit less than a third (28.9%) had over 50 teams. Over half of the respondents had process-related roles (56.4%), such as an agile coach or a Scrum Master. One-fourth (25.5%) had a management role, such as a project or line manager. Development team-level roles (10.3%), such as developers and team leaders, and Product-level roles (6.4%), such as Product Owners and requirement engineers, were included as well.

Before adopting agile scaling frameworks, almost half of the respondents used plan-driven methods (44.6%), one-fourth were already using agile methods in their teams (24.5%), while a small part had adopted hybrid methods combining plan-driven and agile (17.2%). The highest percentage of respondents came from the financial sector (28.4%), followed by the technology sector (12.3%) and the public/government sector (10.3%).

More detailed contextual information about our survey participants can be found in our previous articles [24], [36] that are based on the same survey.

B. RQ 1: Challenges in Adopting Scaling Frameworks

We asked the participants to rate their agreement with perceiving or witnessing sixteen different challenges using a five-point Likert scale ranging from "strongly agree" to "strongly disagree." The challenges included in the survey are shown in Figure 1.

The reason *organizational politics* received the highest mean value ($\bar{x} = 3.95$). This was followed by *team formation challenges* (e.g. *release trains*, *cross-functional teams*) ($\bar{x} = 3.62$), *change resistance* ($\bar{x} = 3.6$), *difficulties in restructuring the organization* ($\bar{x} = 3.59$), and *difficulties in*

TABLE I
WRITE-IN CHALLENGES

Challenges	Framework(s)	n
External and internal teams' collaboration challenges	Internal, SAFe, LeSS	5
Lack of management support	SAFe	5
Moving away from agile	SAFe	2
Struggle for agile mindset	SAFe	2
Time-consuming adoption	SAFe	1

establishing an agile mindset) ($\bar{x} = 3.55$). These challenges were reported in previous literature on SAFe and LeSS, e.g., challenges in organizational politics, difficulties in establishing an agile mindset, team formation challenges, and difficulties in involving non-development units in the transformation [16], [21], [37]. Most of them, such as *change resistance*, were also recognized in the systematic literature review on large-scale agile transformations [18], which, however, did not report *organizational politics* as a challenge at all. This seems to be the most surprising finding that *organizational politics* turned out to be the highest-ranked challenge, instead of some typical scaling-related practical challenges, such as team formation and restructuring the organization.

We received 15 write-in answers to our open question asking for challenges not included in the predefined list. These are presented in Table I. The most mentioned challenges were *external and internal teams' collaboration challenges* and *lack of management support*. The latter one has a close resemblance to the challenge *difficulties in getting the management buy-in* that was one of the challenges included in the survey instrument. Other write-in challenges included *moving away from agile*, which relates to the challenge *using the framework felt like moving away from agile*, and *struggle for agile mindset*, which relates to the challenge *difficulties in establishing an agile mindset*. We can conclude that the write-in challenges did not bring clearly new challenges as most resembled the challenges already listed as survey options. Therefore, it seems that the challenges chosen for the survey instrument provide quite a comprehensive list of challenges of adopting agile scaling frameworks.

C. RQ 2: Differences in Challenges Across Scaling Frameworks

The users of each agile scaling framework face various degrees of adoption challenges. When choosing a framework, organizations must consider how well it aligns with their needs and how to address the possible challenges. Our research aimed to investigate whether the challenges of adopting a particular agile scaling framework vary across different frameworks. For this analysis, we chose to investigate the five scaling frameworks that received the most answers in our survey: the *Scaled Agile Framework (SAFe)*, *Large-Scale Scrum (LeSS)*, *internally created frameworks*, *Scrum@Scale*, and the *Spotify Model*.

To achieve this, we calculated the mean values for all challenges (as shown in Figure 2 where red indicates higher mean

values, while blue indicates the lowest values.) associated with each framework. Our analysis revealed that the mean values differed; subsequently, we performed a *Kruskal-Wallis H test* using the primary framework adopted as the independent variable (SAFe, LeSS, Internally-created, Scrum@Scale, and Spotify) and all sixteen challenges as the dependent variables.

We discovered significant differences between frameworks regarding several challenges. These include: (i) *challenges in breaking down complex projects*, (ii) *difficulties in establishing an agile mindset*, (iii) *difficulties in getting management buy-in*, (iv) *missing guidance on architectural topics*, (v) *missing guidance on how to transform the higher organizational levels (e.g., portfolio management)*, (vi) *the framework does not help in resolving problems with technical dependencies*, (vii) *the scaling framework brings additional work overhead*, and (viii) *uncertainty with respect to middle management's role in agile (e.g., project managers, line managers)*. To identify these differences, we conducted a post hoc analysis. Table II shows the mean ranks for each framework and the pairs of frameworks that exhibited statistically significant differences for each challenge.

For challenge (i) *challenges in breaking down complex projects* (listed first in Table II), a significant difference was found between internally created frameworks, where the mean rank is the highest, and SAFe. However, the mean rank is not the lowest for SAFe but for Spotify. However, a significant difference was not found for Spotify, possibly due to the small sample sizes of the groups. We can speculate that the reason for this difference is that the internally created frameworks did not provide guidance on how to split large projects, whereas SAFe and LeSS both provide guidance, and the Spotify model provides guidance for components of the agile organization.

Perhaps not surprisingly, the challenge (ii) *difficulties in establishing an agile mindset*, was the most salient in SAFe and lowest for LeSS. SAFe is a rather complex model which introduces many roles, levels, and practices that some organizations might experience as bureaucratic. LeSS is a rather simple upscaling of Scrum and therefore has less overhead and extra roles, which might explain the result. We cannot easily explain the results for internally created frameworks or the Spotify model in particular in contrast to LeSS.

Regarding challenge (iii) *difficulties in getting management buy-in*, a significant difference was found between internally created frameworks and LeSS. This is unsurprising, as getting management buy-in for a well-documented framework is likely much easier than for an internally created one. The Spotify Model received the highest mean rank. However, the Spotify Model is not a widely marketed framework, unlike LeSS and SAFe, which have widely available training and consulting for potential adopters.

Both LeSS [38] and SAFe provides structures and guidance on architectural roles and design. In contrast, Spotify and internally created frameworks may not provide much guidance on architectural topics. Thus, Spotify and internally created frameworks had a higher agreement for the challenge (iv) *missing guidance on architectural topics* over LeSS and SAFe.

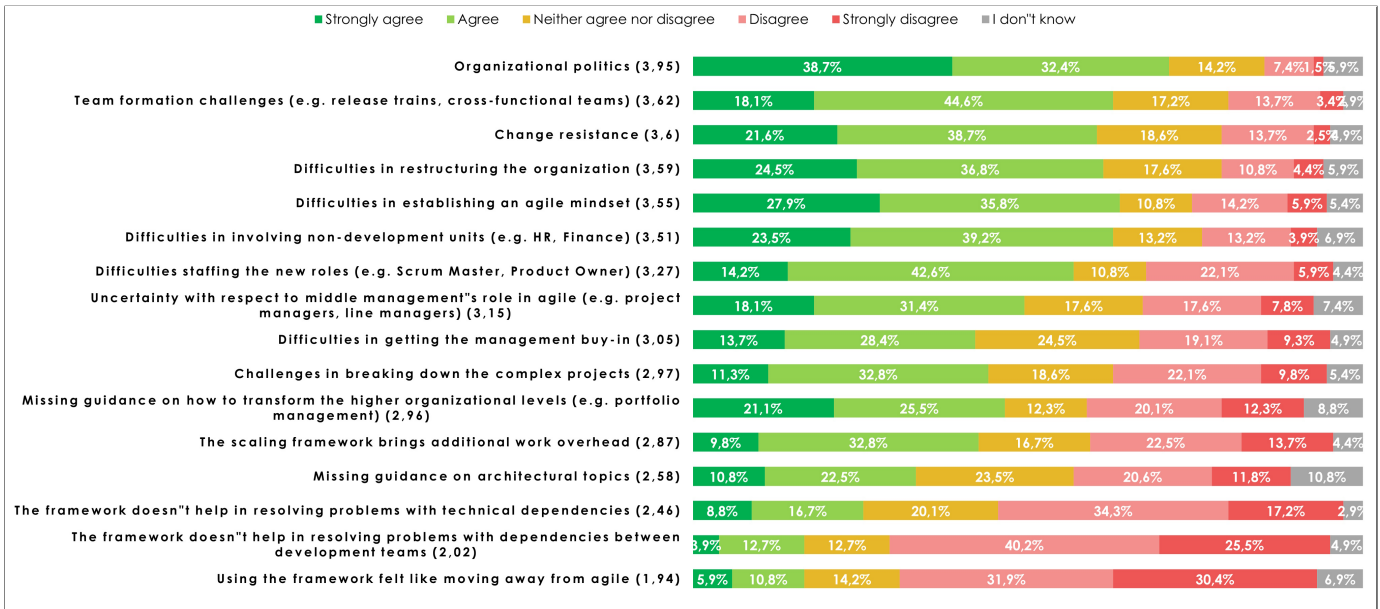


Fig. 1. Challenges of Adopting Agile Scaling Frameworks (all respondents)

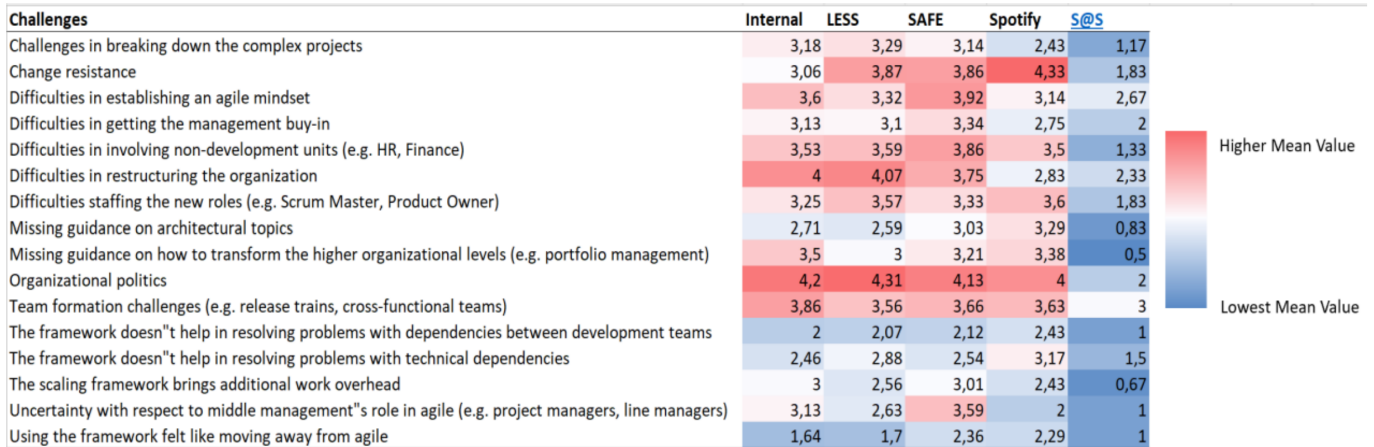


Fig. 2. Mean Values of Challenges for Different Frameworks (challenges in alphabetical order)

Similarly, it makes sense for the challenge (v) *missing guidance on how to transform the higher organizational levels (e.g., portfolio management)* that the internally created methods and Spotify had a higher agreement than LeSS and SAFe. However, it seems slightly surprising that SAFe scored higher than LeSS, as it is the only model that discusses the higher organizational levels at any level of detail.

SAFe [8] is more focused on structured and predictable delivery, while Spotify is known for its emphasis on innovation, experimentation, and team autonomy, which may lead to a greater degree of technical complexity and uncertainty in projects. Thus, the challenge (vi) *the framework does not help resolve problems with technical dependencies* had more agreement among the users of the Spotify Model than among the users of SAFe.

SAFe is a large and complex model that introduces many

roles, meetings, and practices. It is, therefore, unsurprising that the challenge (vii) *the scaling framework brings additional work overhead* had a higher agreement in SAFe compared to the Spotify Model.

The challenge (viii) *uncertainty with respect to middle management's role in agile (e.g., project managers, line managers)* refers to the difficulty that organizations face in defining the new roles for middle managers in an agile environment. The users of SAFe and internally created frameworks agreed more with this challenge than those of LeSS. This is surprising, as SAFe provides more explicit guidance and structure around the role of middle management, as well as more new roles suitable for previous middle managers, than LeSS. While LeSS takes a more decentralized approach to agile, focusing on self-organizing teams and minimizing hierarchy, which provides less clear opportunities for previous middle man-

TABLE II
DIFFERENCES IN CHALLENGES BETWEEN FRAMEWORKS

Challenge	Mean Rank	Statistically Significant Pairs
(i) Challenges in breaking down complex projects	SAFe: 98.23 LeSS: 100.27 Spotify: 95.85 Internal: 127.29 S@S: 108.00	SAFe – Internal
(ii) Difficulties in establishing an agile mindset	SAFe: 108.23 LeSS: 80.22 Spotify: 102.20 Internal: 104.33 S@S: 90.78	LeSS – SAFe
(iii) Difficulties in getting management buy-in	SAFe: 101.07 LeSS: 85.98 Spotify: 122.75 Internal: 121.24 S@S: 120.11	LeSS – Internal
(iv) Missing guidance on architectural topics	SAFe: 101.26 LeSS: 90.65 Spotify: 136.95 Internal: 117.43 S@S: 95.06	LeSS – Spotify LeSS – Internal
(v) Missing guidance on how to transform higher organizational levels	SAFe: 103.01 LeSS: 83.20 Spotify: 119.40 Internal: 125.29 S@S: 79.76	LeSS – Internal
(vi) The framework doesn't help in resolving problems with technical dependencies	SAFe: 98.47 LeSS: 104.48 Spotify: 121.60 Internal: 104.62 S@S: 107.72	SAFe – Spotify
(vii) The framework brings additional overhead	SAFe: 111.36 LeSS: 91.58 Spotify: 78.00 Internal: 114.88 S@S: 84.94	Spotify – SAFe
(viii) Uncertainty with respect to middle management's role in agile	SAFe: 106.62 LeSS: 83.55 Spotify: 90.35 Internal: 122.48 S@S: 89.92	LeSS – SAFe LeSS – Internal

agers. However, one explanation for this difference between SAFe and LeSS might be that SAFe is often used in even larger organizations than LeSS, which might also mean higher levels of hierarchy and more middle managers for whom to find roles. We cannot easily explain the results for internally created frameworks compared to LeSS.

D. RQ 3: Differences in Challenges Across Industries

Next, we studied how the experienced challenges of adopting agile scaling frameworks differed between survey respondents representing different industries. For this question, we compared five industries that had the largest number of responses: the financial sector (28.4%), the technology sector (12.3%), the public/government sector (10.3%), the automotive sector (9.3%), and the telecom sector (4.9%).

TABLE III
DIFFERENCES IN CHALLENGES BETWEEN INDUSTRIES

Challenges	Mean Rank	Statistically Significant Pairs
(i) Difficulties in involving non-development units	Automotive: 76,92 Finance: 118,29 Government: 89,07 Technology: 88,54 Telecom: 84,95	Automotive – Finance Finance – Government Finance – Technology
(ii) Missing guidance on architectural topics	Automotive: 81,08 Finance: 116,96 Government: 123,45 Technology: 103,32 Telecom: 73,50	Automotive – Finance Automotive – Government Finance – Telecom Government – Telecom
(iii) Difficulties in getting management buy-in	Automotive: 72,11 Finance: 113,41 Government: 119,31 Technology: 110,68 Telecom: 92,25	Automotive – Finance Automotive – Government Automotive – Technology
(iv) Using the framework felt like moving away from agile	Automotive: 108,84 Finance: 114,50 Government: 110,93 Technology: 75,14 Telecom: 89,75	Finance – Technology Government – Technology
(v) Difficulties staffing the new roles (e.g., SM, PO)	Automotive: 108,82 Finance: 108,71 Government: 116,33 Technology: 87,25 Telecom: 133,65	Government – Technology Technology – Telecom

We discovered significant differences between different industries. A post hoc analysis was conducted to identify these differences. Table III presents the mean ranks for each industry and the pairs of industries that displayed significant differences for each challenge.

The finance industry has complex and specialized processes related to financial operations, which may require a higher level of involvement from non-development units, such as finance and accounting. This might explain why the finance industry might have reported the most challenges with (i) *difficulties in involving non-development units (e.g., HR, Finance)*.

The government and finance industries agreed the most on the challenge (ii) *missing guidance on architectural topics*. It is unclear why they felt this stronger need for stronger support for architecting. We can speculate that the automotive and telecommunication industries might have a higher level of technical expertise and resources, making them less reliant on guidance or standards for architectural topics. Still, our data does not help to explain this difference.

The higher agreement of the challenge (iii) *difficulties in getting the management buy-in* in the government, finance, and technology industries compared to the automotive sector might reflect a more bureaucratic and risk-averse organizational culture in these industries than in the automotive sector.

Challenge (iv) *using the framework felt like moving away from agile* had the highest agreement in the finance industry, which might reflect the prevalence of SAFe in that particular industry, as it was the framework with the highest reported amount of support regarding this challenge.

Interestingly, the telecom industry reported the highest amount of (v) *difficulties in staffing the new roles* (e.g., *Scrum Master*, *Product Owner*). While we are unsure why, it can be related to the challenges in retraining people from more traditional project roles and the distance between the development teams and the end customers. However, we would expect to find similar situations in the automotive industry and are unsure why the technology sector reports so much less of this issue.

E. RQ 4: Differences in Challenges Across Organizational Roles

With our last research question, we wanted to study whether respondents in different roles faced different challenges while adopting agile scaling frameworks. For this analysis, we grouped the roles into five categories: *process perspective*, *project management*, *line management*, *end-user perspective*, and *development perspective*.

The *process perspective* included roles such as agile coach, Scrum Master, and transformation consultant. The *project management perspective* included project manager roles, while *line management perspective* included, e.g., line manager, section manager, and department manager roles. The *end-user perspective* included roles such as Product Owners and requirement engineers. Finally, the *development perspective* combined developer, team leader, architect, tester, and other software maintenance roles.

Again, we conducted a post hoc analysis to identify significant differences between the challenges faced by different organizational role categories.

The following challenges had the highest agreement for the end-user perspective over one or several other perspectives: (i) *the framework does not help in resolving problems with dependencies between development teams*, (ii) *difficulties in involving non-development units* (e.g., *HR*, *Finance*), (iii) *difficulties in staffing the new roles* (e.g., *Scrum Master*, *Product Owner*), and (iv) *missing guidance on architectural topics*.

As one of the main roles in the end-user perspective is the Product Owner, who needs to coordinate what gets done by one or several teams, and interfaces with other roles in the organization, it is not surprising that the issues related to development team dependencies, and getting non-development units involved are most prevalent when viewed from this perspective. Less clear is why the end-user perspective also reports more agreement with the challenges of staffing new roles and guidance for architectural topics than the other ones. One could expect developers to experience architectural issues more and project or line management to have more issues with staffing than the people in roles representing the end-user perspective.

Project management, line management, and process-related roles all require individuals to navigate the political landscape of an organization. They must be able to build relationships, communicate effectively, and manage conflicts to facilitate the transformation and help ensure that work progresses well in the organization. On the other hand, developers are likely

TABLE IV
DIFFERENCES IN CHALLENGES BETWEEN ORGANIZATIONAL ROLES

Challenges	Mean Ranks	Statistically Significant Pairs
(i) No help for solving problems with dev. team dependencies	End-User: 138.25 Project Mgmt: 99.57 Line Mgmt: 97.43 Process: 97.80 Development: 97.97	End-User–Proj. Mgmt End-User–Process End-User–Line Mgmt End-User–Dev
(ii) Difficulties in involving non-development units	End-User: 136.29 Project Mgmt: 104.46 Line Mgmt: 94.07 Process: 96.53 Development: 91.76	End-User–Line Mgmt End-User–Process End-User–Dev
(iii) Difficulties in staffing the new roles	End-User: 128.20 Project Mgmt: 101.41 Line Mgmt: 87.71 Process: 104.82 Development: 85.61	End-User–Line Mgmt End-User–Dev
(iv) Missing guidance on architectural topics	End-User: 124.83 Project Mgmt: 99.76 Line Mgmt: 85.79 Process: 102.96 Development: 78.03	End-User–Dev
(v) Organizational politics	End-User: 101.38 Proj. Mgmt: 112.02 Line Mgmt: 103.21 Process: 106.94 Development: 66.39	Proj Mgmt–Dev Line Mgmt–Dev Process–Dev
(vi) Difficulties in establishing an agile mindset	End-User: 101.54 Project Mgmt: 105.44 Line Mgmt: 124.79 Process: 103.32 Development: 84.97	Line Mgmt–Dev

protected from conflicts and politics at and between different levels of the organization. Thus, it is unsurprising that the top challenge across all the survey responses, (v) *organizational politics* received a much lower mean rank among respondents from the development perspective than the project management, line management, and process perspectives.

Another significant difference was found regarding the challenge (vi) *difficulties in establishing an agile mindset*. Respondents from the line management perspective saw this as a bigger challenge than the representatives from the development roles. Again, this is not surprising. Line management typically involves overseeing the work of others. Thus they can more easily see if the organization is experiencing this challenge. The development perspective focuses on the day-to-day tasks associated with their specific role, such as writing code and testing software. Thus they might not have as much visibility on the agile mindset in other parts of the organization. Whereas agile methods, such as Scrum, concentrate on the team level, with a lot of guidance and practices, which makes it easier for team members to build a proper agile mindset.

F. Threats to Validity

In this section, we describe the limitations of our study [39].

Internal Validity. We mitigated the partiality by sourcing information from trustworthy origins. Specifically, the bulk

of our data, accounting for over 90 percent, was gathered through in-person encounters at conferences and agile Meetups or through acquaintances who we knew utilized agile scaling frameworks, enabling us to circumvent suspect responses.

External Validity. Respondents in our study held various roles, utilized different scaling frameworks, and hailed from diverse geographical and professional backgrounds. However, our fundamental demographics align with comparable studies, providing some assurance that our sample does not wholly misrepresent the population. Additionally, our participants predominantly comprise individuals and companies actively engaged in the agile community.

Construct Validity. To help ensure construct validity, we drew from previous research in the field of agile and large-scale agile methodologies to develop statements concerning the challenges of adopting scaling frameworks. Given constraints on questionnaire length, we could not include all potential statements measuring challenges. To compensate for this limitation, we incorporated open-ended questions to elicit the most probable challenges for adopting an agile scaling framework.

Conclusion Validity. Conclusion validity pertains to the aptitude to deduce accurate conclusions from the gathered information. The information obtained from the survey primarily utilized the Likert scale, and we applied non-parametric assessments to determine differences between autonomous clusters. Furthermore, we corroborated our post hoc analysis through the Mann-Whitney U test to establish the variances across agile scaling frameworks, industries, and roles. Additionally, we compared our findings with the present literature to substantiate our results.

V. CONCLUSIONS AND FUTURE WORK

With the need to swiftly adapt to dynamic business environments, software professionals are progressively inclined towards leveraging the benefits of agile practices by adopting agile scaling frameworks in large corporations and undertakings [12], [13]. Consequently, there is a mounting scientific interest in understanding the adoption of such frameworks better [20].

Despite the interest in and importance of agile scaling frameworks, their adoption by organizations still poses several challenges. One of these is the lack of research regarding the current state of practice of agile scaling framework adoptions, particularly through surveys targeting organizations that have already implemented these frameworks. To address this issue, we surveyed software practitioners worldwide to evaluate the challenges organizations face quantitatively.

Our outcomes show that the top challenges for adopting agile scaling frameworks are *organizational politics*, *team formation challenges*, *change resistance*, *difficulties in restructuring the organization*, and *difficulties in establishing an agile mindset*.

Moreover, we identified significant differences in challenges across the different agile scaling frameworks, industries, and organizational roles.

The inferential analysis of the selected frameworks, i.e., SAFe, LeSS, internally created methods, Scrum at Scale, and the Spotify Model, disclosed statistically significant differences between the challenges for adopting these frameworks. Notably, we revealed that the *challenges in breaking down complex projects* and *missing guidance on architectural topics* were significant adoption challenges for internally created methods compared to SAFe and LeSS.

For the SAFe framework, *difficulties in establishing an agile mindset* and *the framework brings additional overhead* were recognized as more challenging than for LeSS and Spotify. Whereas *the framework doesn't help resolve problems with technical dependencies* seemed to be a bigger challenge for the Spotify Model than SAFe.

Furthermore, we revealed that the *difficulties in involving non-development units* (e.g., HR, Finance) was significantly more prevalent in the finance industry than elsewhere. The government sector reported the highest agreement with the challenge of *missing guidance on architectural topics*, followed by the finance sector. Interestingly, the challenge of *getting management buy-in* was the lowest in the automotive sector and statistically significantly higher in the finance, government, and technology industries. *Using the framework felt like moving away from agile* was most prevalent in the finance sector, which we speculate might be related to that industry's wide adoption of the SAFe framework. Finally, *difficulties staffing the new roles* (e.g., Scrum Master, Product Owner) was identified as a more critical challenge for government and telecom than for the technology industry.

We also analyzed the challenges faced by respondents in different organizational roles classified into five categories: the end-user perspective, project management, line management, process perspective, and development perspective. We found that the following challenges were most strongly reported by the end-user perspective: *the framework does not help in resolving problems with dependencies between development teams*, *difficulties in involving non-development units* (e.g., HR, Finance), *difficulties staffing the new roles* (e.g., Scrum Master, Product Owner), and *missing guidance on architectural topics*. *Difficulties in establishing an agile mindset* was a significant challenge for the line management perspective compared to the development perspective. In addition, *organizational politics* had a lower impact on development perspective roles than on the project management, line management, and process perspective roles.

Finally, this paper provides insights for further research. We urge researchers to conduct additional quantitative studies to examine challenges across different agile scaling frameworks, industries, and roles. Further research that examines the impact of difficulties faced on the organizations, their reasons, and correlations with the benefits of adoption can give valuable insights to organizations seeking to select the most appropriate framework and offer ways to mitigate challenges. Such research could provide a decision-making base to assist organizations in selecting the most suitable framework.

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