BARBARA MOREIRA BELTRAMI

EXPLORING BARRIERS TO SCALED AGILE AND HYBRID APPROACHES

A thesis presented to the Polytechnic School of the University of São Paulo to obtain the Production Engineering degree.

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RESUMO

Esta tese investiga os desafios enfrentados pelos profissionais na implementação de metodologias ágeis em escala, além de explorar possíveis estratégias de mitigação. O foco do estudo são modelos de projetos escalados, utilizando uma revisão literária para contextualizar o cenário acadêmico e entrevistas qualitativas com profissionais envolvidos em projetos ágeis de uma grande empresa.

O principal objetivo do estudo é entender os desafios mais relevantes na aplicação das metodologias ágeis em escala. A ferramenta N-Vivo foi empregada para analisar os dados coletados, revelando que as barreiras mais significativas são: Questões Relacionadas às Equipes, Barreiras na Aplicação do Método, Questões Gerenciais, Problemas de Produto e Processo e Questões Culturais. Adicionalmente, foram identificadas a coexistência de algumas barreiras, como o apego ao antigo modo de trabalho e a persistência da burocracia.

Os resultados deste estudo podem orientar as organizações no desenvolvimento de estratégias de mitigação mais precisas, a fim de implementar com sucesso a transformação ágil. No entanto, o estudo possui limitações, pois não aborda o tamanho dos impactos que essas barreiras exercem nos projetos e, ademais, utiliza uma amostra de entrevistas que poderia ser mais diversa e abrangente.

Palavras-chave: Metodologia Ágil em escala. Gerência de projeto ágil escalado. Barreiras de implementação. Transformação ágil.

ABSTRACT

This thesis investigates the challenges faced by professionals in implementing agile methodologies at scale, as well as exploring possible mitigation strategies. The focus of the study is on scaled project models, using a literature review to contextualize the academic scenario and qualitative interviews with professionals involved in agile projects at a large company.

The main objective of the study is to understand the most relevant challenges in the application of agile methodologies at scale. The N-Vivo tool was used to analyze the collected data, revealing that the most significant barriers are: Team-Related Issues, Method Application Barriers, Managerial Issues, Product and Process Issues, and Cultural Issues. Additionally, the coexistence of some of these barriers was identified, such as attachment to the old way of working and the persistence of bureaucracy.

The results of this study can guide organizations in developing more precise mitigation strategies to successfully implement agile transformation. However, the study has limitations as it does not address the size of the impacts these barriers have on projects and, moreover, uses an interview sample that could be more diverse and comprehensive.

Keywords: Agile Methodology at scale. Scaled Agile Project Management. Implementation Barriers. Agile Transformation.

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LIST OF ABBREVIATIONS AND ACRONYMS

CGT   Constructivist Grounded Theory
CI   Culture Issues
DA   Disciplined Agile
GT   Grounded Theory
IT   Information Technology
LeSS   Large-Scale Scrum
LSAP   Large-Scale Agile Projects
MAB   Method Application Barriers
MD   Multiple Departments
MI   Managerial Issues
MP   Multiple Projects
MR   Multiple Regions
MSAP   Medium-Scale Agile Projects
MT   Multiple Teams
MVP   Minimal Viable Product
PM   Project Manager
PMBOK   Project Management Body of Knowledge
PMO   Project Management Office
PO   Product Owner
PPI   Product and Process Issues
PS   Project Size
R   Requirements
SAFe   Scaled Agile Framework
SI   Stakeholders Issues
SoS   Scrum of Scrums
SSAP   Small-Scale Agile Projects
TRI   Team Related Issues
US   User Stories

SUMMARY

1. INTRODUCTION

In the subsequent section, you will be introduced to the drive and purpose behind the thesis. Subsequently, there is a brief overview of how the project will be organized.

1.1 Motivation

In today's highly competitive and rapidly changing business environment, organizations must continuously adapt and innovate to maintain their edge. As a result, there has been an increasing interest in agile methodologies as a means to drive organizational success through improved project management, reduced time-to-market, and enhanced collaboration. (LEFFINGWELL; D, 2011) Consequently, it is crucial to study the implementation of scaled agile frameworks, such as Scrum of scrums (SoS), Scaled Agile framework (SAFe), Large-Scale Scrum (LeSS), Scrum, and Kanban, to understand their implications on contemporary companies' strategies and operations.

Firstly, the study of scaled agile implementation is timely and pertinent due to the growing adoption of agile methodologies across various industries. As traditional project management methods struggle to keep pace with the dynamic nature of today's market, organizations are turning to agile practices to improve their flexibility, responsiveness, and efficiency. (LARMAN; C, VODDE;B, 2016) By exploring these frameworks' successes and challenges, this thesis will contribute valuable insights to both academics and practitioners seeking to navigate the realm of scaled agile implementation.

Secondly, understanding the implications of scaled agile implementation is crucial for companies aiming to remain competitive in the digital age. As technology continues to disrupt established business models, organizations must adopt new ways of working that enable rapid adaptation and innovation. Implementing agile at scale not only facilitates a more streamlined approach to project management but also fosters a culture of continuous improvement, innovation, and customer-centricity. (SMITE, 2019) This thesis will be instrumental in projects as they strive to embed agility into their strategic decision-making processes.

Moreover, the study of scaled agile implementation can shed light on how organizations can overcome common challenges associated with scaling agile practices. While the benefits of agile methodologies are well-documented at the team level, scaling these practices across multiple teams or departments can introduce complexities and obstacles. (BROWN; A, LEE; K, 2020) By examining real-world case studies and best practices, this thesis will provide guidance for organizations navigating the complexities of scaled agile implementation.

Furthermore, exploring the implications of scaled agile implementation in various industries will enable companies and organizations to harness the full potential of these methodologies. As different sectors face unique challenges and opportunities, understanding how scaled agile frameworks can be tailored to specific contexts is essential for maximizing their effectiveness.

In conclusion, studying scaled agile implementation has its importance in today's fast-paced business landscape. By understanding the intricacies and implications of various frameworks, this thesis will contribute to the growing body of knowledge on agile practices and provide actionable insights for organizations seeking to enhance their agility, innovation, and competitiveness.

1.2 Objetives

The primary objectives of this thesis are to investigate and analyze the implementation of scaled agile frameworks and understand their implications on modern companies and organization strategies and operations. Specifically, the thesis aims to achieve the four goals explained in the following.

Provide a comprehensive understanding of the core principles, practices, and methodologies associated with leading scaled agile frameworks (this objective will involve a thorough review of the existing literature, including books and articles to provide a solid foundation of scaled agile frameworks and methodologies).

Investigate the benefits and challenges of implementing scaled agile methodologies in various organizational contexts. This objective will be accomplished through an examination

of real-world interviews, exploring how different organizations have successfully implemented these frameworks and the obstacles they encountered during the scaling process.

Identify best practices and recommendations for companies planning to adopt scaled agile methodologies: Building on the insights gained from the literature review and interviews analysis, this objective will focus on synthesizing practical guidance for organizations seeking to implement scaled agile methods.

Contribute to the growing body of knowledge on agile practices and provide actionable insights for academics and practitioners: By achieving the above objectives, this thesis aims to enrich the existing literature on scaled agile frameworks and offer value that can inform decision-making for both researchers and industry professionals.

1.3 The Internship

This thesis was inspired by an internship at a multinational management, information technology and outsourcing consulting firm. During my internship, I was part of a project with a global also multinational company in the luxury, fashion and cosmetics sector. The business in the client company is currently organized in a decentralized way, which is composed of three divisions (Fashion, Fragrance & Beauty, Watch & Fine Jewelry) and five regions (United States, Europe, Japan, APAC and United Kingdom).

The project was launched to provide customers with a consistent and exclusive brand experience - across channels, markets and product categories. Through this project, our client company will evolve from a fragmented customer ecosystem (regional databases, multiple technical vendors, uneven maturity across regions) to a global 3-divisional customer database offering a true single view of the customer. The goal was to developed a integrated system able to consolidate the global network.

The success of a large-scale project requires excellent organization and a close relationship with the client. Each region has a regional lead who is responsible for managing the whole region. Inside the regions, there are small teams related to the products. In the products team, we have the stream lead, responsible for managing a whole team with onshore

and offshore (usually in India) members. There is a sixth regional lead based in India, he is responsible for managing the developers and testers group and make the connection with onshore squads. Finally, there is also some transversal management which includes: program management, architecture, security, planning & delivery management, quality & method, scoping & roadmap and run management. The transversal management is related to assure the quality of the whole project, once their topics cannot be developed without the whole view.

During my internship I performed a team management role focused on Method & Tools. My role was structured in with these objectives:

- Follow the agile methodology implementation, clarify everyone's role and function inside the team and also ensure a good execution tracking
- Find bottlenecks in the methodology applied and find out solutions
- Create new KPIs to track progress
- Automate analysis and time consuming process

The project contained 250 consultant staffed during the system development plus some people from the client side, which provided support to understand the their business and helped to adapt the system aiming to increase client satisfaction. Therefore, I could see the difficulty in applying scaled agile methodology in large scale.

1.4 Structure

This paper is structured in five chapters: Literature Review, Field Research, Critical Analysis of the results, Qualitative Analyses, Discussion and Conclusion.

Figure 1 - Chapter Structure

Literature Review	• Agile project management, main methodologies and its characteristics • Scaled agile: origins and definitions and main scale agile approaches • Barriers for scale agile
Field Research	• Interviews
Critical Analysis of the results	• Interviews analysis and comparison using Nvivo
Qualitative Analyses	• Interviews analysis without software
Discussion and Conclusion	• Analysis resume and simplification and discussion of mitigation strategies

Source: Created by the author

2. LITERATURE REVIEW

A literature review was done to better understand how agile methodologies works, what are the barriers to scale it and why it commonly needs to mix regular agile methodologies and others practices to be successful.

2.1 Agile Project Management

In 1986, some manufacturers caught the attention because they were delivering successful innovations far faster than competitors. They were using a team-oriented approach which means that rather than following a model in which one group of functional specialists' hands off its completed phase to the next stage, they were adopting a model where a single team develops all the way, doing all the phases by itself. This kind of approach which consisted in fewer, simpler rules to allow faster adaptation was called "lightweight" and then changed for the current name "agile". (BECK et al., 2022)

In a world where high quality, low cost and differentiation is not enough to be competitive in the market, companies seek to deliver with speed and flexibility. Aiming to introduce creativity, market-driven ideas and processes into the rigid organizations, companies in Japan and United States began to adopt a holistic approach to develop new products containing six characteristics: built-in instability, self-organizing project teams, overlapping development phases, "multilearning", subtle control and organizational transfer of learning. In this new approach, the team goes back and forth as a unit. Instead of having a phase-to-phase approach with each phase focused on one kind of specialist at a time, the product development process emerges from the constant interactions of multidisciplinary team whose members work together from start to finish and the phases overlap themselves. (Takeuchi; Nonaka, 2016)

In 2001, a group of 17 developers named "organizational anarchists" and founders of several agile approaches such as extreme programming (XP), crystal, adaptive software development (ASD), feature driven development (FDD), and the Dynamic-Systems-development method (DSDM) created the "Manifesto for Agile Software Development" containing four values (individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation and responding to change over following a plan) and 12 operating principles behind the agile manifesto which is used to characterize agile approaches. The twelve operating principles are:

our highest priority is to satisfy the customer through early and continuous delivery of valuable software; welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage; deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale; business people and developers must work together daily throughout the project; build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done; the most efficient and effective method of conveying information to and within a development team is face-to-face conversation; build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done; the most efficient and effective method of conveying information to and within a development team is face-to-face conversation; working software is the primary measure of progress; agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely; continuous attention to technical excellence and good design enhances agility; simplicity–the art of maximizing the amount of work not done–is essential; the best architecture, requirements, and designs emerge from self-organizing teams; at regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly. Since then, agile techniques have been evolving, mixing principles among them, and creating new methodologies called hybrid methodologies. (BECK et al., 2022)

Before the agile methodology origin, project management was characterized by need of control. In traditional approaches, the manager is always worried about having control (changes, risk, and people). With the complexity of the projects due to the size or subject, this world starts to get out of control because one single manager cannot have the vision of everything. That is when managers start to count on tools and elaborative methodology to keep their order and control. But tools fail when neat linear tasks don't easily accommodate dynamic processes and when neat schedules require frequent updating to reflect changing circumstances. (BOEHM; TURNER, 2005) Also, following the technological advance and a higher complexity of the topics, team members need to be more skilled, especially in software development. Skilled, trained, educated people don't really adapt well to micromanagement and tools and techniques used poorly quickly reach their limits. In this case, increasing manager control doesn't really increase order. This is when the control starts to be delegated to the team to a new trial to achieve the order. It marks the transition from the entire hierarchy of the traditional

method to a situation in which the top management provides the whole plan and visibility of the project through indirect control mechanisms. (RASNACIS; BERZISA, 2016).

The built-in instability presented as a characteristic of the firsts holistic method correspond to the fact that usually managers stablish a broad goal, a challenge requirement or a general strategic direction without handing out a clear-cut new product concept. Therefore, the team is responsible for taking initiatives and risks by setting its own directions, establishing their own goals and keep on elevating them throughout the development process. (Takeuchi; Nonaka, 2016)

Normally, in a traditional agile project self-management is present during all the stages. The teams are composed of seven to nine members of multiple functional specializations capable of working on different subjects if needed, which is positive for the project's adaptation to the different scenarios and requirements. They also can leave and join the project anytime (AUGUSTINE et al., 2005). The members drive themselves to self-organization during a specific iteration and this organization can change between two different iterations or even inside one. Iteration proposes short-term planning that leads to short cycles of development configuration testing so that control and visualization of planned activities are continuously possible throughout the project. In the middle of the flow, an overall humanistic problem-solving approach is needed once all the team members must be considered as skilled and valuable stakeholders in the team management and the project management must rely on the collective ability of autonomous teams as the basic problem-solving mechanism. (RASNACIS; BERZISA, 2016)

The need to produce higher quality, more cost-effective, and faster solutions is leading more and more institutions to adopt agile methodology in their projects. Agile methodologies are widely implemented especially in software development projects, but not exclusively. (RASNACIS; BERZISA, 2016) Agile Project Management is characterized by highly adaptive life cycles, with the progressive building of requirements from minimized up-front planning and execution iterations. It is related to the ability of the project team to quickly change the project plan in response to customer or stakeholder needs, market or technology, to achieve a better design and product. Information passes through team members, and they benefit from knowledge available from multiple sources instead of having several documentation processes. The richness of the interaction among team members depends largely on their openness to the exchange of information. For an agile team to adapt, information must be open and free

flowing. Ideally, in an agile project, information flows freely and team members benefit from the power of knowledge no matter what its source. (BOEHM; TURNER, 2005)

Communication inside the team is essential, the teams must maintain optimal internal channels of communication and minimize the effects of a lack of interaction. The vision must be disseminated, sustainable and defined for all the team members even if the team is composed of more than 15 members. (AUGUSTINE et al., 2005). Due to this importance in the communication part, scaled agile methodology can be hard to implement especially because it is harder to align with all the team members the vision, values and process. The set of rules (no matter which agile methodology is adopted) must be accepted and followed by all members of the team. The manager's function is to identify practices that are not being followed, to understand why and to remove obstacles to their implementation. All of that should not restrict the autonomy and creativity of the team. (BOEHM; TURNER, 2005)

Agile methodology is used to get things done faster, to get the client feedback earlier and be able to fix things before deliveries. The goal is to make development and requirements evolve through collaboration between team`s members that allows producing high quality solutions by allowing changes during the development process. (HARB; NOTEBOOM; SARNIKAR, 2015)

2.2 Main methodologies and its characteristics

There are more than 20 different agile methodologies like Scrum, Kanban, Lean software development, feature driven development, agile unified process, XP, Crystal and others. (RASNACIS; BERZISA, 2016) Their goal is to define the project disciplines like project management, project life cycle, team management, engineering, and delivery. Since their officialization in the agile manifesto, companies executed several attempts to use the agile methodology in their projects resulting in successful but also failed implementation. The result depends mainly on people factors, training, customers, team size, team motivation, team capability, company culture, planning and scheduling. (RASNACIS; BERZISA, 2016)

All agile methodologies have some common features: development style, project team size, team distribution, customer involvement, level of documentation, and iteration period. The development style consists of an iterative and incremental development process performed in a highly collaborative by self-organizing teams. The teams by themselves are encouraged to be small so less process and planning is needed to coordinate the team. It gets more complicated

depending on the distribution, for example when we have an increasing number of teams in the project specially if they are part of different organizations, several problems can appear due to that like miss-communication, difficulties in coordination, work style and country`s culture in case you have an international project. (MONIRUZZAMAN; HOSSAIN, 2013)

Customer involvement is high, encouraged, and continuous in every agile methodology, the clients are part of the project, and they actively participate in the development in a form of customer collaboration and empowerment. On the other side, documentation process is mostly replaced by efforts on developing the solution, resources and time are not wasted on writing documentation. In a traditional agile process, it is normal to have some light documentation to exchange views or to do some knowledge transfer. Finally, the iteration process is divided into releases that can be short or long (from two weeks to one year). In the end of a release customer should be able to evaluate the product and request changes if not satisfied. (BOEHM; TURNER, 2005)

2.3 Scaled agile: origins and definitions

Besides all the benefits listed above, most agile methods have been defined and recommended primarily to small team environments in which collocation, ready access to interactive customers, and small team size are the defining rule. Large- Scale Agile development is the term used to describe agile development in large teams or large multi-team projects that adopts agile methodology. The participants of the workshop XP 2014[1] defined the large-scale agile development as shown below. . (LEFFINGWELL, 2007)

Figure 2 - Definitions of large-scale agile by the participants of the workshop XP 2014

Definitions of large-scale agile development
Over 50 developers OR 1/2 million lines of code OR more than 3 sites / time zones.
Over 50 persons, over 5 teams, developing together the same product / project using agile method.
Agile being applied to more than one team, one project, one product.
Agile applied on the organisational level.
Truly agile development in a context of more teams than one person can manage, and larger products than few teams can handle.
When coordination of teams can be achieved in a new forum like a Scrum of Scrum forum.
Several arenas are needed for coordination, like multiple Scrum of Scrums.
Large teams -– how to get everyone on board with framework.
Big projects / Many people / Crucial to organisation / Customer focused / Flexible change / Many projects.
It is when you don´t know everyone else working in the same project/product.
Large-scale agile success depends on having the right structures in place "freedom to perform".
Agile organisations are those that learn fast and are effective in creating value.
Multiple teams working together in order to deliver software artefacts.
When the values/principles or practices scale, extends to other functions, units of a company, i.e. beyond team and projects (+ how it is done).
Driven by many needs and challenges in organisations.
Emergent complex and adaptive approach, cultural based – a mind-set.

Source: LEFFINGWELL (2007, p. 281)

As said before, the shared vision is something essential in an agile method project to unify the teams and their objectives creating a holistic system as result. In light weight approaches, normally we have the implementation of the backlog, which should be enough to communicate a good part or all the vision to the team. The product owner is the responsible to keep the backlog updated and define priorities on the future scope. When the backlog works as it should, it allows the product owner, the developer, and the tester to work in close collaboration in the project. (LEFFINGWELL, 2007)

Having the common vision so needed in agile projects is a great challenge when you have a bigger team or multiples teams working together to the same solution. This kind of system is composed of subsystems and components which have their own local requirements and global requirements that must be shared with all the members. Also, when building a common integrated solution, it is needed to develop a common number of specifications required by all the teams, for example internalization specifications, logo and presentation guidelines, report formats, system-level performance, scalability, and availability criteria. This

makes the low level of documentation a challenge in a bigger scaled agile team. Therefore, while in traditional agile teams' documentation is something reduced to the minimum required, in a scaled configuration the team need to be more formal but always keeping down the level of constraints. (LEFFINGWELL, 2007)

The architecture is also a key point when dealing with scaled agile processes. The definition of the architecture includes three parts: architecture of the system, the structure of the development organization and the production infrastructure. Architecture is a key to define how work is coordinated and this coordination depends on the levels of uncertainty and changes. (TONELLI et al., 2014)

The portfolio management is also a point that needs to be focused. Dealing with scaled agile methodology means dealing with several agile portfolios in the same portfolio, which means that some small changes in one of them can affect the whole system. In this case, control is essential, especially the informal control included in the development group to monitor and evaluate the team according to acceptable behavior. (TONELLI et al., 2014)

Following the logic explained above, there are seven agile team practices that is needed to scale: the define component team, two-level planning, tracking the plan, mastering the iteration, smaller and more frequent releases, concurrent testing, continuous integration and regular reflection and adaptation. However, only these practices themselves will not drive productivity and quality for larger teams, teams of teams and systems of systems. When we have a complex, scaled environment, commitment to some points is also needed to complement the practices described. These points are the intentional architecture, lean requirements at scale, systems of systems and the agile release train, managing highly distributed teams, impacting on customers and operations, changing the organization, and measuring business performance. In the scaled agile world having this focus is essential to be more competitive and more successful. (LEFFINGWELL, 2007)

2.4 Main scale agile approaches

2.4.1 Scaled Agile Framework (SAFe)

The Scaled Agile Framework (SAFe) is a highlighted topic when we talk about scaled agile, it was created in 2011 by Dean Leffingwell. It was described as "proven, publicly available, framework for applying Lean|Agile practices at enterprise scale, presented in a structured, interactive, web format". The model was inspired in the book "Agile Software Requirements". This book says that some Lean aspects are needed to scale agile methodologies due to the focus on streams, principles, tools that increase customer value added and reduce useless material production. Since 2011, the framework has continued to evolve and adapt to new agile requirements, it executes with perfection the idea of continuous value adding. Nowadays, we already have five versions of it, the last one was released in 2020. (FAWCETT, 2022)

SAFe is inspired on ten immutable, underlying Lean-Agile Principles: take an economic view, apply systems thinking, assume variability; preserve options, build incrementally with fast integrated learning cycles, base milestones on objective evaluation of working systems, visualize and limit WIP, reduce batch sizes and manage queue lengths, apply cadence, synchronize with cross-domain planning, unlock the intrinsic motivation of knowledge workers, decentralize decision-making, organize around value. (DEMING, 2021)

2.4.2 Large Scale Scrum (LeSS)

Large Scale Scrum (LeSS) is about applying the principles, purpose, elements of Scrum in a large-scale context containing multiteam, multisite and offshore agile development. The large scale scrum is a framework that also reflects the lean thinking pillar of continuous improvement, it is used for inspecting and adapting the product and process when there are many teams. In lean thinking and large scale agile methods the focus is on global systems goals which means delivering value fast with high quality and morale (global optimization) (LARMAN; VODDE, 2008)

LeSS can be adapted according to the number and organization of the teams. In the examples below we have two LeSS models: the first one with only one Product Owner and up

to "ten" teams working together and the second one with beyond ten teams and Product Owners organized by areas. In the second model, there are some new roles such as Area Product Owner and Area Backlog (which consist of the same general backlog only filtered by each team). (LARMAN; VODDE, 2008)

In the first model, there is only one PO and one Product Backlog. The PO focuses on the overall product aiming to prioritize the product backlog from a product perspective. Each team has its own scrum master which acts as normal scrum masters: help the team by facilitating conflict and removing obstacles, remind the team of their goal and bring change to the organization by optimizing the product development. Therefore, each team has its own regular Sprint Backlog. (LARMAN; VODDE, 2008)

Figure 3 – LeSS Proposed Model 1
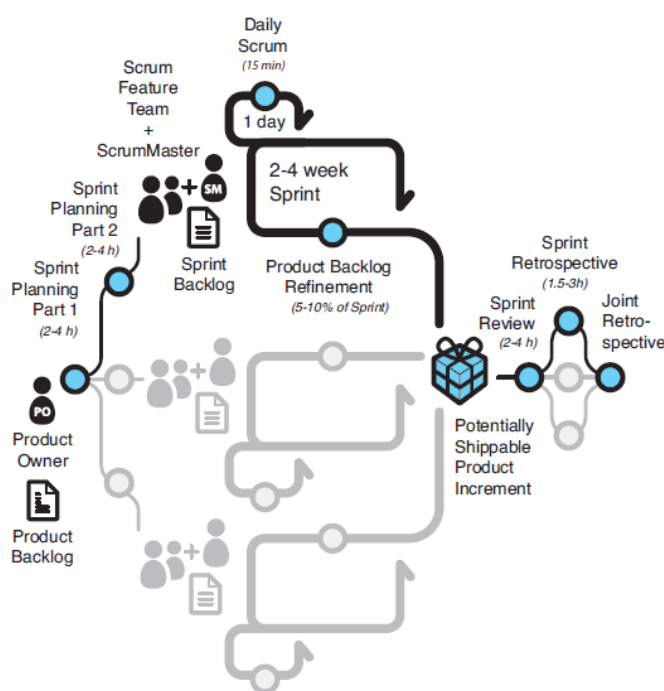
Source: LARMAN, VODDE (2008, p. 292)

Comparing to the first model, the second model has a little more complexity once it needs area product owner and also area product backlog. In this case, the sprint planning,

the product backlog refinement, the sprint review (done in a general way for the first model) is executed in a separated way for each area. (LARMAN; VODDE, 2008)

Figure 4 – LeSS Proposed Model 2
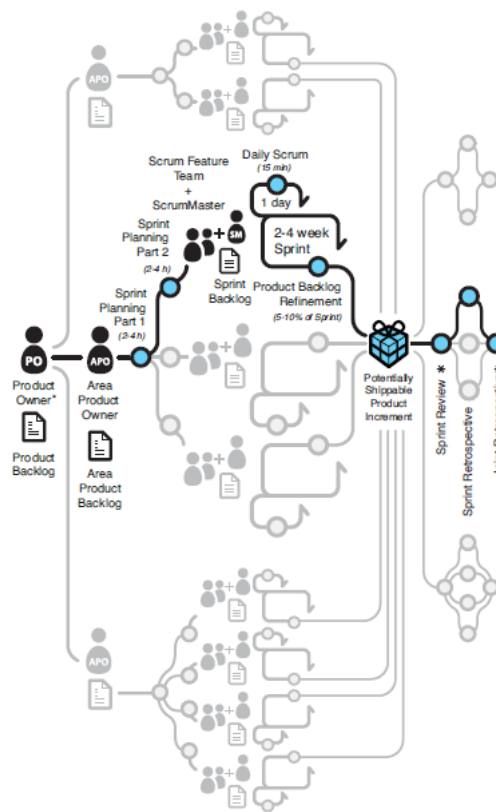
Source: LARMAN, VODDE (2008, p. 299)

2.4.3 Scrum of Scrums (SoS)

When adopting large-scale Scrum in these configurations, there is certain dysfunctions or misconceptions that can be highlighted like fake scrum masters, coordination dysfunction and assumption that the group needs a multiteam coordination meeting. Fake Scrum Masters: in large groups there is usually an existing cadre of established project or first-level team managers. It is common to have someone with Scrum Master title while this person acts like a project manager. This is bad because most commonly project managers or team managers fill the world with misunderstandings by resisting changes and refusing to learn. Coordination dysfunction: coordination activity is led by an existing management layer rather than handled by regular team members. Healthy self-managing teams are themselves responsible for their

coordination and communication with other groups. Assumption that the group needs a multiteam coordination meeting such as an SoS (Scrum of Scrums): it may be a sign that there are not real cross-functional, cross-component feature teams that can work independently on a complete feature, or a sign that there is not a focus on coordination at the code level through continuous integration. (LARMAN; VODDE, 2008)

2.4.4 Spotify

Spotify is a software company providing music streaming services that launched in 2008. It has managed to continuously grow and become one of the most innovative companies as well as an icon for the new generation of agile organizations. Spotify has six research and development offices in three countries. Their ways of working and organizational structures are designed to promote innovation, productivity, collaboration, and autonomy with bottom-up governance. A key part of Spotify's success is driven by the company's unique approach to organizing around work to enhance team innovation and productivity by focusing on autonomy, quality, communication and accountability. (MOE; LEVINTA; FLORYAN, 2019)

Introduced in 2012, the Spotify model consists of a people-driven, autonomous approach for scaling agile that emphasizes the culture and network. It isn't a framework, it is a method to scale the technical and cultural perspectives. Since its launch, the Spotify model generated a lot of buzz and became popular in the agile transformation space. It differs from the others traditional scaling frameworks because it focuses on how businesses can structure an organization to enable agile. It promotes team autonomy so each team selects its own framework (Scrum, Kanban, etc). Finally, the model has some key elements to define how people and teams should be structured: squads, tribes, chapter, guild, trio and alliance. There are not a lot of practices that need to be followed or ceremonies that need to happen. Squads may have ceremonies like sprint planning and retrospectives, but the focus of the Spotify model is on how teams organize around work. (CRUTH, 2019)

The squads are self-organized multi skill teams with five to seven engineers that focused on one feature area. It usually has access to a coach and a product owner that will help the team to succeed in a long term mission. The squad has a vision and a goal for itself and it determines which agile framework will be used. Tribes are multiple squads working together on a related feature. The tribes normally consists of 42-150 individuals and it has a lead who is responsible for creating a productive and innovative environment for the squads. Tribe leaders pay close attention to the squad dependencies and analyze to what extent those dependencies are blocking or slowing the squad down. Their job is to eliminate problematic, blocking and cross-tribe dependencies. The trio, therefore, is the name given for the union of the three roles: tribe lead, product lead and design lead which exists in every tribe to ensure its continuous alignment between these three perspectives when working on features areas. Finally, the alliance is the

name given to a union of tribe when they need to work together to accomplish a goal. (MISHRA, 2020).

Chapters are the group of each specialty, helping to keep engineering standards and best practices in place across a discipline. Chapters are typically led by a senior technology lead, who may also be the manager for the team members in that chapter. (CRUTH, 2019)

A guild is a community of interest, a group of people with similar skills that share knowledge, tools or code across Spotify. Guilds are designed beyond the formal structures and unite members with shared interests, whether leisure-related or engineering-related. One single member can join more than one guild since they are open to everyone and have representatives 3from other squads, tribes and chapters. It is coordinated by one or more guild coordinators. (PAASIVAARA; LASSENIUS, 2014).

Figure 5 - Spotify's Basic Organizational Structures
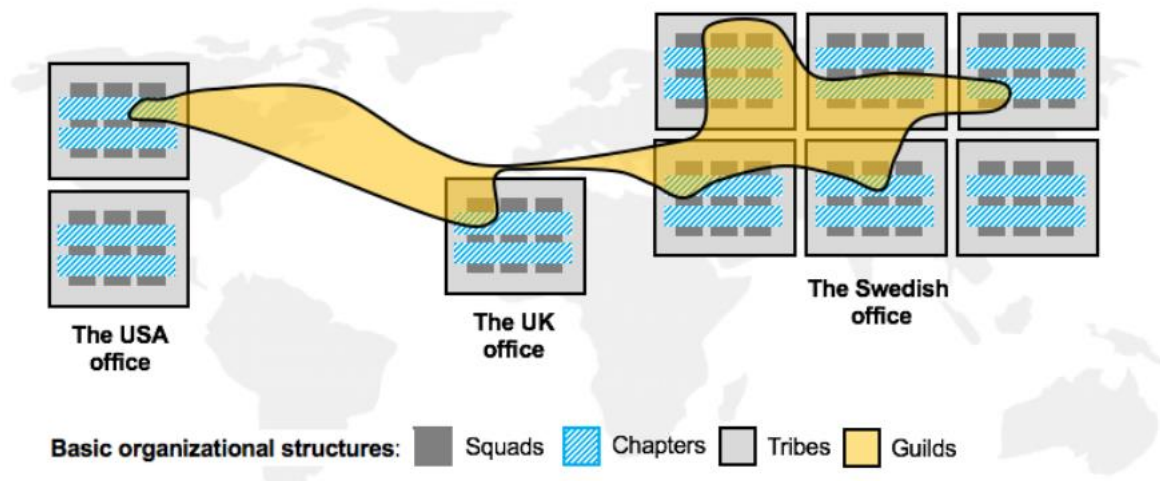
Source: (SMITE, 2019)

2.4.5 Crystal

The method Crystal started with an American scientist Alistair Cockburn in the year of 1991. He created the method for IBM and he focused on communication, collaboration as opposed to regulated step-by-step methods. The framework has some properties: frequent

delivery (regularly deliver products and test code to real users), reflective improvement (always improve the product or service), osmotic communication (gather all the team in the same physical space for information to flow between members), personal safety (everyone should feel safe to discuss ideas openly), focus (every member knows what they are assigned for, they know where to focus their attention), easy access to expert users (enhances communication and promotes feedback), technical tooling (technical tools to be used by the team during testing, management and configuration) and continuous feedback. (SATYABRATA, 2022)

The framework created has a seven color code to represent different teams sizes and project critically and priority: crystal clear, crystal yellow, crystal red, crystal sapphire, crystal orange web, crystal diamond. The crystal clear defines one to six members team and it is adapted for short-term projects with all members in the same workspace; the crystal yellow defines seven to twenty members team, automated testing to resolve bugs faster and less documentation; the crystal orange defines a 21 – 40 members team and it is divided according to their functional skills. In this case, the project normally lasts one to two years and has a release every 3 to 4 months; the crystal orange web has a lot of similarities with the crystal orange for example the team size, but it is usually related to a series of initiatives that requires programming; the crystal red defines a 40 – 80 members team where the team is divided according to the requirements; crystal maroon involves large-sized projects where the team size is 80-200 members and where methods are different and as per the requirement of the software; crystal diamond & sapphire defines a large project containing potential human life risks. (SATYABRATA, 2022)

As the team size grows, Crystal implementations change to add more formality to the structure and management of the project. Project criticality also increases the rigidity of the project needs to ensure the expected demands can be delivered. Crystal thus acknowledges that each project may require a slightly tailored set of policies, practices, and processes to meet the project's unique characteristics. (CHANG; M, 2010)

This method is flexible, it is usable for small or large teams to work on simple or complex topics. It gives importance to the development competences and iterations which encourage the exchange between the teams. Being an agile methodology, it is also beneficial to the clients, once it aims to deliver the most important components first. Its drawbacks are: a lack of pre-defined plans which may lead to confusion and potentially unpleased mangers used

with waterfall methods, for example; lack of structure may slow down inexperienced teams, remote teams can have some difficulties to execute communication informally. (CHANG; M, 2010)

2.5 Barriers for scaling agile

After a literature review, it is necessary to explore some of the complexity described above. This subchapter is dedicated to describe and explain the main barriers for scaling agile found in the literature review and how they appear inside the projects and companies context.

2.5.1 Team Related Issues

Within a huge organization with multiples teams, there are several coordination challenges. The coordination problem can be a reflection of autonomous team model challenging. When first creating an organization model where the team operates autonomously, there are some common problems that come along, for example the balance between the broader and global goals of the organization. People tend to focus on their own objective instead of the global ones. The coordination can also be a key problem when two teams are working for different clients even thought their system are interdependent. (KAISTI et al., 2013)

Also, the difficulty in coordinating the work interdependent for several agile teams can be one of the challenges. While introducing agile had created flexibility at the team level, the surrounding organization was not responsive enough. The roll-out of agile had not removed dependencies, and the dependencies made managing development difficult. (KAISTI et al., 2013)

The situation can be even harder when the team is globally distributed, further problems such as missing kick-off meetings, reduced feelings of proximity when telecommunication is needed and also the extra difficulty in arranging meetings between more than one team due to the time zone. It is worth to remember that the globally distribution will impose additional burden on communication and requires additional care, but it is still possible to conciliate agile and distribution. (SAGESSER; JOSEPH; GRAU, 2013)

Also, the social and technical integration between the teams can be another problem specially if they don't have the same cadence and if both work are interdepend. The lack of

standardized build scripts in case of development team or the architecture is one of the reasons in the technical side. Sometimes the quality pattern is not the same as well. In the social side, it is possible to say that teams are usually focus on their own work and communication channels may be narrowed because of some new practices like self-management teams and daily meetings. It is really important to have a balance between completing new stories from the backlog and maintaining overall stability of the application. (LYON; EVANS, 2008)

Furthermore, the way people adapted the agile to fit their special needs - as the method by the book is not always the best way to transform their organization -sometimes simple means skipping practices, which led to problems. Agile methods has core elements which are part of its conception, these elements cannot be ignored otherwise agile mindset will not be set. Also, a poor customization may lead teams to adopt only practices that directly reflects their current needs, thus failing to achieve any real change in the process. Finally, keeping old vocabularies to name something similar to the old way of working can make people block new ways of thinking. (COHN; FORD, 2018)

2.5.2   Requirements Problems

The requirements refinement is usually reported as challenges. Sometimes it was defined in a high level way by the marketing requirements documents or functional specifications and it is not always useful by agile development teams, therefore it needs to be still adapted. (COHN; FORD, 2018)

While product managers and business analyst struggle with creating high level requirements, the teams struggle to break it down to a size that is possible to estimate efforts. It is also a good thing to remember that the work package which needs to be estimated may have one size for one team and another size for the others if not correctly aligned. The requirements often come in a big form resulting in development teams spending a significant amount of time to break it down into features, user stories or whatever is the name of the smallest package they use to estimate work. The literature shows that a lot of studies and training were necessary in product management and development levels to master the new process of creating user stories.

The most common problems were ambiguity in the requirements and effort estimation for stories. (COHN; FORD, 2018)

The ability to track and trace requirements, test runs, and anything else in the product lifecycle is also something that must be consolidated. Enhancing traceability allows critical parts of the system to ensure that later tasks can meet higher expectations and accuracy. One of the problems is that traceability is an important part in traditional software development but it is not a standard practice for the agile methods. The lack of elements to promote traceability can be misinterpreted by the minimum documentation principle of agile methods. In scaled agile, especially when the features are codependent, traceability information between requirements, source code and unit tests can also be used to drive software development, by identifying requirements for which unit tests and/or source code has not been implemented yet. In addition, traceability information can also be used to support refactoring. (LUCIA; QUSEF, 2010)

2.5.3 Method Application Barriers

Implementing agile can be tricky and tense when the teams have a different managing approach. The collaboration between an agile and a waterfall method for example was usually seem as a challenging situation. One of the particulars problems was the design of the solution which had to be as detailed as possible in waterfall methods while in agile the design of the requirements can happen during the sprints meaning the start would be much faster in the agile way. (SAGESSER; JOSEPH; GRAU, 2013)

It can happen due to several reasons, sometimes only part of the organization team decided to commit to agile or the transformation starts gradually or maybe part of the company start to lose faith in it when managers realizes reports on costs and progress were not produced as the way before. Agile does not commit to fixed schedules and therefore can be sometimes considered unreliable. (LYON; EVANS, 2008)

Even when the team is committed to implement agile method, in some cases we see development efforts controlled on the top level by a project management office (PMO). In this cases, we see a lot of rigidity and attachment to the old ways of working causing friction in the agile adoption. The PMO is sometimes a bottleneck for agile implementation and when it

happens it is usually necessary to break the middle structure to penetrate agile practices. (LYON; EVANS, 2008)

Besides all the behavior topic discusssed above, it is necessary some basic behaviors policy to implement agile in a sustainable way for example literature guidance, agile concepts clarity, documentation, technology and tools and a good understand of the development cycle which comes all together. (LYON; EVANS, 2008)

Without sufficient literature guidance, organizations may struggle to identify and implement best practices for scaled agile implementation. Best practices provide proven strategies and techniques for successful implementation, and their absence can lead to trial-and-error approaches that may result in inefficient or ineffective implementation. Also, organizations may struggle with inconsistency in how agile practices are implemented across teams or departments. This can lead to misaligned processes, communication breakdowns, and challenges in achieving consistent results. (LEFFINGWELL; D., 2007)

On the other hand, to great sustainable process, it is necessary to explore the documentation topic. The minimal documentation characteristic of scaled agile implementation, as advocated by frameworks such as the Scaled Agile Framework (SAFe) and Disciplined Agile (DA), can offer several challenges. While the intention is to reduce unnecessary documentation and promote agile principles, there are potential downsides that may arise. Minimal documentation may result in insufficient documentation of requirements, design, and other critical information, leading to ambiguity and confusion among team members. This can result in misunderstandings, rework, and delays in the development process. Besides, in regulated industries or organizations with strict compliance requirements, minimal documentation may not be sufficient to meet regulatory or audit standards. This can lead to compliance issues and potential legal and financial risks. (BOHNER; S., BIRKHOLZER;T., 2019)

Finally, minimal documentation may pose challenges during onboarding of new team members or knowledge transfer within and across teams. In the absence of adequate documentation, new team members may face difficulties in understanding the system, its design, and dependencies, resulting in longer ramp-up times and decreased productivity. (BOHNER; S., BIRKHOLZER;T., 2019)

Concerning the tools, implementing scaled agile requires appropriate tooling and infrastructure to support collaboration, communication, and coordination across teams. Lack of adequate tools and infrastructure can hinder the implementation and adoption of scaled agile practices (SCOTT; JOHNSON, 2008).

2.5.4 Culture Issues

People tend to offer some resistance to every change if they don't understand the reasons or how to do it. Even companies with a flexible culture sometimes offer resistance to change. It shouldn't be expected a consensus towards the change, this means that some people will be a good follower of the new practices and will proactively spread it, others will be a neutral element which can be influenced but won't help the overall system to go towards the changes and finally there will be some elements that offers a lot of resistance and probably will never adapt to the new way of working. (DINGSOYR; MOE, 2013)

The origin for the resistance can come from several sources: the ecosystem can be cautions and risk-averse, some people may worry about the new role and responsibilities agile might bring for example cross-functional tasks outside their area of expertise, another reason can be the reallocation from individual offices to shared spaces (people may feel they are being monitored). (SAGESSER; JOSEPH; GRAU, 2013)

The skepticism towards the new way of working can be one of the main reasons. Although people sometimes acknowledge the benefits of agility but opposed its introduction due to contract reasons, the matrix organizations or others organization practices. The popular agile concept that it does not work for complex products, that it need to be implemented in a by-the-book way, that frequent meetings will cause overhead and that this model misses governance or a work plan helps to create the skepticism and makes the transformation harder and more painful. (COHN; FORD, 2018)

The initial steps of the transformation is also very important and has a lot of interference on how resistance will show its face. People need to understand the value of the new method, that is why a good presentation, a lot of training and several sessions for clarification is needed. It is necessary to define a clear goal for using agile, otherwise it loses credibility and developers

may feel that the agile methods may be replace by something else at any time. A top-down manage can sometimes dilute the understanding of the reasons and the feeling that management is not on the flow, that means, they are not being affect by the challenges of the chance. (SAGESSER; JOSEPH; GRAU, 2013)

"Organizations do not change merely because the boss says so, at least not in the way that is intended". (SCOTT; JOHNSON, 2008)

Another related problem is when managers represent the resistance themselves. Some cases have a changing starting bottom-up and when the high hierarchy offers some resistance it becomes impossible to change the organization above the team level. Lack of middle management support for change and resistance to change management culture were seen as some of the most serious problems in the transformation. Inside the agile methodology, there are some specifications for some management roles and lack of understanding will leave managers left out. (DINGSOYR; MOE, 2013)

On the other hand, sometimes people are just so conditioned that it gets harder and harder to adapt to the new of working. In some cases, the challenges to implement the new transformation displaced agile because people were struggling to focus on the development while changing their habits and culture. The stress caused by the combination of schedule pressure and a huge change at once can pull people back to the old habits. Also, as new practices were being introducing, it can happen a decrease in performance which may also lead the team to revert to the old way of working. In this cases, a well-educated team and managers are really important, the benefits are usually not immediate. (BECK et al., 2022)

2.5.5 Stakeholders Issues

Due to some agile principles like the shift from a long term planning to a shorter term planning, the relationships between stakeholders, especially with clients and suppliers, can be a concern. Enable operation with only shorter term planning requires educating stakeholders and reviewing contracting practices. (LYON; EVANS, 2008)

In scaled agile implementations, there may be multiple customers with diverse needs and expectations. Balancing these different customer requirements can be challenging, especially if they have conflicting priorities or lack alignment. All the stakeholders have to be

comfortable with the idea of not having a complete visibility or control of long term features and also learn to delegate work for the team to manage itself. The self-management team characteristic can pass an idea of lack of control specially to the final clients if they are not familiarized with the agile practices. (LUCIA; QUSEF, 2010)

The involvement of key stakeholders, such as senior leadership and decision-makers, is crucial for successful scaled agile implementation. However, if key stakeholders are not actively engaged or lack understanding and support for agile practices, it can result in resistance, lack of commitment, and slow decision-making. (KNIBERG; H, SKARIN; M, 2016)

A group related characteristic can be the over-optimism or unrealistic expectations about the benefits and outcomes of scaled agile implementation. It may lead to underestimating the effort, time, and resources required for successful implementation. This can result in inadequate planning, unrealistic deadlines, and failure to achieve desired results. (LEFFINGWELL, 2007)

In the overall process, the stakeholders need to have some flexibility to adapt to the model, they need to learn how to work with a little long term uncertainty so the focus can be in the short term process. (LUCIA; QUSEF, 2010)

2.5.6 Managerial Issues

The implementation of scaled agile can be complex and challenging, and there are several managerial issues that organizations may encounter during the process. (SANTOS;P, CARVALHO;M, 2021)

Leadership plays a crucial role in driving and sustaining the scaled agile implementation. Lack of leadership support, commitment, and engagement can hinder the adoption of scaled agile practices. It can happen specially if the leaders keep in their way of work the waterfall mode. (Paasivaara et al., 2018).

From leadership behavior it is common to heritage problems like the strategic direction organization adopts. These issues revolve around the strategic alignment of scaled agile implementation with the overall organizational goals and objectives. Some common strategic issues in implementing scaled agile may include: lack of clear organizational vision and alignment and inadequate leadership support. Organizations need to have a clear vision and align their scaled agile implementation with the overall strategic goals of the organization. If

there is a lack of alignment, it can result in confusion, miscommunication, and misalignment of priorities, leading to implementation challenges. (DIKERT; PAASIVAARA; LASSENIUS, 2016)

Another problem inside the managerial issues can be the lack of roles. It can be related to two factors: people overloaded in their function or lack of some specific roles directly linked to agile such as investment for training or most commonly coaching. (DINGSOYR; MOE, 2013)

Sometimes the transition or adaptation to agile model starts during the work routine therefore the workload of the personal is not adjusted to correspond to the changes, people can be overcommitted. It gets harder and harder to teach someone news ways of work and behavior if they are already stuck in their process. It can happens to anyone in the team: managers, team members, developers, etc. (GIUDICE; KISKER; ANGEL, 2014)

When the investment on the project is not enough to have coaching and training position the transformation or adaptation can be harder. The reluctance of investment in those roles will potentially cause an ill preparation for all the effort needed and also lower motivation. The coach role is extremely important to achieve the right mindset over time and its lack is one of the main reasons why the success of pilot teams could not be repeated when agile was adopted more widely. In large organizations, numerous teams may need to be coached and therefore the demand can exceed the capacity of available coaches, generating also an overload problem. Often, people less experience would be named as coach and therefore it increases the risk that agile practice would not be taught correctly. (DINGSOYR; MOE, 2013)

When we work with hybrid projects evolving waterfall and agile or even if there are old way stakeholders evolved, contracts can be an attention point. Agile emphasizes flexibility, collaboration, and adaptability, while fixed contracts often include strict requirements, timelines, and deliverables. This misalignment can create conflicts and hinder the Agile implementation process. For example, fixed contracts may require detailed specifications upfront, which goes against the Agile principle of embracing change and prioritizing customer collaboration over contract negotiation. This can result in delays, rework, and increased costs, as Agile teams may need to renegotiate contracts or seek waivers for changes. (BROWN; A, LEE;K, 2020)

Another challenge is the lack of flexibility in contractual obligations. Contracts are often legally binding agreements that outline specific deliverables, milestones, and deadlines. However, in Agile implementations, requirements and priorities can change frequently based on feedback from customers and stakeholders. This can make it challenging to meet contractual obligations as initially defined, resulting in potential disputes and conflicts. (BROWN; A, LEE;K, 2020)

Contractual criteria can also introduce complexity in contractual compliance for scaled Agile implementations. Agile practices emphasize simplicity, transparency, and fast feedback loops, while contracts may introduce complexity in terms of legal language, documentation, and reporting requirements. This can create additional overhead and administrative burden for Agile teams, distracting them from their primary focus on delivering value to customers. (JOHNSON; L, 2019)

2.5.7 Product and Process Issues

Product and process require a special attention because it is what you usually delivery to your client. It is important to track, document, maintain and develop all the things related to it. Traceability refers to the ability to trace requirements, features, or work items across different levels, from strategic themes and portfolio epics to program features, user stories, and tasks at the team level. Traceability helps establish clear links between strategic objectives, customer needs, and the work being done by Agile teams. It enables organizations to understand the flow of value and track the progress of work items from ideation to implementation. (MIKE; C.,2005)

Aligned with traceability, there is progress measurement in SAFe involves tracking and measuring the progress of work items, such as epics, features, user stories, and tasks, to ensure that they are on track to meet their objectives and deliver value. Progress measurement provides insights into the status, quality, and completion of work items, which enables organizations to identify and address any issues or risks early on. There are various techniques and tools available for progress measurement in SAFe, such as cumulative flow diagrams, burn-up/burn-down charts, velocity charts, and cycle time analysis, which provide visual representations of progress and enable data-driven decision-making. These techniques and tools can help

organizations measure progress, identify bottlenecks, and make data-based adjustments to optimize flow and value delivery. (BOHNER; S., BIRKHOLZER;T., 2019)

Maintaining high-quality standards for the product and for the documentation is essential in any software development process.. However, ensuring quality in a scaled agile environment can be challenging due to factors such as increased complexity, distributed teams, and rapid development cycles. Poor quality can lead to defects, delays, and customer dissatisfaction, making it a significant barrier to successful scaled agile implementation. (BOHNER; S., BIRKHOLZER;T., 2019)

Finally, talking about the effort invested in planning events is something crucial once it can become hard when we have a complex environmental. It originates from the other problems already discussed in this chapter like debate between long-term planning vs short-term planning, lack of visibility and coordination, lack of clarity in customer relationship. Creating a planning is something complex because everyone needs to agree with it and the gears need to be align and working with the same pace which is one of the barriers to implement scaled agile. (DIKERT; PAASIVAARA; LASSENIUS, 2016)

2.5.8 Literature summary

In conclusion, 49 barriers were identified for the implementation of scaled agile. These barriers were organized into seven main categories: coordination problems, inconsistent project management approaches, lack of agile methodology understanding, lack of roles, requirements problems, resistance to change, stakeholder's education problems. They are summarized in the Table 1 bellow.

Table 1 - Barriers to scaled agile implementation summarized

Level 1	Level 2	Code	Reference	#
	Team Coordination	TRI_01	[9];[14];[16]	4
	Reward systems	TRI_02	[6];[7];[14];[18];[23]	5
	People Overloaded	TRI_03	[6]	1
Team Related	Lack of training	TRI_04	[5];[6]	3
Issues (TRI)	Team Maturity	TRI_05	[1];[5];[7];[16];[23]	6
	Geographic distribution	TRI_06	[22]	1
	Communication	TRI_07	[9];[16];[22]	3
	Integration	TRI_08	[7];[9];[12];[16]	4

	Self-Management Team Challenges	TRI_09	[4];[13];[18];[22]	5
	Different Agile Approach	TRI_10	[5];[11];[12];[22]	4
	Mix of Agile and Traditional Approach	TRI_11	[5];[11];[22]	3
	Dependency	TRI_12	[1];[7];[16]	3
	Teamwork	TRI_13	[1];[7];[16];[18];[23]	6
Stakeholders Issues (SI)	Multiple Customers	SI_01	[1]; [6]; [11];[23]	4
	Customer relantionship	SI_02	[6];[11];[14];[23]	4
	Non - Involvement of key stakeholders	SI_03	[1]; [6]; [11]	3
	Over Optimism	SI_04	[14]	1
	Long term planning vs short time planning debate	SI_05	[6];[22]	3
Method Application Barriers (MAB)	Agile Poorly Adapted	MAB_01	[1];[6];[23];[26]	5
	Lack of literature guide	MAB_02	[6];[14];[26]	3
	Misunderstanding Agile Concepts	MAB_03	[6];[26]	2
	Top-down orders and recommendations resistance	MAB_04	[22];[26]	2
	Minimal Documentation	MAB_05	[2];[18]	2
	Technologies/tools/methods	MAB_06	[14];[23];[24]	3
	Development cycle	MAB_07	[2]; [23]; [24]	3
Culture Issues (CI)	Old bureaucracy kept	CI_01	[1];[22];[25];[26]	4
	Attachment to the old way of working	CI_02	[1];[22];[26]	4
	Fear of changing roles and responsibilities by adopting the method	CI_03	[1];[24];[26]	3
	Move from life cycle models towards to iterative and feature centric	CI_04	[16];[19];[24];[26]	3
Requirements (R)	Creating Work items (User Stories) Challenges	CI_05	[6];[14];[17]	2
	Estimating Work items (US) Challenges	CI_06	[6];[14];[17]	2
	High Level Requirements Management Largely Missing in Agile	CI_07	[6];[14];[15]	2
	Regulatory Compliance	CI_08	[3];[10];[21];[23];[26]	5
Product and Process Issues (PPI)	Traceability	PPI_01	[2];[20];[23];[25]	4
	Documentation	PPI_02	[2];[20];[25]	3
	Quality	PPI_03	[1];[2];[23]	3
	Project size	PPI_04	[1];[23];[25]	3
	Maintenance	PPI_05	[1];[2];[20];[23];[25]	5
	Effort invested in planning events	PPI_06	[6];[11];[17];[22]	4
	Development of interfaces	PPI_07	[14];[17]	1

Managerial Issues (MI)	Progress measurement	PPI_08	[14]	1
	Management in waterfall mode	MI_01	[6];[22];[26]	3
	Management resistance	MI_02	[3];[5];[6]	3
	Middle managers role unclear	MI_03	[12];[13]	2
	Resource Management - lack of roles	MI_04	[1];[6];[7]	3
	Scope Management	MI_05	[7];[14];[23]	3
	Contractual Criteria	MI_06	[3];[8];[10];[21];[26]	4
	Configuration Management	MI_07	[7];[14];[16];[23]	4
	Strategic Management	MI_08	[1];[5];[10];[14];[26]	5

Source: Created by the author

3. METHODOLOGY

This chapter targets the thesis process of construction abording the methodology chosen to analyze the barriers for implementing scale agile methodologies for this research.

3.1 Research phases

The research topic can be divided into two sectors: the first one is the search for an official method to follow, aiming to do a more structure development of this paper and the second is related to the research of the real subject and content of the work.

This paper was inspired in two methodologies, mixing them both: the constructivist grounded theory (CGT) by Charmaz (CHARMAZ; K, 2008) and the approach "Building Theories from Case Study Research" by Eisenhardt (EISENHARDT; K, 1989).

Grounded theory is an approach to qualitative research that involves developing theory through the analysis of data. The aim of grounded theory is to develop a theory that is grounded in the data, rather than starting with a preconceived theory and trying to fit the data to it. Constructivist Grounded Theory (CGT) is a variant of grounded theory that was developed by Kathy Charmaz. CGT is based on the idea that knowledge is constructed by individuals through their own experiences and interpretations of the world. This means that reality is not objective and fixed, but rather is constructed by individuals in their social and cultural contexts. (CHARMAZ; K, 2014)

CGT involves a process of constant comparison, where the researcher compares the data they collect with the emerging theory. The aim is to develop a theory that is grounded in the data, but also takes into account the researcher's own interpretations and understanding of the data. Throughout this process, the researcher

is constantly comparing the emerging theory with the data, and refining the theory based on their own interpretations and understanding. (CHARMAZ; K, 2014)

Secondly, the approach explained by Kathleen M. Eisenhardt consist of the Building Theories from Case Study Research. It consists of a methodology for conducting and analyzing case study research to develop new theories. The author argues that case studies can be a valuable method for theory building, as they allow researchers to examine complex, real-world phenomena in their natural setting. Eisenhardt outlines a six-step process for using case studies to develop theories. The first step is to select a research question and choose cases that are relevant to that question. The second step is to collect data on the cases, which can include interviews, observations, and documents. The third step is to analyze the data, looking for patterns and themes that can inform the development of a theory. The fourth step is to develop a framework for the theory, based on the patterns and themes that emerged from the data analysis. The fifth step is to test the theory, by comparing it to other cases or by collecting additional data to see if the patterns and themes hold up. The final step is to refine the theory based on the results of the testing. (EISENHARDT; K, 1989)

Eisenhardt (1989) emphasizes that the process of theory building through case studies is iterative and often requires multiple rounds of data collection, analysis, and testing. She also notes that the process can be challenging, as it requires researchers to balance the need for generalizability with the need to maintain the richness and complexity of the case data. (EISENHARDT; K, 1989)

Based on that, the initial research aimed to give a good understanding on what is seen in the theorical field and explore the barriers encountered in the application of scaled agile methodology and understand which of them are the most relevant obstacles. Secondly, the questions proposed for this research are:

Q1: What are the main barriers encountered when implementing scaled agile implementation ? And which of them interferes most in the success of the organizations ?

Q2: What effect these barriers have on the business, product and process and team benefits ?

Q3: Is there a possible mitigation strategy to avoid the negative consequences of the main barriers ? Which ones ?

Aiming to answer them, the research is divided in five main steps: literature review, field research, critical analysis of the results, qualitative analysis, and discussion and conclusion.

Having a first contact with the main barriers in the literature review, helps to go to the next step (interviews) with more awareness of what is critical and need to be explored during the interviews. After this first recognition the next step would be the field research itself.

3.2 Cases Selection

Altogether, 5 projects were explored, one of them (Project 2) containing several regions that could be explored as an individual project due to its characteristics. The interviews were made with 3 project managers, 1 project management officer, 2 scrum masters, 1 coach leader and 2 coaches.

Table 2 - Interviews summary

Interview ID	Interviewee ID	Project ID	Interviewee Role	Original Country	Platform and Interview Duration
I1	PM1	PJ1	Program Manager	Brazil, São Paulo	Microsoft Teams, 80 minutes
I2	PM2	PJ2–R1	Project Manager	France, Paris	Microsoft Teams, 60 minutes
I3	C1	PJ2-R2	Coach	France, Paris	Microsoft Teams, 60 minutes
I4	SM1	PJ2-R2	Scrum Master	France, Paris	Microsoft Teams, 50 minutes
I5	SM2	PJ2-R3	Scrum Master	France, Paris	Microsoft Teams, 50 minutes
I6	PMO1	PJ2-R4	Project Management Office	India	Microsoft Teams, 50 minutes

I7	PM3	PJ3	Project Manager	Brazil, São Paulo	In-person interview, 60 minutes
I8	C2	PJ4	Coach	Brazil, São Paulo	In-person interview, 60 minutes
I9	CL1	PJ5	Chapter Leader	Brazil, São Paulo	Microsoft Teams, 60 minutes

Source: Created by the author

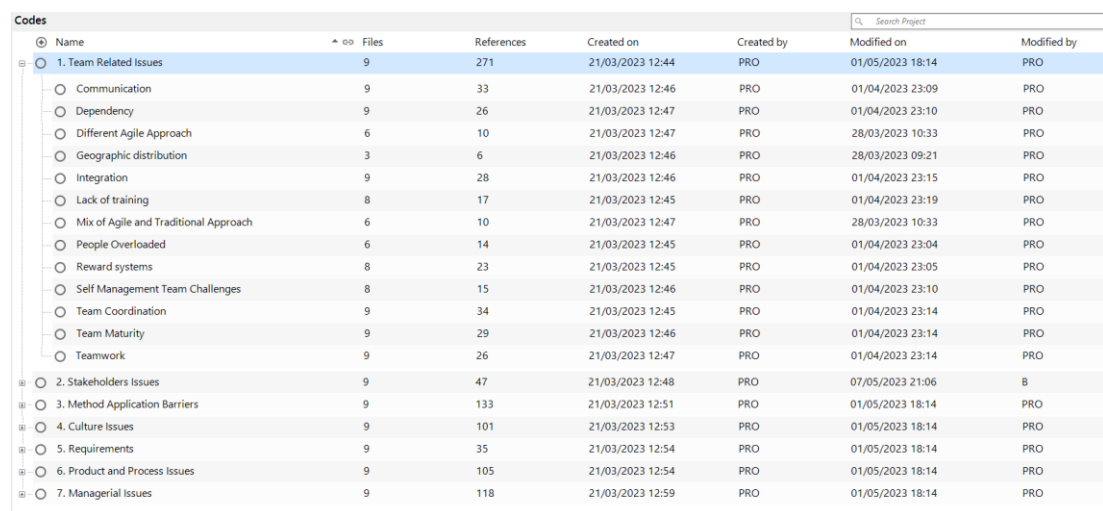### 3.3 Qualitative Data Analysis

As described above, after getting a first perspective from the literature review, the inductive-abductive method starts by an interactive research process which refines the conclusions based on the data collected. The Table 1 summarizes the barriers studied in the literature and complemented by some barriers collected during the interviews. The second step therefore is data collection which was made by nine interviews with different process. The guide used for the interviews was built also based in the literature review and it can be found in the Appendix A. It gives a direction to explore the matter of this research, but it also contains several open questions aiming to give the interviewee space to explore his own context and give his own perspective of the barriers and opportunities scaled agile promotes. The goal of the interviews is to explore the challenges encountered during the application of scaled agile methodologies in projects or inside the organizations.

The guide is built in: context (role, agile methodology, trainings, numbers and size of teams, etc), perspective of the interviewee about performance, results, quality of the scaled agile implementation, perspective of the interviewee about business, process, product and team benefits, challenges and its context encountered during the implementation, mitigation strategy used by the interviewee and their perspective about the implementation of a hybrid approach aiming to reduce the barriers described by them.

3.3.1 Data Coding

All the analysis were made in the N-VIVO® platform after the interviews transcription. After finding all the barriers in the literature review, they were inputted in N-Vivo as codes. The codes were written firstly according to the literature review and then refined with interviews using the constructivist grounded theory (CGT) as explained before.

Figure 6 - NVivo codes

Name	Files	References	Created on	Created by	Modified on	Modified by
1. Team Related Issues	9	271	21/03/2023 12:44	PRO	01/05/2023 18:14	PRO
Communication	9	33	21/03/2023 12:46	PRO	01/04/2023 23:09	PRO
Dependency	9	26	21/03/2023 12:47	PRO	01/04/2023 23:10	PRO
Different Agile Approach	6	10	21/03/2023 12:47	PRO	28/03/2023 10:33	PRO
Geographic distribution	3	6	21/03/2023 12:46	PRO	28/03/2023 09:21	PRO
Integration	9	28	21/03/2023 12:46	PRO	01/04/2023 23:15	PRO
Lack of training	8	17	21/03/2023 12:45	PRO	01/04/2023 23:19	PRO
Mix of Agile and Traditional Approach	6	10	21/03/2023 12:47	PRO	28/03/2023 10:33	PRO
People Overloaded	6	14	21/03/2023 12:45	PRO	01/04/2023 23:04	PRO
Reward systems	8	23	21/03/2023 12:45	PRO	01/04/2023 23:05	PRO
Self Management Team Challenges	8	15	21/03/2023 12:46	PRO	01/04/2023 23:10	PRO
Team Coordination	9	34	21/03/2023 12:45	PRO	01/04/2023 23:14	PRO
Team Maturity	9	29	21/03/2023 12:46	PRO	01/04/2023 23:14	PRO
Teamwork	9	26	21/03/2023 12:47	PRO	01/04/2023 23:14	PRO
2. Stakeholders Issues	9	47	21/03/2023 12:48	PRO	07/05/2023 21:06	B
3. Method Application Barriers	9	133	21/03/2023 12:51	PRO	01/05/2023 18:14	PRO
4. Culture Issues	9	101	21/03/2023 12:53	PRO	01/05/2023 18:14	PRO
5. Requirements	9	35	21/03/2023 12:54	PRO	01/05/2023 18:14	PRO
6. Product and Process Issues	9	105	21/03/2023 12:54	PRO	01/05/2023 18:14	PRO
7. Managerial Issues	9	118	21/03/2023 12:59	PRO	01/05/2023 18:14	PRO

Source: Screenshot from NVivo screen

The process to insert codes can be described based on the Figure 7. After the first code collection in the literature review, all the codes collected during the interviews were also searched and studied in the literature before being code in NVivo and considered to analyze the following interviews.

Figure 7 - Qualitative Analyses Structure
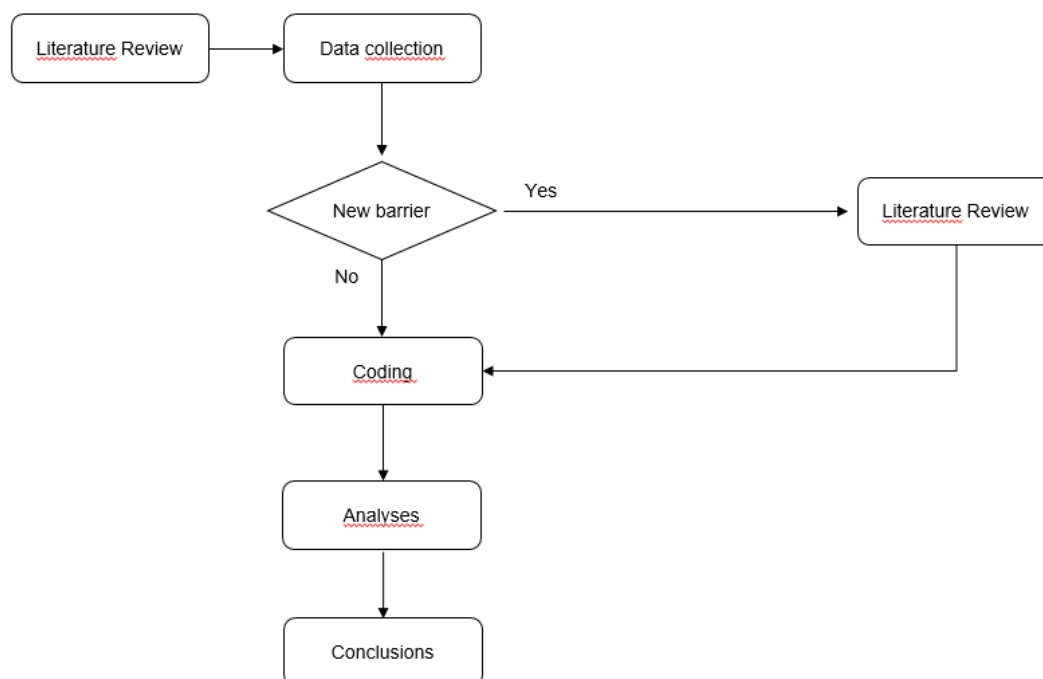
Source: Created by the author

The barriers found were grouped by their similar characteristics as we can see in the Table 1 and in the Figure 6. After coding, all the interviewees had their interviews parts labeled according to those barriers. This coding process allows to identify how many times a specific barrier was referred in the interview.

N-Vivo allows us to classify each one of the interviews with attributes, this tool was used to set the context within Family A, B and C as explained in the chapter 3.2 Qualitative Analyses. Figure 8 shows the file classification group called Project Context which contains all the families classification. As the goal is also to study how the barriers behave with the combination of the three families, they were coded in the same group so it would be possible to use the N-Vivo resources Queries and Map to correlate the barriers and the projects context.

Figure 8 - Attributes describing Families A and B in N-Vivo screen

Classificações de arquivo				
⊕ Nome	▲ Criado em	Criado por	Modificado em	
⊟ Project Context	5/1/2023 12:09 PM	PRO	5/26/2023 8:36 PM	
⊕ Nome	Tipo	Criado em	Criado por	Modificado em
Multiple Regions	Booleano	5/1/2023 12:12 PM	PRO	5/26/2023 8:36 PM
Multiple Teams	Booleano	5/1/2023 12:12 PM	PRO	5/26/2023 8:36 PM
Multiple Projects	Booleano	5/1/2023 12:13 PM	PRO	5/26/2023 8:36 PM
Multiple Departments	Booleano	5/1/2023 12:13 PM	PRO	5/26/2023 8:36 PM
Size	Texto	5/13/2023 1:13 PM	B	5/26/2023 8:36 PM

Source: Screenshot from NVivo screen

3.4 Data Analysis

For the conclusion chapter, the data analysis will be divided in five parts: barriers mapping, barriers distribution analysis and prioritization, barriers behavior with attributes presence, barriers co-occurrence and finally a description and manual analysis of the interviews.

The first four analysis will be executed using the tools: mapping, queries, diagrams and charts of N-Vivo software. The five analysis will be a critical analysis provided by the author based on the literature review.

4. RESULTS

This chapter shows the qualitative analysis results. First, the context of each project is presented. Each interview was analyzed separately, and the barriers found were explored taking into account the project context. Second, the cross-case analysis considers the key variables. The analysis was built considering the references for each coded barrier encountered within the interviews.

4.1 Project's profile and context

4.1.1 Project 1

The context in which PM1 was inserted was a context of hybrid methodologies, where there were at the same time agile teams and teams that worked in waterfall. They had a program management approach: inside the program they had several projects wich needed to be managed themselves and also the interdepence between them. The program contained 60 fixed people and another 200 people on demand. The projects teams have between 6 to 15 people. The interview conducted with PM1 shows that the main difficulties came at the beginning of the implementation, when the teams did not know how to interact with each other. For PM1 the hybrid context fitted in this program because they had some contracts concerning the delivery dates. They had a defined scope to be delivery at a defined date (turn key) and also contracts with the suppliers.

This fact is related with one of the barriers found in the category "Stakeholder Education Problems": Long term planning vs short time planning debate. As they had already a defined scope and a long term date to delivery everything built at once, they didn't have one of the main points of the agile methodology which is the incremental added value. In this case the hybrid method was the solution to deal with stakeholders and contracts. The development flexibility was limited due to these contracts with suppliers.

PM1 himself was responsible for guaranteeing the implementation of agile practices and at the same time keep the requirements of the contracts in mind. Overall, PM1 experience was positive as explained in the next paragraphs, although he mentioned that it worked because he was there watching and coaching the team.

> "*The agile teams were being well monitored and trained, they knew what to do. They had a job description. Scrum Masters, for example, were designated as a role, not a position, and they should be able to understand the methodology and extract the best possible result from it. During the implementation of the teams, we mapped out who would do what, we mapped what was already being done by each of them, what would no longer be done and would move to another team, in order to minimize task overlap and prevent anything from being left in limbo and not getting done.*" (Interview 1 | PM1 | Translated by the author)

This affirmation enforces the importance of a trained agile coaching specially in this initial moment. When this role is missing there is a risk of having misusage of the methodology. As PM1 has several trainings from Project Management Institute (PMI) and PMP (Project Management Professional) he had the rituals and good practices consolidated and was able to coordinate the program according to it. The initial challenge, as referred by PM1 was to organize the team internally.

> "*It is not so trivial to integrate teams that do not have the same delivery cadence and that do not necessarily see the systemic values in favor of individual values, or the correlation between leveraging the system as a whole and their own work.*" (Interview 1 | PM1 | Translated by the author)

PM1 especified that he had a good panorama of the team's work, with frequent meetings which happened weekly and "on demand". The documentation was not reduced in this cenario as it should be in agile context. For each meeting, they had a meeting report specifying who was in the meeting, what were the decisions made during the meetings and the risks associated with it.

"We had documentation: meeting minutes (who were the participants, what were the risks and decisions made, etc.). It was a Word document that each team stored in their own places in the cloud. The documentation was at a high level compared to agile, and this was necessary because we had associated a waterfall part that required more extensive control." (Interview 1 | PM1 | Translated by the author)

Part of the agile good practices was to reduce the documentation level. In this scenario there is some evidence it was not properly follow due to: they had a waterfall part which needed more documentation, they did not use the tool in place (Bitrix 24) meaning that ideally they have a word document stored for each one of the meetings they made.

"There was even a space in Bitrix for this, but it was not used; the test evidence, for example, was attached to a separate flowchart outside of the tool." (Interview 1 | PM1 | Translated by the author)

Accordingly to PM1, there was a problem with the quality of the documentation specially with the document Definitions of Ready: they were not well written, they did not specify all the scenarios it needed to be tested for example or the business rules because the users were not trained for it.

"The only problem I see today is that the specification documents (Definitions of Ready) are not well written, the business rules are not specified, users who write them are not trained for this, and the variation scenarios for that functionality are not always described in full (having each scenario, what it receives as input and what it expects as a result for each scenario)." (Interview 1 | PM1 | Translated by the author)

Although he recognizes that part of the problem was related with the Definitions of Ready documentation, he believe he did not struggle to measure project performance. For him, the goal of the methodology was really to deliver more value without increasing the team capacity. For that it is necessary to know exactly where you want to arrive in the short term journey and how to better distribute the team for

it. The whole point is that to be effective on this prioritization and decision make you have to measure well team performance and results.

> "*Precisely because the objective of this methodology is to bring greater benefits in less time for the business, it is necessary to have an idea of where we are getting with the deliveries. When we have this vision and prioritization is done properly, the project ends up performing very well because, in addition to maintaining motivation since we are achieving results, it avoids rework. There are rare cases where we stop in the middle of development to say, "Oops, this is no longer a priority now, we move on to this other thing." Performance is then measured in terms of deliveries, and since the process is fluid, the time used is usually the actual time allotted for the delivery in question, not a period spent unlocking or correcting something.*" (Interview 1 | PM1 | Translated by the author)

Related to the topic discussed above he have the category Resistance to Change in the barriers encountered in the scaled agile implementation. Specially because the short term planning and incremental value together facilitate the decision make in order to bring results faster, the resistance to change tends to be lower. When well measured, people can see the results and this encourages transformation in all the organization chart: the leaders get more excited about the performance of the company in the market for example, and team members get more motivated because they can see their work is bringing results.

Concerning the business benefits, the benefits for process and product and the benefits for the team of the scaled agile implementation, PM1 is highly satisfied with all of them. For the business benefits, he believes that breaking the work down in small pieces that he can develop and test fast reduces the cost of the business. Plus, the definition of what will be done each small cycle generates a constant communication between business and technology teams, aligning strategy and goals with both parts.

> "*This reduces the damage because knowing quickly if I am on the right path generates a faster response from the environment that validates whether I am on the correct strategy without taking a year to plan and monitor my path.*

This response is confirmed in each cycle, which can vary between 15 and 30 days." (Interview 1 | PM1 | Translated by the author)

Concerning the benefits for process and product, PM1 believes that having a constant feedback from the client part creates a model turned to the client instead of a model turned to the scope. It stops you from having a focus on obsolete subjects.

"*… I have a fast feedback cycle running. I am constantly gathering input and opinions from the customer, so my business becomes customer-focused, instead of being scope-focused where large and laborious pre-specified tasks may already be obsolete. Furthermore, I have incremental improvements: I deliver high-value items very quickly, always starting with the MVP (Minimum Viable Product).*" (Interview 1 | PM1 | Translated by the author)

In this case, the interviewee was positive about the interactive process described above but it is important to keep in mind that this process requires a life cycle models towards to iterative and feature centric which needs the input of external stakeholders and a good understanding of agile concepts. Both of these requirements are potential barriers described in the barriers chapter.

PM1 sees agile methodology as something that encourages transparency and therefore trust, leadership acts, promotes inspection and quality, collaboration instead of competition, data driven decisions make and stimulates an environmental turned to innovation.

"*The environment becomes more prepared for innovation (people are encouraged to think small, validate a hypothesis, and explore further only if the result is good, or apply their thinking to something else).*" (Interview 1 | PM1 | Translated by the author)

PM1 raised the leadership barrier: Top down orders recommendations resistance as the biggest one. For PM1, the leaders don't understand the benefits of letting go part of the control, they believe if they do it everything will become out of control which is not necessarily right specially in agile methodology. This is also

related with the topic: self-management team challenge. The majority of the teams in agile methodology requires (teams need to govern themselves, they are supposed to be self-management teams).

> "*For me, the biggest challenge is building an environment where leadership understands that giving up a portion of command and control doesn't mean the organization will be adrift, but rather that you will make better use of collective intelligence, empower people, and therefore, create a more mature company to deal with difficult issues. Decentralizing decision-making (with restraint) is a positive thing. It is complex because it affects egos and established distributed powers (it changes the status quo that created the environment) and because this mindset needs to come from the top-down.*"
> (Interview 1 | PM1 | Translated by the author)

Another main barrier for PM1 is the method application related with two barriers: fear of changing roles and responsibilities by adopting the method and misunderstanding of agile concepts. People in his project were not motivated by what they were told to do, they were inspired by the leaders behavior and because they did not see the leadership acting differently, they did not feel fearless to act different. Basically, the environmental that generated the status KO did not change, therefore people kept their old ways of working too, accordingly to PM1.

PM1 also talked about integration and communication challenges between the teams, but in his opinion it could be easily resolved by having the ideal tools and a someone responsible for updating it. It can be related with the traceability and lack of minimum documentation barriers described inside the requirements problems. PM1 specifies that they missed a dashboard easily updated to understand where were the risks and blockers and make decisions on time (they missed the high level view).

> "*The problem with tools is something relatively easy to establish; it is necessary to organize a starting point and governance for it. The objective would be to generate dashboards easily and quickly to understand where the risks are, identify blockages, and take actions at the right time. It is necessary*

to make it clear in follow-up meetings where the risk is, what is being impacted, and the ultimate and most significant impact of this problem. Additionally, a systemic view is needed so that each area understands where it can contribute to this process." (Interview 1 | PM1 | Translated by the author)

Finally, PM1 commented a culture problem related to the fact that people takes things personally: they start to defend themselves from the transparency of the meetings, finding another area or process to be responsible for something that is not going as it supposed to. This is one of the barriers studied in the literature review called: rewarding model not teamwork. It makes people find the responsible for each one of the mistakes instead of focusing in the solution by doing a teamwork.

4.1.2 Project 2

The project 2 was a huge project containing five different regions and three different divisions. Due to this project size and the fact that each region could be considered individually as a scaled agile case with its own characteristics, this projects was splinted in regions to be analyzed.

The interviewee 2 is a Project Manager or Regional Lead of one of the regions, the Europe region. He mentioned that he uses a hybrid approach of Scrum, SAFe, and LeSS, and has undergone training in SAFe and Scrum as a product owner and master.

His project consists of 10-15 teams which is a significant number of teams to coordinate in a large-scale agile project. He is responsible for the ACN build EU team, which consists of four people. All the teams have a level of interaction with the other. The team size varies between 1 and 8 members, and roles and responsibilities are well-defined. The team uses various agile mechanisms such as Sprint Planning, Sprint Review, Releases, Increment, minimum viable product (MVP), Daily meetings, Product Backlog, Burndown Chart, Stories, Release Deliverables. The team also uses tools like ADO, Teams, Mural/Miro (design sessions), and Excel to manage and plan their agile project.

The combination of methodologies and frameworks suggests that the project team is trying to tailor their approach to the specific needs of their project, which is a common practice in scaled agile. However, the use of multiple methodologies can also introduce complexity and create communication challenges, especially when different teams are using different approaches.

"The teams usually are not aligned in the same rhythm or cadence which makes the communication and integration between them hard to execute" (Interview 2 | PM2)

A major challenge is the need for all teams to work together with the same cadence and rhythm, and in the same methodology, as the operation is iterative and requires communication among all the teams. Implementing agile methodology in an organization with pre-existing teams can also pose challenges because changing the way they work is difficult specially when the rewarding model is not teamwork. When this happens, teams tends to be more individuals which can make even harder the integration process.

"Agile requires an operation together with all the teams, it is about iteration and communication, so if you don't have the same cadence for all the teams, and they don't work together with each other one organization ruins the other and so on." (Interview 2 | PM2)

"The dependencies and integration between the teams can be a problem because sometimes the requirements require a lot of time but do not add value to all the teams. Sometimes the team needs to work on something that will add value only to another team" (Interview 2 | PM2)

When they first started implementing agile methodology, the teams were already there used to the old way of working. Therefore, PM2 notes that it took a lot of time to define everyone's job and to establish integration and communication processes between teams. This suggests that the project team faced challenges in defining roles and responsibilities, ensuring that each team understood how their work fit into the larger project, and establishing communication channels between teams.

This is a common barrier to implementing scaled agile, particularly in large-scale projects with many teams and stakeholders.

> *"Right now, I am satisfied with those topics (integration and communication), but it took a lot of time to define everyone's job, to define the integration and communication process between the teams."* (Interview 2 | PM2)

One of the challenges in implementing a scaled agile approach is to ensure that everyone in the team is performing their role and responsibilities effectively while avoiding overloading individuals. As things changes very fast, it adds a certain complexity to follow everyone's workload. Overloading individuals can lead to burnout, decreased productivity, and ultimately project failure. In an agile project, every team member is expected to contribute to the project, and if one person is overloaded, it can have a ripple effect on the entire team's performance.

> *"We had some problems between what was written in the contract versus real life, sometimes people to have a specific role, but they finished doing more than they were supposed to. And sometimes they did less. We finished with some people overload because they cared more about the project. It was an interactive process to get everyone onboard with their tasks and to make the whole system work communicating with each other without overcharging anyone."* (Interview 2 | PM2)

It is essential to monitor team members' workload regularly and have a process in place for redistributing work when necessary. Team members should also be encouraged to communicate any concerns about workload or capacity to their team leader or project manager so that appropriate action can be taken.

Another consequence of this charge is that people may not have the time or energy to create documentation if they are overloaded. They may feel that they need to prioritize other tasks that are more pressing, and as a result, they may create only cursory documentation that is incomplete or hard to understand. This can be especially problematic when other people need to use the documentation to complete their own

work. Also, people may not have the skills or expertise to create effective documentation. They may not know how to structure information in a way that is easy to understand, or they may use technical jargon that is unfamiliar to others. This can make the documentation less useful and less accessible to people who need it. Finally, people may not have the motivation to create documentation when they are overloaded. They may feel that it is an additional burden on top of their other responsibilities, or they may not see the value in it. This can lead to a lack of documentation, which can be a major problem for the project or organization.

PM2 addresses the documentation process as one of the biggest problem in his project. He believes that just the ADO which is the tool they use to do it is not enough as documentation. It can be due to the reasons described above or it can be due to the wrong choice of the tool or even both problems. As he have a big project to manage, he needs more documentation to be able to get the context, so the minimum documentation principle may not fit here too.

"*Documentation is a big problem: lack of documentation about what to do and what was asked. Historically, this can be an issue and causes headaches, energy, and money. Just ADO is not enough to be a documentation.*" (Interview 2 | PM2)

4.1.3 Project 2 -

C1 and SM1 were part of the same region inside the project 2. In this topic, both interviews will be analyzed together. They both work in a region with about 10 teams working together with the same agile project. Teams size varies between 5-50 people. In agile, it is not common to have a 50 people team, most of the teams have up to 10 peoples. This large team size could be a barrier to effective Agile implementation as it may lead to difficulties in coordination, alignment, and communication among teams. In terms of methodologies and tools, they mentioned that the project is using a hybrid approach, incorporating Agile (Scrum, Scale Agile (SAFe)) and waterfall.

Between the barriers they found, both of them agree that they have some problem about the scope. Arthur mentioned that the scope is too different for each team, which generates different pain points, and as a result, teams do not have a lot of knowledge to share. This indicates that there may be inconsistency or misalignment in how different teams are approaching their work, leading to challenges in coordinating efforts and sharing best practices. Aurelie, on the other hand, identify a scope creep as a barrier to implementing scaled Agile. According to her, the scope of the project has been growing, but the organization has not adapted accordingly. As a result, team members are overloaded, and they do not have time to learn new practices or attend meetings to align everything with their teams.

"*The scope is too different for each team, and it generates different pain points, so the teams don't have a lot of knowledge to share*" (Interview 4 | SM1)

"*I believe this is a matter of scope: we see the scope growing but the organization is not changing, that means people are overloaded, so they do not have time to learn new general and best practices behaviors.*" (Interview 3 | C1)

SM1 expressed dissatisfaction with the integration and communication among teams, especially between the onshore and offshore team members. He mentioned that there is a lack of processes to understand what is going on, what priorities the teams are focusing on, and where they are in the process. This lack of visibility makes it difficult for Arthur to answer client questions about when features will be finished. Aurelie goes in the same direction highlighting that some teams in her project have similar objectives and face challenges in working together, aligning their practices, and following official communication channels. Another communication-related barrier is the cultural differences between team members in different locations.

"*We work together and we try to organize the team every week, so we don't leave things undone, but we always have the so-called 'urgent topics' which occupies a lot of effort and normally we need people to stop their main goals to help in these topics.*" (Interview 4 | SM1)

> "*They don't work together to accomplish the same goals, they don't have the same best practices and, they have different pain points, which creates some difficult to align the teams.*" (Interview 3 | C1)

In large-scale projects, team members may be working in different locations and have different cultural backgrounds. This can impact their efficiency, as some team members may not see the importance of align meetings or writing well their job. Developers and testers, in particular, may face challenges in the non-technical part of their jobs, such as communication and collaboration.

Arthur mentioned that roles and responsibilities are not well-defined, even in tasks as we can see in the quote above. This lack of clarity in roles and responsibilities may lead to confusion, overlapping efforts, and difficulties in prioritization. Aurelie by herself mentioned that some roles, such as a coach or facilitator, are missing in the project, and this could lead to other roles getting overloaded with work. They both talked about the same problem in a complementary way.

In agile methodology, teams work towards common goals, and team members collaborate closely to ensure that everyone is aligned with the project vision. However, when one person is working on multiple products or projects, they can become overwhelmed and demotivated, especially if they do not have clear common goals. This can impact their productivity and the overall efficiency of the team.

> "*In my opinion, we have some roles missing like a coach or facilitator and maybe more scrum masters. Because we have some roles missing, the other roles need to absorb the extra work and get overloaded.*" (Interview 3 | C1)

About the progress measurement, Arthur mentioned that he does not have a good panorama of his team's work and struggles to measure project performance. He mentioned that the client frequently asks for details about deadlines, and the team does not always have a direct answer. This indicates that there may be challenges in tracking progress, identifying bottlenecks, and providing accurate updates to stakeholders. Aurelie on her side complement this analysis specifying they use various tools such as

ADO, Power BI, Teams, excel, and emails for project management. This indicates that there may be challenges in using the right tools effectively for Agile implementation.

> "*No, I don't have a good panorama of my teamwork. We have a lack of common principles and guidelines across teams, and it makes it hard to follow their work. They don't see so much value added in passing details bottom up and every time we try to implement a new method it lasts just a little... Yes, it is the same as I said before. The client is always asking where we are and frequently, we don't have a direct answer*" (Interview 4 | SM1)

Concerning the stakeholders, Arthur also mentioned that the client defines the team's priorities and it gives the impression that the team does not have control over their work. He expressed a desire to proactively give the client what they want before they ask for it, indicating that the team may not have enough autonomy to make decisions and prioritize work based on their expertise and understanding of the project.

Clients often have specific deadlines and delivery dates in mind, and they may not fully understand the agile methodology or the importance of flexibility and adaptation to change. This can lead to misunderstandings and conflicts between the team and the client, which can impact the overall success of the project.

Concerning the organization structure, Aurelie mentioned that the organization is not changing despite the growing scope of the project. Additionally, she noted that some teams have a large number of people and could potentially be split into smaller teams for better efficiency. This indicates that the organization structure may not be conducive to effective Agile implementation.

In conclusion, based on their interviews, the barriers to the implementation of scaled Agile in their project include team size, communication and integration, organization structure, roles and responsibilities, and the use of tools and methodologies. Addressing these barriers would require efforts to improve coordination, alignment, and communication among teams, review and optimize the organization structure, define clear roles and responsibilities, and ensure the appropriate use of tools and methodologies to support Agile practices.

4.1.4   Project 2 -

From Interviewee 5's interview, it is evident that his organization uses a hybrid approach, incorporating different Agile methodologies such as Scrum, Scaled Agile Framework (SAFe), and Large-Scale Scrum (LeSS). The team size ranges from 2 to 50+ members. Interviewee 5 plays several roles such as Scrum Master, Coach, and Lead of one of the project streams. However, he has not received any training in Agile Project Management.

Interviewee 5 faces several challenges in his project, especially with resource allocation, integration, and communication between the different teams. Sometimes resources get occupied with another stream, leaving his team with insufficient resources. Integration and communication between the teams are not well aligned, and sometimes urgent situations arise in other streams, requiring the teams to work together to solve them.

> "… *sometimes we have problems with our resources because other streams need more resources. In this case, some of my resources get occupied with another stream and I don't have the resources I need. I would say the integration and communication are not well aligned because of that. Normally, the teams should work in parallel helping each other and not interfering in the work to be done. But some urgent situations always come up in other streams and we need to work together to solve it instead.*" (Interview 5 | SM2)

Another challenge is related to the complexity of managing several features, releases, people, and streams simultaneously, which can make the application of Agile methodology complex.

The project uses different agile mechanisms such as sprint, sprint planning, sprint review, releases, increment, minimum viable product (MVP), product backlog, stories, and epics deliverables. The team uses different tools such as Azure DevOps, ADO test plans, Teams, and Excel to manage and plan their agile project. Interviewee 5's organization applies different project management approaches such as traditional,

waterfall, agile, program management, and hybrid. He consider agile as the main mechanism.

Interviewee 5 is satisfied with the benefits of the project concerning business, process, product, and team. Mohamed acknowledges that while he has a good panorama of his team's work, visibility can be improved by better completeness of Azure DevOps items, especially effort estimates, priority, severity, actual effort, and related items. For example, to improve visibility, a bug created must be linked to a specific user story.

> "*In large-scale projects, adopting agile methodology presents several challenges due to the application of the methodology on several features, releases, people, and streams. The complexity of handling all these factors simultaneously can make the application of the Agile methodology difficult. To tackle this, each feature should be well scoped, and the feature's priority and release should be clear as a pre-requisite. These scoping notes should be validated by all key stakeholders, and the functional and technical solutioning should be reviewed.*" (Interview 5 | SM2)

Overall, the challenges identified by Interviewee 5 are common in large-scale Agile projects. Coordination and communication between different teams and streams can be complex and require careful planning and management. Effective use of Agile mechanisms and tools can help improve visibility and project performance. Mohamed's suggestion of better scoping and validation of key features by stakeholders can help ensure clear priorities and smooth implementation of Agile methodology in large-scale projects. Interviewee 5 suggests doing more integrated planning and tracking dependencies between the squads to solve the challenges.

4.1.5   Project 2

Based on Interviewee 6's interview, there are several challenges that he faces in implementing a scaled agile methodology in his project. These challenges include coordination, communication, constant changes, and mindset.

Interviewee 6's team has between 2 and 9 teams engaged in the same Agile project, with a team size ranging between 2 and 50+ members. His offshore team has 50+ members, which belong to three different streams in the global region. Interviewee 6 is responsible for managing all the resources offshore, no matter which stream they belong to. Scaling agile requires support from senior management, who must be committed to the process and willing to invest the necessary resources. Without this support, it can be difficult to overcome resistance to change and ensure that the process is fully adopted across the organization.

Interviewee 6 faces a team size problem since the organization is not well structured and there are too many people directly obeying to him, it makes hard even to create the self-management teams that agile promotes. Despite being trained in agile project management, some team members may still resist adopting new processes and practices. This can lead to delays and lower productivity, as team members may not fully embrace agile methods.

He is not satisfied with the integration and communication between his team members, as they face problems in the processes, which make it hard to keep all the developers under control and to get instructions from the onshore team. He believes that communication and alignment are two pain points for his 50+ person team. Differences in communication styles, work practices, and expectations can all contribute to miscommunication and delays.

> "*Not much, sometimes we have problems in the processes. It is hard to keep all the developers under control and to get instructions from the onshore team and make sure they are all respected by everyone. Especially because requirements, priorities and needs change all the time. I believe communication and alignment are two good pain points for our 50+ person team. We can't make meetings all the time to align everything with everyone and even when we do sometimes the developers have a more urgent topic and they cannot be present, or during the meeting they are doing something else.*"
> (Interview 6 | PMO1)

In terms of adopting agile methodologies, Interviewee 6's team uses Scrum, Scale Agile (SAFe), and Project Management Body of Knowledge (PMBOK) in a hybrid approach. They adopted several agile mechanisms such as Sprint, Sprint Planning, Sprint Review, Releases, Daily meetings, Product Backlog, Stories, and Epics/Deliverables. They use Azure Devops for maintaining the product backlog, excel sheet for project tracking and capacity planning, and Outlook and MS Teams for communication.

Interviewee 6's team struggles to adapt their mindset to agile processes and to track the work done and remaining work, which gives the project performance at any point of time. Effective scaled agile requires robust tools for collaboration, communication, and project management. If the tools being used are inadequate or not well-suited to the needs of the project, this can hinder the effectiveness of the agile process.

> "*I think that the project documentation level is insufficient and that it is indeed to maintain a requirement in the documentation (specifications / framing / solutioning / architecture diagram) on the one hand because that acts and documents all the decisions and on the other hand because there is an important turnover and that helps enormously for the knowledge transfer.*" (Interview 6 | PMO1)

Interviewee 6 believes that the main challenges of adopting an agile methodology in a large-scale project are related to coordination, constant change, high-level changes, and mindset. He suggests that some of these challenges can be solved by implementing a hybrid approach, for example, by increasing team engagement and communication.

4.1.6 Project 3

Interviewee 7 is currently a Project Manager in one of the divisions, and he uses Agile mixed with other PM methods (hybrid). They use Waterfall, Scrum, Kanban, and SAFe. He had a one-day session of training to explain about agile principles, given by a consulting firm in his company.

In Interviewee 7's project, they work with nine teams in total, most of them operate in agile mode. Interviewee 7 is the Program Manager in one of the nine teams, and he is responsible for other three sub-teams with 7, 3, and 10 people. Other sub-teams below the nine vary between 3 and 20 people. The team's size varies between 3 and 20 members.

Interviewee 7 mentions that they have faced several challenges in their implementation of Scaled Agile. The first challenge they have is poor alignment and communication between teams, which leads to blocked requests and blaming between the different areas. He also mentions that they do not value teamwork and struggle with transparency within the team. This lack of transparency leads to some things being left unsaid intentionally, which hinders the project's progress.

> *"Unfortunately, we have many problems measuring project performance. Despite having weekly meetings to track the progress of features, the information we receive is not always transparent because it depends on other areas, and there is strong interdependence. Also, as we don't use ServiceNow the way we should, updates are not made in real-time, and sometimes people don't have access to them because they are stored in documents like Excel or PowerPoint that are not necessarily shared with all areas."* (Interview 7 | PM3 | Translated by the author)

Another challenge they face is the problem of prioritization. Many of the things they decide to do are not properly prioritized based on their business characteristics. This lack of proper prioritization can lead to inefficiencies and delays in project delivery. Additionally, they have problems in product flows because one area finishes much faster than the other, and user stories are left in the process until they are released.

> *"We do not have good alignment; we are always blocked waiting for some request from another area. The areas blame each other, and we do not value teamwork. We also have problems in product flows because one area finishes much faster than the other, and user stories are left in the process until they are released. We also struggle with the transparency of the areas;*

many things are not communicated intentionally because people are afraid of the consequences." (Interview 7 | PM3 | Translated by the author)

Interviewee 7 mentions that the roles and responsibilities in his project are not well defined. This lack of clarity is due to the fact that they did not have the right number of people during the transformation to become an agile company. They are planning to have more people, but for the moment, the roles are kind of mixed for some of the divisions.

"The roles and their responsibilities are not well defined because when we executed the transformation to have an agile company, we did not have the right number of people. For some of the teams, we have PM that acts as well as PO and BO. It adds a lot of overloaded people, although some people say it helps to make strategic decisions. (Interview 7 | PM3 | Translated by the author)

In terms of Agile rituals, Interviewee 7 mentions that they adopted Sprint Planning, Sprint Review, Releases, Increment, minimum viable product (MVP), Product Backlog, Stories, and Release Deliverables. They use Service Now, Teams, and Excel to manage and plan their Agile project.

Interviewee 7's company applies a hybrid approach, which combines Agile and waterfall methodologies. However, they have many problems measuring project performance. Despite having weekly meetings to track the progress of features, the information they receive is not always transparent because it depends on other areas, and there is strong interdependence. Some initiatives have monitoring problems, and some are not monitored at all and occasionally appear unexpectedly.

However, he admits that the team struggles to measure project performance and faces challenges in communication and collaboration due to interdependence between different departments.

"It can be challenging to ensure that work is being done consistently across different teams when using different methodologies. For example, when we asked the teams to create user stories it became a challenge. Each team was using a different size of work for each package of work. In the end, it was really difficult to

build a schedule with that because we had no clue when topics would finish."
(Interview 7 | PM3 | Translated by the author)

Interviewee 7 is satisfied with the business benefits and the benefits for the process and product of using agile methodology, but believes there is still room for improvement. He is neutral about the benefits for the team, as he believes that the agile transformation is still in its early stages and the team is not yet fully embracing the new approach.

Finally, Interviewee 7 also discusses the challenges of adopting agile methodology in a large-scale project. He notes that some of the challenges include resistance to change, lack of alignment, communication breakdown, integration challenges, planning and coordination difficulties, maintaining consistency, overhead and complexity, and the need for additional training and support for employees.

4.1.7 Project 4

From the interview with Interviewee 8, it is clear that the company uses Agile methodologies such as Scrum, SAFe, and Spotify Chapter for their projects. The project involves 45 teams with a team size between 10-13 people. The teams are divided into PIX, voucher, check, and payroll, with the management of these services having a specific team. All POs, Scrum Masters, etc. were in technology. The company had created communities by business line, but the communities were purely technology-focused, without any business component.

Interviewee 8 mentioned that the community model had been implemented for 5-6 years, but they had not yet made the move to bring business into technology. Business leaders became leaders in the communities, and some agile roles such as PO became business-oriented. Interviewee 8 identified that culture and mentality were the barriers in implementing agile effectively. This highlights the need for ongoing communication and engagement strategies to ensure everyone is aligned and working towards shared goals.

"With this change, integration and communication improved significantly compared to before, creating the vision that they are all one and share responsibility. However, there were still issues with changing mindsets and motivating people to participate more actively in the process." (Interview 8 | C2 | Translated by the author)

According to Interviewee 8, the roles and their responsibilities were well-defined, but people were too prescriptive. Having too many agile roles and ceremonies can lead to bureaucracy and excess paperwork. This can be a common issue in scaled agile implementations, as teams may struggle to find the right balance between structure and flexibility. It's important to continuously evaluate the effectiveness of roles and ceremonies and make adjustments as needed.

"They are very well defined, almost too much so. The downside was that people were too prescriptive. This is bad because sometimes there were not enough resources. There were too many agile roles that ended up creating bureaucracy. The more roles we had, the more layers and consequently more bureaucracy added." (Interview 8 | C2 | Translated by the author)

The company adopted several agile mechanisms such as Sprint, Sprint Planning, Sprint Review, Releases, Increment, Minimum Viable Product (MVP), Daily meetings, Product Backlog, Burndown Chart, Periodical stand-ups, Kanban, Stories, Planning Pocker, Epics/deliverables. They also adopted the characteristic rituals of Agile at scale such as PI Planning, Quarter Review, etc.

"For a scaled implementation, the rituals increase in cadence and complexity level. It is necessary to manage dependencies, the backlog between the areas. Traditional agile models focus too much on the delivery part, but we also need to look at the discovery part. We need to have the discovery rituals: Lean Inception and Design Sprint." (Interview 8 | C2 | Translated by the author)

The company used Jira and ServiceNow to manage and plan their Agile project. They implemented OKRs and KPIs to track the achievement of the mission

and the "run the business," tracking the business as usual. The KPIs are related to efficiency (sustainability, deliveries, etc.), while the OKRs are related to effectiveness (changing the business).

Interviewee 8 was satisfied with the Business Benefits, but he believed it could be better if there were fewer papers and fewer ceremonies. He thought there was too much excess, making it too complex and even a bit bureaucratic. Interviewee 8 was also satisfied with the Benefits for Process and Product. The business's "Skin in the game" approach to being part of the community and a focus on result-oriented production has been very beneficial for the product itself.

He mentions that his teams were transitioning to a results-oriented approach focused on impact rather than just delivery. This highlights the importance of measuring outcomes and impact, and aligning metrics and KPIs with broader business goals and objectives.

Overall, the main challenges faced by Interviewee 8 and his team were related to changing mindsets and motivating people to participate more actively in the Agile process. They also faced issues with too much bureaucracy and excess ceremonies. To overcome these challenges, the company needs to focus on creating a culture that embraces Agile methodologies and values, reduce bureaucracy and streamline the ceremonies, and motivate the team members to participate more actively in the Agile process.

4.1.8   Project 5

Based on the interview with I9, it is evident that there were some challenges faced in the implementation of scaled Agile. The project consisted of 21 squads with each squad comprising a developer, Agile Master, and Product Owner. I9 was the Chapter Lead responsible for leading the Agile coaches. The company used the Kanban method with some aspects of Scrum. The Agile mechanisms adopted included Releases, Increment, Dailies, Product Backlog, Kanban (board), Stories, and Epics. The Kanban method was considered to be more practical than Scrum. The company

used Slack, Kanbanize, and Google Data Studio as tools to manage and plan their Agile project.

One of the significant challenges faced was role definition. While the roles were well established, some individuals were overloaded, especially the Middle management part.

"The three engineering managers who were responsible for overseeing the work of the 21 squads were not able to cope with the workload, which led to a restructuring of the management hierarchy. However, this restructuring caused its own set of problems, as the tech leads who were tasked with managing people did not want to take on this responsibility, preferring to focus on technical tasks instead." (Interview 9 | CL1 | Translated by the author)

This highlights the importance of careful planning and allocation of resources, as well as clear communication and expectations management with team members.

The interviewee's experience with measuring project performance using agile metrics such as lead time, cycle time, and Monte Carlo simulations highlights the importance of using data-driven approaches to monitor and improve project performance.

"Nowadays, I had a good overview and was able to measure performance well with agile metrics (Lead Time, Cycle Time, Monte Carlo (quarterly predictability based on historical data, how long it took to wait for input etc). At the beginning, despite having efficiency metrics, they did not follow these processes well. It is a process that requires a lot of discipline at the beginning and it is hard work and usually companies cannot pass this initial barrier." (Interview 9 | CL1 | Translated by the author)

However, the interviewee also noted that this process requires a lot of discipline and hard work, particularly at the beginning of a project. This underscores the importance of having a dedicated person or team responsible for monitoring and implementing agile processes and metrics, as well as ensuring that team members are

adequately trained and equipped to use these tools effectively. The interviewee's was satisfied with progress measure.

The interviewee also noted that the hierarchical structure of top management was a significant barrier to achieving the full benefits of agility for the business part. It was difficult to have the strength to prioritize what made sense since the managers had already made their mind sometimes and sometimes managers became bottlenecks, holding investment. This suggests that even when implementing agile practices at the team level, it is important to consider the larger organizational context and the potential impact on company culture and leadershI9 structures. Successful implementation of scaled agile requires buy-in and engagement from all levels of the organization, and may require significant changes to traditional management structures and practices.

> *"There was still a very hierarchical structure of top management, it was difficult to have the strength to prioritize what made sense. Managers were not engaged and became bottlenecks, holding investment. The hierarchy problem would be a barrier to achieving the full benefits of agility to the business part."* (Interview 9 | CL1 | Translated by the author)

The use of Kanban with some aspects of Scrum highlights the importance of tailoring agile practices to fit the specific needs and context of a project or team. This underscores the importance of agile coaches and other experts who can help teams navigate the complex landscape of agile methodologies and practices, and tailor them to fit their specific needs and context.

> *"While Scrum provides a well-defined set of ceremonies and practices, Kanban is more flexible and adaptable, allowing teams to start with what they have and add what makes sense."* (Interview 9 | CL1 | Translated by the author)

Regarding benefits, I9's level of satisfaction with Business Benefits was neutral, neither dissatisfied nor satisfied. The hierarchy problem was a barrier to achieving the full benefits of agility to the business part. I9's level of satisfaction with Benefits for Process and Product was good (4/5), with Agile proposing continuous

process improvement, which is great. The level of satisfaction with Benefits for the team was also good (4/5), with I9 being satisfied with the well-being of the team.

Overall, the interviewee expressed a moderate level of satisfaction with the benefits of scaled agile for the project, process, and team. While there were certainly challenges and barriers to implementation, the interviewee noted several areas where agile practices had led to positive outcomes, including continuous process improvement, deliveries based on customer feedback, and improved team well-being. This suggests that while implementing scaled agile may require significant effort and resources, it can ultimately lead to tangible benefits and improved outcomes for teams and organizations.

4.1.9   Cross-case analysis

Each one of the projects have an agile configuration which can use one or a combination of agile methodologies. Based on the literature review, the most common methodologies in a scaled agile configuration are Large Scale Scrum, Scrum of Scrum, Spotify, Crystal, Kanban. Additionally, as sometimes the scaled agile methodology is implemented together with the waterfall method, there is a column (Waterfall with agile) to express its presence which can be in the routine or only in contracts. The interviews are related to those methodologies according to Table 3.

Table 3 - Classification according to Agile Methodologies

Project	ID	SAFe	Large Scale Scrum	Scrum of Scrum	Spotify	Crystal	Kanban	Waterfall with Agile
PJ1	I1	No	No	Yes	No	No	Yes	Yes
PJ2–R1	I2	Yes	No	Yes	No	No	No	Yes
PJ2-R2	I3	No	Yes	Yes	No	No	No	Yes
PJ2-R2	I4	No	Yes	Yes	No	No	No	Yes
PJ2-R3	I5	Yes	Yes	Yes	No	No	No	No
PJ2-R4	I6	Yes	No	Yes	No	No	No	No
PJ3	I7	Yes	No	Yes	No	No	Yes	Yes
PJ4	I8	Yes	No	Yes	Yes	No	No	No
PJ5	I9	No	No	Yes	No	No	Yes	No

Source: Created by the author

Aiming to understand how the barriers behave according to the project context, the interviews were classified by size and also by two types of Family A and B.

Family A is divided into four variations: multiple regions, multiple teams, multiple projects, multiple departments. This division was built according to what was found in the literature review combined to the interviews content. The idea was to explore how the variation of those topics can influence in the effect each barrier has on the companies and projects. The Table 4 is a matrix to summarize how each project is settled for each one of those attributes.

Table 4 - Classification according to Family A

Project	Interview	Multiple Regions	Multiple Teams	Multiple Projects	Multiple Departments
PJ1	I1	No	Yes	Yes	No
PJ2–R1	I2	Yes	Yes	No	No
PJ2-R2	I3	Yes	Yes	No	No
PJ2-R2	I4	Yes	Yes	No	No
PJ2-R3	I5	Yes	Yes	No	No
PJ2-R4	I6	Yes	No	No	No
PJ3	I7	No	Yes	No	Yes
PJ4	I8	No	Yes	No	Yes
PJ5	I9	No	Yes	No	Yes

Source: Created by the author

Family B, on the other hand, refers to the amount of people encountered inside the project. Being all those Projects an example of scaled agile implementation, they all have a lot of people involved. The idea is to test if the number of people is a relevant factor for how the barriers behave or if the size factor is something that matters less than how the organizations organize themselves and their practices.

In large organizations, the number of people involved in projects can significantly impact the complexity, communication channels, and coordination efforts required. By categorizing the projects into different sizes, it becomes easier to analyze patterns, challenges, and barriers unique to each group and compare the results.

Table 5 - Size Category

Category	Size	Name
A	50 - 100 people	Small-Scale Agile Projects (SSAP)
B	100 - 170 people	Medium-Scale Agile Projects (MSAP)
C	More than 170 people	Large-Scale Agile Projects (LSAP)

Source: Created by the author

Table 6 – Interviews Family B - Size Classification

Project	Size	Category
PJ1 – I1	60 people	A
PJ2-R1 – I2	75 people	A
PJ2-R2 – I3	154 people	B
PJ2-R2 – I4	154 people	B
PJ2-R3 – I5	75 people	A
PJ2-R4 – I6	50 people	A
PJ3 – I7	135 people	B
PJ4 – I8	450 people	C
PJ5 – I9	105 people	B

Source: Created by the author

Classifying the interviews according to Family A and B will help to understand how each context can influence in the barriers behavior. The study will provide which project configuration enhance each barriers effect aiming to understand how organizations can better organize themselves to increase benefits.

4.2 Barriers Mapping

Aiming to show how the barriers are distributed between them, N-Vivo has a tool called Project Map. The child relationship used is already standard in the software, but it is possible to customize them if needed. Each one of the barriers type: Team Related Issues, Stakeholders Issues, Method Application Barriers, Culture Issues, Requirements, Product and Process Issues, Managerial Issues has a map that shows all the children originated in the literature review and all the highlighted barriers came after doing some interviews following the process illustrated in the Figure 7.

Figure 9 - Team Related Issues Barrier Mapping
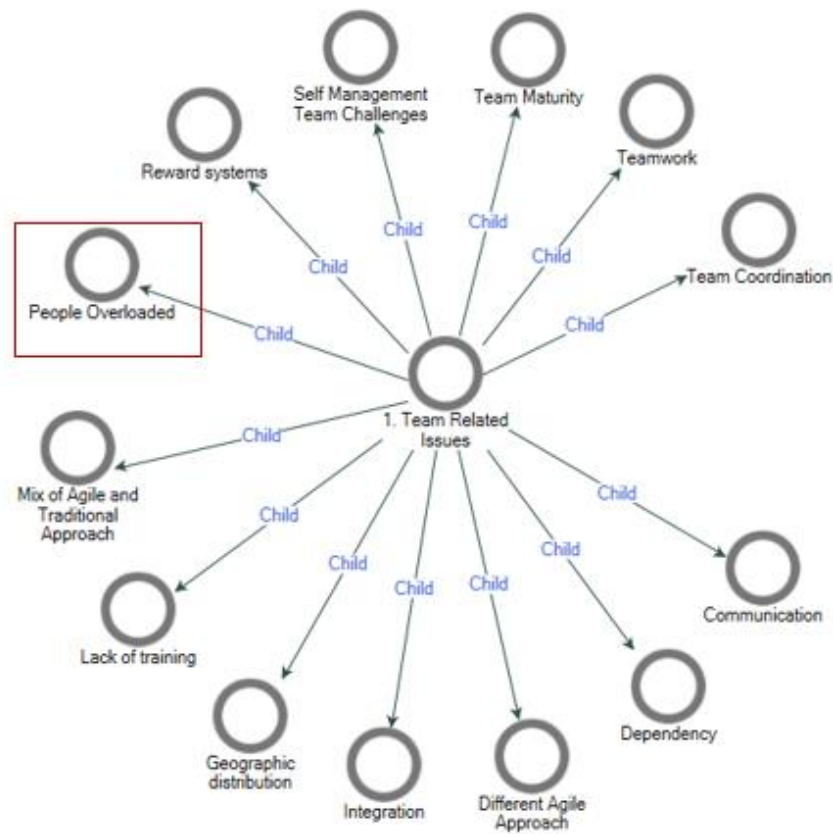
Source: Created by the author based on NVivo results

For Team Related Issues, the only barrier added after doing the interviews was people overloaded. This barrier appeared for the first time in the second interview evolving the PM2. But it also appeared in the interviews three (PJ2 – R2), four (PJ2 – R2), six (PJ2 – R4), seven (PJ3) and nine (PJ5) showing that it was relevant. It possible to see how the references in the interviews are distributed inside this barrier in the Graph 1.

Graph 1 - Reference distribution in Team Related Issues Children
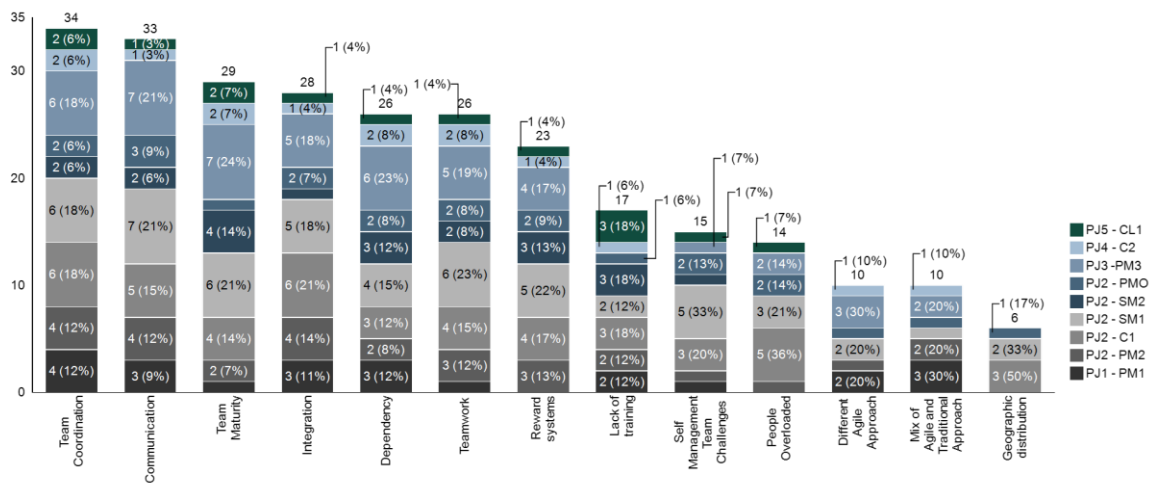
Source: Created by the author based on NVivo results

Team Coordination is the most frequently referenced sub-barrier, appearing in every interview. This indicates that coordinating team efforts and ensuring everyone is working in sync is a significant challenge when implementing scaled agile methodologies. Communication is the second most referenced sub-barrier, also appearing in every interview and a common barrier.

Geographic distribution is the least referenced sub-barrier, with only 6 references across all interviews. As not all the projects have different geography distribution it is not possible to conclude that this barrier is not relevant in this case.

It is interesting to observe that Team Maturity and Integration have similar frequencies, as well as Dependency and Teamwork. It is possible to hypothesize possible reasons for these close relationships.

A more mature team is likely to have better-established processes, communication channels, and experience working together. This maturity can lead to smoother integration of team members, their tasks, and their outputs, resulting in fewer challenges when implementing scaled agile methodologies. Conversely, less mature teams may struggle with integration due to a lack of well-defined processes,

communication, and experience. Therefore, the challenges related to team maturity and integration may be closely linked, with one affecting the other.

Effective teamwork is crucial in managing dependencies between team members and their tasks. When team members collaborate and communicate effectively, they can better identify, manage, and resolve dependencies, reducing the potential for bottlenecks and delays in project delivery. On the other hand, poor teamwork can exacerbate dependency-related issues, as team members may not communicate or collaborate effectively, leading to unresolved dependencies and potential project delays. As a result, the challenges related to dependency and teamwork may also be closely linked, with one impacting the other.

Different Agile Approach and Mix of Agile and Traditional Approach both have 10 references, indicating that the specific agile methodology used and the mixing of agile and traditional approaches may be a concern for some teams, but not as prevalent as other issues.

Figure 10 - Stackholders Issues Barrier Mapping
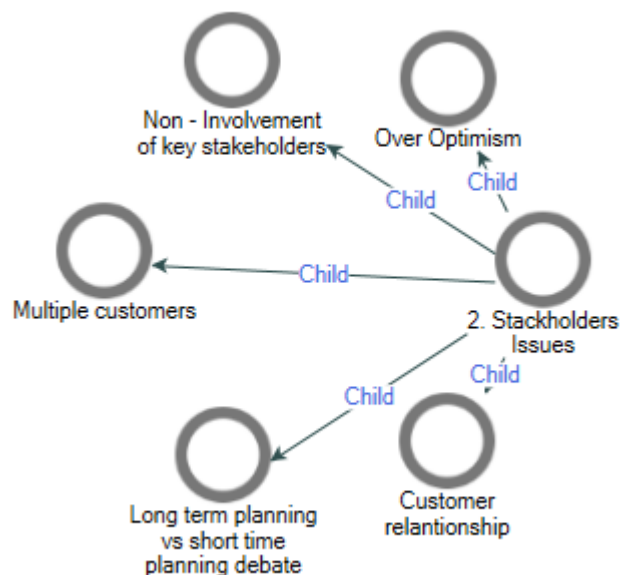
Source: Created by the author based on NVivo results

For the Stakeholders Issues, all the five children were already added before starting the interviews and it is possible to see how the references are distributed between them in the Graph 2.

Graph 2 - Reference distribution in Stakeholder Issues
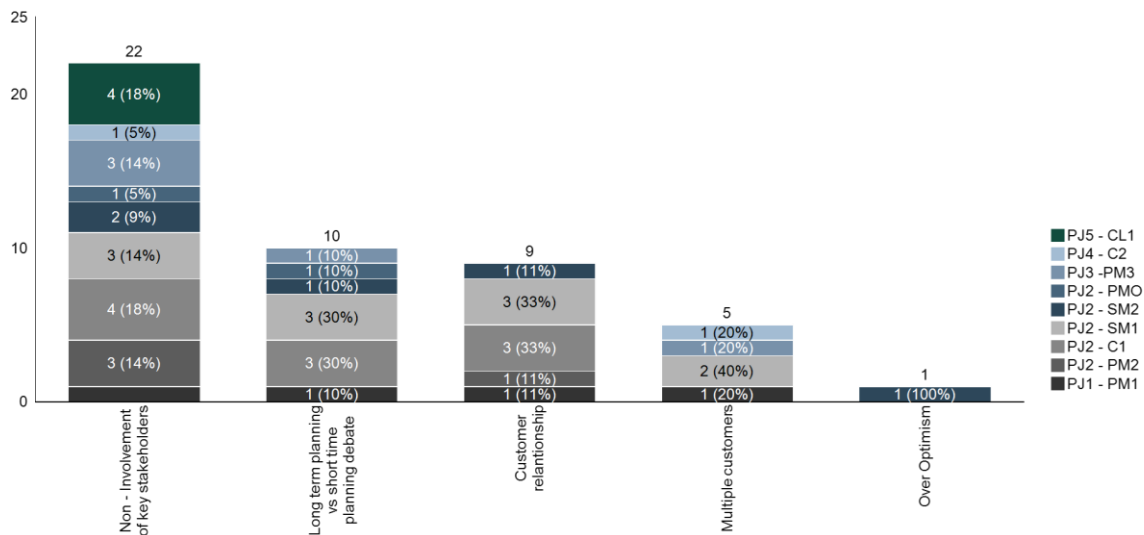
Source: Created by the author based on NVivo results

Non-Involvement of key stakeholders is the most frequently referenced sub-barrier, with 22 references across all interviews. This indicates that the lack of involvement or engagement of key stakeholders is a significant challenge when implementing scaled agile methodologies. Long term planning vs short time planning debate has 10 references, making it the second most frequently referenced sub-barrier.

Customer Relationship and Long term planning vs short time planning debate have similar frequencies, with 9 and 10 references, respectively. A possible reason for this close relationship is that effective customer relationship management often involves addressing customer concerns and expectations related to long-term and short-term planning. Balancing customer expectations for long-term strategic planning with the iterative, short-term nature of agile methodologies can be challenging, leading to potential issues in customer relationships. By addressing both customer relationship management and the long-term vs short-term planning debate, organizations can better

navigate the challenges associated with stakeholder-related issues in implementing scaled agile methodologies.

Multiple customers and Over Optimism have the least number of references, with 5 and 1 references, respectively. This suggests that while managing multiple customers and over-optimistic expectations can pose challenges, they are not as relevant as the other and don't need to be prioritized.

Figure 11 - Method Application Barriers Mapping
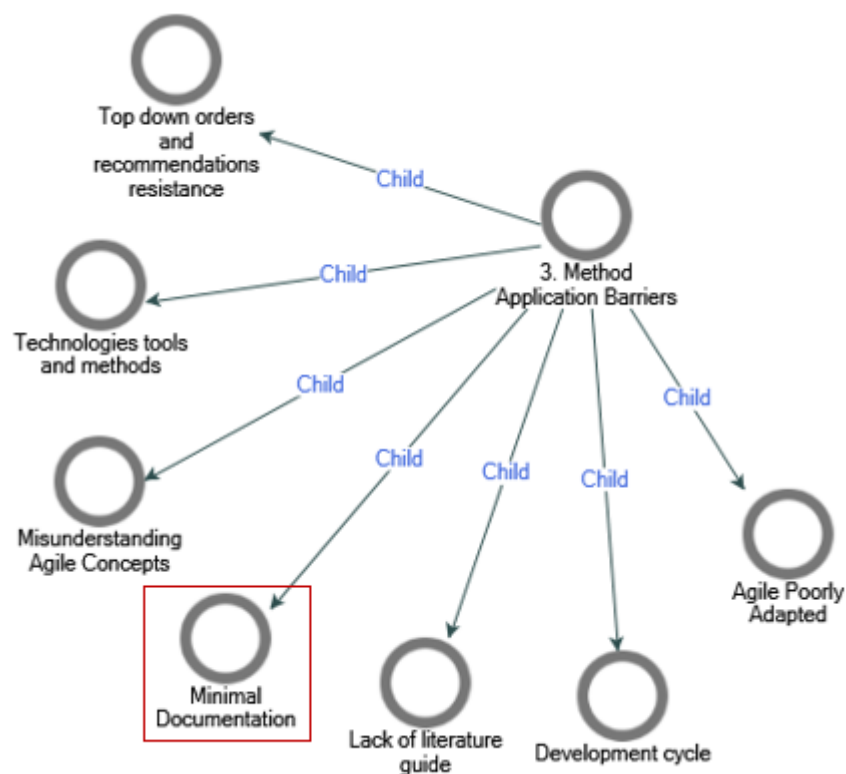
Source: Created by the author based on NVivo results

For Method Application Barriers, the only barrier added after doing the interviews was minimal documentation. This barrier appeared for the first time in the second interview evolving the PM2 and it was added in the interview guide as a key

question due to its relevance described also in the literature review. It is possible to see how the references are distributed between them in the Graph 3.

Graph 3 - Reference distribution in Method Application Barriers Children
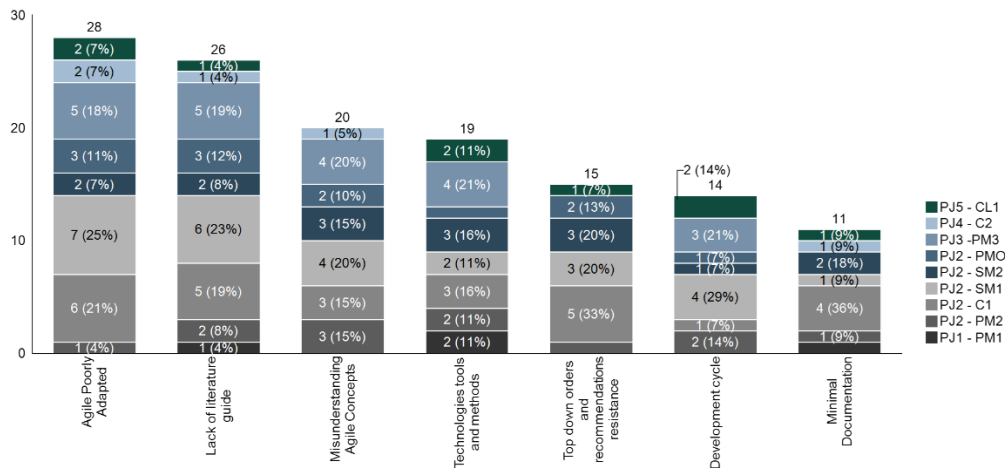
Source: Created by the author based on NVivo results

Agile Poorly Adapted is a common barrier across most interviews, with interviewees 4 (PJ2 - SM1) and 3 (PJ2 – C1) experiencing the highest number of references (7 and 6, respectively). This indicates that organizations may not be providing sufficient training or resources for their teams to effectively implement scaled agile methodologies. Lack of literature gride has 26 references, making it the second most frequently referenced sub-barrier inside Method Application Barrier.

Looking to the graph, it is possible that some of these sub-barriers are actually correlated: technologies tools and methods may be correlated with development cycle issues as challenges in integrating various tools and technologies can hinder the adaptation of development cycles to accommodate scaled agile methodologies; Agile Poorly Adapted may be correlated with misunderstanding concepts as insufficient training can lead to a lack of understanding of the core principles and concepts of scaled agile methodologies.
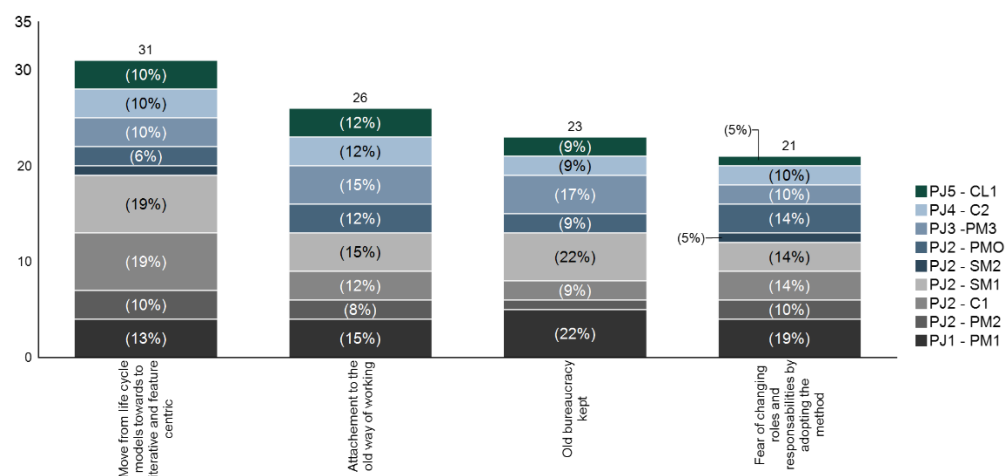
Figure 12 - Culture Issues Barrier Mapping
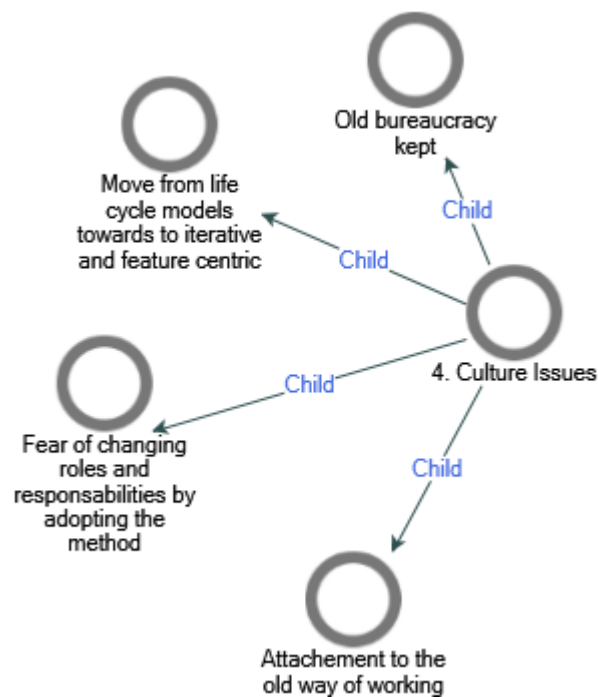
Source: Created by the author based on NVivo results

For the Culture Issues, all the four children were already added before starting the interviews and it is possible to see how the references are distributed between them in the Graph 4.

Graph 4 - Reference distribution in Culture Issues

Source: Created by the author based on NVivo results

The move to iterative models is a prevalent barrier, with interviewees 3 (PJ2 - C1) and 4 (PJ2 - SM1) experiencing the highest number of references (6 each), indicating that organizations may face challenges in transitioning from traditional life cycle models to more iterative and feature-centric approaches. Attachment to the old way of working has 26 references, making it the second most frequently referenced sub-barrier inside Method Application Barrier.

The hypotheses of co-occurrence between sub-barriers inside Culture Issues are: attachment to old ways of working may be correlated with old bureaucracy kept as both barriers indicate a resistance to change and a preference for traditional ways of working within organizations; fear of changing roles may be correlated with the move to iterative models as individuals may be resistant to adopting new roles and responsibilities associated with the transition from traditional life cycle models to more iterative and feature-centric approaches.

Figure 13 - Requirements Barrier Mapping
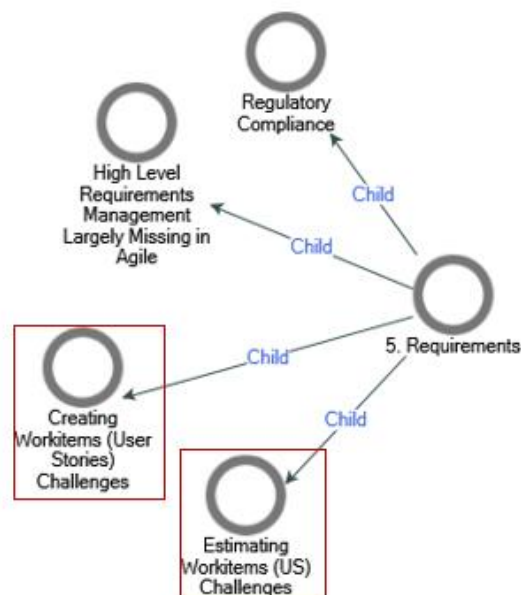
Source: Created by the author based on NVivo results

For Requirements Issues, the two barriers added after doing the interviews were Creating Work items (User Stories Challenges) and Estimating Work items (US) Challenges. Those barrier appeared for the first time in the fourth interview evolving the SM1. But it also appeared in the interviews six (PJ2 – PMO), five (PJ2 – SM2), seven (PJ3 – PM3) and nine (PJ5 – CL1) showing that it was relevant. It possible to see how the references in the interviews are distributed inside this barrier in the Graph 5.

Graph 5 - Reference distribution in Requirements
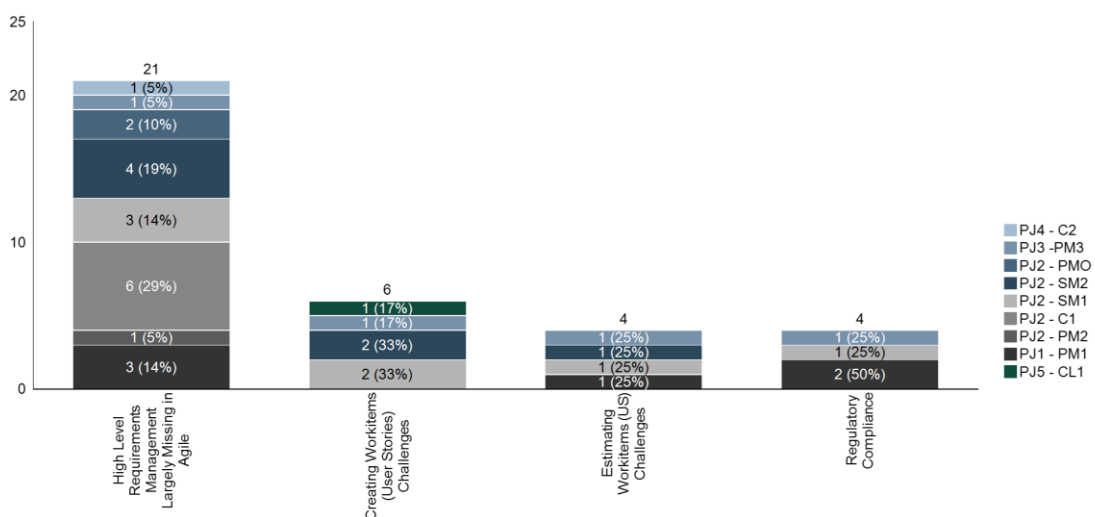
Source: Created by the author based on NVivo results

High Level Requirements Management Largely Missing in Agile is a common barrier across most interviews, with interviewees 3 (PJ2 - C1) and 5 (PJ2 - SM2) experiencing the highest number of references (6 and 4, respectively). It is by far the most frequency barrier in this category: requirements management.

Creating worktimes (User Stories) Challenges may be correlated with Estimating workitems (US) Challenges as both barriers involve difficulties in handling workitems, such as user stories, within the context of scaled agile methodologies. On the other hand, High Level Requirements Management Largely Missing in Agile may be correlated with Regulatory Compliance as both barriers indicate challenges in

managing high-level aspects of projects, such as requirements and compliance, when implementing scaled agile methodologies.

Figure 14 - Product and Process Issues Barriers Mapping
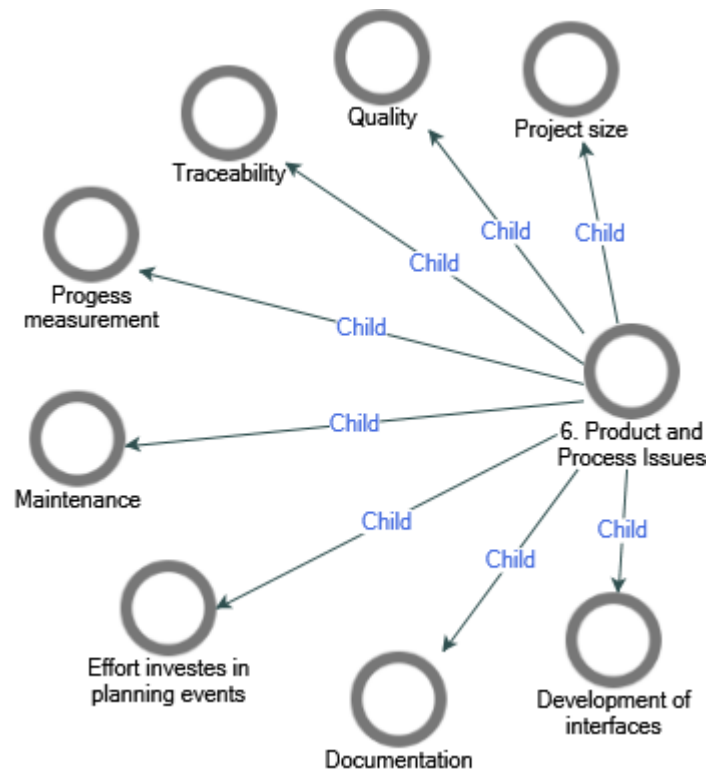
Source: Created by the author based on NVivo results

For Product and Process Issues, none of the sub-barriers were added during interviews, they were all added during literature review.
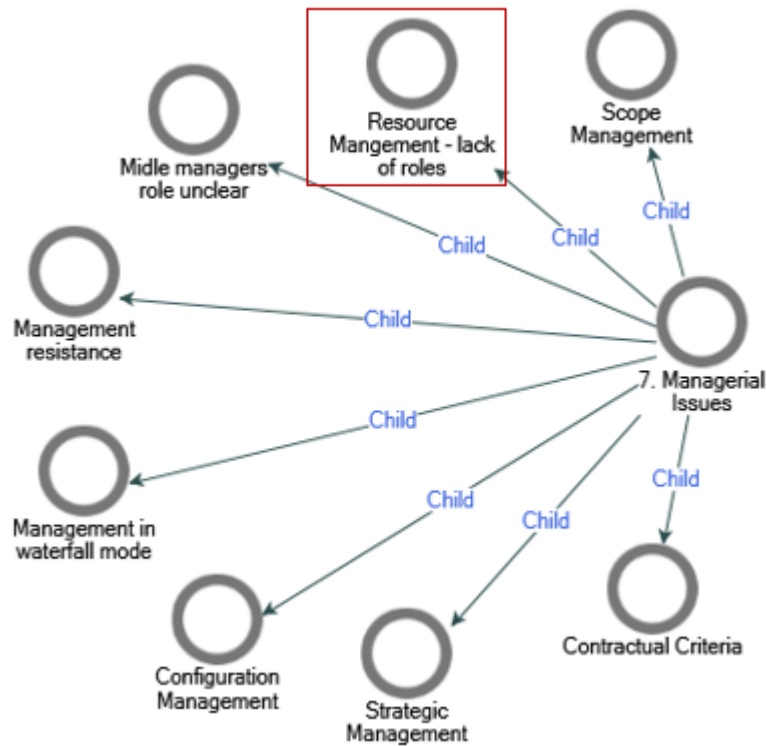
Graph 6 - Reference distribution in Product and Process Issues
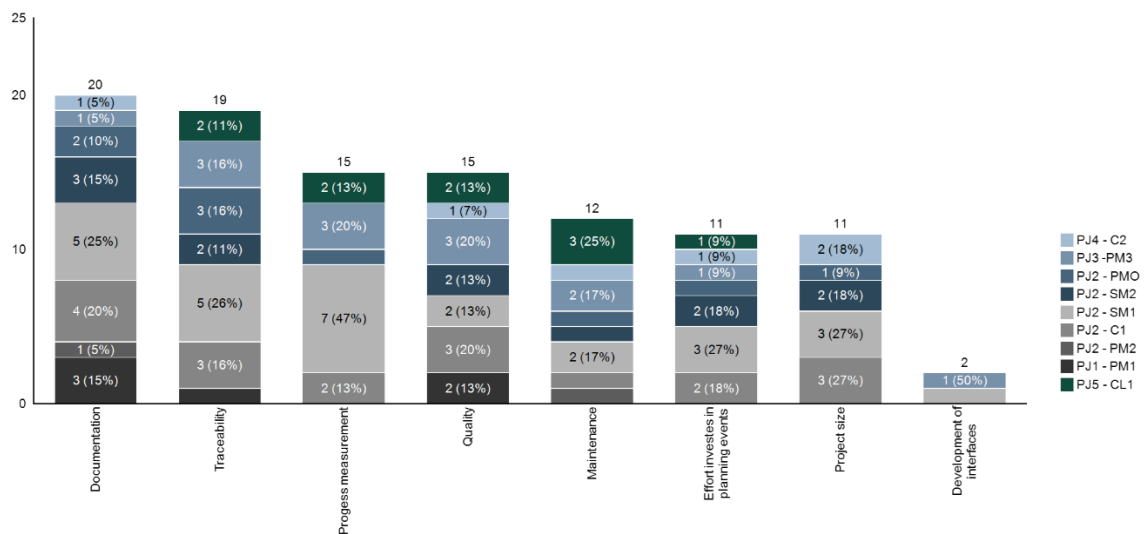
Source: Created by the author based on NVivo results

Documentation is a prevalent barrier and most frequency barrier, with interviewee 4 (PJ2 - SM1) experiencing the highest number of references (5). This suggests that organizations may struggle with maintaining proper documentation when implementing scaled agile methodologies. Traceability follows documentation in the reference frequency ranking. Development of interfaces is the less common barrier, with interviewees 4 (PJ2 - SM1) and 7 (PJ3 - PM3) experiencing only one reference each.

Exploring the co-occurrence between the barriers, documentation may be correlated with traceability as both barriers involve challenges in maintaining proper records and tracking within the context of scaled agile methodologies; on the other hand, progress measurement may be correlated with quality as both barriers involve challenges in managing various aspects of project quality within the context of scaled agile methodologies.

Figure 15 - Managerial Issues Barrier Mapping

Source: Created by the author based on NVivo results

For Managerial Issues, the only barrier added after doing the interviews was Resource Management – lack of roles. This barrier appeared for the first time in the third interview evolving the C1. Looking at the literature, it was possible to identify its relevance. The distribution between the barriers can be found in the Graph 7.

Graph 7 - Reference distribution in Managerial Issues
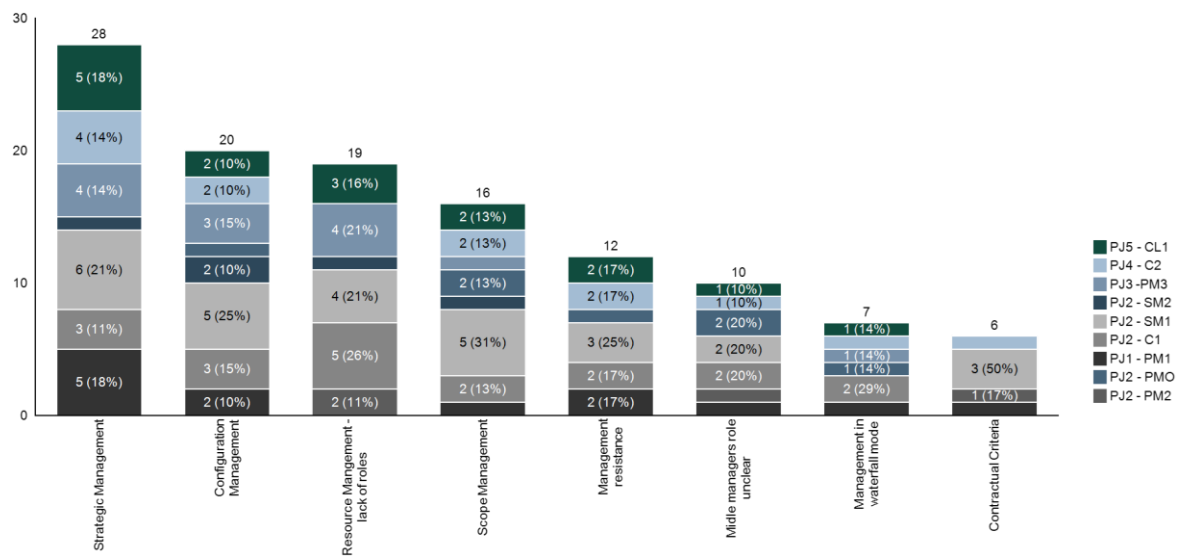
Source: Created by the author based on NVivo results

Strategic Management is a prevalent barrier, with interviewee 4 (PJ2 - SM1) experiencing the highest number of references (6). This suggests that organizations may face challenges in aligning their strategic management with the implementation of scaled agile methodologies. Configuration management follows Strategic Management in the ranking of frequency.

The co-occurrence to be tested in this barrier category can be: management in waterfall mode may be correlated with Management resistance although as both barriers indicate challenges in transitioning from traditional management approaches to agile methodologies and overcoming resistance from management.

4.3 Barriers Distribution Analysis and Prioritization

This subchapter will provide a distribution analysis about the barriers aiming to prioritize the barriers that are more relevant in the study.

Using the Matrix Coding Query tool from N-Vivo we can see that team related issues is one of the most important barrier type when the subject is the project impact. Considering all the interviews, this barrier were considered a problem 91 times, which corresponds to 25% of all the references. Following that first barrier type, we have the method application barriers and managerial issues representing 17% and 15% of the references. The Graph 8 shows in a descending order how the references coded are distributed between the barriers high level categories and also between the interviews. From the analysis made in the Graph 8, we can see that Team Related Issues, Method Application Barriers, Managerial Issues, Product and Process Issues and Culture Issues barriers references represent 83% of all the references.

Equation 1 - Prioritization of the barriers

$\% \; of \; Team \; Related \; Issues, Method \; Application \; Barriers, Managerial \; Issues,$
$Product \; and \; Process \; Issues \; and \; Culture \; Issues \; barriers = \frac{297}{359} =$
$83\% \; of \; all \; references$

Source: Calculated by the author

**Graph 8 - Quantity of references per barrierr type and project**
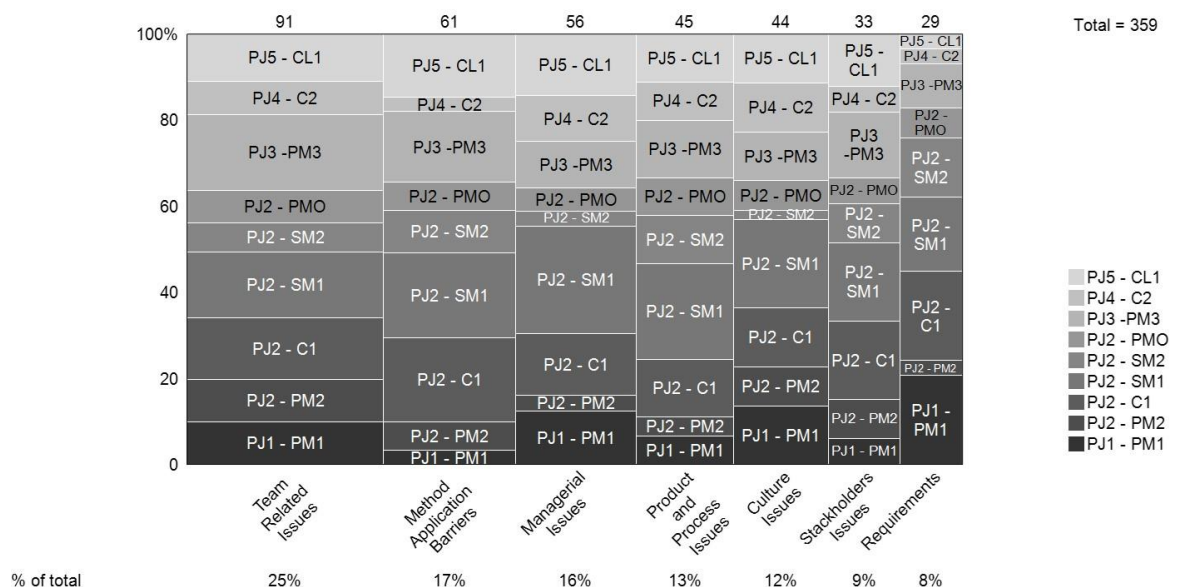
Source: Created by the author based on NVivo results

In order to place a greater emphasis on identifying the root causes of each type of barrier, the most referenced barriers (containing 83% of all the references) will be studied deeply in their subcategories in the next chapters following the 80-20 rule or Pareto Principle.

Regarding the sub-barriers, their frequency was also studied to identify what are the most frequency sub-barriers. All the blue segments in the Graph 9 represents the 80% of the total number of references, that means that for every sub-barriers that comes before People Overload should be prioritized in the 80-20 rule.

The 80-20 rule suggests that in many situations, a small number of factors or causes have a significant influence on the results, while the majority of factors have a relatively minor impact. This principle is frequently applied in areas such as business management, sales, and productivity to identify key drivers of success and prioritize resources and efforts.

Graph 9 - Sub Barriers Reference distribution
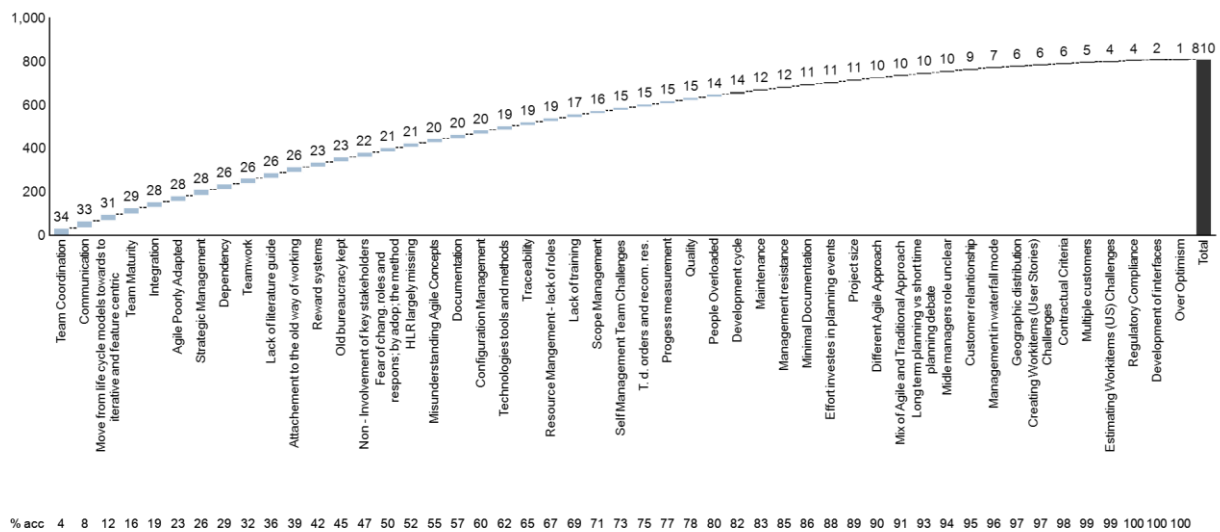
Source: Created by the author based on NVivo results

As the prioritization was made in the high level view on Graph 8, the Graph 9 is used only for information on the low level panorama.

4.4 Barriers behavior with attributes presence

This chapter aims to study how the context can interfere in the barriers behavior. For that, we used the attributes described in the Tables 4 and 5 to classify the project.

In order to calculate the average number of references for each barrier type in each file, the number of references found for each barrier type and attribute was divided by the corresponding quantity of files for that attribute. This operation has the goal to normalize the number of barriers and is represented by Equation 2. This method aims to eliminate any potential bias that may be introduced by the collected interviews, as the total number of files varies for different attribute values.

Equation 2 - Average number of references per barrier per attribute

$$Avrg\ nb.ref. = \frac{Total\ number\ of\ references_{ijk}}{Total\ number\ of\ files_{jk}}, \ \ i \rightarrow barries\ type\ i, j \rightarrow attribure, k \rightarrow attribute\ value$$

Source: Created by the author

Aiming to study how the barriers behave according to the attributes of both Families A e B, Graph 10 and 11 shows the number of references for each one of the attributes and their values.

Graph 10 – Average references per interview by attributes and values – Family A
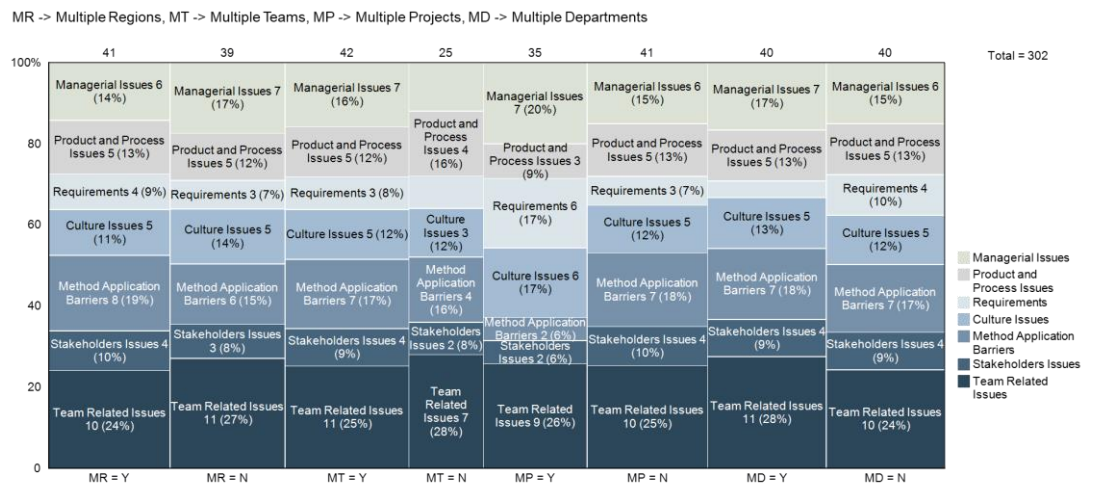
Source: Created by the author based on NVivo results

Graph 10 shows us how the general barriers references (including all types and sub-barriers) increase or decrease according to a specific attribute and its value.

Team-related issues have the highest average references across all attributes. This suggests that team-related issues are the most significant barriers to implementing scaled agile methodology regardless of the project's attributes. It is an insights aligned with what was seen in the Graph 8, the high level of team related issues is explained because this barrier is common in all the kinds of projects studied.

It is possible to see that the proportion between each barrier type inside the attributes are close, although a little distortion is found on the bar multiple department equals to yes. Culture issues, Requirements and Managerial Issues have a bigger importance in this case than others. On the other hand, Stakeholders Issues and Product, Process Issues are not as relevant as in the others cases. Multiple departments in a project typically involve collaboration between various specialized groups with different skillsets, knowledge, and even organizational sub-cultures. This can create unique challenges in the scaled agile implementation. The involvement of multiple departments, each with their specific input and expertise can explain the extra charge of the requirements barrier in this case. This might lead to more complicated requirements that need careful coordination, prioritization, and planning, resulting in an increased emphasis on this barrier. Finally, having more levels of governance when working with multiple departments involved in a project can make it harder to ensure that different departmental goals and priorities are aligned, while still adhering to the overarching project objectives. It may pose a considerable challenge to managers overseeing the scaled agile implementation, explaining why managerial issues is more relevant in this case. On the other hand, the lower relevance of product and process issues could be attributed to the fact that each department may have its own established processes and product development expertise. As a result, these issues might be considered less significant in comparison to the challenges arising from inter-departmental collaboration and alignment.

Graph 10 also shows that the attribute Multiple Teams has a big effect in the project or company performance as the number of barriers reference was 42 when there were multiple teams and 25 when there were not multiple teams. This analysis confirms what was seen in the Graph 8, Team Related Issues are the biggest obstacle in the scaled agile implementation and having multiple teams increases the challenge.

On the other hand, we can see that having multiple projects might actually help the scaled agile implementation as the number of barriers references increase in 6 units when the projects have multiple projects. The project with multiple project is the Project 1 – PM1. During his interview he explained that the teams were well trained

and monitored, they have a scaled agile program with trained coaches, which can be relevant to have less barrier effects as the Graph 10 shows.

Having multiple projects can lead to the establishment of a dedicated Agile Center of Excellence or similar structure within the organization. This center can focus on promoting agile practices, coaching, and mentoring teams across various projects. The existence of such a centralized support system can enhance the implementation of scaled agile methodologies, potentially reducing the impact of various barriers.

The barriers did not show a big sensitivity with multiple departments or multiple region. This is aligned with the results we explored in the chapter Barriers Mapping, Graph 1 where it is possible to see that geographic distribution is not a prevalent barrier. Organizations that work with multiple departments may have developed strong internal communication channels and an inclusive company culture. Such factors could help mitigate any department-specific barriers that might arise during scaled agile implementation, resulting in a relatively stable barrier distribution between the attribute values "Yes" and "No". This hypothesis can be confirmed by looking at the size of Projects 3, 4 and 5 (they all have multiple departments – Table 4) and their size is B, C, B respectively.

Graph 11 - Average references per interview by attributes and values – Family B
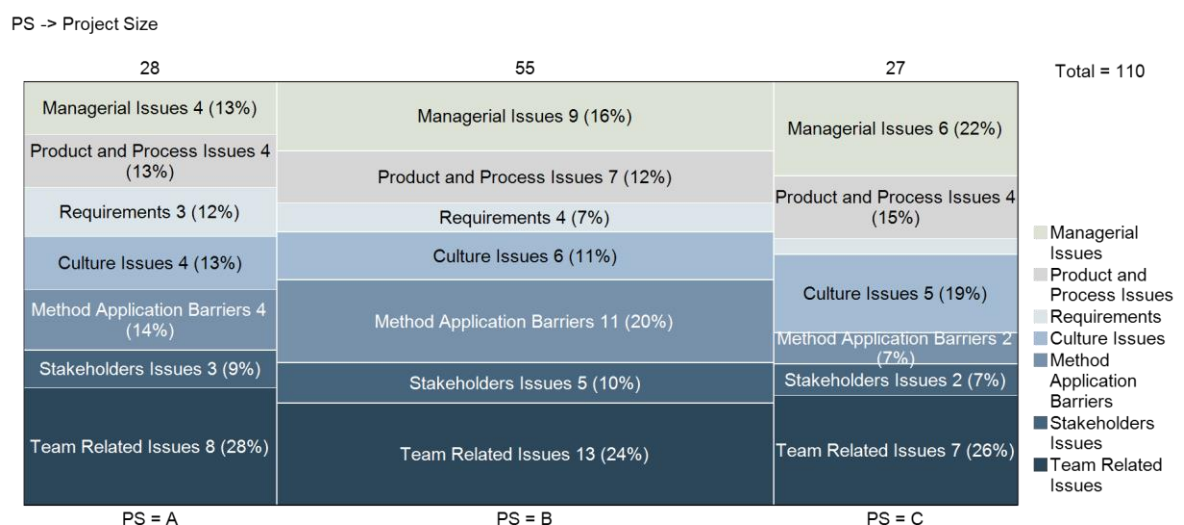
Source: Created by the author based on NVivo results

From Graph 11, it is possible to conclude that projects with range size B actually are more sensitive (almost two times) to the barriers than others size. The hypothesis for this behavior are: hypothesis 1 (projects with size B might be more susceptible to barriers due to the limited availability of resources compared to smaller projects (size A) or large projects (size C) that might have enough resources to handle the challenges. The intermediate scale of size B projects could limit the ability to allocate resources efficiently, leading to increased sensitivity to barriers); hypothesis 2 (size B projects might have an intermediate hierarchy and communication structure compared to the more flexible structure in size A projects and the more established communication channels in larger size C projects. This could make size B projects more susceptible to barriers such as method application, stakeholder issues, and managerial issues since the communication pathways might not be as well-established or clear); hypothesis 3 (size B projects may experience more challenges in implementing and scaling agile methodology due to their unique project scale. As these projects fall between the sizes of small and large projects, they may face additional barriers in adapting agile practices to suit their specific needs).

To test the hypothesis, the idea was to analyze how teams size A, B and C behaves according to the sub-barriers: people overloaded, team coordination, lack of training, reward systems, team maturity, teamwork, communication, integration, agile Poorly Adapted, lack of literature guide, attachment to the old way of working, fear of changing roles and responsibilities, move from life cycle models to iterative and feature centric, traceability, configuration management, resource management – lack of roles and strategic management. These sub-barriers addresses all the 3 hypothesis.

Graph 12 - Distribution according to selected sub-brriers to test hyphotesis
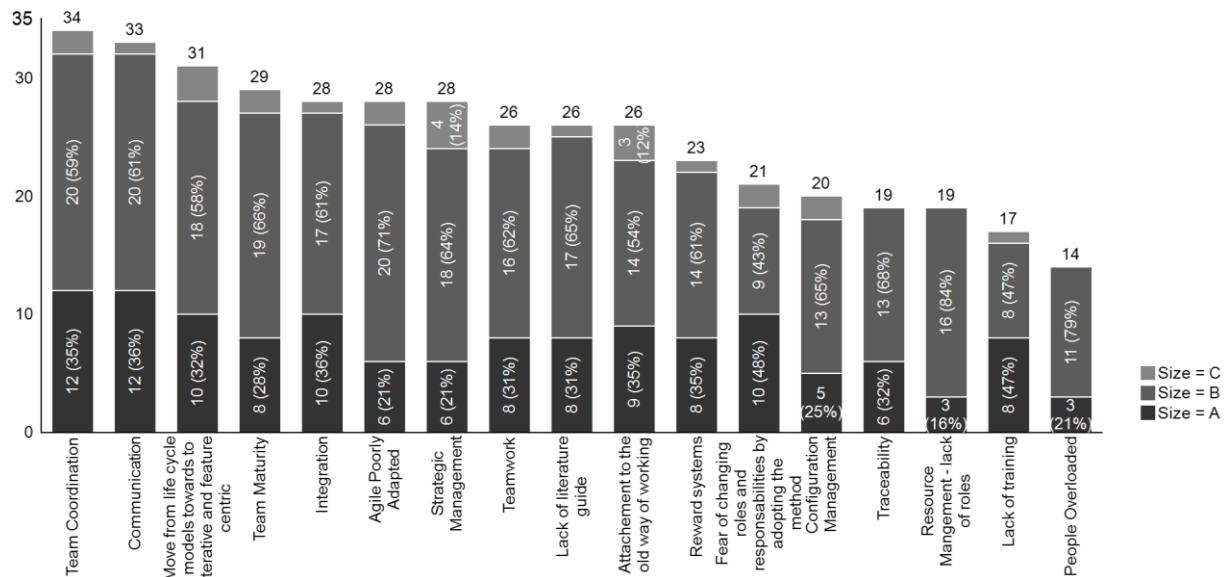
Source: Created by the author based on NVivo results

According to the Graph 12, agile poorly adapted (71%), resource management – lack of roles (84%), people overloaded (79%) are the sub-barriers that size B has the major percentage comparing to the others. These makes the hypothesis one and three the strongest ones. On the other hand, we can see that every time size B had a more relevant influence of the barriers than the rest, which leads to the conclusion that all the hypothesis could actually be validated.

It is also curious that the proportion of the barriers are slighted different on projects size C. Managerial issues, product and process issues and culture issues gained more relevance when the number of people increased which is completed aligned with the analysis built in Graph 10. The hypothesis for this behavior are also described above within the analysis of Graph 10.

4.5 Co – Ocurrence

It is also necessary to study the co-occurrence between the barriers. For that, NVivo has a resource called queries which can be explore to show the references (interviews parts) coded for more than one barrier. It is possible to code a query that explore the files you want and finds only the parts which were code with the barriers type you want.

The Table 7 shows the number of references encountered in both barriers type depending on the matrix position. For example, we have 24 references that is related to both Team Related Issues (TRI) and Stakeholders (SI). The stronger co-occurrence is between Team Related Issues (TRI) and Method Application Barriers (MAB) with 40 references coded for both barriers type, followed by the Product and Process Issues and Managerial Issues.

Table 7 - Co-occurrence between two barriers

Barriers	TRI	SI	MAB	CI	R	PPI	MI
TRI	-	24	40	28	23	30	32
SI	-	-	21	14	6	15	17
MAB	-	-	-	22	15	28	26
CI	-	-	-	-	11	15	20
R	-	-	-	-	-	16	12
PPI	-	-	-	-	-	-	19
MI	-	-	-	-	-	-	-

Source: Created by the author based on NVivo results

Scaled agile methodology relies heavily on teamwork and collaboration across different teams, functions, and departments. It requires a high level of coordination, communication, and alignment among team members to ensure the successful execution of projects.

Table 5 shows that Team Related Issues and Method Application Barrier are often interrelated in scaled agile implementation. Addressing both sets of barriers is critical to ensure the success of scaled agile projects. Teams need to be properly trained on the methodology, aligned around its principles, and have effective communication and collaboration to work together effectively. When teams face Method Application Barriers, they may struggle to understand and apply the methodology effectively,

which can result in confusion and frustration. This, in turn, can exacerbate Team Related Issues, as team members may struggle to work together due to a lack of clarity and direction.

Inside the barriers types showed in Table 7, there are several sub-barriers that can be correlated themselves. As the number of sub-barriers is too big and not all the co-occurrences is interesting, this chapter will use the prioritization assisted by the Graph 8, that means that only the barriers type Team Related Issues, Method Application Barriers, Managerial Issues, Product and Process Issues and Culture Issues will be deeply analyzed.

The hypothesis created in the sub-chapter Barriers Mapping will be used to explore the sub-barriers inside those items. From the Graphs 1,3,4,6 and 7 it is possible to create the Table 8 which resumes the hypothesis created earlier in this document. In this chapter N-Vivo will be used to test them.

Table 8 – Sub- barriers co-occurrence s hyphotesis to be tested

Barrier Category	*Hypothesis*
A. **Team Related Issues (TRI)**	1. Team Maturity has co-occurrences with Integration
	2. Dependency has co-occurrences with Teamwork
B. **Method Application Barriers (MAB)**	1. Technologies tools and methods has co-occurrences with Development Cycle
	2. Agile poorly adapted has co-occurrences with misunderstanding concepts
C. **Culture Issues (CI)**	1. Attachment to the old way of working has co – occurrences with Old bureaucracy kept
	2. Fear of changing roles and responsibilities by adopting the method has co – occurrences with Move from life cycle models towards to iterative and feature centric
D. **Product and Process Issues (PPI)**	1. Documentation has co-occurrences with Traceability
	2. Progress Measurement has co-occurrences with Quality

E. **Managerial Issues (MI)**	1.	Management in Waterfall has co-occurrences with Management Resistance

Source: Created by the author based on NVivo results

The Table 9 resumes the analysis of the co-occurrences based on N-Vivo queries results. The column # Coded References represents the number of coded references for each sub-barriers, the column #Co-Occurences show how many of the references in the column before were coded for both sub-barriers. The criteria used to confirmed the hypothesis was: if the column % Co-occurences/Coded references was 60% or bigger that means that the hypothesis presented in the Table 8 is confirmed.

Table 9 - Results Resume of Co-Occurrences analysis

Hypothesis	Sub-barriers	# Coded References	# Co-Occurences	% Co-occurences/ Coded references	Hyphotesis Confirmed?
A.1	Team Maturity	29	11	38%	✘
	Integration	28		39%	✘
A.2	Dependency	26	10	38%	✘
	Teamwork	26		38%	✘
B.1	Technologies tools and methods	19	1	5%	✘
	Development Cycle	14		7%	✘
B.2	Agile poorly adapted	28	13	46%	✘
	Misunderstanding concepts	20		65%	✔
C.1	Attachment to the old way of working	26	19	73%	✔
	Old bureaucracy kept	23		83%	✔
C.2	Fear of changing roles and responsibilities by adopting the method	21	12	57%	✘
	Move from life cycle models towards to iterative and feature centric	31		39%	✘
D.1	Documentation	20	11	55%	✘
	Traceability	19		58%	✘
D.2	Progress Measurement	15	3	20%	✘
	Quality	15		20%	✘
E.1	Management in Waterfall	7	5	71%	✔
	Management Resistance	12		42%	✘

Source: Created by the author based on NVivo results

Only hypothesis B.2, C.1 and E.1 were confirmed in some level. For hypothesis B.2 it is possible to say that most of the time the projects experimented misunderstanding concepts the agile was also poorly adapted. Although, Table 9 shows that most of time agile poorly adapted was an issue it was not necessarily linked with misunderstanding concepts.

Secondly, hypothesis C.1 shows us that attachment to the old way of working is linked with old bureaucracy kept in both directions. Most of the times the interviews expressed a problem with attachment to the old way of working they also noticed the old bureaucracy kept and the contrary is also true. It's worth to highlight that keeping the old bureaucracy probably leads to the attachment to the old way of working, once we see a bigger percentage (83%) in this sub-barrier.

In conclusion, hypothesis E.1 shows that management using a waterfall approach often leads to resistance in implementing scaled agile. However, this resistance can also occur when the management is not operating in waterfall mode. Therefore, although the waterfall approach can be a significant cause of management resistance, it is not the only factor contributing to this issue.

5 CONCLUSION

This chapter aims to devise a framework based on the collected outputs throughout this study. The idea is to guide future scaled agile methodology projects in a way that minimizes the impact of the main barriers. Based on the conducted interviews, a step-by-step approach was proposed, grounded on five key parameters that should serve as the foundation for implementing a scaled agile methodology.

5.1 Discussion

The analyzed projects demonstrated that by achieving these steps, a higher success rate can be obtained in the application of a scaled agile methodology. During the interviews, it was observed that more mature projects, or those with greater support from coaches and agile methodology experts, tended to focus more on managerial or procedural barriers rather than on initial barriers such as communication, team integration, and coordination. This behavior can be seen both in the interview descriptions and in Table 10, where projects represented in pink exhibit more mature behaviors, with a higher percentage of managerial issues, while projects shown in blue illustrate initial behaviors and barriers mainly related to team adaptation. This demonstrate a temporal logic to fully apply scaled agile methodology and it show how barriers type evolves inside this logic.

Table 10 - % of barrier type in each project

	PJ1 - PM1	PJ2 - PM2	PJ2 - C1	PJ2 - SM1	PJ2 - SM2	PJ2 - PMO	PJ3 -PM3	PJ4 - C2	PJ5 - CL1
Team Related Issues	10%	10%	14%	15%	7%	8%	18%	8%	11%
Stackholders Issues	6%	9%	18%	18%	9%	6%	15%	6%	12%
Method Application Barriers	3%	7%	20%	20%	10%	7%	16%	3%	15%
Culture Issues	14%	9%	14%	20%	2%	7%	11%	11%	11%
Requirements	21%	3%	21%	17%	14%	7%	10%	3%	3%
Product and Process Issues	7%	4%	13%	22%	11%	9%	13%	9%	11%
Managerial Issues	13%	4%	14%	25%	4%	5%	11%	11%	14%

Source: Created by the author based on NVivo results

In this way, based on the inputs collected from both the literature review and the interviews, the framework shown in Figure 16 was created. This illustrates the

perceived success pillars for implementing a scaled agile methodology. The implementation and stabilization logic of these pillars operates from the left to the right side, aiming to mitigate the effects of initial barriers first and eventually address secondary barriers that gain more importance as the primary ones cease to be the main issue.

The framework presented in Figure 16 and the following discussion emerged from literature review and interview's content analysis. Merging the context of the interviews with the most highlighted barriers it was possible to create the framework in Figure 16, which represents a cycle of challenges. It is also possible to see those problems in the interviews descriptions in the subchapter 4.1.

In the early stages of a project, or during the scaling of agile implementation as illustrated by the blue projects in Table 10, numerous team aspects (Figure 17) and agile implementation issues (Figure 18) affect the potential of scaled agile organizations. As internal organization improves and teams gain better understanding and integration with one another, stakeholder issues begin to emerge as more critical factors. Progression through the framework sees a simultaneous increase in the visibility of stakeholders (Figure 19) and system issues (Figure 20). This occurrence is primarily due to teams becoming more efficient and coordinated, subsequently shifting their focus to external problems (stakeholders) and ways to streamline their work (technology and automation). Ultimately, management problems (Figure 21) are identified as greater obstacles in more mature teams. This is attributed to teams recognizing how to grow and function independently; however, management may pose a barrier if they resist risk-taking or additional resource allocation (cost), for instance.

Figure 16 - Framework to implement Scaled Agile Methodology

Source: Created by the author

An in-depth analysis of each main framework pillars was performed considering main pains, aggravating factors and potential solutions, (see Figures 17, 18, 19, 20, 21).

Figure 17 - Content analysis for Team Aspects

Pain Points	Aggravating Factors	Possible Solutions
Team Aspects • Inconsistency or misalignment in their approaches or best practices • Coordination • Difficulty in tracking progress and identify bottlenecks • Inefficient and time-consuming meetings • Ambiguous roles and responsibilities • Skills and Expertise • Collaborative work environment • Alignment of vision and goals in the micro atmosphere	• Having multiples teams • Having multiples regions • Having multiples projects • Strong Dependencies between areas • Different Methodologies between teams • Different and not standardized tools • Team with a large number of people • Cultural diferences	• Establish clear communication and shared channels promoting visibility into priorities, progress, and expectations • Encourage knowlodge sharing across teams to help align efforts • Encourage regular check-ins to maintain visibility and transparency on progress and priorities • Increase integration and open space between teams and areas • Evolve people in meetings that can possibly affect them, but never if it is something not interesting for them • Consider breaking down larger teams into smaller ones for better efficiency and communication. • More integrated planning between squads and tracking dependencies among them to address challenges related to resource allocation and communication among teams • Foster a culture of trust among team members through activities such as team-building exercises or social events that encourage relationship building across different locations.

Source: Created by the author

Figure 18 - Content analysis for Agile Implementation

Pain Points	Aggravating Factors	Possible Solutions
Agile Implementation • Resistance to change • Lack of understanding agile principles • Importance of tailoring agile practices like Kanban or Scrum to the specific needs and context of a project or team. • Inadequate training and coaching • Overloaded roles and unclear role definition, particularly in middle management, causing difficulties in handling workload and managing people • The hierarchical structure of top management becoming a barrier to fully benefiting from agile implementation, leading to bottlenecks and inadequate investment priority. • Organizational culture and structure and misunderstanding agile concepts	• Having multiple teams • Having multiple regions • Having multiple departments • Top-down decision-making	• Provide coaches or facilitators to ensure workload is distributed evenly across all positions • Streamlining tool usage can help improve coordination and communication among teams. • Provide training sessions or workshops focused on cultural awareness to help team members understand each other's perspectives • Establish processes to monitor scope changes and ensure that organizational structures adapt accordingly to prevent overloading team members. • Including regular meetings or using appropriate tools/platforms for better visibility of priorities and progress. • Well Scoping Features, clear priority definition, functional and technical solutioning should be reviewed.

Source: Created by the author

Figure 19 - Content analysis for Stakeholders

	Pain Points	Aggravating Factors	Possible Solutions
Stakeholders	• Lack of stakeholder buy-in • Insufficient stakeholder engagement • Misaligned goals and priorities • Inadequate stakeholder understanding of agile • Difficulty in managing expectations and balancing stakeholders' interests.	• Having multiple teams • Having multiple customers • Having multiple regions • Long term contracts • Over optimism stakeholders	• Encourage stakeholder understanding and autonomy support initiative • Educate stakeholders about benefits agile methodologies while allowing more significant decision-making input from experts who understand requirements well

Source: Created by the author

Figure 20 - Content analysis for Systems

	Pain Points	Aggravating Factors	Possible Solutions
Systems	• Legacy systems and technical debt • Systems integration • Inadequate tooling and automation • Scalability challenges • Data management and governance • Limited system modularity and difficulty in system testing.	• Having multiple teams using the different systems • Having multiple departments with different needs • Having multiple regions • Not having a strong and fast IT department • Not having an adaptable system with specific needs • Not having a responsible role for the system completion and update • Multiple tools are being used for project management (ADO, Power BI, Teams, Excel, emails)	• Evaluate current tools being used by different teams, select a core set of essential tools that best support Agile implementation • Completeness of the system items is necessary like effort estimates, priority, severity and related items. • Invest in continuous learning opportunities for all roles involved in implementing scaled Agile methodologies (Scrum Masters, Product Owners) to ensure they have the necessary skills and knowledge required to use the systems. • Strengthen project performance monitoring - Implementing dedicating resources to properly monitor agile metrics can improve efficiency and establish a solid foundation for continuous improvement. • Streamlining tool usage can help improve coordination and communication among teams.

Source: Created by the author

Figure 21 - Content analysis for Management

Source: Created by the author

Based on this in-depth analysis recommendations, some guidelines were proposed in the column Possible Solutions (Figures 17, 18, 19, 20, 21), which can be put into practice with the aim of optimizing the five pillars of the framework.

5.2 Contributions

The objective of this study was successfully achieved by exploring the principles and practices of implementing scaled agile methodology, as well as identifying the main problems faced and the benefits for projects operating in this methodology. In addition, best practices and recommendations were identified for companies to adopt scaled agile methodologies.

The scaled agile methodology offers numerous benefits, primarily because it allows for solutions to continually evolve based on market and customer feedback. This means that products and services can be adapted according to demand, always prioritizing the delivery of value in the shortest possible time. In a world of constant technological evolution, this ability for rapid and continuous adaptation is extremely valuable, and the agile methodology aims to promote this agility.

However, when implementing this methodology, companies face various types of barriers, such as team-related problems, method application, managerial issues, product and process issues, and cultural issues. Challenges related to stakeholders and requirements were also identified during the interviews conducted.

To address these barriers, it is essential for companies to understand their impact and prioritize which ones need to be tackled during the implementation of the scaled agile methodology. This can be done through quantitative analyses, using prioritization by barrier type or prioritization by sub-barrier, as described in the chapter of Barriers Distribution Analysis and Prioritization. This assessment will help identify which barriers have the greatest impact on the implementation projects of the scaled agile methodology, allowing companies to focus their efforts on the most critical areas.

By adopting recommended practices and effectively addressing the barriers faced, companies will be able to enjoy the numerous benefits of the scaled agile methodology, resulting in more efficient, flexible, and capable projects to face the dynamic environment of today's markets. Some of these recommended practices include establishing clear and transparent communication among team members, providing adequate training on agile methodology and its tools, encouraging collaboration between different departments, and ensuring support and commitment from top management in the implementation process.

Continuing with the study of barriers, it is important to note that the context can influence the effects caused by the barriers, for better or worse. Therefore, it is crucial to identify where your project stands within the five pillars outlined in the decision chapter. These pillars are responsible for addressing coherent actions depending on the project's current state. Addressing the five pillars will decrease the probability of encountering problems during the agile adoption in projects.

Some of the findings from the literature review and interviews correspond to the reinforcement of the five pillars defined in the discussion chapter.

Organizing an agile change must begin by aligning the organizational context to customize the agile methods and practices according to the framework, needs, culture, and obstacles to attain a successful execution. As a result, the numerous complexities to take into account when setting up the agile strategy emphasize the need for trial runs before complete adoption (Dikert, Paasivaara, & Lassenius, 2016).

Incorporating a communication plan as a risk reduction measure enables regular feedback, updates, and goal alignment with the stakeholders. Additionally, it enhances their participation and confidence by keeping them actively involved. Therefore, it is vital to designate a communication coordinator to manage this aspect of the project. Simultaneously, the presence of committed executive backing plays a significant part in addressing issues related to stakeholder communication and engagement. (WESTFALL; B, 2018)

In order to address barriers in scaled agile pertaining to systems and sources of truth, it is crucial to establish a unified and centralized information repository that serves as the single source of truth for all teams and stakeholders. This can be achieved by implementing an integrated project management and collaboration tool that consolidates documentation, requirements, user stories, and progress indicators, allowing for seamless and transparent access to up-to-date information. Moreover, fostering open communication and collaboration among teams fosters a shared understanding of objectives and practices, reducing discrepancies, and aligning efforts towards achieving the overall project goals. Regularly scheduled cross-functional meetings and workshops can also help resolve any conflicting viewpoints and maintain alignment throughout the project lifecycle. (SAHORA; K, 2018)

Furthermore, in scenarios involving larger teams, affecting cultural change often involves reorganizing the team structure, which stimulates the adoption of a new culture. As a result, dividing the team can help reduce issues associated with culture and size. In the context of Scaled Scrum, the ideal team size is around ten members, so teams with this size or bigger can experiment higher challenges related to coordination and communication. (LAYTON; C, 2017)

By considering all the points mentioned above, organizations can further bolster their likelihood of successfully implementing and maintaining scaled agile methodologies. Clear communication, stakeholder engagement, a unified information repository, continuous improvement, shared governance, and ongoing training and development are all crucial components of an effective scaled agile adoption strategy. By integrating these aspects into their overall approach, companies can derive the maximum benefits from the agile transformation, driving enhanced adaptability, efficiency, and overall project success.

5.3 Limitations

Finally, it is important to clarify that this research presents some limitations that could offer opportunities for future studies.

To better understand the impact of the barriers, they could be measured using quantitative indicators and metrics for prioritization instead of relying solely on the number of references in the research. A single barrier may appear several times, even though its actual impact might be minimal.

The interview guide could have been tailored and redefined for each interview and context, allowing for a more precise understanding of the specific challenges faced in different settings and organizations.

The analyses conducted in Chapter 4 could be expanded to encompass all the identified barriers, not just the prioritized ones. This would provide a more comprehensive understanding of the overall impact of various barriers on the implementation of scaled agile methodologies.

The number and diversity of projects included in the study could be increased, leading to a larger and more significant sample for analysis. This would enable researchers to draw more robust conclusions and provide more informed recommendations for companies looking to implement scaled agile methodologies.

Despite the limitations mentioned above, the research still suggest some insights for organizations seeking to adopt scaled agile methodologies. Future

studies, taking into account the additional aspects outlined here, could further enhance our understanding of the challenges and potential solutions associated with implementing these methodologies. This, in turn, will enable practitioners and decision-makers to make more informed choices and devise more effective strategies for their own scaled agile projects, ultimately leading to better project outcomes and overall organizational success.

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7   APPENDIX

APPENDIX A – Interview Guide

Figure 22 - Interview Guide

Interview Accenture

Context: Agile methods have mainly been utilized in relatively small-scale and simple projects and have not been sufficiently tested in the large-scale projects although researchers have reported that large-scale and complex projects also benefited from agile development methods. One solution to this issue is to create a new hybrid method. As part of my thesis, I am trying to understand the main barriers in large scale projects agile implementation and how a hybrid method can help to solve them. For this reason, I have proposed this interview to understand how hybrid approaches can help to implement agile methodology in large scale projects.

Are you currently in a project?

☐ Yes   ☐ No

What is your role in the project? (You can choose more than one option)

☐ Project Manager
☐ Team (Squad) member
☐ Project Owner
☐ Scrum Master, Coach, Facilitator
☐ Guild or Chapter member
☐ Project Management Office (PMO)

Other: _____

Do you use the Agile method in the project (s) in which you participate?

☐ Yes, only agile project management
☐ Yes, agile mixed with other PM methods (hybrid)
☐ No

If yes, what kind(s) of the project management approach did your company apply? (More than one is possible)

☐ Scrum
☐ Spotify
☐ Large Scale Scrum (LeSS)
☐ Scale Agile (SAFe)
☐ PMBOK (Project Management Body of Knowledge)
☐ IPMA (International Project Management Association)
Other: _____

Have you had any training in Agile Project Management?

☐ Yes.

What kind? _____

☐ No

In your project or your sub team, how many teams are engaged to deal with the same Agile project? How is the organization chart? Are you satisfied with their integration and communication?

☐ 1   ☐ 2-9   ☐ 10-15 ☐ >15   ☐ I don't know

How big are the agile project teams (squad) in your project?

☐ 2-5 people   ☐ 6-10 people   ☐ I don't know

☐ 10-20 people   ☐ More than 20 people

Which mechanisms of agile you adopted (rituals ...)

☐ Sprint

☐ Sprint Planning

☐ Sprint Review

☐ Releases

☐ Increment, minimum viable product (mvp)

☐ Daily Meetings

☐ Product Backlog

☐ Burndown Chart

☐ Periodical stand-ups

☐ Kanban

☐ Stories

☐ Planning pocker

☐ Epics/deliverables

Any tool in specific that you used to manage and plan your agile project? And to animate your team, in terms of collaborative situation (in meetings, design thinking etc)? And for communication?

Do you use only agile tools and methodologies or also traditional ones? Each one and at what extent?

What kind(s) of the project management (PM) approach did your company apply? (You can choose more than one: Traditional, waterfall, agile, program management, hybrid)

Do you believe you have a good panorama of your team's work?

Do you struggle to measure project performance?

For all the benefits promised for an agile organization, what are your level of satisfaction for each category?

Business Benefits

Not Satisfied   ☐ 1   ☐ 2   ☐ 3   ☐ 4   ☐ 5   *Completely Satisfied*

What would you say is included in the business benefits if any?

Benefits for Process and Product

Not Satisfied   ☐ 1   ☐ 2   ☐ 3   ☐ 4   ☐ 5   *Completely Satisfied*

What would you say is included in the benefits for process and product if any?

Benefits for the team

Not Satisfied   ☐ 1   ☐ 2   ☐ 3   ☐ 4   ☐ 5   *Completely Satisfied*

What would you say is included in the benefits for the team if any?

In a large-scale project, can you describe what are the challenges of adopting an agile methodology?How did you tackle those challenges?

Do you think the challenges listed in the last question can be solved by implementing a hybrid approach?

Some ideas:
Planning & coordination process, Implementation process, Monitoring/follow up process, Delivery process, Managing process (requirements, validation/certification processes, traceability, etc)

Communication, Organizational aspects, Social aspects, knowledge aspects (agile method & tools), Teams aspects, Customer related aspects, technical factors (specific of the project or the organization)

If you have a hybrid approach in your project, can you list its benefits and characteristics?

Did you have more phases or iterations than agile approach?

How do you proceed with the documentation process? Do you think you have enough documentation process?

Source: Created by the author

APPENDIX B – Barriers of scale agile implementation references

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