CHALMERS
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Optimization of Portfolio Management

How to prioritize work within different departments and portfolios

Master's thesis in Quality and Operations Management & Product Development

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Abstract

In recent years, many prominent manufacturing companies have adopted Agile development methods to respond swiftly to market dynamics and customer demands. This adoption has led to the integration of Agile practices into traditional Stage-Gate processes, resulting in what is termed as a hybrid approach. However, implementing such hybrid models poses challenges, especially in the realm of Portfolio Management. This thesis delves into the Portfolio Management practices within a manufacturing company operating in the automotive industry, specifically focusing on the function Vehicle Technology. The product development within Vehicle Technology develops embedded vehicle system solutions and services based upon both in-house and sourced software and hardware components, such as electronic control units and sensors. Through a case study approach, the research aims to explore the challenges and opportunities associated with Portfolio Management in a hybrid Agile-Stage-Gate environment. The study investigates how the Case Company prioritizes epics within its portfolios, identifies primary challenges in utilizing prioritization lists, and proposes recommendations to enhance the effective utilization of such lists.

Drawing on insights from interviews with key stakeholders, the research identifies three primary challenges: inadequate implementation of Agile methodologies, lack of standardized estimation processes, and inefficient utilization of prioritization lists. Implementing Agile methodologies presents challenges, including ambiguity in adoption and resource-demand imbalances. Additionally, the absence of standardized estimation processes complicates effort and resource planning. Furthermore, inefficiencies arise from the inadequate utilization of the prioritization lists, leading to conflicts and missed opportunities. Addressing these challenges requires clarity, consistency, and optimization in Agile implementation, estimation practices, and prioritization frameworks.

In addressing these challenges, the study offers insights into potential solutions and recommendations for optimizing Portfolio Management strategies. These include enhancing clarity and consistency in Agile implementation, developing standardized estimation processes, and refining prioritization frameworks to better align with organizational goals and capabilities. By shedding light on the complexities of Portfolio Management in a hybrid Agile-Stage-Gate environment, this research contributes to a deeper understanding of how organizations can navigate the challenges of epic prioritization, resource allocation, and decision-making in business environments.

Keywords: *Project Portfolio Management, Portfolio Management, Prioritization within Portfolio Management, Agile Methodologies, Stage-Gate Organizations, Agile-Stage-Gate Methods, Agile Planning.*

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Sofia Nilsson and Emilia Palm, Gothenburg, May 2024.

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1
Introduction

This chapter begins with an overview of the contextual background related to the issue under investigation at the Case Company, followed by an exploration of the research project's objectives. Subsequently, research questions are specified to address and accomplish the research project's goals. The contextual environment of the Case Company is also described. The thesis also delineates its delimitations, followed by an outline of its structure.

1.1 Background

In a global and competitive market, managing projects effectively is necessary for organizations to maintain competitiveness. Simultaneously, the management of projects is growing more challenging in today's business environment, marked by high complexity and rapid changes (Bergmann & Karwowski, 2019). In recent years, an increasing number of prominent manufacturing companies have adopted Agile development methods for the development of new products (Cooper & Sommer. 2020). These pioneers in adoption have commonly integrated Agile methods within the stages of their conventional Stage-Gate processes. Agile development methodologies have enabled companies to respond more quickly to a changing market and customer demands. However, the introduction of the Agile method has an impact on the management of the product portfolio, giving rise to both new challenges and benefits.

The hybrid project model is a mix of practices and tools from the Agile methodology and the Stage-gate methodology (Bianchi et al., 2021). However, the hybrid approach should not be perceived as a singular method for organizations to adopt. Instead, it should be viewed as a methodology that integrates elements from two approaches in various combinations, as suggested by Bick et al. (2017). The justification lies in the acknowledgment that there is no universally applicable solution, and the methodology should instead be tailored to the specific circumstances (Bianchi, 2021). Therefore, the decision on whether to implement a more Agile-oriented approach compared to a traditional one, or vice versa, depends on the unique characteristics of the organization and its project environment.
Furthermore, managing portfolios for new-product development involves making resource investment decisions, such as determining which projects to pursue or terminate and prioritizing projects (Cooper & Summer, 2020). The goal is to maximize the portfolio's overall value, achieve an optimal mix of projects, and balance re-

source requirements with the available resources. The ultimate objective in Portfolio Management is to establish an optimal portfolio based on the most favorable risk-return opportunities within specific risk constraints. To facilitate decision-making, it is essential to quantify the level of risk associated with a particular opportunity (Brentani, 2003). However, there is limited guidance available on how to adapt Portfolio Management practices after implementing Agile within companies (Dias & Tenera, 2023). A commonly used Agile framework is the Scaled Agile Framework (SAFe) which aims to be applied universally in any organization. Further, the Scaled Agile Framework (SAFe) offers methods and structures for organization-wide Agile transformations, providing valuable insights for developing a Portfolio Management process aligned with Agile principles. The aim of integrating Agile principles is to enhance effectiveness and enable prompt response to consumer needs and expectations. However, Agile frameworks, such as SAFe, do not prescribe specific solutions, as they aim to be applicable universally across various organizations. Instead, their objective is to offer a broad approach to address key aspects of Portfolio Management, including strategic planning and alignment, optimization and prioritization, and capacity and capability management. This can pose difficulties and uncertainties when implementing Agile frameworks in Portfolio Management.

Since 2018 the Case Company, which is a manufacturing company within the automotive industry, has implemented Agile methodologies to better respond to evolving market dynamics and customer demands. Previously the Case Company has used the Stage-Gate model to manage and streamline the planning and processes within the organization. The change has influenced how the company utilizes methods and tools for planning, documentation processes, and implementing processes, including Portfolio Management. Presently, the Case Company operates under a hybrid model that combines the Agile methodology and the Stage-Gate methodology, referred to as the Agile-Stage-Gate. The transition to a hybrid model has prompted a reassessment of Portfolio Management practices to ensure that investments align with the business strategy and its objectives. Consequently, new challenges associated with Portfolio Management have arisen for the case company. The new challenges have caused misalignment and inconsistency in prioritizing epics within the Case Company's portfolio across the different hierarchical levels. Therefore, the master's thesis was created to investigate the underlying causes of the new challenges associated with Portfolio Management and explore potential actions to enhance the effectiveness of project Portfolio Management utilization and the prioritization processes.

1.2 The Case Company

The Case Company is part of a larger global group, referred to as Group X, which employs approximately 100,000 people worldwide and has its headquarters located in Gothenburg, Sweden. Group X specializes in providing transport and infrastructure solutions with a strong emphasis on sustainability. Operating in roughly 200 markets, the company faces intense competition, compelling it to meet diverse customer demands. Nevertheless, Group X consistently endeavors to establish itself as a market leader.

The Case Company operates within Group X's transport solutions division, focusing on technology and product development related to transport solutions. Its primary responsibilities include conducting technology research, leading product development initiatives, and providing support for aftermarket products. Innovation and technology therefore stand as pivotal pillars within the Case Company, evident through its extensive range of products. Despite Group X's unwavering commitment to pioneering new technologies, importance is placed on quality, with customer satisfaction and continuous improvement serving as primary objectives.

In addition, the Case Company is operating in alliances and joint ventures with different external brands and partners and offers products and services to customers in market segments around the world. Further, the Case Company is committed to collaborating with diverse stakeholders across society to pursue an improved quality of life for individuals in both urban and rural settings. The core values of the Case Company embody a steadfast dedication to leading the change toward a sustainable transport industry. Their commitment extends to ensuring our customers' success and maintaining their position at the forefront.

1.3 Purpose and Research Questions

This thesis is carried out in collaboration with a manufacturing company within the automotive industry. The purpose of the study is to investigate the Portfolio Management landscape within the function Vehicle Technology and offer insights to enhance its effectiveness. Additionally, to enhance comprehension of challenges associated with Portfolio Management, and provide valuable insights into best practices that can be shared and refined for the continual improvement of Portfolio Management processes. Furthermore, the study aims to provide recommendations for aligning and optimizing Portfolio Management strategies. To address the purpose of the thesis, the following three research questions will be examined:

- RQ1: *How is the Case Company currently working with its planning methods and tools to prioritize projects within the project portfolio?*
- RQ2: *What are the primary challenges associated with utilizing a prioritization list within the Case Company?*
- RQ3: *How can the Case Company enhance the effective utilization of its prioritization list within its project portfolio?*

1.4 Delimitations

The study will be limited to focusing on a single company to facilitate a thorough analysis of the topic. This suggests that the study's findings and recommendations will mainly apply to the specific Case Company and, to a limited extent, may have generalizability. While there is potential for some results to be generalized, it should be noted that the applicability and validity of these findings will not explicitly be

tested. Further, the recommendations provided for the Case Company will not be implemented. Another limitation of this thesis is that it does not encompass an analysis of all portfolios within Vehicle Technology. Six out of seven portfolios were chosen from the function Vehicle Technology, while three portfolios were selected from other functions within the Case Company due to their close collaboration with Vehicle Technology's portfolios. The selected portfolios from Vehicle Technology are portfolios A, B, C, D, E, and F, and the selected portfolios from the other functions are portfolios G, H, and I. Lastly, another delimitation of the study is the research period which will be limited to 5 months.

1.5 Thesis Outline

This report is divided into the following chapters: Introduction, Literature Review, Method, Organizational Context, Findings & Results, Discussion, and Conclusions. The content of each chapter is briefly described in Table 1.1.

Table 1.1: The structure of the thesis.

Chapter	**Content**
1. Introduction	The thesis begins by introducing the research area and its significance in relation to the investigation, along with providing an overview of the Case Company. Following this, the thesis outlines its objectives, research questions, and any limitations imposed on the study.
2. Literature Review	The thesis reviews prior research on the subject drawn from existing literature, along with exploring other pertinent areas essential for the analysis and conclusions. Additionally, it introduces a theoretical framework derived from the literature reviewed.
3. Method	The thesis outlines the methodology that forms the foundation of the study.
4. Organizational Context	The organizational context is described in terms of its operational practices and the outcomes associated with its approach to Portfolio Management.
5. Findings & Results	The empirical findings from the interviews are presented.
6. Discussion	Each research question is addressed and answered.
7. Conclusion	The conclusions of the thesis and recommendations to the Case Company are presented.

2
Literature review

This chapter outlines relevant literature to contextualize the study and offer guidance for addressing the research questions. Firstly, various project management methods are presented, followed by a description of Portfolio Management and its challenges. The theoretical framework integrates existing literature and demonstrates how the three areas will contribute to addressing the research questions posed in the thesis. Table 2.1 delineates the links between the research questions and the theoretical underpinnings.

Table 2.1: Research questions and associated theories

Research Question	**Theory**
RQ1: How is the Case Company currently working with its planning methods and tools to prioritize projects within the Project Portfolio?	2.1 Stage-Gate model 2.2 Agile Project Management 2.3 Agile-Stage-Gate model 2.4 Portfolio Management 2.5 Prioritizing projects within a portfolio
RQ2: What are the primary challenges associated with utilizing a prioritization list within the Case Company?	2.4 Portfolio Management 2.5 Prioritizing projects within a portfolio
RQ3: How can the Case Company enhance the effective utilization of its prioritization list within its Project Portfolio?	2.4 Portfolio Management 2.5 Prioritizing projects within a portfolio

2.1 Stage-Gate Model

Stage-Gate is a popular approach in managing the development of new products, breaking the innovation process from concept to launch into approximately five distinct stages (Cooper, 1993). Each stage is characterized by a specific purpose, a set of anticipated activities, and resulting deliverables. At the end of each stage, the project undergoes evaluation at a gate, an important decision point where a determination to proceed or stop the project is made. If the decision is to proceed, resources are allocated for the subsequent stage. This framework is designed to

mitigate risk by breaking down the product development process into a sequence of incremental steps, with decisions made at each gate based on the progress achieved. While Stage-Gate is not a project management methodology, it serves as a guiding model for the product development process at a higher level (Cooper & Sommer, 2017). According to Cooper (1993), the key stages are:

1. **Preliminary investigation:** a quick investigation and outlining of the project
2. **Detailed investigation:** an additional detailed investigation, containing project definition and justification
3. **Development:** the development and the actual design of the product;
4. **Testing and validation:** tests or trials conducted in the marketplace, lab and manufacturing to confirm and validate the proposed new product, as well as its marketing and production processes
5. **Full production and market launch:** the start of sales and marketing activities and the beginning of full production

The origin of the development process lies in a new product idea (Cooper, 1993). Therefore, a fundamental aspect of the product development system is the generation of ideas. Ideas are often conceived to capitalize on opportunities arising when technological capabilities align with market needs and anticipated demands. However, a particular technology may not be readily available or sufficiently advanced. In such cases, it typically undergoes further development, often through concept development initiatives. Subsequently, the product development activities process, including the formulation of manufacturing or operations plans, the creation of marketing launch strategies and operational plans, and the definition of test plans for the subsequent phase. Figure 2.1 illustrates the presence of decision points or gates preceding each stage. These serve as either go/kill or prioritization points. Projects held less promising are killed at these gates, and resources are reallocated to the most promising projects, which progress to the next stage. It is at these critical junctures that the Project Portfolio is assessed. This organizational practice facilitates the integration of the new product development process with the earlier described portfolio decisions (Auguso Cauchick Miguel, 2008).

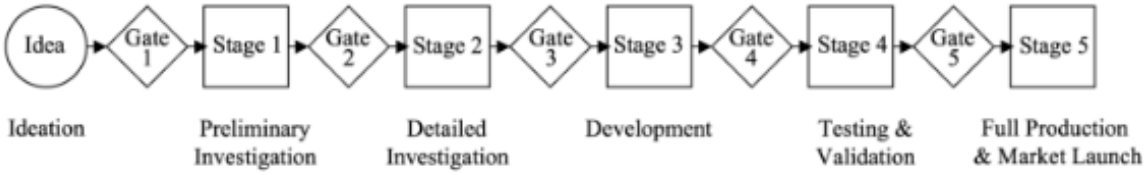

Figure 2.1: Stage-Gate model (Cooper, 1993)

A significant challenge with Stage-Gate lies in the field of portfolio metrics. Within the traditional Stage-Gate model, senior leaders typically assessed the portfolio from a plan-driven perspective. Many companies evaluate project progress and ongoing value based on meeting milestones and adhering to budgetary constraints. They often rely on tracking metrics such as traffic light indicators to assess whether a project is meeting milestones and staying within budget. If a project remains on schedule and within budget, the default decision is usually to proceed. However, simply adhering to the schedule is not a sufficient rationale for continued investment in a project; indeed, a project may deviate from the schedule for reasons that actually enhance its value (Cooper & Sommer, 2020).

Lastly, Cooper and Sommer (2018) explain that in nearly every project, crucial aspects of product definition and action plans undergo modifications as development progresses. Customers can change their minds and the market requirements change and plans must adjust accordingly. The Stage-Gate model, however, lacks the flexibility to accommodate such changes, as it rigidly locks in the product definition and development plan, leading to downstream change management challenges. Gating systems, with their linear and inflexible nature, struggle to effectively adapt to the dynamic and ever-changing markets and customer demands that drive modern product development (Cooper & Sommer, 2018).

2.2 Agile Project Management

Agile can be defined as a collection of development methodologies characterized by a flexible, iterative, and incremental process (Beck et al., 2001; Deemer et al., 2010; Nyman, 2010). The purpose of Agile methods is to facilitate adaptive planning, evolutionary delivery, a time-boxed iterative approach, and a flexible response to change (Cooper, 2016). Originating from the software sector, Agile project management (APM) has transitioned into a widely utilized approach across various industries (Thesing et al., 2021). Špundak (2014) contends that the values are also pertinent to APM in the context of software development projects. The essence of APM is built upon the fundamental principles outlined in the Agile Manifesto, which encompasses four core values, which is defined as (Beck et al., 2001):

- Emphasizing the importance of individuals and their interactions over rigid processes and tools is a fundamental tenet of APM.

- Prioritizing functional products over extensive documentation is a cornerstone principle within APM.
- In APM, placing a premium on customer collaboration rather than focusing solely on contract negotiation is paramount.
- In APM, giving precedence to adapting to change rather than rigidly adhering to a predefined plan is of utmost importance.

APM is distinguished by its heightened customer collaboration and capacity to adapt to changes. Furthermore, Bergmann and Karwowski (2019) underscore the method's iterative approach, facilitated by numerous planning and development cycles. These cycles enable continual adjustments to evolving requirements and data, fostering a continuous improvement process. As a result, the approach can be viewed as heavily dependent on customer feedback to steer the project's direction (Vinekar et al., 2006). According to Nerur et al. (2005), this enables APM to tackle uncertainties effectively. Nevertheless, McCormick (2012) underscores that while sufficient customer involvement is essential, it also poses a risk. Projects are more prone to deviate from their intended course when customers encounter uncertainty and are unable to clearly articulate the desired project outcome. However, it is apparent that APM is a people-centric approach to project management (Bergmann & Karwowski, 2019), and leveraging it effectively can yield numerous benefits for organizations. These advantages include reduced delivery time, heightened customer and stakeholder satisfaction, enhanced efficiency, and resource savings (Ciric et al., 2019; Salameh, 2014; Thesing et al., 2021). Furthermore, Thesing et al. (2021) underscore the benefit of early error detection in contrast to traditional methodologies.

Despite APM being hailed as a groundbreaking method, some organizations implementing APM encounter challenges. According to Ciric et al. (2019), certain organizations encounter difficulties in reaching agreements with stakeholders and effectively prioritizing essential tasks. As a result, integrating APM into organizational practices is perceived as one of the significant challenges associated with the method.

Furthermore, multiple authors concur that one contributing factor to APM implementation failures is rooted in the organizational culture (Loiro et al., 2019; Papadakis & Tsironis, 2018; Thesing et al., 2021). APM necessitates a culture that welcomes new challenges (Papadakis & Tsironis, 2018), and as noted by Noteboom et al. (2021), the adoption of the method must stem from both top-down and bottom-up initiatives. Therefore, implementing APM often demands a cultural shift, and given the challenge of altering well-established cultures—a process that is arduous and time-consuming—many organizations face difficulties in adopting APM (Boehm & Turner, 2003). Another contributing factor to the challenges associated with APM is the persistent skepticism towards the method. This skepticism can lead to a lack of support from management and an inadequate allocation of resources necessary for the successful implementation of the method (Ciric et al., 2019). According to Noteboom et al. (2021), addressing the lack of support from management is particularly critical for the success of the method.

Finally, APM appears to pose particular challenges when implemented in larger organizations (Dumitriu et al., 2019; Sommer et al., 2015). As noted by Bergmann and Karwowski (2019), this difficulty can be attributed to the inflexibility and high degree of systematization and formalization commonly observed in larger organizations. Another contributing factor, as noted by Dumitriu et al. (2019), is that larger organizations often have multiple teams concurrently pursuing projects, resulting in numerous interdependencies. Consequently, this situation can pose challenges related to misalignment and knowledge sharing between teams.

2.2.1 Agile Principles

Agile development emerged within the software development industry at the start of the 21st century (Dingsøyr & Moe, 2014). First introduced in the Agile Manifesto, Agile development prioritizes flexibility and adaptability, customer engagement throughout the development process, reduced standardization of processes and tools, heightened interaction among team members, and prioritizes functional products over extensive documentation (Cohen et al., 2004). Although Agile has been widely adopted as the preferred approach for small software development teams since the inception of the Agile Manifesto, scaling Agile practices to larger teams and organizations is often seen as more challenging. Nevertheless, driven by perceived benefits and the fast-paced nature of evolving industries, an increasing number of companies are endeavoring to implement Agile at a large scale (Dingsøyr & Moe, 2014).

2.2.2 Large Scaled Agile

Initially, Agile methodologies were crafted with small team utilization in mind (Boehm & Turner, 2005). Although implementing Agile in larger projects and companies poses greater challenges, its adoption beyond small project teams has grown due to its demonstrated benefits (Dyba & Dingsoyr, 2009). While Agile development is ideally suited for small projects, larger projects require additional coordination. One particular challenge when applying Agile in larger projects is managing inter-team coordination. In larger organizations, there are typically more dependencies between projects and teams, leading to an increased need for formal documentation, which contradicts Agile values and principles (Dikert et al., 2016). Moreover, development teams in such organizations often interact extensively with other units that may not embrace Agile practices. Large-scale Agile can be characterized as software development organizations with 50 or more people or at least six teams.

A significant obstacle for organizations striving to implement Agile at a large scale is effectively coordinating the efforts of multiple teams (Dikert et al., 2016). Although Agile enhances flexibility at the team level, not all teams may share equal responsibility. These inter-team dependencies consequently pose a significant challenge in managing Agile development on a large scale. The Agile principles advocating for

an autonomous team model can also present certain challenges. Teams must strike a balance between aligning with the broader goals of the organization and pursuing their own objectives, with many teams opting to prioritize the latter. Consequently, coordination may be impeded by teams failing to fully appreciate the larger context. Ensuring technical consistency can also prove challenging when coordinating on an inter-team level. The emphasis on autonomous teams, for example, may lead to fragile architecture, variations in coding styles, and a lack of trust between teams. Additionally, differing interpretations of Agile among teams can exacerbate these issues. In a multi-team environment lacking consistent Agile guidance, friction and fragmentation may arise. Hence, it is preferable to minimize disparities in Agile cultures across different teams.

Although implementing methodologies at a large scale presents numerous challenges (Dikert et al., 2016), many organizations are successfully doing so, thereby harnessing Agile's potential (Rigby et al., 2016). An essential factor for success is acknowledging the significance of the Product Owner's role (Dikert et al., 2016). Teams with effectively implemented Product Owners tend to function more cohesively and deliver higher-quality products. Another critical success factor is empowering teams to self-organize. Granting teams the authority to make decisions regarding work items can lead to increased productivity and morale. Furthermore, maintaining alignment within the organization, all working towards a common goal, is regarded as a key success factor for large-scale Agile. Both teams and management must be aligned to effectively coordinate Agile practices in a large-scale context.

2.2.3 Scaled Agile Framework (SAFe)

Numerous frameworks exist for scaling Agile, with one of the most widely utilized is the Scaled Agile Framework, commonly referred to as SAFe, and are illustrated in Figure 2.2 (Nilsson Tengstrand et al., 2021). Developed by Dean Leffingwell, SAFe is designed to facilitate Agile scaling within large organizations, drawing upon a blend of Lean product development and Agile principles (Scaled Agile Inc., 2023). SAFe was created to assist companies in managing Agile methodologies on a large, often organization-wide scale. It stands out as one of the most commonly employed frameworks for implementing large-scale Agile, primarily because of its comprehensive and well-defined role descriptions (Ebert & Paasivaara, 2017). The extensive and complex array of roles, artifacts, and guidelines is the primary distinguishing factor and advantage of SAFe compared to other frameworks. However, it is also frequently perceived as the main drawback. At times, SAFe is viewed as introducing additional bureaucracy to an organization and diminishing some of the Agile advantages. Moreover, there are indications that while SAFe outlines best practices, roles, and artifacts, it lacks concrete implementation strategies. This makes it challenging for companies to discern priorities and allocate effort effectively (Turetken et al., 2017). However, when tailored and adjusted to suit the specific context of an organization, SAFe can effectively facilitate a company-wide Agile implementation (Ebert & Paasivaara, 2017). Organizations that successfully implement Agile using

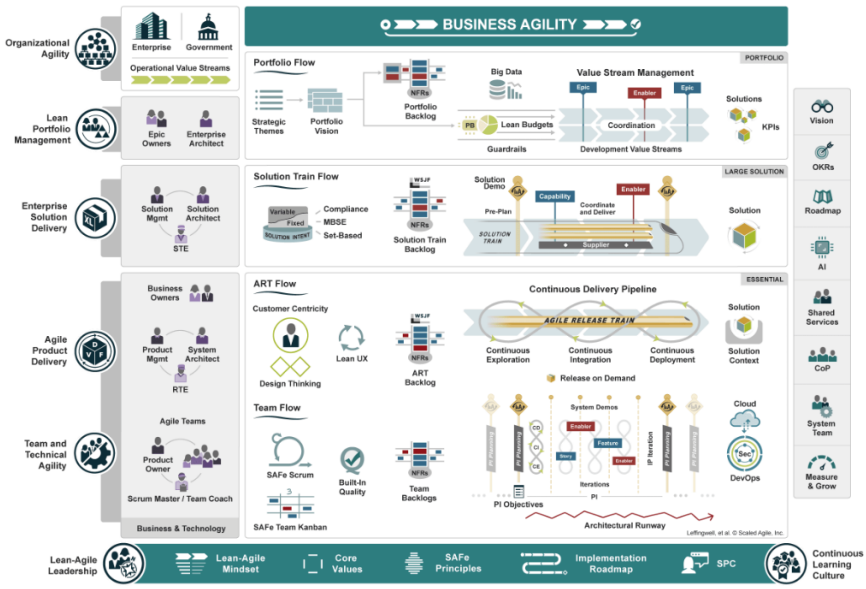

Figure 2.2: Large picture of the Full SAFe framework (Scaled Agile Inc., 2023)

SAFe often experience several benefits, including quicker time to market, enhanced productivity and quality, lower project costs, and diminished overall project risks (Turetken et al., 2017).

SAFe integrates practices from other Agile methodologies like Scrum and Extreme Programming (XP) (Turetken et al., 2017). Moreover, SAFe incorporates elements from Product Development Flow and Lean methodologies. SAFe organizes the organization into three layers, each with a distinct scope and scale (Vaidya, 2014). Agile and Lean practices are employed across all three layers (Vaidya, 2014).

2.2.3.1 Weighted Shortest Job First (WSFJ)

Work is prioritized using the Weighted Shortest Job First (WSJF) methodology to maximize economic value (Scaled Agile Inc., 2023). When sequencing features, capabilities, or work items, the cost of delay (CoD) is estimated using the WSJF technique. According to Bruns and Johnson (2019), work items that have the highest value delivery (CoD) and the shortest length are given priority over those that have a lower value and a longer length. When using SAFe, the relative cost of delay is divided by the relative job duration to estimate WSJF. To get optimal economic results in a flow-based system, priorities need to be modified regularly. Put differently, job sequencing yields optimal outcomes instead of assigning a job a priority based on its potential return on investment. SAFe uses WSJF to prioritize backlogs in order to achieve this goal. The WSJF method, which takes into account job size, risk mitigation and/or opportunity enablement, time criticality, and relative user and business value, is used to continually prioritize backlogs. Furthermore, WSJF simply and automatically disregards sunk costs, which are a cornerstone of Lean economics (Scaled Agile Inc., 2023).

2.2.3.2 Epic

In the Agile SAFe framework, an epic is defined as a archive for an substantial Solution development endeavor, encompassing significant investments made within a portfolio (Scaled Agile Inc., 2023). Given their extensive scope and influence, epics necessitate the delineation of a Minimum Viable Product (MVP) and approval by Lean Portfolio Management (LPM) before being implemented. Portfolio epics usually traverse multiple value streams and PIs, being cross-cutting in nature. SAFe suggests employing the Lean Startup build-measure-learn cycle for epics to expedite the learning and development phases while mitigating risks. During the initial phases, pre-studies are carried out to delineate the scope of an Epic. These pre-studies are generally conducted with a select group, including key strategic individuals, to establish the overarching hypothesis for the Epic.

Furthermore, a portfolio epic is overviewed by the portfolio manager (Rehkopf, n.d). The portfolio epic is then broken down at the different hierarchical levels presented as Large Solution, Agile Release Train, team, and employee as illustrated in Figure 2.3. An example of what an epic can be is for instance a new mobile app to accompany an online beauty retailer (wrike.com, n.d).

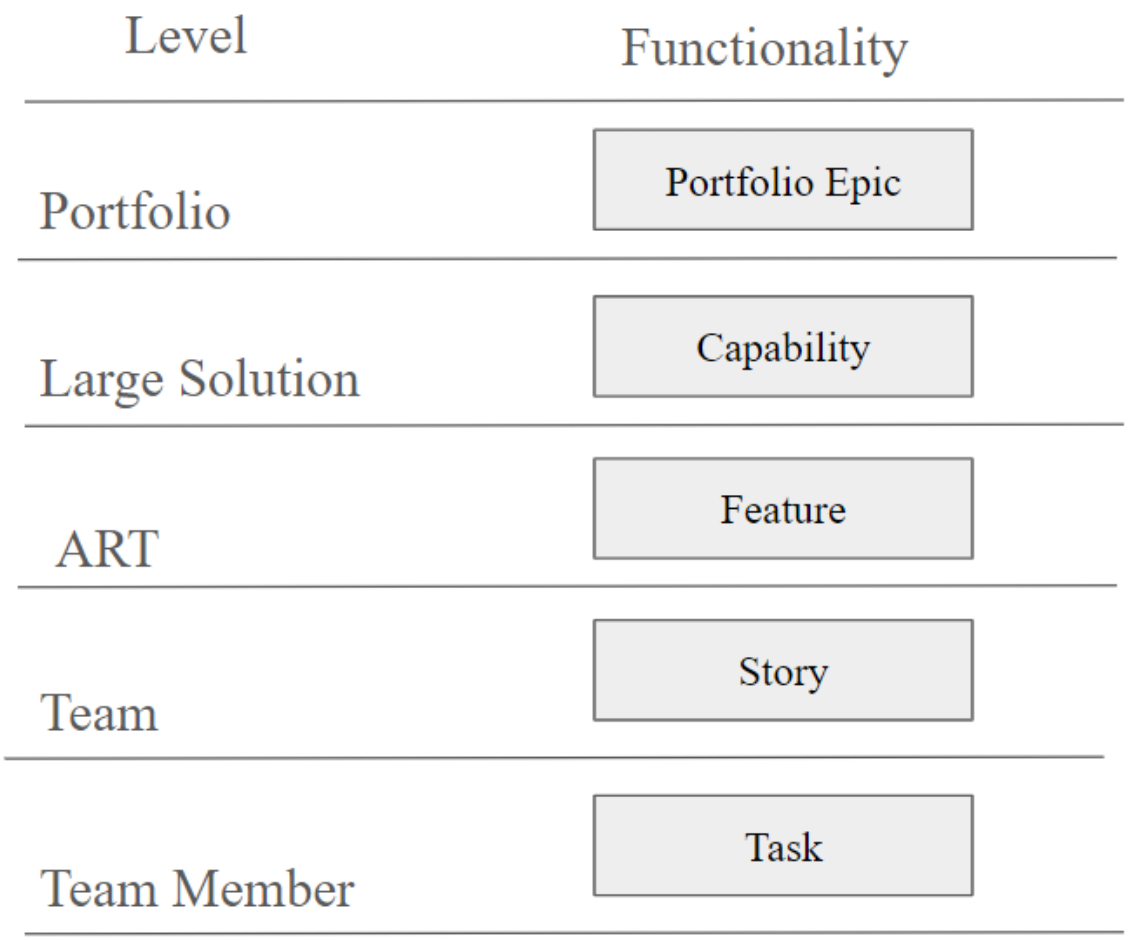

Figure 2.3: Epic breakdown

The portfolio epic is first broken down to a capability at the large solution level which typically is overseen by a Solution Manager (agility.ac, n.d). Capabilities are items at the large solution level in SAFe, an optional level within the framework. The solution manager creates capabilities for a solution train, which then moves through a solution kanban system. This includes the solution backlog, where the solution manager prioritizes the capabilities. Capabilities are too extensive to be delivered within a single PI by a single ART, so they are broken down into features. This decomposition is carried out by product and solution management, in collaboration with solution and system architects or engineers. Typically, this occurs two weeks before PI planning, allowing time for the resulting features to be prioritized and communicated before the PI planning events.

When the capability is broken down into features at the ART level, the Product Manager creates the features (agility.ac, n.d.). A feature is a service or function of the product that delivers business value and fulfills the customer's need (Quick, 2024). An example of a feature could be "in-service software update" (Scaled Agile

Inc., 2023). The features progress through a program kanban system, which includes the program backlog where the product manager prioritizes the features (agility,ac, n.d.). Features must be small enough to be delivered within a single PI by a single ART.

Further, during PI planning events, Agile teams break these features down into stories. Stories, also referred to as "user stories," are brief requirements or requests articulated from the perspective of an end user (Rehkopf, n.d.). An example of a story could be “Android users need to be connected to the Apple Store”. The product owner within the team has content authority over the stories and prioritizes them in the team backlog. All stories must be small enough to fit into a single iteration for a single Agile team. There are two categories of stories: user stories and enabler stories (agility.ac, n.d).

The story is then broken down into a task which is typically completed by a single team member (agility.ac, n.d). A task is an individual unit of work derived from a user story and should be small enough to be completed during a PI. An example of a task could be "testing if a newly developed software code runs accordingly".

Worth noting is that an epic diverges from a project in various aspects (Scaled Agile Inc., 2023). For instance, an epic lacks a definitive start and end date, featuring a variable scope, whereas a project adheres to a fixed scope and has clear start and end dates. The progression of an epic is evaluated by its outcomes against benefit hypotheses, while a project's progress is evaluated by task completion. Epics are implemented following the build, measure, and learn the cycle of the SAFe Lean Startup approach, whereas projects typically follow a phase-gated waterfall process for implementation.

2.2.3.3 Epic Owner

The Epic Owner (EO) coordinates epics through the portfolio Kanban System, working with stakeholders to define the epic, outline the MVP, and manage the epic from start to finish (Leffington, 2010). The EO integrates epics into implementation with ARTs and guides them through analysis, creating a Lean business case, and defining the MVP. EOs ensure collaboration across the enterprise and bridge planning and execution gaps, typically working on epics within their expertise.

The EO's four main responsibilities according to Scaled Agile Inc., (2023) are:

- Guiding Portfolio Epics: Leading epics through the Kanban system from identification to implementation, collaborating with stakeholders and experts.
- Creating the Lean Business Case: Developing and presenting the Lean Business Case for a go/no-go decision, ensuring optimal investment choices through collaborative discussions
- Supporting MVP Development: If approved, working with ARTs to develop the MVP using an iterative build-measure-learn cycle until the hypothesis is

proven or the investment is exhausted.

- Coordinating Epic Development: If the hypothesis is proven, collaborating with Product and Solution Management to decompose the epic into features, prioritizing backlog items, participating in PI Planning, and reporting progress

The EO's role typically continues until the ARTs have fully integrated the epic into their road-maps and no longer require the EO's expertise or coordination (Scaled Agile Inc., 2023).

2.2.3.4 Team Level

The smallest-scale level in terms of scope is characterized by a typical Agile Scrum team structure, with some modifications (Turetken et al., 2017; Vaidya, 2014). The team consists of a Scrum Master, a Product Owner, and a Development Team comprising five to nine members (Vaidya, 2014). They employ a combination of XP and Scrum practices, including User Stories, Daily Stand-Ups, Sprint Planning, and others (Turetken et al., 2017). The Product Owner collaborates with the Product Manager at the Program level to strategize and prioritize the Program Backlog, aiming to enhance the delivery of features (Vaidya, 2014). At the team level, work is organized into Sprints, aiming to produce Product Increments by the end of each Sprint. SAFe promotes synchronized Sprints across teams, which facilitates coordination among them (Vaidya, 2014).

2.2.3.5 Program Level

Operating at a broader scope and larger scale than the Team level, this level focuses on coordinating multiple teams to deliver value at the Program level (Turetken et al., 2017). Typically, one Program comprises between five and twelve Agile teams (Vaidya, 2014). At the Program level, a development initiative is broken down into features that are delivered through the Agile Release Trains (ARTs). The development is divided into planning increments (PI), typically spanning 60 to 120 days. (Turetken et al., 2017; Vaidya, 2014). Several Agile teams are assigned to an ART, focusing on releasing Product Increments within a predetermined time frame (Vaidya, 2014). Analogous to the Team level, a Program includes a Product Manager and a Release Train Engineer, serving roles similar to the Product Owner and Scrum Master, respectively (Vaidya, 2014). The Product Manager oversees the Program Backlog and coordinates with and directs various Product Owners, ensuring alignment and prioritization (Vaidya, 2014). On the other hand, the Release Train Engineer focuses on driving continuous improvement, managing risks, and facilitating execution at the Program level (Vaidya, 2014). At the Program Level, there is also a dedicated System Architect who is tasked with guiding the architecture for all teams within the Program (Vaidya, 2014).

2.2.3.6 Portfolio Level

At the highest level of the organization, with the most extensive scope, portfolios are coordinated to align with the overall strategy of the organization (Turetken et al., 2017). At the Portfolio level, a team of business executives holds responsibility for establishing the overarching vision, strategy, and investments of the entire organization (Vaidya, 2014). Through initiatives at the Portfolio level, Agile Release Trains (ARTs) within a Program are aligned along Value Streams, ensuring that value is effectively delivered to customers (Vaidya, 2014). In essence, Portfolio-level executives allocate investments in Agile Release Trains (ARTs) to align with both the company's objectives and Value Streams. These investments can target business goals, such as enhancing customer-facing initiatives to realize business benefits, or architectural goals, such as investing in technology initiatives to bolster the portfolio's future competitiveness (Vaidya, 2014).

2.3 Agile-Stage-Gate Model

As the Agile trend has gained resistance in numerous organizations, the integration of Agile methods into traditional organizational structures has presented various challenges. According to Nerur et al. (2005), *"Most organizations cannot ignore the Agile wave, but for those steeped in traditional systems development, adoption of Agile methodologies will likely pose several challenges since the two software development methodologies are grounded in opposing concepts".*

In an Agile-Stage-Gate hybrid model, Agile methodologies are integrated into each stage of the Stage-Gate model, replacing traditional planning methods such as Gantt charts, timelines, and critical path plans (Cooper, 2016). While Stage-Gate aims to manage uncertainty from the outset to prevent subsequent changes, Agile strives to adjust to uncertainty and incorporate changes throughout a larger portion of the development process (Bianchi et al., 2020). The characterization of Agile methodologies varies across literature, but Cooper and Sommer (2016) define them as employing tools such as sprints, scrums, and backlogs. Other Agile methodologies commonly utilized in large organizations include PI planning and system demos, with the latter showcasing the team's completed work during the iteration or sprint to validate progress (Sreenivasan & Kothandaraman, 2019).

Moving on, Cooper and Summer (2020) explain that the sprints are planned in real-time, responding to the outcomes of the previous sprint, resulting in a highly responsive and adaptive process. After each sprint, the project team delivers a tangible outcome—such as study results, a concept or prototype, design drawings, or a prototype—that can be demonstrated to stakeholders for validation and feedback. This feedback informs the planning of the next sprint. If the outcomes of a sprint do not meet expectations, it may prompt an interim go/kill evaluation. Each sprint concludes with a retrospective meeting, where the team assesses whether the planned tasks were completed and identifies opportunities for improvement in fu-

ture sprints. Similar to Agile practices in software projects, the project team ideally works full-time on the project and is co-located in one team room. Daily stand-up meetings, also known as scrum meetings, help keep the team aligned and facilitate communication.

The Agile-Stage-Gate has a lot of benefits and some of them can be summarized from a case study made by Karlstrom and Runeson (2005, 2006) as they studied three large high-technology firms where Stage-Gate and Agile were integrated for IT-projects, which are the following;

- Better internal team communication, leading to the team: feeling more in control, and, incidentally, to better and more visually intuitive progress metrics for management, for example, the burndown chart.
- More efficient planning, based on early customer feedback on the really important product features, avoiding inflexible, fixed plans that lead to delays on important features, and "requirements cramming" at the end of development.
- Improved customer feedback, as Agile processes, seek continuous feedback from customers, making the technical project manager a good candidate for the role of customer representative.
- Clearer resolution of documentation issues, as priorities are resolved between documentation and code.
- Improved attitudes, as developers are more motivated by the improved communication and sense of control.

Despite the benefits, there are challenges associated with implementing Agile-Stage-Gatehybrids. One of the major difficulties is managing communication and coordination between project teams, especially in larger organizations (Bick et al., 2017). In addition, there is a risk of poor knowledge management between different functions in the organization, and it can be difficult to close and hand over projects between teams (Sommer et al., 2015). Additionally, organizational culture and established ways of working can be barriers to implementing Agile methodologies into a Stage-Gate process successfully (Sommer et al., 2015).

Furthermore, one of the most difficult challenges is trying to make investment decisions when the product itself is not defined and much of the information about it is fluid. The flexibility and dynamic nature of Agile–Stage-Gate projects make them very ambiguous, with much uncertain and fluid information, rendering traditional financial evaluation tools almost useless (Cooper and Sommer, 2020).

Lastly, Cooper and Sommer (2020) mean that Agile projects come with ever-changing plans and evolving product designs. As a result, it is almost impossible to forecast the resources needed and the duration of the project; realistically estimating the likely development cost at the beginning of the process is simply not possible.

2.4 Portfolio Management

Portfolio Management is an important discipline that organizations can adopt to maximize the value derived from their project investments. Portfolio Management involves translating strategy and organizational goals into projects, programs, and operations (portfolio components); allocating resources to these components based on organizational priorities; aligning components with organizational objectives; and effectively managing and controlling them to achieve organizational goals and benefits (Enoch, 2015). This process is dynamic, requiring ongoing evaluation of the business's current projects and adjusting resource allocation to align with evolving innovation objectives. New projects must align with the portfolio's priorities, while existing projects may need to be extended, expedited, or terminated accordingly (Cooper and Sommer, 2022). Efficient Portfolio Management results in a more balanced portfolio, an increased share of high-value projects, and improved alignment between projects and resources (Cooper et al, 2004; Edgett 2013). The advantages are clear: companies equipped with systematic Portfolio Management systems typically outperform in new-product development, achieving a greater proportion of successful product launches meeting sales and profit objectives, enhanced profitability of new products, and the creation of new avenues for growth (Cooper and Sommer, 2022). Portfolio Management doesn't solve all of an organization's problems, but it's designed to help organizations accomplish more with fewer resources (Enoch, 2015).

2.4.1 Challenges with Managing a Project Portfolio

The most frequent challenge in Portfolio Management is having too many development projects ongoing at the same time (Enoch, 2015). Consequently, resources are lightly distributed across numerous projects, leaving each project under-resourced. The need for more essential resources is a primary factor causing prolonged time-to-market for projects. Moreover, it is often responsible for shortcuts in the product development process, aimed at time-saving, which later pose challenges for the project team (Cooper et al., 2004). Furthermore, another challenge with too many projects is the failure to kill bad projects within a reasonable time. A lot of projects are typically approved initially due to their low initial resource commitments and good reasons for undertaking each of them. However, projects that seem promising at the beginning often lose their attractiveness over time as new information shows up (Cooper & Sommer, 2022).

A study conducted by Haijian et al. (2022) on a high-technology company revealed that senior management seldom terminated projects. The senior team managed to halt projects only on rare occasions, typically in cases of clear failure. Whenever there was a suggestion that a project might be terminated by the senior management team, project leaders often presented "new" information highlighting promising prospects and renewed optimism. Senior management generally preferred to maintain faith in the project's success rather than acknowledge potential losses, even when the failure was evident.

However, the project keeps moving forward because of certain reasons like company politics, the idea of not wanting to waste money already spent, strong feelings of attachment, or not having a proper way to review the project; and this momentum can keep pushing the project along, even if it's not the best idea (Aberdeen Group, 2006). When too many projects are initially approved and the weaker ones are not removed over time, the outcome is unavoidable: a development pipeline that is overloaded, with more projects than the available resources can support (Cooper & Sommer, 2022).

Another common problem faced in traditional Portfolio Management is the lack of data integrity (Edgett, 2013). Not only does unreliable data result in bad decisions, but it also adds to pipeline blockage by preventing the closure of underperforming projects. In the very beginning of projects, the phase of a new-product project coming up with ideas and starting to invest heavily in development - is known to be a crucial part of the innovation process. This is where a lot of the information needed to make decisions should be gathered (Koen et al., 2014). Traditional gating processes usually include one or two early stages where the project team needs to conduct market and technical assessments to gather the necessary information before proceeding, but in reality, the front-end work is not executed as wished. A poor front-end work can result in a lack of understanding of customer needs and desires, addressing a problem that doesn't exist for customers, targeting the wrong market, and setting incorrect pricing (Lane, 2017). The front-end work is often done poorly just to obtain approval, without adding value to the portfolio (Cooper & Sommer, 2022).

2.5 Prioritization within Portfolio Management

Managing Project Portfolios entails overseeing a collection of projects, programs, and operational endeavors, all contending for limited resources, aimed at fulfilling strategic business objectives (Enoch, 2015). Enoch (2015) claims previous literature on Project Portfolio Management primarily concentrated on selecting and prioritizing projects and programs. However, it's crucial to note that merely selecting the appropriate components for the portfolio isn't sufficient. Decisions made during Portfolio Management could potentially undermine the initial efforts put into establishing the portfolio. Instead, attention should be directed toward devising strategies to ensure that appropriate decisions are made regarding the termination, acceleration, or postponement of portfolio components. This approach contributes to the portfolio's success and, ultimately, the business. Without this comprehension, decisions regarding whether to postpone, expedite, or terminate portfolio components are likely to be subpar. Further, choosing the appropriate portfolio components is only a partial step toward achieving success. However, making the right decisions at the right time throughout the management of the portfolio will further enhance its success, consequently benefiting the organization as a whole. In addition, when making decisions about the portfolio it's vital to take into account how portfolio components contribute to organizational objectives, i.e. the strategic fit. Evaluating the

contribution of portfolio components to organizational objectives relies on assessing multiple criteria. Therefore, an important cornerstone in Portfolio Management is that the portfolio manager understands both the individual and collective contributions of portfolio components to organizational objectives, as well as the probable impact of such decisions on goal attainment.

Moreover, project prioritization is essential for ensuring the execution of projects that yield the highest revenue potential for the company (El Hannach et al., 2016). However, the project prioritization process is complex, given the need to achieve multiple objectives simultaneously, conflicting objectives, and difficulties in measurement. Moreover, they are often constrained by various factors, ranging from the inaccuracies of the data utilized in the estimation cycle to uncertainties surrounding the values employed in the analysis. The information accessible to decision-makers for constructing these processes is frequently incomplete. A universally applicable formal process does not exist for all organizations. To guarantee that all chosen projects in the portfolio maximize revenue generation, the prioritization process should integrate an evaluation system that aligns with the business strategies and criteria of the organization. A formal prioritization process for transmission projects can be achieved by integrating independent scales to measure criteria evaluation.

Lastly, Project Portfolio Management doesn't claim to solve all of an organization's problems (Enoch, 2015). Nevertheless, its purpose is to empower organizations to accomplish more with fewer resources. Ensuring that organizations allocate their funds to the most appropriate project investments is now more critical than it has been in recent decades. This depends heavily on influential stakeholders playing a pivotal role in the decision-making process during Portfolio Management.

2.5.1 Portfolio Management Decision-making and Supportive Software Tools

Implementing organizational strategies primarily relies on the projects in the organization's Project Portfolios (Newton & Girardi, 2007). For a company to gain competitive advantages, its projects must be aligned with these strategies. New business applications are assuming a progressively strategic role within corporations. There's a growing demand for increasingly complex information systems that support organizational decision-making. Currently, the IT market provides numerous information systems for managing project and program portfolios (Yehorchenkova et al., 2020). However, these systems typically offer only basic functionality, such as planning, budgeting, and analysis, despite the need for automation in many other Project Portfolio Management processes. Yehorchenkova et al. (2020) reveal that many essential Project Portfolio Management functions still need to be addressed by existing information systems. This scenario leads to the majority of Project Portfolio Management functions being executed manually, resulting in a slowdown and inaccuracies within the project management processes of the portfolio, thereby diminishing the likelihood of their successful completion.

Further, in a Project Portfolio setting, common decisions involve project estimation, selection, decision valuation, risk assessment, quality assurance, resource planning, and process engineering (Auer et al., 2003). The effective management of these ever-evolving Project Portfolios is pivotal for achieving success in strategic software development. Frequently, portfolio decisions rely on informal portfolio models or experience. However, they must be instead grounded in empirical portfolio data. Decisions regarding software projects encompass both multi-project and Project Portfolio aspects. The effective management and comprehension of portfolio information are essential success factors for making rational and consistent portfolio decisions. Often a critical aspect affecting portfolio decisions is information overflow and inadequate quality of information. Research has demonstrated that organizations utilizing software tools to manage their Project Portfolios can better visualize project progress and make data-driven decisions more effortlessly.

Moreover, organizations that adopt a shared reporting approach to streamline the flow of information from the component level to the portfolio level have been shown to be more successful (Enoch, 2015). Making decisions with the appropriate tools and at the right time can significantly enhance the long-term sustainability of any organization (Kharat & Bhukya, 2018). In times of rapid change, decision-making must be prompt and trustworthy. The diverse software tools employed in Project Portfolio Management play a crucial role in shaping business practices. The authors claim the effectiveness of Project Portfolio Management can be significantly enhanced by leveraging a variety of software tools and techniques. These tools not only facilitate decision-making but also contribute to improved accuracy and efficiency. Levine (2005) outlined common features typically incorporated in such software:

- A database for proposed and active projects.
- Project selection criteria and weight factors with various parameters.
- A database for financial and resource allocation data.
- Tools for calculating potential project benefits, considering risks and costs.
- Project prioritization and ranking.
- Project selection.

The primary goal of Project Portfolio Management software is to enable organizations to efficiently manage their resources and time by selecting the most strategic projects that provide the highest business value (Daradkeh, 2019). Through Project Portfolio Management software, organizations can assess, choose, and prioritize new projects, expedite, discontinue, downgrade ongoing projects, and allocate resources in a manner that optimizes the projects' impact on the organization's overall success and productivity. The significant factors compelling organizations to implement Project Portfolio Management software stem from the diverse needs of Project Portfolio Management professionals and stakeholders, structural shifts in today's business landscape, the expanding complexity and scale of projects, and the imperative for seamless collaboration and integrated task management in real time.

In addition, the proliferation of cloud services and mobile technologies has significantly contributed to the widespread adoption and deployment of Project Portfolio Management tools across organizations of all sizes and types. When effectively implemented, Project Portfolio Management tools have the potential to deliver enhanced business benefits at a portfolio level rather than focusing solely on individual assets. They help mitigate associated risks and, crucially, ensure that projects align with the organization's strategic objectives according to its resources and capabilities. Further, organizations with mature Project Portfolio Management software utilization achieve a 35% higher rate of successful completion across their Project Portfolios while minimizing time and cost wastage.

Moreover, these types of software also commonly offer progress reporting and communication of essential project data through dashboards, along with cost and benefits tracking (Kharat & Bhukya, 2018). These features enable users to evaluate the Project Portfolio and assist them in making crucial financial and business decisions. The ease of use of the software and regular training sessions on these tools are found to be highly beneficial. However, the most important aspect when incorporating software tools is that they are suited to the organization's operational context. Dedicated Project Portfolio Management software is superior to typical Excel lists still used by many organizations for planning and monitoring their Project Portfolios. Other commonly used software tools employed in Project Portfolio Management are compiled on ClickUp.com (ClickUp, 2017).

In addition, one widely adopted tool is the Jira Portfolio, which is tailored to aid managers in streamlining their development procedures. Jira Portfolio also empowers teams to swiftly and effortlessly construct comprehensive product roadmaps, facilitating the management of crucial milestones and deliverables across the entirety of the portfolio development lifecycle. In Figure 2.4 an example of a Jira portfolio roadmap is presented illustrating the different functionalities that can be utilized in a team backlog. In the Jira portfolio roadmap, the team can generate numerous epics and stories directly (Smith, 2015). Subsequently, after finalizing the plan, they can proceed to create epics and stories in bulk, enabling the team to actively address issues in Jira. The team can also maintain a concise and easily manageable backlog on the Agile board. Typically, they only generate issues from the plan before the planning meeting for the next sprint. For any upcoming sprint, the relevant issues can be directly created from the schedule view. However, the benefits derived from software tools ,such as Jira, are contingent upon their adoption (Kumar & Subramaniam, 2013). If employees are resistant to using the software tools as recommended, the organization may not fully gain the advantages of these tools.

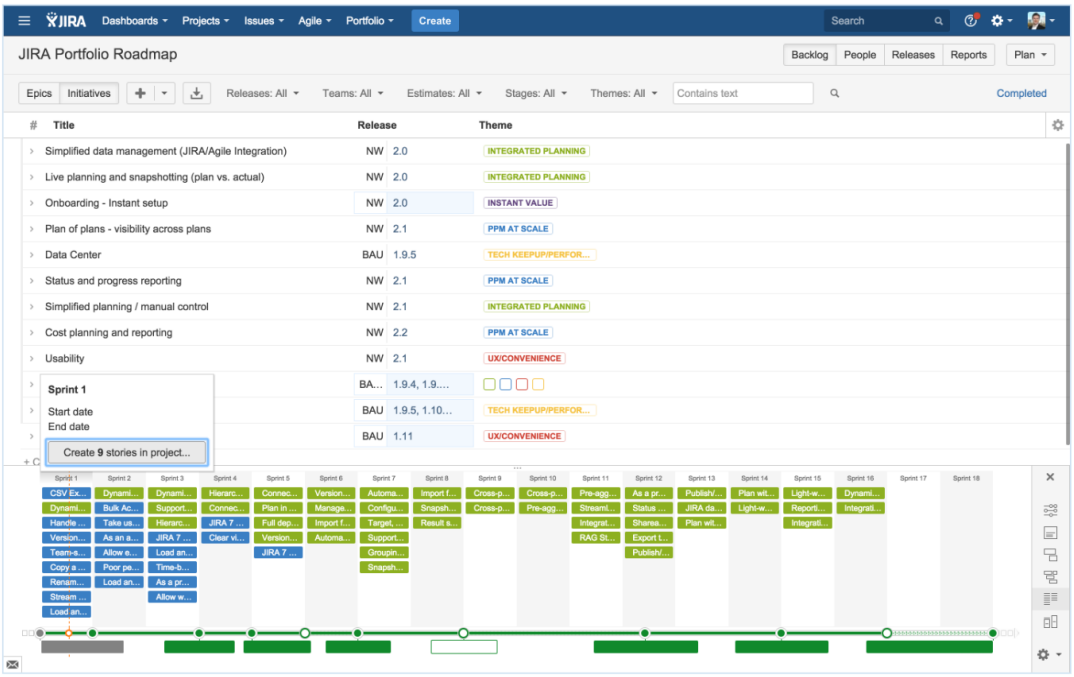

Figure 2.4: Jira Portfolio Road-map (Smith, 2015).

2.5.2 Decision-making Models to Prioritize Project within the Portfolio

According to Enoch (2015), there's a pressing need for decision-making in Project Portfolio Management, as many organizations struggle to adopt a definitive approach in determining which portfolio components to terminate, accelerate, or pause during Portfolio Management. Some opt for the simpler route, trimming budgets across all components by a predetermined percentage to meet affordability constraints. Alternatively, some organizations cancel components solely because they have yet to commence.

Further, Project Portfolio Management is described as a dynamic decision-making process, involving the continual updating and revision of a business's list of active new product projects (Kharat & Bhukya, 2018). Within this process, new projects undergo evaluation, selection, and prioritization, while existing projects may be accelerated, terminated, or reprioritized. Resources are allocated and reallocated to active projects as needed. The portfolio decision process is characterized by uncertain and evolving information, dynamic opportunities, multiple objectives and strategic considerations, interdependencies among projects, and involvement from multiple decision-makers across various locations. Numerous techniques exist for evaluating, estimating, and selecting Project Portfolios, each with its degree of recognition and complexity. However, many of these techniques remain underutilized for various reasons. Some are deemed too complex and demanding in terms of input data, while others offer inadequate treatment of risk and uncertainty. Additionally, certain techniques may overlook interrelated criteria or prove too difficult to com-

prehend and implement effectively. Finally, some techniques may not be employed within a structured and organized process. To thrive in competitive environments, firms seeking to select the most suitable projects must utilize techniques grounded in the most crucial project measures. However, these techniques are unlikely to be adopted if they are not explicit and easily understood by decision-makers.

Several methods have been proposed for selecting optimal Project Portfolios (Namazi et al., 2023). For instance, Cooper et al. (1997a,b) utilized a decision tree to devise a model capable of assessing the probability of project success. Likewise et al. (1999) introduced an evaluation approach that assigns relative values to projects according to their suitability and cost. Employing fuzzy logic, Coffin and Taylor (1996) introduced a multi-criteria decision-making method for strategically selecting R&D investments. In addition, Mitchel et al. (2022) offer insights into optimizing information utilization by evaluating projects against relevant criteria and assigning scores. While companies have long employed such scoring methods, they often overlook the importance of designing and configuring scoring tools effectively. The authors delineate a framework for crafting a scoring tool tailored to specific contexts and showcase the benefits of creating a customized scoring method that encompasses factors under opportunity and feasibility. They propose guidelines for selecting factors to enhance scoring consistency and objectivity, as well as strategies for addressing uncertainties inherent in early-stage projects.

2.5.2.1 Scoring Model

Financial methodologies encompass a range of widely employed techniques for evaluating and ranking projects. Utilizing these methodologies involves assessing the priority of projects by employing diverse financial indicators to gauge their potential impact (Cooper et al., 2001). Key metrics commonly utilized for this purpose include net present value (NPV), return on investment (ROI), and payback period. NPV seeks to assess the financial impact of an investment by discounting the future cash flows of the project. Likewise, ROI endeavors to gauge the efficiency of the investment by comparing it to the project's financial return. In contrast to NPV and ROI, the payback period evaluates the duration until the investment turns profitable. Besides financial models, alternative approaches like scorecards are also extensively employed for project prioritization. The commonly employed techniques involve scoring models, and utilizing scorecards to evaluate projects based on questions and performance estimates (Cooper, 1981). Once all questions and estimations are defined, the score is determined by assigning weights to each factor's relevance and is subsequently utilized for prioritization. Conversely to financial methods, project evaluation extends beyond financial metrics alone, incorporating other factors that can be weighted according to their relative significance (Miller, 2002). Since scoring models can encompass a broader array of attributes compared to financial metrics, they often enable the attainment of multiple goals associated with Project Portfolio Management. Consequently, they can contribute to the portfolio's equilibrium and strategic alignment (Cooper et al., 2001). However, scorecard methods are not without flaws, as they are susceptible to subjective biases and typically overlook interdependencies among projects (Jugend & Silva, 2013).

Scoring models are among the most highly recommended tools for maximizing the value of Project Portfolio Management in general (Cooper, 2006). These models comprise various main criteria and sub-criteria used for evaluating projects from different perspectives. Each project, consequently, can be distinguished as winners or losers, or the criteria should serve as predictors of future project success or failure. When strategic criteria are employed, scoring models aid in aligning the Project Portfolio with the overarching strategy. In addition to generating a ranked list, the score of each project can also be compared to a predetermined minimum score. If the total project score falls below this threshold or if it receives a notably low rating in one or more specific criteria deemed crucial for a high rating, the project may be dismissed (Cooper et al., 2001). Table 2.2 depicts the primary criteria recommended by Cooper et al. (2001) for both R&D projects and product development projects.

Table 2.2: Project evaluating and selection criteria for R&D and product development projects (Cooper et al., 2001).

Research & Development	**Product Development**
Business Strategy Fit	Strategic alignment and importance
Strategic Leverage	Product and competitive advantage
Probability of technical success	Market attractiveness
Probability of commercial success	Leverage core competencies
Reward	Technical feasibility
	Financial reward

Further, a crucial aspect of scoring models is the rating scales utilized to evaluate projects across various criteria. Typically comprising four or five steps, these scales assign numerical values to different ratings, such as 1, 2, 3, 4, and 5. However, it's generally advised to accompany these rating scales with corresponding anchored scale phrases. These phrases are intended to encapsulate what qualifies a project to receive a particular rating on a criterion. If an anchored scale phrase best describes a project compared to others within that criterion, the project is assigned the corresponding rating number associated with that phrase. The anchored scale phrases offer a standardized framework, enabling multiple participants to assess projects collectively. This approach simplifies and strengthens the process of obtaining multiple ratings consistently from individuals evaluating projects at various times. Utilizing anchored scale phrases enhances the organization of the assessment process (Cooper et al., 2001).

Table 2.3 showcases sub-criteria alongside anchored scale phrases for the main criterion "probability of technical success". Among the recommended alternatives for this main criterion is "competencies and skills," as proposed by Davis et al. (2001). The following five bullets represent suggested anchored phrases for this sub-criterion and are presented as follows:

1. This has never been done before.
2. While this may be novel to us, it's not a new concept in the broader world.
3. This is not new to us but it's not within our current skill set.
4. While it aligns well with our core competencies, we haven't yet undertaken a project of this nature.
5. We are experts and have done this before.

In addition, it's commonly advised to assign weights to both main and sub-criteria to ensure their relative importance influences project scores and final ranking lists (Cooper et al., 2001). Determining these weights can be accomplished through various methods such as the Delphi method, simple opinion polls, or by referencing relevant research findings. Brenner (1994) outlines a step-by-step procedure for developing a scoring model, recommending the use of pairwise comparisons to determine weights. However, Brenner's pairwise comparison tool employs a five-degree rating scale for conducting these comparisons. Additionally, this weighted procedure typically involves subsequent discussions to assess whether the output appears plausible or requires adjustments before finalizing the weightings.

Table 2.3: Anchored scale phrases

Criteria	**0**	**4**	**7**	**10**
Size of technical gap	Large gulf between current practice and objective; must invent new science	"Order of magnitude" change proposed	Step change short of "order of magnitude"	Incremental improvement; more engineering focus
Program complexity	Difficult to define; many hurdles	Easy to define; many hurdles	A challenge; but do-able	Straightforward
Technology skill base	technology new to the company	Some R&D experience but probably insufficient	Selectively practiced in company	Widely practiced in company
Availability of people and resources	No appropriate people/facilities; must hire/build	Acknowledged shortage in key areas	Resources are available; but in demand; must plan in advance	People/Facilities immediately available

3
Method

3.1 Research Strategy

Bell et al. (2022), describe that a research strategy accounts for the approach by which the study is conducted. The authors outline two primary strategies, qualitative and quantitative, each linked to distinct research orientations or settings of the research. The quantitative research strategy involves testing theories and is frequently associated with a deductive approach that investigates the connection between reality and theory. Qualitative research typically employs an inductive approach to theory, as noted by Bell et al. (2019). It is particularly well-suited for studies that involve the collection and analysis of words to generate novel theories (Kaplan & Maxwell,2005). This supports the choice of choosing a qualitative research strategy for the thesis. The chosen research strategy enables a comprehensive analysis of the research questions, as Bell et al. (2022) emphasized, concurrently aligning with the study's purpose. Moreover, the thesis adopts an inductive approach to theory since it is suitable for research that collects and analyzes words to generate new theories (Kaplan & Maxwell, 2005), which aligns with the intention of this thesis. Furthermore, a qualitative study is distinguished by its flexibility and iterative nature (Kaplan & Maxwell, 2005), reinforcing the justification for selecting this research strategy. This choice is particularly fitting, as the research process is more iterative than subsequent.

3.2 Research Design

A research design guides data collection and method selection, providing a structured framework (Bell et al., 2019). By considering the purpose of the study and the research questions, a single embedded case study was chosen to answer the research questions. Single-embedded case studies are valuable for exploring intricate details and context-specific factors, providing rich insights into the phenomena studied (Yin, 2018), which matches the setting/context/outline of the thesis. The goal is to gain a comprehensive and nuanced understanding of the specific case under investigation. Hence, answers to the research questions will be delivered primarily by analyzing the data from the interviews. Further, the decision to undertake a single embedded case study for this thesis is supported by Bell et al. (2019), who emphasize its suitability for conducting a comprehensive analysis of a particular subject. The study examines an automotive manufacturing company's project portfolio management. The research includes analyzing how projects within the portfolios are prioritized

and how the prioritization list is utilized, Further, identifying opportunities and challenges linked to the utilization of the prioritization list.

3.3 Data Collection

This chapter outlines the selected data collection methods for the study. The methods selected for the study encompass a literature review, information obtained from the Case Company's intranet source, and interviews. The reasoning behind these choices of methods will also be presented. The thesis initiated with a literature review to provide researchers with an understanding of the research area. Subsequently, the case study began with the collection of empirical data at the studied firm, consisting of information from the intranet source and interviews.

3.3.1 Interviews

According to Bell et al. (2022), interviews are one of the most common methods to collect empirical data in qualitative research. Interviews have many advantages over other methods of research, such as observations, as they allow for an in-depth focus on a specific topic while ensuring a diverse array of perspectives from various individuals. Interviews are also a great way to ensure that all viewpoints are taken into account when conducting a study (Bell et al. 2022). Furthermore, interviews were therefore be chosen as the primary method to collect empirical data from employees at the Case Company. In qualitative research, interviews are less rigidly structured to provide more flexibility to gain valuable insights and perspectives from the interviewees. Bell et al. (2022) explain qualitative interviews are divided into semi-structured or unstructured interviews. Semi-structured interviews are a mix of structured and unstructured interviews (George, 2022). The study will adopt a semi-structured interview approach as the method, chosen for its capacity to enhance comparability between interviews and ensure alignment with the relevant topic. The semi-structured method will be based on a predetermined interview guide (see Appendix A) where the questions were formulated to be open-ended, giving the respondents an identical theoretical framework that will be explored in different ways depending on the interviewee. This allows the interviewee to move and explore the interview in different ways.

The process of how interviewees were selected had a starting point with a predetermined list consisting of the portfolio managers. Thereafter, the study implemented purposive sampling, a non-probability sampling approach frequently employed in qualitative research (Bell et al., 2022). Maxwell (2012) describes purposive sampling as a way to make the selection of interviewees more representative and to demonstrate any potential diversity within a group. Therefore, a purposive sampling technique was well-suited for the study, as it aimed to include interviewees with various roles to ensure a diverse representation and attain a comprehensive perspective of the researched issue. The primarily purposive sampling forms used in the study were snowball sampling and theoretical sampling. The list of interviews expanded through a snowball sampling technique, which facilitated the identification

of additional interviewees based on referrals from previously interviewed individuals (Bell et al., 2022), to identify relevant participants. Theoretical sampling can be characterized as an iterative process in which data collection relies on prior sampling efforts (Bell et al., 2022). This supports the selected sampling strategy, as it corresponds with the study's aim of deliberately selecting interviewees based on their suitability. Furthermore, theoretical sampling incorporates the concept of theoretical saturation, enabling researchers to continuously evaluate the need for further data during the data collection process (Bell et al., 2022). This further underscores the selection of the sampling method, as the researchers terminated the interview process upon reaching data saturation. This indicates that subsequent interviews did not yield any new information crucial to addressing the research questions.

The interviews conducted were primarily in person at the Case Company's office. This facilitated conducting the interviews in a setting familiar to the interviewees, as recommended by Bell et al. (2022). This is important to make the interviewee feel comfortable to achieve a good result (Kothari, 2004). At the end of the interview process, 2X semistructured interviews with the duration of the interviews ranging between 45 minutes to one hour were conducted. All of the interviews were recorded, the interviewee gave consent and later transcribed as a base for the analysis. Bell et al. (2022) state recording interviews is an important procedure to achieve a more detailed and correct analysis. This enabled the researchers to review the answers again to ensure the accuracy of the information utilized in the study. In addition, recording the interview simplifies the interviewing process by allowing the interviewers to fully focus on what is being said and formulate enriching follow-up questions, instead of being distracted by taking notes (Bell et al., 2022). Furthermore, the interview language was either Swedish or English, depending on the preferred language of the interviewee.

In Table 3.1 are the conducted interviews listed with the date and the interviewees' specific roles and departments. To reduce the risk of identifying interviewees, any specific role titles have been replaced with general ones. The roles interviewed were six Portfolio Managers, three Global Technology Managers, four Program Managers, three Product Owners, one Agile Coach, one Release Train Engineer, and one Group Manager. Additionally, one of the Portfolio Managers also oversees Portfolio A; however, for confidentiality reasons, details regarding this overlap cannot be disclosed and are therefore not specified in Table 3.1.

Table 3.1: Interviewees list

Interviewee number	Role	Technology stream	Interview date
1	Portfolio Manager	B	2024-03-25
2	GTM	B	2024-03-18
3	PM	B	2024-03-26
4	Portfolio Manager	C	2024-03-05
5	GTM	C	2024-03-27
6	RTE	C	2024-03-27
7	PM	C	2024-03-26
8	PO	C	2024-03-18
9	Portfolio Manager	D	2024-02-27
10	GTM	D	2024-03-28
11	PM	D	2024-03-05
12	PO	D	2024-03-05
13	PM	E	2024-03-19
14	PO	E	2024-03-18
15	Portfolio Manager	F	2024-03-01
16	Agile Coach	F	2024-02-21
17	Portfolio Manager	G	2024-02-29
18	Portfolio Manager	H	2024-03-04
19	Group Manager	I	2024-02-27

3.3.2 Literature Review

A literature review involves gathering and evaluating existing research that has been conducted and can be pursued for various purposes (Bell et al., 2022). Further, the authors emphasize the significance of existing literature in all research endeavors. Utilizing existing literature allows researchers to assess the credibility of their work and fosters the development of new insights and knowledge. In this thesis a literature review was utilized to develop comprehension of the research domain and to aid in analyzing the collected empirical data, thereby supporting the answering of the research questions.

In qualitative research, narrative reviews are commonly employed because of their particular appropriateness for this type of inquiry (Bell et al., 2022). Given fewer constraints on review boundaries, a narrative review is recommended, allowing for greater adaptability as these boundaries can be adjusted during the process (Bell et al., 2022). Consequently, this thesis adopted a narrative review approach, wherein findings from empirical data collection guided exploration into new relevant areas in both the literature study and the case study.

To identify relevant literature, an iterative collection process was employed, starting with the review of articles suggested by the supervisor at Chalmers, who possesses expertise within the research domain. Subsequently, to gather relevant literature, the subsequent keywords were employed Project portfolio management, portfolio management, prioritization within portfolio management, agile organization, stage-gate organizations, agile-stage-gate methods, and Agile planning. The literature was obtained from Chalmers Library's databases, Google Scholar, and Scopus. Further, the literature search underwent continuous refinement and narrowing as both the literature and empirical findings provided further guidance. Moreover, to enhance the process of identifying relevant literature, snowball sampling, a method wherein researchers explore additional literature through the reference lists of already identified sources (Bell et al., 2022), was utilized.

3.3.3 Other Empirical Data

Apart from conducting literature reviews and interviews, data was gathered from internal documents from the Case Company. In addition, information was obtained through attendance at meetings to gain an understanding of how the organization facilitates the planning process for each 10-week increment. Through these documents and attending meetings, the researchers acquired insights into how the firm and its implementation of agile and traditional working methods, as well as the company's organizational structure. This background understanding was instrumental in contextualizing the case before conducting interviews.

3.4 Data Analysis

Examining qualitative data primarily involves identifying categories and concepts within the data, a task that can be challenging due to its often unstructured nature (Bell et al., 2022). While there are no universal rules for qualitative data analysis, many researchers in the qualitative field utilize coding as a method for analyzing data (Vaismoradi et al., 2016). In this thesis, coding was implemented simultaneously with data collection to assist in both data collection and analysis processes (Bell et al., 2019).

The data collected from interviews underwent a thorough evaluation to guarantee accurate documentation of every aspect of the interview. Specifically, both researchers carefully reviewed the notes and subsequently discussed them together to ensure that all details from the interview were comprehensively captured, including specific formulations. If there was any ambiguity, the audio recordings were replayed and then discussed again. Furthermore, through scrutiny of the interview notes, the researchers deepened their understanding of the data, thereby improving their capacity to interpret it (Vaismoradi et al., 2016). This is significant, as the academic contribution of qualitative research heavily relies on researchers' interpretation (Bell et al., 2019).

Furthermore, the data gathered from the interviews were analyzed using a thematic analysis. Thematic data analysis involves identifying themes that seem pertinent to the phenomenon under examination (Fereday & Muir-Cochrane, 2006). The process involves identifying themes through careful re-examination and review of the data. Thematic analysis lacks a specific technique for data analysis (Bell et al., 2022). The strategy for identifying themes involved manual open coding, a process of breaking down and structuring raw data into codes that describe relevant information. This approach allowed for organizing data from organizational documents, interview transcripts, and literature into condensed information. To construct codes and themes effectively, researchers must depend on their skills to recognize patterns among various data sets (Richards, 1999). The open coding process for the thesis followed the recommended steps and was initiated by breaking down the data into codes and then grouped into concepts suitable for the purpose of the study. The next step was to proceed with a different level of coding to establish hierarchical connections and relationships between concepts, ultimately producing categories and sub-categories (Bell et al., 2019). To mitigate the risk of incorrect identification and classification, an affinity workshop was organized. An affinity workshop is a collaborative meeting aiming to categorize and group a large set of data (Pernice, 2018). This facilitated further refinement of data into codes and aided in identifying overarching themes.

3.5 Research Quality

When examining qualitative research, Bell et al. (2022) advocate for trustworthiness as a significant criterion, the four dimensions are credibility, transferability,

dependability, and confirmability. To assess the quality of this thesis, the criterion of trustworthiness is utilized. The four dimensions are defined as follows: Credibility - pertains to the believability of the study's findings. Transferability - refers to the extent to which the findings can be extrapolated and applied in analogous contexts. Dependability - addresses the consistency and stability of the findings within the given context. Confirmability - pertains to the extent to which the researchers' values have influenced the study's outcomes.

To enhance the credibility of the thesis, several steps have been taken. In conducting the literature review, various databases were employed to gather articles from numerous journals, thereby increasing the breadth of data sources, which enhances credibility as noted by Yilmaz (2013). To further strengthen the credibility interviews at the Case Company were conducted with individuals occupying different roles and representing various areas, facilitating a comprehensive exploration of different aspects. The interviews were also recorded with the interviewee's consent to ensure all the data was captured. In addition, the researchers ensured accurate interpretation of the data by validating quotes and other information with the interviewees. This was considered particularly crucial for some quotes translated from Swedish to English.

Transferability as outlined by Bell et al. (2019), replicability of the study is highlighted as a common deficiency in single case studies. To enhance this criterion, a comprehensive description of the case was developed, following the recommendation of Bell et al. (2019). This ensures that other organizations can consider these factors when attempting to apply the findings in a different company or context. In addition, while this study was conducted within a particular social context with distinct characteristics, others can evaluate the extent to which its findings apply to different situations.

Dependability is described as the validation that the selected methodology and procedures were executed correctly (Bell et al., 2019). Dependability is also characterized as a criterion that evaluates the consistency of the process over time and its replicability by other researchers (Yilmaz, 2013). Nonetheless, the emphasis on replicability is usually less pronounced in qualitative research compared to quantitative research, as it is perceived as unattainable due to the multitude of procedures that cannot be standardized (Jenner et al., 2004). The dependability was ensured by archiving the interview recordings, and transcripts, and consistently documenting the findings. Furthermore, enhancing the replicability of the case study can be achieved by publishing the interview guide utilized (Bell et al., 2019), which is another step taken in this study to augment its quality.

Lastly, confirmability entails ensuring that while qualitative research inherently lacks complete objectivity, personal values do not influence the study (Bell et al., 2022). Thus, it is unfeasible to ensure the complete absence of personal values or inclinations (Bell et al., 2022). To strengthen the confirmability of this thesis the emerging analyses and conclusions in the thesis were collaboratively derived by both researchers.

Further, the results of the thesis were continuously reviewed by supervisors from both the Case Company and Chalmers. While these measures cannot completely eliminate the possibility of interpretations influencing the outcome of the thesis, they are considered to have mitigated the associated risks.

3.6 Ethical Considerations

Ethical aspects can arise when conducting research, and the four following ethical principles will be outlined to make sure that ethical aspects are not negotiated (Bell et al., 2019).

- Harm to participants - Concerns about preventing the physical and psychological harm
- Informed consent - Concerns about participants being fully informed before making a decision
- Invasion of privacy - Concerns about the privacy of participants
- Deception - The concern is whether the study's intention is accurately reflected in reality

Ethical considerations may surface at various stages during the process and require careful management (Brinkmann & Kvale, 2018). Firstly, harm to participants encompasses emotional, physical, and professional aspects. This can occur if the interviewee is placed in a situation that induces stress or discomfort, or if their professional role is compromised. Brinkmann and Kvale (2018) suggest that the interview should be constructed so that the communication between the researcher and the interviewer does not create feelings of anxiety, or stress or might hurt the interviewee's self-esteem.

To reduce the risk of participants being harmed, an interview guide was made. It was clearly communicated to the interviewee that they did not have to answer a certain question without reasoning, as Bell et al. (2019) recommended. Furthermore, all of the interviewees are completely anonymous and confidential.

The next principle according to Bell et al. (2019) to ensure informed consent, involves informing the participants about the research and how their answers will be used. The interviewees chose by themselves whether they would like to participate or not. To make sure that consent was gained, an invitation (or a comprehensive explanation) of why the researchers requested to conduct interviews with the Case Company with the thesis's purpose and objectives. This also made it possible for the interviewee to ask questions and made sure that the interviewee was well-informed.

The third principle related to invasion of privacy is connected to informed consent, as it guarantees comprehension of the potential implications of participating in the study (Bell et al., 2022). Additionally, it is crucial to recognize that privacy is individual and sensitive topics may differ among the participants. Nevertheless, as mentioned earlier, the participants' anonymity was maintained.

The last principle, the issue of deception, involves being dishonest about the research and what it involves (Bell et al., 2019). Issues of deception might happen when the study is badly presented or when the participants lack information or are misinformed. In this research study, there is no indication of deception as all information communicated regarding the research was honest and in compliance with reality.

3.7 Usage of AI

The AI tool, ChatGPT, serves as a multi-functional chatbot connected to the GPT-3 language model. ChatGPT is specifically used to generate text closely mirroring human expression, responding skillfully to given prompts or interactive conversations (Yan, 2023). Its capabilities extend to engaging in natural, open-ended chats on a broad spectrum of topics. This adaptability has been recognized in the context of education, where the use of artificial intelligence-based ChatGPT has been explored, highlighting its potential challenges and contributions to the development of creative writing skills (Shidiq, 2023).

Furthermore, ChatGPT utilizes natural language processing (NLP) algorithms to simulate conversations with humans (Shah, 2023). It's important to note that ChatGPT relies entirely on raw data provided during training, requiring domain-specific training data for optimal performance within a given business domain. However, instances have been observed where ChatGPT outputs faulty and vague results, particularly in scenarios involving domain-specific knowledge or context (Kung et al., 2023). Given the uncertainty in natural language, ChatGPT may face challenges in formulating phrases or sentences, potentially resulting in inaccurate responses (Zielinski et al., 2023). These nuances should be acknowledged and considered.

The Case Company maintains strict directives concerning the management of its informational assets, particularly those of a sensitive nature. Compliance with these directives ensures that no confidential data from the company will be processed through ChatGPT. Furthermore, the authors have completed mandatory training sessions aimed at strengthening the safeguarding of the company's assets. This training aims to develop awareness regarding the inherent value of information and strategies for its protection. AI and ChatGPT have only been utilized to improve the existing texts by the authors and are employed solely for this purpose. The chapters affected by the use of ChatGPT are only the literature review and method chapter. It is important to underscore that ChatGPT only was used to improve the language, aiming for a higher academic level and structuring of sentences. Therefore, ChatGPT will not be used to generate texts or to handle confidential information, as it cannot guarantee the accuracy of information.

4

Organizational context

This chapter aims to answer research question 1 by providing a thorough overview of the operational dynamics within the Case Company, including insights into its organizational structure, planning methods, and tool utilization.

4.1 Organizational Overview

The Case Company is divided into six functions, each functioning as a department with its own specific area of product development. These six functions are interconnected and collectively essential to create the final product that the Case Company manufactures. Each function is overseen by a Vice President, with overall supervision provided by a Senior Vice President.

Vehicle Technology, the function of interest, is dedicated to software development, technical solutions, and integrating services into the product. This function is composed of seven Technology Streams. Each Technology Stream handles a specific aspect of product development or architectural management, covering areas such as connectivity, interaction & infotainment, thermal management, dynamics, safety, product testing, and data & simulation. Moreover, each Technology Stream have their own portfolio manager and each portfolio consists of various epics, with the respective Technology Stream owning these epics. Nonetheless, an epic might require contributions from multiple Technology Streams.

Within each Technology Stream, there are one or more substreams known as Agile Release ARTs (ARTs). Product development occurs within these ARTs, with each ART responsible for its delivery in every PI-planning. Development activities may include coding and programming, system development, and product testing on test rigs, among others. Significant progress is made within the ARTs, ultimately resulting in a complete product ready for delivery to the paying end customer. Each ART is led by a Global Technology Manager. Moreover, the ART operates at the program level, featuring key roles such as the Release Train Engineer, System Architect, and Product Manager. These managerial roles oversee development teams at the Team Level, which consist of a Product Owner, a Scrum Master, and developers. The entire ART works collaboratively towards a common goal.

In the next section, research question 1 will be answered. An organizational overview of Vehicle Technology part of the Case Company is depicted in Figure 4.1. The spe-

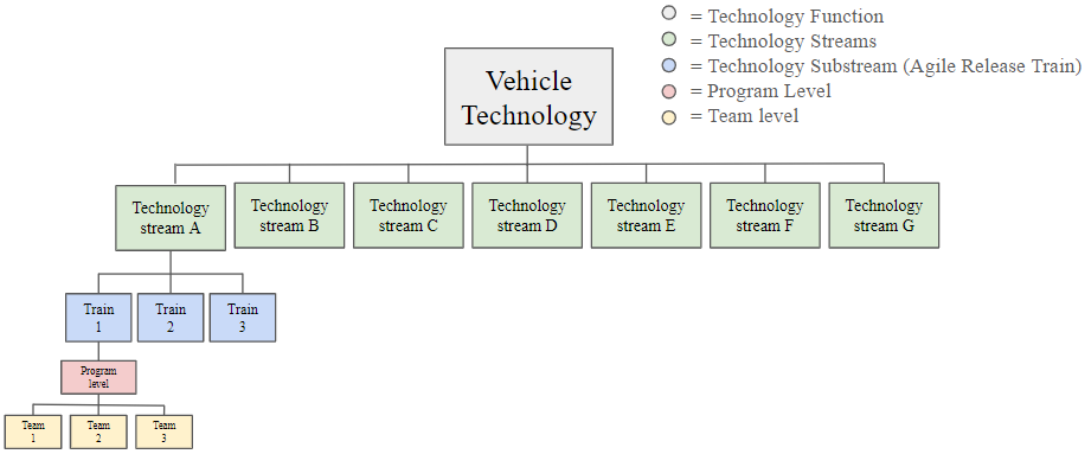

Figure 4.1: Organizational structure

cific roles relevant to this master's thesis will be further explained. A simplified overview of the roles at the different hierarchical levels is presented in Figure 4.2.

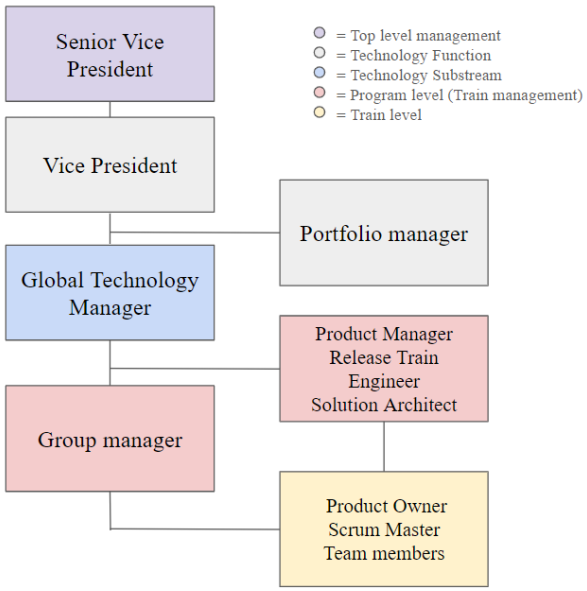

Figure 4.2: Roles within the Case Company

4.2 Which Planning Methods and Tools Does the Case Company Utilize to Make Prioritizations?

To make prioritization of epics the organization employs planning methods and tools. Some methods and tools are consistent across various hierarchical levels, while others are only used at specific hierarchical levels. Even if certain planning methods and tools are used by everyone in the organization, how they are utilized can vary. For instance, these methods and tools may serve different purposes depending on the hierarchical level at which they are employed.

The identified planning methods within the organization are Introblocks and Program Increment (PI) planning. Further, the identified tools are the Global Prioritization List, the 1-10 Levels List, and Jira. The identified planning methods and tools will be presented and further explained in this chapter.

4.2.1 Introblock

An Introblock is a specific date when new products and/or product changes are introduced into production. It involves a series of developments and modifications that are implemented simultaneously across all vehicles produced in series, marking the start of production and covering the entire vehicle as well as associated services. There are four Introblocks scheduled each year, and each Introblock depends on the completion of several epics by this specific date. Normally an Introblock is driven by a larger vehicle project, led by a Program Director and/or one or several Chief Project Managers. They establish the top-level key project milestones and

integration points. A larger vehicle project consists of several Epics of different sizes.

Further, some examples of what an Introblock could involve are business requirements such as marketing strategies of the different brands, addressing sales demands, regulatory compliance, quality enhancements, cost reductions, or supplier crises. The purpose of the Introblocks is to ensure precision and quality in deliveries involving multiple stakeholders across various business areas. This approach enables brands to introduce new product offerings and maintain high-quality services. The production date of a Introblock is non-negotiable, requiring meticulous planning and coordination among all contributors to meet deadlines.

4.2.2 PI-Planning

In 2018 the Case Company implemented Agile methodologies, such as the SAFe framework, marking a significant departure from previous Stage-Gate methods and project planning approaches. During the transition to the hybrid model, a notable addition is the introduction of Program Increment (PI) planning from the SAFe framework. A PI is a defined period in which an Agile Release ART (ART) delivers incremental value through tangible, functioning outputs. A PI is 10 weeks long and divided into 2-week sprints.

PI-Planning begins with a standard agenda that includes a presentation of the business context and vision, followed by team planning breakouts. During these breakouts, teams develop their Iteration plans and objectives for the PI. The initial agenda is facilitated by the RTE and includes all members of the ART. This event takes place during the Innovation and Planning (IP) Iteration in the first week of the PI. Conducting the event during the IP Iteration prevents disruptions to the scheduling or capacity of other iterations within the PI. PI-Planning typically spans two days, but the ART can extend this timebox to accommodate teams operating in different time zones.

After PI-planning, the ART operates in five 2-week sprints per PI. During the sprint, the GTM breaks down the epic into features and communicates these to the PM. The PM then further decomposes the features into stories and tasks. Subsequently, the POs from each team within the ART discuss how to organize the backlog and determine which tasks should be prioritized for each 2-week sprint. After each 2-week sprint, the POs evaluate the output and repeat the process until the PI is complete. The tasks undertaken during a PI are linked to the Introblocks. This schedule results in approximately five PIs between each Introblock.

While all teams within the ART follow similar approaches during PI-planning, the Case Company, which primarily operates on a project-based model, does not fully capitalize on Agile methodologies. The company's products are highly complex, requiring both embedded software and hardware implementation, which complicates the ability to work solely within an Agile framework for all the ARTs. This results in a conflict regarding which methodologies should be adopted from the hybrid model

and the SAFe framework since the hardware products necessitate continued project-based work. At the same time, software affords greater flexibility for Agile practices.

4.2.3 Global Prioritization List

Before 2018, when the Case Company exclusively utilized the Stage-Gate model, there was no necessity for formal prioritization between projects, as each project was allocated a set amount of resources. The prioritization between projects was made informal and not documented. However, with the shift to a hybrid model, resources are now involved in several epics simultaneously, necessitating formal prioritization meetings where the organization's epics are ranked in order of importance and documented. Therefore the Global Prioritization List was developed. The Global Prioritization List is an Excel list consisting of the largest epics within the Case Company and is handled manually. An example of an epic within the Case Company's portfolio could be the development of a new software platform or updating the product to meet new legal requirements. However, not all epics are included since the Global Prioritization List would be too extensive. Epics excluded from the Global Prioritization List exist within one of the Technology Stream's Jira backlogs, and some Technology Streams are additionally on their internal prioritization list.

The purpose of the Global Prioritization List is to provide an overview of the Case Company's strategic direction and facilitate prioritization among epics. In the past, under a project-based approach, projects often progressed based on the assertiveness of their project managers. The aim of the Global Prioritization List now is to objectively prioritize epics, ensuring the Case Company effectively attains its goals and business objectives. In addition, the Global Prioritization List streamlines the prioritization process by indicating the prioritization number, the start of production, the Technology Stream responsible for the epic, and the additional Technology Streams to contribute to the epic along with their progress status for the PI. For every contributing Technology Stream, there exists a column detailing the status of each epic. This status is updated using one of three colors: red, yellow, or green. Red indicates that the requested scope is unsupported, yellow signifies partial delivery within the scope with described risks, and green denotes planned and delivered deliveries. Lastly, the long-term impact of the deliveries from the Technology Streams for the epics is described.

Moreover, for a new epic to qualify on the Global Prioritization List, it must have a certain budget, business value, and dependencies between the Technology Streams. Otherwise, new epics will be managed within the Technology Stream that has the ownership and the other Technology Streams affected.

4.2.4 1-10 Levels List

To enhance the effectiveness of managing the Global Prioritization List, the Case Company must adopt a forward-looking approach that anticipates short-, medium-, and long-term shifts. Establishing precise and decisive prioritization criteria facilitates detailed oversight and control over the Global Prioritization List, thereby optimizing the likelihood of attaining organizational objectives within stipulated time-frames and quality benchmarks. The 1-10 Levels List is a simple list that serves as a logical and transparent framework for prioritization, encompassing ten levels delineated from 1 (indicating the highest priority) to 10 (signifying the lowest priority). Table 4.1 provides an illustrative example elucidating the evaluative criteria associated with each level, thereby guiding the valuation of epics within the Global Prioritization List.

Determining the business impact of epics across varying priorities presents a formidable challenge. Such assessments often necessitate a reliance on experiential insights and intuitive judgment rather than quantifiable metrics. In the Global Prioritization List, approximately 30 epics exist at the same priority level, yet the number of epics varies at each priority level. In instances where epics share identical priority numbers, sub-numbers (e.g., 1.2, 1.3,..., 1.30) are allocated to delineate and prioritize them further. Despite sharing equivalent base priorities, epics are sequenced according to their respective sub-numbers. For instance, priority 1.2 is more important than 1.3.

Table 4.1: Example of the 1-10 levels list.

1.	Secure running production & critical customer cases
2.	Secure running production & customer uptime
3.	Impact on safety, high warranty cost, bad customer image
4.	Critical deliveries to secure business value with high impact
5.	Legal with hard SP start
6.	Legal with early SP start
7.	Medium critical impact on the Case Company
8.	Low-medium impact on the Case Company
9.	Business critical
10.	Epics on hold

4.2.5 JIRA

JIRA can be described as a comprehensive project management software tool designed to facilitate Agile methodologies and practices within teams and organizations. It provides a centralized platform for teams to plan, track, and manage their work, offering features such as backlog management, sprint planning, issue tracking, and reporting. Jira enables teams to visualize their work, collaborate effectively, and maintain transparency throughout the development process. epics are added with a description of the scope, prioritization number according to the Global Prioritization List, and dependencies between the different Technology Streams. epics

are broken down into features and stories, which are then added to each team's backlog. Furthermore, JIRA incorporates its prioritization system, enabling epics to be ranked within the backlog using a prioritization number. Additionally, its integration capabilities with other tools and systems make it a versatile solution for managing complex epics and portfolios.

4.3 How the Case Company Works With Prioritization of Epics

To gain a deeper understanding of how different hierarchical levels prioritize within their respective domains, the initial focus will be on the governance of epics, followed by an explanation of prioritization methodologies within Portfolio Level, GTM-level, Program Level, and Team Level.

4.3.1 Portfolio Governance Meetings & the Portfolio Priority Preparation Team

The Portfolio Priority Preparation Team (TPPPT), composed of a representative from all Technology Streams and chaired by a leader, establishes the priority of every epic. The TPPPT ensures the epics include coverage of all brands and business areas within the Case Company. The Technology Stream, which holds ownership, prepares the priority number for an epic prior to the meeting. A shared priority is established through the review of proposed changes, confirmation of completed tasks, and the prioritization of new epics or the reorganization of existing ones. This preparation takes place during weekly global meetings, with periodic reviews to delve deeper into potential impacts and dependencies. If the TPPPT cannot reach an agreement, the prioritization will be escalated to the Vice President (VP) or Senior Vice President (SVP). This is not common since the meeting follows an established process where discussions continue until a consensus is reached, which typically occurs smoothly.

The epics included in the Global Prioritization List are those that impact the entire Case Company and usually involve more than one individual Technology Stream. While one stream may have a highly important project they want to prioritize, if it does not affect the entire organization, their epic may need to wait. One must adopt a "Case-Company mindset" and recognize that there are other projects that are more critical. Epics with technical dependencies need to align with each other and therefore have a greater chance of being included on the Global Prioritization List.

It is noteworthy that preparations for the governance meeting are interpreted differently, and there are no clear guidelines on how prepared one should be for the meeting. During planning meetings, each portfolio manager is expected to be familiar with their portfolio and be able to respond immediately to whether they can accept a job or not. This applies regardless of how much they know about the new

epic, whether there is a set scope, clear goals, resources, and a timeline. If these are not available, they should still be able to respond to whether they can accept the epic or not.

4.3.2 Portfolio Level

The role of the Product Portfolio Manager entails leading the development of the Product Plan, the Project Plan, and the associated R&D Budget within their designated area of oversight. This involves assessing alignment among product strategies, technology strategies, desired feature positioning, and the product plan/project portfolio, along with the budget. Working closely with relevant stakeholders, the portfolio manager assesses any inconsistencies and raises significant issues to top management for resolution. Given the interdepartmental dependencies inherent in numerous epics managed by a Portfolio Manager, they are further tasked with the crucial responsibility of ensuring alignment with these departments. Integral to their role is the overarching objective of maximizing the value derived from their products for the organization.

In the domain of Portfolio Management overseen by individual portfolio owners, there's a notable absence of standardized methodologies. While most of the portfolio managers set up their own portfolio of epics, encompassing those listed in the Global Prioritization List as well as additional epics, a consistent approach is lacking. Many prefer to maintain a separate list in Excel, often derived from the Global Prioritization List, while other portfolio managers compile their epics into platforms like JIRA or Confluence. However, some portfolio managers choose not to have a separate list at all, instead, they only utilize the Global Prioritization List. Different technology teams may have varied practices because their responsibilities for setting priorities differ; for example, some may work closely with production, and some may not.

Within their portfolios, portfolio managers often encounter numerous projects primarily focused on completion. Consequently, these projects are less reliant on numerical prioritization, regardless of their assigned priority level. This is often due to various factors such as legal mandates, epics nearing production commencement, or the need to ensure customer uptime, among others. Instead of strictly adhering to numerical prioritization, portfolio managers frequently adopt an MVP approach. This approach involves strategically reducing the scope of epics to a level where they can be executed within the constraints of time and resources, thereby ensuring the timely delivery of products with discernible business value. As a result, the distinction between epics ranked priority 1.1 and 1.12 becomes less significant, as the primary focus remains on the comprehensive completion of all epics.

4.3.3 Global Technology Manager

From the literature, three levels are described (Portfolio Level, Program Level, and Team Level). However, the Case Company's organization differs from the theory

presented in Chapter 2 since the organization consists of significantly more roles. Therefore, an additional role will be introduced. This role is also involved in the prioritization of epics and is called Global Technology Manager (GTM). The GTM, also referred to as the section manager at the Case Company, typically serves as the responsible line manager at the program level, overseeing the implementation of technology leaders' plans and guiding engineering team leaders. They are the connection between the Portfolio level and the ARTs, and often take information from top-level managers to discuss or cascade to employees. Typical duties include executing top-level plans, guiding people managers with advice, and completing group performance evaluations. GTM can also be depicted as a section chief overseeing the overarching plans; the role entails a focus on the big picture and governance across all its operations, rather than delving into intricate details, accountable for overseeing the delivery of the entire ART.

Regarding the Global Prioritatzion List, GTMs do not typically provide inputs to the portfolio manager regarding the priority of an epic. Most GTMs also do not maintain their own list of epics concerning their ARTs, although exceptions exist. However, they are involved in breaking down portfolio epics alongside PMs to deliver them to their PO, who then passes them on to their backlog. GTMs vary in how they choose to break down portfolio epics; some simply break them down, while others assign an initial priority number during the process. If prioritization occurs during the breakdown, the 1-10 Levels List is always used and represents a high-level priority. Generally, there is trust that the ARTs and teams understand their tasks, and sequencing, relying on developers to have a realistic grasp of the situation. Resource planning involves a high-level overview without a detailed capacity estimation of what the ART can deliver, leaving this responsibility to the Group manager, PO, and the team.

4.3.4 Program Level

At the Program Level, an important role that gave valueable insights and another point of view regarding the teams work and deliveries, is the group manager. The group manager is the accountable line manager for the team's deliveries and they hold a highly strategic role and are responsible for managing the entire product life-cycle. Furthermore, the group manager is having close collaboration with the PM and ART management, but is not included in the priorization or portfolio management.

Moving on, the Product Manager serves as an intermediary between the Portfolio Level and Team Level, while also being the point of contact for stakeholders seeking information or updates. This involves building the backlog at a program level, liaising with suppliers, customers, brand representatives, and development teams, and ensuring the timely completion of tasks. They identify needs, prioritize future development efforts, and align teams around a product road-map. When stakeholders express their requirements, the Product Manager assesses the cost, provides time estimates, and oversees the implementation phase. This is where portfolio planning

becomes crucial, as some tasks may be completed while others are not. Additionally, alliances and joint ventures, not included in the global list, have their own funding and thus receive high priority, enabling capacity purchase.

The Product Manager does not maintain a separate internal prioritization list for all projects but rather derives priorities from the Global Prioritization List, breaks them down, and directly inputs the refined features and stories into the Agile teams JIRA for prioritization. The prioritization tool may vary, with some PMs using a 1-10 levels prioritization list and others opting for their own version with 1-7 levels. epics planned for the PI are often discussed with the respective GTM and portfolio manager beforehand and then presented to the PO. The MVP approach is commonly employed to expedite the completion of portfolio epics, by scoping down epics to deliver something of value to the customer. This often requires clearing the path for the customer and maintaining effective communication, which can be challenging but necessary for timely delivery.

Moreover, there is significant variability in terms of role delineation, particularly evident in estimating epic timelines and the ability to decline epics. The methods employed by different PMs vary greatly, depending on whether they have estimated time and resources for epics. Furthermore, when faced with a choice between pursuing a portfolio epic or an internal epic, the latter usually takes precedence. The primary difference lies in the use of reference projects, which will be further discussed in Chapter 5. In summary, the majority of PMs do not adhere to a specific guideline or process; instead, decision-making is based on guesswork, intuition, and experience.

4.3.5 Team Level

At Team level, it's the Product Owner who's responsible for their team's delivery. The Product Owner reports to the Group manager and is responsible for building and constructing the backlog and the team's deliveries. The Product Owner operates more tactically than strategically, unlike the Product Manager, and focuses more on solutions and technology. All teams use the software tool JIRA to build their backlog. The epics to be undertaken originate from the Global Prioritization List, developed by the responsible GTM and PM for each ART. These epics are then broken down into features, stories and tasks because they're too high-level to be placed directly into a single team, often involving dependencies across multiple ARTs and spanning multiple PIs.

The team consists of up to 10 engineers, who collaborate to develop the Case Company's products. Their tasks are concrete, unlike those at other hierarchical levels, and this is where pure product development occurs. A development team may include engineers with various specializations, such as simulation engineers and design engineers, which can complicate task assignments from the backlog due to their different areas of expertise. The type of development work also varies depending on which ART the team is part of. Additionally, there is a constant trade-off regarding

which features should be tackled in what order. Given the different roles within a team and limited resources, it's not feasible to simply pick tasks from top to bottom based on prioritization. As a result, the team might work on lower-priority tasks before higher-priority ones. Team members must also assess what they can realistically accomplish. If a low-priority feature can be completed before the next PI with certainty, it might be better to tackle it rather than start a higher-priority feature that won't be finished in time. Gaining a clear overview of the portfolio list is challenging; it's not just about following a linear structure from top to bottom, despite the PM's preference. Focusing solely on prioritization can risk losing momentum and efficiency. A more effective approach is to view the portfolio list as a guide to understanding the direction the Case Company aims to take.

Within JIRA, there exists a prioritization system wherein POs arrange their features and stories. Nevertheless, this prioritization scheme diverges from the standardized 1-10 Levels List employed by portfolio managers. Surprisingly, a majority of POs remain oblivious to its existence. Analogous to the portfolio level, POs prioritize based on their wealth of experience, intuitively determining which epics will deliver the greatest value to the organization.

Frequently, there are interdependencies among various teams and ARTs, yet these are not depicted on a unified JIRA board or backlog. Rather, it falls upon the PO to delve into the backlog of other teams to track progress. In the context of the Case Company, the PO doesn't technically possess ownership of a specific functionality; however, it is effectively owned by the development team. This dynamic can sometimes lead to imbalance, especially in communication, as the PO must oversee software development for something formally owned by another team. This emphasizes the importance of each PO maintaining a comprehensive understanding and assuming significant responsibility for their team's deliverables.

4.3.6 Epic Owner

The Epic Owners within Vehicle Technology were not interviewed as they are not involved in the prioritization process and therefore not part of this thesis' scope. However, they are still relevant for gaining an understanding of the organization.

The Epic Owner is responsible for coordinating epics through the Global Prioritization List. If an epic is deemed feasible, an Epic Owner is appointed to lead its development. They are responsible for identifying and establishing milestones and integration points, thereby ensuring the overall plan for introducing the product development initiative is secure. Serving as a central point, the Epic Owner possesses comprehensive knowledge of the epic, including its scope, plans, and expected features, and ensures all relevant information is available in Jira and further broken down by impacted ARTs.

The Epic Owner plays a crucial role in keeping the PM and PO informed about the epic and holds ultimate responsibility for its information and knowledge. Given

the complexity of epics, the PO may not have exhaustive knowledge about every aspect, making the Epic Owner pivotal in providing explanations of specifics, key integration points, business value, and other pertinent details. Epic Owners lead the essential collaboration needed to guide epics through this phase, often involving multiple ARTs working together, a task that the Epic Owner coordinates.

4.4 Key takeaways of the Organizational Context

The key takeaway from this chapter is that the organization is utilizing a hybrid Agile-Stage-Gate way of working, however, the implementation of the SAFe framework varies across different Technology Streams and hierarchical levels. Moveover, even within the same role, the methods and tools utilized differs a lot. This has resulted in a lack of uniformity in the prioritization processes of epics and the use of prioritization tools and methods.

5
Findings & Results

This chapter presents the identified challenges and related issues based on the interviews and data analysis findings. These challenges were formulated and selected based on the outcome of the thematic analysis and relative importance to the study. The findings resulted in 4 challenges, whereas 3 of the challenges have related issues. All of the challenges and related issues are presented in Table 5.1.

Table 5.1: Challenges and related issues

Challenge	**Issue**
Inadequate implementation of Agile methodologies	*Ambiguous which elements of Agile should be adopted*
	Balancing resources and demand upon Agile implementation
Lack of standardized estimation processes	*Lack of standardized time-estimation processes for epics*
	Lack of standardized estimation processes for resources
Inadequate integration of the Global Prioritization List	*Lack of a shared perception of the Global Prioritization List within the organization*
	The ability to say no to an epic epics with low priority
Inefficient utilization of the 1-10 Levels List	

5.1 Inadequate Implementation of Agile methodologies

In this section, the first identified challenge is the inadequate implementation of Agile and its related issues will be presented.

5.1.1 Ambiguous which Elements of Agile should be adopted

In 2018, the organization introduced Agile methodologies along with the SAFe framework. Yet, according to all interviewees, the organization hasn't fully embraced agility and hasn't implemented all aspects of the SAFe methodology. However, the organization doesn't strive to be completely Agile rather, it aims to operate in accordance with SAFe principles. In addition, there's inconsistency within the organization regarding which parts of SAFe are adopted and how they're applied. The majority of interviewees agree upon the statement, and interviewee 11 states "The organization has implemented Agile, but it doesn't work in all situations, and there is a misalignment of what Agile means for the different parties. Agile is based on the absence of dependencies and flexible output. In reality, they have many dependencies and a fixed output". This indicates a lack of uniformity in working methods across the organization, as noted by the diverse perspectives shared by interviewees from various hierarchical levels and departments. The interviews provided several instances illustrating this situation. An example of this situation is whether the output of each PI increment should be flexible or not. The organization determines fixed and predetermined outputs of each increment which collides with Agile methodologies promoting flexible outputs. Evidently, based on the interviews, this has led to conflicts within the organization. A significant majority of the teams produce flexible outputs and do not complete every task committed to in the PI increment, whereas management anticipates receiving every delivery committed to by the teams. However, it's evident that the resources available are insufficient to complete every planned task within the PI increment. Interviewee 11 illustrates an example of one of the team's perspectives "Committing to a task does not mean that you can complete it". Interviewee 10 further explained the situation "We do not deliver what we promised. The output is 40% of what we committed to."

Moreover, the Weighted Shortest Job First method from the SAFe framework is implemented differently across the organization. While some interviewees endorse prioritizing epics with the Weighted Shortest Job First method, its adoption faces challenges due to certain teams in the organization solely concentrating on large epics. This disparity makes it challenging to implement this method universally. Concluding, there isn't a unified perspective on whether the method should be utilized or not. Interviewee 5 claims "If we would work after the method weighted shortest job first, no large-scaled epics would be finished,[...] the organization advocates for the weighted shortest job first but we operate in opposition by primarily focusing on large epics".

Although the organization has implemented Agile and SAFe, the introblocks are

still project-based. It is evident, based on the interviews, that some ARTs struggle to balance the combination of Agile and Stage-Gate. Interviewee 11 "It's difficult to combine Agile with the introblocks that have a fixed deadline, fixed price, and a fixed date, for example". Although the organization has adopted Agile methodologies, the challenges of working in an Agile manner vary depending on the department and Technology Stream and the specific product being worked on. For instance, Interviewee 2 operates closely with production, where all components of the product must function seamlessly and are influenced by every epic impacting the start of production. This implies they depend very much on the stage gate model with fixed deadlines and milestones. Interviewee 2 explains "Our work is primarily based on the introblock". Compared to other departments and Technology Streams where teams can work almost entirely in Agile and incorporate deadlines from the introblock in an efficient way. Interviewee 14, a Product Owner, explains that the balance between Agile and the project-based introblock works fine and states "When the start of production date is close, the way or working becomes more Agile, [...] however, it is important being able to adjust the way of working after the introblock". However, based on the interviews it can also be concluded that there are varied opinions regarding whether combining epics and the Agile way of working with the introblock is challenging or not. Some interviewees claim that the epics are incorporated into the introblock while others struggle to identify the connection between the tasks of an epic and the introblock it aligns with.

Finally, there's an observation regarding the organization's adoption of Agile methodology, which involves transitioning from project-centric to epic or epic-centric work. However, in certain instances, this shift appears to be merely nominal, without a substantial change in operational approach. The distinction between an epic and a project lacks consistency. Sometimes, an epic and a project are synonymous, while in other instances, there's a clear distinction between the two.

5.1.2 Balancing Resources and Demand Upon Agile Implementation

Upon adopting Agile methodologies, there was a notable shift in resource utilization. Previously, projects adhered to a fixed allocation of resources. However, under the Agile framework, resources are now engaged across multiple epics simultaneously, fostering parallel execution. In a majority of the interviews from all the different hierarchical levels, it's asserted that there exists an imbalance between the demand and the available resources every PI increment. Interviewee 17 characterizes the situation as "With their adoption of Agile and the implementation of a priority list, there's a sudden expectation to do everything. In the previous project-based approach, projects couldn't commence without available resources. Now, numerous teams find themselves overwhelmed". A lot of teams build their backlog for each increment with more tasks than they have available resources. Certain interviewees contend that the portfolio planning is overly comprehensive, resulting in an excessive number of epics being accommodated. This heightened workload for teams is a con-

tributing factor to a diminished outcome. Interviewee 5 said “We need a moderate amount of work to do because then we can actually prioritize and get things done. We become much more efficient if we’re not constantly lagging behind and if we can actually finish one task and start a new one thereafter. Right now, we’re jumping around and trying to solve everything at once". From the interviews, it is evident that maintaining a moderate workload is essential for effective prioritization and task completion. Several interviewees have expressed that when there’s a balanced workload, individuals and teams can focus better, prioritize effectively, and achieve tasks efficiently. Constantly being overwhelmed by an excessive workload leads to inefficiency, as individuals struggle to keep up and often end up multitasking or jumping between tasks, which ultimately hampers productivity and quality of work.

5.2 Lack of standardized Estimation Processes

In this section, the second identified challenge, lack of standardized estimation processes, and the related issues will be presented.

5.2.1 Lack of Standardized Time-Estimation Processes for Epics

From the interviews, it was evident that there are no standardized processes for time-estimating the effort required for an epic. Depending on the level of experience possessed by the interviewees and the duration of their time in the position, the responses varied significantly. Those with higher levels of experience perceive no significant issues with the absence of standardized time-estimation processes and rely on intuition for estimation, drawing from their accumulated experience to determine the potential business value. Conversely, interviewees with less experience and understanding find it challenging to time-estimate an epic in the absence of standardized guidelines. For instance, Interviewee 4 elucidates, "For me, it’s mostly about understanding what each project entails. You have to have some idea of the work involved and the complexity. You can’t just be a messenger; you have to understand what it’s about, what’s the scale, what’s the complexity". Additionally, interviewee 13 was the only one who utilized reference projects to map out and estimate the number of hours required for an epic.

Moving on, from an interview conducted at a higher hierarchical level, the interviewee contends that it has become much more challenging to estimate a timeline and allocate resources to an epic since the implementation of Agile. Prior to Agile implementation and the use of the waterfall method, a timeline was set, resources were secured, and once everything was ready, the project could commence. Interviewee 9 elaborated: "When I started here, it was just diesel-powered, and everything was focused on the next legislative change, i.e., emission targets, and it was a much easier world to plan in. The only focus was to meet emission targets, and then concepts and solutions were broken down to achieve that. Today, it’s instead about how we propel the vehicle forward? Fuel cells, electric, autonomous vehicles, connec-

tivity options? It's much more complex now, and therefore, it's challenging to plan ahead with a 5-6 year time horizon as a project usually has". Due to the increased complexity of solutions, the interviewees argue that Agile is beneficial because it allows for a partially flexible output, but complicates the ability to see the holistic overview. Interviewee 5 stated that "When Agile was implemented, processes for time-estimation of projects disappeared".

5.2.2 Lack of Standardized Estimation Processes for Resources

Prior to the implementation of Agile, numerous interviewees have conveyed that while operating within the Stage-Gate model, which was exclusively project-based, estimating the required resources in terms of the number of employees needed, was simpler. This was because each project had an allocation of resources dedicated solely to it. However, in an Agile environment, resources may be allocated to multiple epics simultaneously, which complicates resource estimation. Several interviewees emphasized that resources in an Agile organization require consideration of more aspects compared to a project-based organization. In addition, when Agile was implemented there was a lack of standardized and unified estimation processes, leading employees to rely on their knowledge and experience for estimations. For instance, interviewee 5 stated, "We do the estimation of resources based on experience, [...] Since the implementation of Agile we had to learn and gain knowledge about the time-frame of different epics to conduct better estimations." It has also been noted from several interviews that the estimation process needs to be improved, which was underscored by interviewee 2 who stated, "We are pretty bad at doing estimations.", Additionally, interviewees 5 and 6 both claimed that "The estimation process is definitely a point of improvement".

Further, the organization's available resources and the degree of workload for each team have never been visualized or quantified, as emphasized by interviewee 5, who stated "We have never visualized the resources we have. The group managers try to estimate the resources for their teams and the time plan for the epics. However, there is no standardized process for estimations for resources [...]". It is up to the team to know to which degree their workload is, which also aligns with the Agile way of working. However, Global Technology Managers and Product Managers are also engaged in resource estimation at a higher level. Nevertheless, their involvement and the extent of it in resource planning vary across the organization. Thus interviewee 9 claims that "On a portfolio level, they need to know which data needs to be collected to understand to which degree the teams' work can be loaded". Additionally, during the interviews, it was also brought up that there is an absence of monitoring of how resources were allocated and utilized within the PI increment. Interviewee 5 highlighted this as an area for improvement, stating, "There is a lack of measurable objectives as well as documentation, which makes the follow-up difficult and sometimes nonexistent".

Moreover, the estimation process varies at the ART and within the teams, depending on the teams. Nevertheless, across the organization, it can be concluded that teams often overestimate their capabilities and resources based on most teams delivering approximately 40% of their commitments each PI increment. Interviewees 5, 6, and 7 all stated, “Some teams have a too positive attitude towards their own capability and often make overestimations”. Interviewee 14 agrees and further describes “We often overestimate to an extent degree, 30-40%. The expectations are often reasonable, sometimes maybe too low. If we were to focus on efficiency, we would realize the need to improve these processes and tools.”. However, interviewee 13 provided an additional perspective regarding why it sometimes is difficult not to overestimate the team capability "One reason behind the overestimation is that as soon as you say no to committing to a task during the PI, there is no acceptance”. Conversely, the overestimations made by the teams can have several reasons. One key factor might be that the teams are overloaded with work relative to their size.

5.3 Inadequate Integration of the Global Prioritization List

In this section, the third identified challenge, inadequate integration of the Global Prioritization List and its related issues will be presented.

5.3.1 Lack of a Shared Perception of the Global Prioritization List within the Organization

The Global Prioritization List, which ranks the organization's epic, serves as a guiding reference. Yet, a collective consensus on its utilization remains elusive, lacking a unified perspective. Based on the conducted interviews, it becomes evident that there exists a diversity of perspectives regarding the optimal utilization of the global prioritization framework. While some individuals interpret it as a prescriptive guide dictating the sequence and focus of epics, others perceive it primarily as a general orientation tool. This divergence in perception leads to clashes among employees, exemplified by Interviewee 17's description of the situation: "Some people view the Global Prioritization List as a sense of direction, another view it as a bible". Employees who perceive the Global Prioritization as a guiding tool demonstrate higher flexibility in determining which epics and tasks to incorporate within the PI increment. For example, they may include tasks from an epic with a low prioritization number in the PI increment because they acknowledge that the task itself may be more urgent, thus carrying a higher prioritization number than the epic. Therefore, it should be prioritized accordingly. Conversely, those who regard the Global Prioritization List as a definitive guide often equate the priority of linked tasks with the corresponding epic, regardless of any urgency the task may possess. Interviewees 6 and 7 encapsulated this scenario by expressing "Some people use the priority lists as a bible, which means that minor blockers to epics with lower priority can halt the progress of many tasks".

Moreover, on the team level, the Global Prioritization List is rarely used as a guideline. Some teams have only seen the Global Prioritization List once or twice and assume that the Product Manager communicates the comprehensive perspective of their Technology function and the prioritization sequence of epics they are involved with. In addition, employees at the team level believe that the Global Prioritization List operates at too high a level for it to be meaningful or relevant to their specific teams. Interviewee 14 said, “The prioritization list is great to communicate a holistic view. However, the list is on a to high level for it to make sense for me as a PO”. Interviewee 5 agrees and adds “We need to know what is most important now and not just the entire epic as an answer. The large epics need to be broken down into smaller tasks with different prioritizations”.

5.3.2 The Ability and Possibility to Say No to Epics

The ability to decline an epic varies significantly depending on one's role and position within the hierarchical structure. At a higher hierarchical level, where governance meetings occur as explained in Chapter 4, Portfolio managers are expected to be able to accept epics, despite the lack of information, unclear scope, and absence of project timelines. Furthermore, some employees are very adept at overriding the decisions made from the governance meeting, particularly those working within an international context. The predominance agrees and interviewee 15 explains: "[...], they excel at escalating matters to gain pressure from VP or SVP-level executives." Furthermore, individuals from abroad demonstrate proficiency in increasing the scope. For example, when initiating a project and finding someone close to the start of production, the department abroad tends to elevate its priority. Subsequently, expanding the project's scope to sustain the illusion of high importance this dynamic presents a formidable challenge, making it complicated to decline epics. To summarize, at higher organizational levels, there is zero tolerance for down turning epics.

Furthermore, at lower hierarchical levels, there exists a notable disparity concerning the capacity to decline an epic. While individuals at higher organizational tiers may lack the authority to outright reject epics, those situated at the team level assert full autonomy in exercising this privilege. Equipped with extensive technical expertise, team members wield their discretion to reject epics they perceive as unviable within the confines of the present PI or if they require delay to subsequent PIs. Both Interviewee 8 and 14 contend that they can deny epics without fear of reprisal, grounded in their understanding of operational constraints and commitments. Interviewee 14 elucidates: "[...], as experts in our technical domain, we have the authority to reject proposals we believe are unwise or offer alternative solutions. There's plenty of room for expressing disagreement".

Additionally, the respondents assert that the effectiveness of the Global Prioritization List is compromised due to the inability to decline epics. Furthermore, if every item on the list is deemed mandatory, the rationale behind having a prioritization list becomes questionable. Interviewee 9 elucidates, "[...] The present prioritization strategy revolves around executing crucial tasks, leaving no room for alternative undertakings". This paradigm conflicts with the principle that the Case Company should refrain from initiating projects without ensuring the availability of the needed resources. Indeed, if adequate resources were accessible, prioritization would be rendered redundant. Hence, there exists a fundamental dilemma: should prioritization even be necessary? While acknowledging the necessity of some form of prioritization, there's a consensus among the respondents that a reevaluation is warranted, perhaps with a more detailed focus at the team level.

5.3.3 Epics with Low Priority

Regarding epics with low priority, even if the Global Prioritization List consists of epics with levels 1-10, it is clearly stated from the plurality of interviews, that epics with prioritization 7 or lower, will not be done. This is underscored by interviewee 15 who stated “All the epics from 7 to 10 will never be completed”. In addition, interviewees 5, 6, and 7 stated “Some people use the Global Prioritization List to say no to doing tasks, with no flexibility”. This implies that certain teams establish a strict threshold, only committing to epics with prioritization numbers down to a certain sub-number. Consequently, when presented with a task linked to an epic with a priority of 6, they are inclined to refuse, citing their policy of not engaging with epics below that certain sub-number, regardless of potential urgency or dependencies requiring collaboration across multiple teams.

Furthermore, the interviewees from a higher hierarchical level collectively agree that the Global Prioritization List is excessively lengthy and dense, with many epics deemed impractical or unattainable in practice. However, the reluctance to remove any epics from the list stems from the fear that once removed, they will not be revisited, leading to a perception of abandonment. Interviewee 15 elucidates, "There is a hope that epics far down in the list, for instance, a certain Technology stream, want something done but it won’t happen for a while, so they can remain on the list, [...], many of these cases haven’t determined when they will go to the start of production, and I can’t push a start of production date that is not set". The interviewees contend that elevating the priority level to expedite the epic’s completion is ineffective, given the substantial time-frame remaining before production is scheduled.

Due to the organization’s unwillingness to pursue epics with low priority, there are missed opportunities that could yield significant advantages and business value. The interviewees all agree with the statement, "An example is a small task that has a low priority but can generate high business value and profit". Another challenge associated with epics of low priority is that they may become "hidden" or dismissed by attributing their lack of progress to their low-priority status. This creates misalignment within the organization, as some recognize the potential value of these epics while others use the Global Prioritization List as an excuse to avoid working on them. Lastly, the greater part of the interviewees mean that "If it has a very low priority, we may prioritize it out completely," leading to a complete misunderstanding of the purpose of the Global Prioritization List.

5.4 Inefficient Utilization of the 1-10 Levels List

A distinction emphasized by numerous interviewees revolves around the utilization of the 1-10 Levels List. Primarily, there is a substantial variance in who employs the list. At higher hierarchical levels, the list is widely recognized and utilized by the majority of those interviewed. However, delving deeper into the hierarchical structure, the 1-10 Levels List has never been employed or encountered before. As

a result, it is not employed for prioritizing features and tasks within their respective backlogs. "1-10 Levels List? No, I have never come across it," remarked Interviewee 8.

Furthermore, various employees hold different interpretations regarding the significance of levels 1-10. This variance becomes particularly pronounced when understanding the distinctions between high, medium, and low business values. It is perceived as difficult to understand how much business value an epic will generate simply by assigning it a particular number. Interviewee 18 elucidates, "The type of business value is not specified, and the level of business value is not quantified". Several interviewees confirm this opinion, expressing dissatisfaction with the levels of the 1-10 list. Interviewee 4 points out, "There's a deficiency in connecting a value to the number. What's the significance of a particular number? It's likely an algorithm computing the decimal, but at the integer level, 3, 4, 5, what sets them apart? Why does one rank higher than the other?" And further emphasizes with the rest of the interviewees, "The primary enhancement should involve clearly delineating between level 5, level 6, and level 7".

Moving forward, interviewee 18 further describes that too much time is spent determining sub-priorities for an epic, even though they all have the same priority; "We spend a lot of time setting priorities like 5.1-5.36 when it doesn't really matter. What kind of mathematical madness is that?". Interviewee 10 agreed and formulated, "It is inefficient to differentiate between priorities 5.1 and 5.2. Is the distinction truly significant? We should trust our development teams to discern what is truly important". Rather than viewing the Global Prioritization List as a tool to categorize epics into 5.1, 5.2, 5.32, and the greater part proposes consolidating them all under 5.0, given their equivalent priority levels, as a means to streamline operations and save time. The allocation of time towards setting sub-priorities could have been directed towards more substantial endeavors, such as the actual development of epics. To summarize, it is evident that the interviewees agree that the 1-10 Levels List needs to be more comprehensive with detailed explanations for each level and there should be quantification of what constitutes high, medium, and low business values.

5.4.1 Result Analysis

The results and findings in this thesis are based on 19 interviews. It's important to note that these results may not fully represent the entire organization, which has over 10,000 employees. Only the findings mentioned by the majority of interviewees were included in the thesis, while data points mentioned by only a few were excluded. However, many of the findings align with existing literature, indicating that numerous other organizations have encountered similar experiences as those presented in this thesis.

6
Discussion

In this chapter, answers to the research questions are presented. The findings identified in the case study are discussed and analyzed in relation to the literature, to provide comprehensive answers to the research questions.

6.1 RQ1: How is the Case Company Currently Working with its Planning Methods and Tools to Prioritize Projects within the Project Portfolio?

In this section, the analysis will delve into the primary research question, examining its alignment with existing literature on planning methods and tools.

6.1.1 Tools Utilized For the Prioritization Process

In times of rapid change, decision-making must be prompt and trustworthy (Enoch, 2015). The diverse software tools employed in project portfolio management are crucial in shaping business practices. The case company relies mainly on a 1-10 Levels List to prioritize projects, assigning each epic a prioritization number. These epics are then compiled into an Excel file known as the Global Prioritization List. Consequently, both prioritization tools are managed manually. According to Yehorechenkova et al. (2020), manual handling of portfolio management functions can lead to a slowdown and introduce inaccuracies in the project management process of the portfolio. Therefore the decisions regarding making prioritizations rely on the experience of the employees. This is evident from the interviews where interviewees utilize the 1-10 levels list to assign a prioritization number to an epic. Interviewee 18 emphasizes this situation by stating, "The type of business value is not specified, and the level of business value is not quantified". In the literature, it is evident that decisions regarding prioritizations should be grounded in empirical portfolio data (Auer et al., 2003). Within the case company, there is an absence of collecting portfolio data and utilizing data to make decisions. An example of this is stated by interviewee 9 who claimed that “on a portfolio level, they need to know which data needs to be collected to understand to which degree the teams’ work can be loaded”.

Further, the effective management and comprehension of portfolio information are essential success factors for making rational and consistent portfolio decisions (Auer et al., 2003). Research has demonstrated that organizations utilizing software tools to manage their project portfolios can better visualize project progress and make data-driven decisions more effortlessly. The absence of a software tool to manage their portfolio not manually could potentially impact their ability to make objective and accurate decisions. This reliance on experience alone, without utilizing such software tools, may compromise their decision-making process. In addition, making decisions with the appropriate tools and at the right time can significantly enhance the long-term sustainability of any organization (Kharat & Bhukya, 2018). In addition, the effectiveness of project portfolio management can be significantly enhanced by leveraging a variety of software tools and techniques. These tools not only facilitate decision-making but also contribute to improved accuracy and efficiency.

In the literature, it is also concluded that dedicated project portfolio management software is superior to typical Excel lists still used by many organizations for planning and monitoring their project portfolios. The case company still utilizes an Excel list to prioritize and manage all of the largest epics within the organization. However, there is a connection between the Excel list and the software tool JIRA. The epics from the Global Prioritization List are transferred to JIRA, where teams create their own boards for prioritizing epics. JIRA is a widely adopted software tool commonly used for portfolio progress (ClickUp, 2017). However, there are also challenges with JIRA stemming from the dependencies between different Agile release trains and teams. This necessitates Product Owners to take on the responsibility of knowing when their team is contributing to other teams' epics. Additionally, they need to locate the other teams' JIRA boards to find the tasks linked to the epic. The literature emphasizes that organizations with mature project portfolio management software utilization achieve a 35% higher rate of successful completion across their project portfolios while minimizing time and cost wastage (Daradek, 2019). By implementing a software tool alongside data collection for decision-making purposes, the case company could potentially boost the accuracy of its decisions and enhance the decision-making process.

Furthermore, scoring models are among the most highly recommended tools for maximizing the value of project portfolio management in general (Cooper, 2006). These phrases are intended to encapsulate what qualifies a project to receive a particular rating on a criterion. If an anchored scale phrase best describes a project compared to others within that criterion, the project is assigned the corresponding rating number associated with that phrase. The anchored scale phrases offer a standardized framework, enabling multiple participants to assess projects collectively. This approach simplifies and strengthens the process of obtaining multiple ratings consistently from individuals evaluating projects at various times. Utilizing anchored scale phrases enhances the organization of the assessment process. The company has anchored scale phrases to each of their 1-10 levels. However, it has become evident that interviewees still face challenges when assigning a prioritization number, particularly for levels 5, 6, and 7, as it is challenging to discern the difference between low, medium, and high business value. Interviewee 18 articulates the situation by stating, "The type of business value is not specified, and the level

of business value is not quantified".

6.2 RQ2: What Are the Primary Challenges Associated with Utilizing a Prioritization List within the Case Company?

In this section, the second research question will be discussed, analyzed, and compared to the literature regarding challenges within portfolio management and prioritization.

6.2.1 Agile Project Management

Despite APM being acclaimed as a groundbreaking method, some organizations implementing APM encounter challenges. According to Ciric et al. (2019), certain organizations encounter difficulties in reaching agreements with stakeholders and effectively prioritizing essential tasks. As a result, integrating APM into organizational practices is perceived as one of the significant challenges associated with the method. The literature aligns with the organizational context when operating in an Agile manner. When Agile was implemented in 2018 resources began to be utilized across multiple epics concurrently, as opposed to being exclusively allocated to a single project, as was the case under the stage gate model. This caused the necessity of prioritizing between epics. Thus, the effective use of a prioritization list can sometimes be ineffective when stakeholders are unwilling to accept that their requests will be prioritized for scheduling at a later time. In addition, it has also become apparent that for effective prioritization and task completion, the workload must be kept at a moderate level. This was underscored by Interviewee 5 who stated "We need a moderate amount of work to do because then we can actually prioritize and get things done. We become much more efficient if we're not constantly lagging behind and if we can actually finish one task and start a new one thereafter. Right now, we're jumping around and trying to solve everything at once".

Furthermore, multiple authors concur that one contributing factor to APM implementation failures is rooted in the organizational culture (Loiro et al., 2019; Papadakis & Tsironis, 2018; Thesing et al., 2021). APM necessitates a culture that welcomes new challenges (Papadakis & Tsironis, 2018), and as noted by Noteboom et al. (2021), the adoption of the method must stem from both top-down and bottom-up epics. Therefore, implementing APM often demands a cultural shift, and given the challenge of altering well-established cultures—a process that is arduous and time-consuming—many organizations face difficulties in adopting APM (Boehm & Turner, 2003). The literature mirrors similarities observed in the case company's implementation journey of Agile methodologies. Although the adoption of Agile methodologies and SAFe began in 2018, the implementation is not yet fully completed. This suggests that the implementation of Agile is both time-consuming and complex. Another factor impacting the adoption of Agile is that in larger organizations, there tend to be more dependencies between projects and teams, necessitat-

ing greater formal documentation, which may contradict Agile values and principles (Dikert et al., 2016). The literature resonates with the organizational context of the case company, where dependencies among departments and teams are widespread and significant. Interviewee 11 characterized the contextual situation as "The organization has implemented Agile, but it doesn't work in all situations, and there is a misalignment of what Agile means for the different parties. Agile is based on the absence of dependencies and flexible output. In reality, they have many dependencies and a fixed output.". This highlights the considerable complexity involved in implementing Agile within a large organization with numerous dependencies.

Another factor contributing to the challenges associated with APM is the ongoing skepticism towards the Agile methods (Ciric et al., 2019). An instance of this skepticism is evident in the case of the Agile method Weighted Shortest Job First (WSJF), where some employees within the organization find it inefficient. They argue that the method is effective when working only with large epics. However, other employees find it efficient and incorporate the method in each PI-planning.

Lastly, Cooper and Sommer (2020) claim that Agile projects come with ever-changing plans and evolving product designs. As a result, it is almost impossible to forecast the resources needed and the duration of the project; realistically estimating the likely development cost at the beginning of the process is simply not possible. This literature resonates with the case company's challenge of forecasting and estimations of budgeting and resources. Based on the interviews there is an absence of standardized estimation processes for resources and epics. Instead, the estimation process heavily relies on the knowledge and experience of employees. Interviewee 5 described the situation as: "We do the estimation of resources based on experience, [...] Since the implementation of Agile we had to learn and gain knowledge about the timeframe of different epics to conduct better estimations. [...] When Agile was implemented, processes for estimation of projects disappeared". Thus, several interviewees have raised this situation as an area for improvement.

6.2.2 Agile-Stage-Gate Hybrid Model

The organization has historically relied exclusively on the Stage-Gate model for decades, profoundly influencing its culture and the way of working. This deeply ingrained culture of operating within the stage gate model may have contributed to the differing perspectives among various departments regarding which SAFe methods to adopt and how best to utilize them. This is elucidated in the literature, which addresses the challenge of implementing Agile in larger organizations. Organizational culture and established ways of working can be barriers to implementing Agile methodologies into a stage-gate process successfully (Sommer et al., 2015). Additionally, this difficulty can be attributed to the inflexibility and high degree of systematization and formalization commonly observed in larger organizations (Bergmann and Karwowski, 2019). Another contributing factor to the challenge of implementing Agile in larger organizations as noted by Dikert et al. (2016), is that differing interpretations of Agile among teams can exacerbate these issues. In

a multi-team environment lacking consistent Agile guidance friction and fragmentation may arise. Hence, it is preferable to minimize disparities in Agile cultures across different teams. An example of this existing misalignment within the organization is the disparity between teams and management regarding the output of each PI increment and the interpretation of task commitment. Management determines a fixed and predictable output of each increment and anticipates that the tasks the teams commit to will be completed. However, some teams interpret agility differently, believing that committing to a task does not necessarily mean that you have the ability to complete it and deliver a flexible output. Interviewee 10 stated "We do not deliver what we promised. The output is 40% of what we committed to."

Furthermore, Agile methodologies are integrated into each stage of the Stage-Gate model, replacing traditional planning methods such as Gantt charts, timelines, and critical path plans (Cooper, 2016), with PI planning and tools such as sprints, scrums, and backlogs (Sommer, 2016). However, some Agile release trains within the organization struggle to balance the combination of Agile and the stage gate model. This is due to the difficulties with effectively planning after Introblocks that have fixed milestones and deadlines in combination with the PI planning. An Epic within the Technology function that is connected to a specific Introblock needs to adhere to a few general decision points to secure progress. In a way, this is similar to a project's gate-model. Interviewee 11 described the situation as "It's difficult to combine Agile with the Introblocks that have a fixed deadline, fixed price, and a fixed date, for example".

6.2.3 The Ability to Say No to Epics

Based on the findings regarding the ability and possibility to decline epics, it becomes apparent that portfolio managers are expected to accept epics, despite insufficient information, unclear scope, and the absence of project timelines. Consensus among portfolio managers suggests that thorough pre-study and enhanced information gathering should precede the inclusion of epics in the Global Prioritization List during the weekly meetings of the Global Prioritization Team. This sentiment is echoed by Lane (2017), who underscores that traditional gating processes often entail early stages where market and technical assessments are conducted to gather essential information before proceeding, yet this front-end work is often neglected. Moreover, Markham (2013) contends that this constitutes a critical aspect of the innovation process, necessitating comprehensive information for decision-making, an aspect identified by portfolio managers as an area for improvement in Portfolio governance meetings.

Furthermore, at lower hierarchical levels, teams assert that they possess full authority to decline epics. According to interviews with Product Owners, as long as they possess deep technical knowledge and understand the requirements for current and upcoming PIs, they can reject epics without difficulty. This assertion is supported and emphasized by Dikert (2016), who suggests that proficient and experienced product owners tend to collaborate effectively and deliver higher-quality products.

The ownership and product-centric approach empower the team to influence technical development significantly, fostering high morale. Dikert (2016) further states that granting teams decision-making authority over work items can enhance productivity and morale, which, in this case, indicates a successful implementation of Agile practices within the company. In conclusion, there is a distinct difference between higher and lower hierarchical levels within the organization, and Dikert (2016) suggests that both teams and management must align to effectively coordinate Agile practices on a large scale.

6.2.4 Epics with Low Priority

By maintaining a Global Prioritization List, it becomes crucial to prioritize various epics based on multiple criteria to maximize business value. As noted by El Hannach et al. (2016), project prioritization plays a pivotal role in ensuring the execution of projects that promise the highest revenue potential for the company. However, the process of project prioritization is complex, given the necessity to address multiple objectives simultaneously, contend with conflicting priorities, and cope with measurement challenges. The company's reluctance to pursue epics with low priority suggests that not all epics capable of delivering high business value to the company are pursued due to their lower prioritization number. Consequently, this impedes the organization's ability to leverage the benefits of having a prioritization list within portfolio management. Increasing the uptake of tasks with lower priority could significantly boost the company's capacity to deliver enhanced value to its end customers.

Furthermore, epics with a priority of 7 or lower are not pursued, and the main issue lies in the excessive length of the list, with too many epics included. Cooper et al. (2004) explain that the most common challenge in portfolio management is managing numerous concurrent development projects. Despite being a common issue in portfolio management, the process of selecting epics is not entirely straightforward. From the interviews, it became apparent that various other factors impact and take precedence over low-priority epics, such as legal requirements, quality issues, or impending start-of-production deadlines. Therefore, one cannot simply work through the list from top to bottom, ticking off epics one by one; rather, the list is a dynamic document requiring continuous updates. This perception is strengthened by Cooper and Sommer (2022), who states, "[...] existing projects may need to be extended, expedited, or terminated accordingly". However, the reluctance to remove any epics from the list is also described in the interviews, stemming from the fear that once removed, they will not be revisited, leading to a perception of abandonment. According to Haijian et al. (2022), senior management rarely terminates projects, opting to halt them only in clear cases of failure, which applies in this case.

Furthermore, it is frequently observed that portfolio managers "hide behind" the Global Prioritization List and abstain from pursuing an epic based on its low priority number. Cooper (2006) describes that scoring models are among the most highly recommended tools for maximizing the value of project portfolio management

in general. These models comprise various main criteria and sub-criteria used for evaluating projects from different perspectives. In the context of the case company, although the scoring model is theoretically implemented, its practical application is lacking. This deficiency becomes particularly evident when epics with priorities lower than 7 are consistently overlooked. As a consequence, the intended functionality and effectiveness of the prioritization list and scoring models are compromised.

6.3 RQ3: How Can the Case Company Enhance the Effective Utilization of its Prioritization List within its Project Portfolio?

Based on the analysis above, 6 recommended actions have been formulated, all of which are considered to improve the utilization of the Global Prioritization List and the prioritization process. The recommended actions are as follows, without any particular order of importance:

1. Clearly communicate which parts of SAFe and Agile should be adopted:
The organization should clearly communicate which methods of Agile and the SAFe framework should be adopted to ensure alignment within the organization and establish a unified approach to the way of working. Further, it's crucial to analyze whether all suggested Agile practices from the SAFe framework can be universally applicable across the organization, or if some Agile practices are better suited at different parts of the organization depending on their technical domain.

Further, Agile and the SAFe framework emphazises flexibility and adaptable outcomes, often because epics have no fixed start and end dates according to the information provided by the SAFe framework. However, the organization demands predictability with clear start and end dates. Therefore, it's crucial to consider whether this aspect of Agile should be integrated into the organization or not. Additionally, understanding how to work with flexibility within the organizational context is essential.

Another recommendation is to provide additional clarification on which features, stories, and tasks are associated with each Introblock in JIRA. This would ensure that teams have a clearer understanding of the timeframes, making their work more manageable. Additionally, the priority number of tasks must be visible at all levels within JIRA.

Finally, the organization needs consistency in what an epic is, its components, and the differentiation between what an epic is and what a project is.

2. Implement clear dependencies:
To easily and effectively utilize the Global Prioritization List dependencies should be mapped between ARTs for each epic and its related tasks. To streamline operations at higher levels, there should be a system leader spanning across all departments,

similar to a system architect but at the functional level, coordinating efforts. This individual should possess strong technical knowledge, understand how everything interconnects, and be able to support epic owners who may lack technical expertise. The system leader would make decisions instead of various streams making separate decisions regarding a complex product, mapping relationships between epics and epics. For instance, an epic prioritized at level 5 may need to be completed before a level 2 epic can commence.

Furthermore, at the team level, there should be a shared JIRA board or similar system to clarify dependencies between ARTs and teams. This alleviates the burden on POs, who would otherwise need to navigate different teams' JIRA boards to check their status. While experienced POs often have a clear understanding of dependencies and ownership, establishing a central repository can aid new POs, foster collaboration between ARTs and teams, and provide visualization for better oversight.

Lastly, it is recommended to add an additional dimension to the Global Prioritization List. This dimension should analyze how many of the affected ARTs involved in an epic's delivery can complete their tasks during the PI. For example, if a majority (>50%) of the ARTs can complete their tasks during a specific PI, this should mandate that the remaining ARTs also prioritize the epic's tasks, even if the epic holds a lower priority compared to other tasks in the ARTs' backlog.

3. Data-driven decisions:
To enhance the decision-making process and ensure more accurate decisions and forecasts of the output, the organization should initiate data collection. This data should be used to strike a balance between available resources and the number of tasks planned to be completed by each PI increment. Analyzing and iterating on the data of committed tasks and completed tasks will help achieve predictable and accurate forecasting of the output for each PI. This will offer insight into the resources that are available and ultimately ensure the appropriate number of tasks are committed to. Currently, teams have too many tasks, resulting in lower output due to the excessive workload.

Furthermore, the organization could gain advantages and save time by adopting a software tool capable of automatically collecting and managing all relevant data for the prioritization process. This not only saves time but also enhances the likelihood of attaining more precise and predictable results. Additionally, such software is superior to the manual handling of Excel sheets, empowering the organization to make data-driven decisions more efficiently.

4. Improve the 1-10 Levels List:
To enhance clarity regarding the criteria outlined on the 1-10 list, additional clarification is essential. It is necessary to quantify and elaborate on what constitutes high, medium, and low business value. The prioritization list from 1-10 lacks adequate definition at certain levels, particularly levels 5-7, where quantification is lacking

and interpretation by employees regarding business value is relied upon. This uncertainty leads to discussions and frustrations among portfolio managers and can prolong decision-making processes. To streamline this, a reference list with examples of epics classified under priority levels 1, 2, 3, etc., would be beneficial. Additionally, all new hires should receive training to ensure uniform interpretation of the list. While this may seem time-consuming initially, it is likely to be more efficient in the long run as it ensures alignment in how the 1-10 list should be utilized.

5. Improve the utilization of the Global Prioritization List:

- Prioritization process

The prioritization process could be improved in several ways. Firstly, there should be an easily accessible guide for understanding how the Global Prioritization List works, ensuring clarity regardless of one's position in the hierarchy. This would also be beneficial for new employees to more easily grasp the prioritization process. In addition, the Global Prioritization List is at too high a level for it to be practical for POs and ARTs to use it as a tool. If the intention is for the Global Prioritization list to be utilized at all levels of the hierarchy, a breakdown structure should be discussed.

Further, communication on how to utilize the global prioritization list should be provided to establish a common understanding. This would prevent misalignment of how to utilize the list and enhance the way of working. In addition, this would ensure that the Global Prioritization List is not used as an excuse for neglecting low-priority tasks or lacking flexibility in the tasks planned to be completed during the PI. This would also ensure the likelihood of low-priority epics and their related tasks being completed. In addition, to ensure epics and tasks with low priority are completed, the tasks should be derived from the epics prioritization number. This means a task of an epic of priority 7 could be given priority 5 since tasks within an epic may be urgent even if the epic itself has a low prioritization number.

Moreover, clear communication is essential regarding what should be prepared and the necessary preparations required before the Portfolio governance meetings. Additionally, the scope of the epics should always be thorough and comprehensive. This is crucial for portfolio managers to understand if the Technology Stream has the capability to commit to the epic. Furthermore, to achieve a unified way of working within the portfolios, a suggestion is for all portfolio managers to maintain internal lists. This addition would facilitate a unified approach to breaking down epics across the hierarchy and provide clarity for GTMs and PMs when communicating goals and strategies to the Agile release trains.

Finally, a process for removing epics should be established to ensure that all epics are kept up to date and aligned with the Case Company's strategic objectives. This would increase the likelihood of completing more epics within the same time-frame, as ARTs can focus on fewer tasks simultaneously.

- Administration

A suggestion for improving the Excel list itself would be to add another color that represents "Committing to complete the task," in addition to the green color that currently signifies "Committing to delivery," but in reality means committing to start the tasks.

6. Implement standardized estimation processes:
Establishing a reference project for estimating the time and resource requirements of a new epic is crucial. Sole reliance on experiential insights and bottom-up computations poses the risk of overlooking critical aspects, potentially culminating in unforeseen challenges during subsequent stages. Implementing a standardized approach to estimating epic scope helps simplify the process by comparing it to similar past epics or endeavors.

Moreover, the integration of an estimation tool assumes significance in calculating capacity, visualizing resource availability, and discerning team workload, as underscored by interviewees. Presently, teams independently assess their capacity utilizing various methodologies, such as whiteboard deliberations or Excel-based compilations, owing to the absence of standardized protocols. The requisite tool need not be advanced, but should adhere to standardized practices. This tool serves as a pivotal support mechanism, furnishing insights into resource availability, team workload, and allocation of time assets. Standardizing the approach to capacity estimation, encompassing variables such as development cycles, velocity metrics, and the inputting of parameters like capabilities, hours, and days, emerges as a fundamental principle for productive epic governance.

7
Conclusion

The purpose of this thesis is to investigate the portfolio management landscape within the Technology function at the Case Company and offer insights to enhance its effectiveness. Additionally, to enhance comprehension of challenges associated with portfolio management, and provide valuable insights into best practices that can be shared and refined for the continual improvement of portfolio management processes. The thesis utilized a literature review and conducted a case study at the Case Company to answer the research questions and fulfill the defined purpose. Thereafter, an analysis of empirical data from the case study was performed to identify potential challenges and findings.

The findings of the report display that since the implementation of Agile a prioritization list has become necessary to prioritize initiatives. The Global Prioritization list is found to be an efficient and useful tool to provide guidance and ensure alignment with the case company's strategic direction and objectives. However, it is evident that there are opportunities for improvement regarding the utilization improvement in both the utilization of the Global Prioritization List and the prioritization process within the organization. These improvements include standardized prioritization processes, standardized estimation processes, and a unified adoption of Agile and SAFe to ensure alignment and consistent ways of working across the organization. To improve the prioritization process within the case company six recommended actions were formulated as follows, without any particular order of importance:

1. *Clearly communicate which parts of SAFe and Agile should be adopted*
2. *Implement clear dependencies*
3. *Implement data-driven decisions*
4. *Improve the 1-10 levels list*
5. *Improve the utilization of the Global Prioritization List*
6. *Implement standardized estimation processes*

In conclusion, this thesis revisits extensive research domains of portfolio management and prioritization processes, offering a springboard for enhancing current practices. The recommendations presented serve for continual improvement in the realm of portfolio management within the Case Company.

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A

Appendix A

A.1 Interview Guide Portfolio Manager

Background

1. Can you describe your role and your responsibilities?
2. Which portfolio are you responsible for?

Questions related to RQ1:
"How is the case company currently working with its planning methods and tools to prioritize projects within the project portfolio?"

1. What needs to be prepared within your portfolio ahead of the prio meetings with the other portfolio managers?
   (a) Which meetings and with whom (e.g., PM, PO, RTE) do you have within your portfolio ahead of the prioritization meetings with the other portfolio managers?
   (b) Do you use any planning methods or tools from the SAFe framework?

2. What impact do the various stakeholders have on the prioritization process, and who are your most important stakeholders?
   (a) How are their inputs integrated into the decisions about prioritizing initiatives?

3. Do you have your own extended prioritization list for your portfolio, or do you solely rely on the global prioritization list?
   (a) How do you determine the prioritization order of initiatives for it? Is the 1-10 list used?
   (b) Do the trains use that list, or do they develop another priority list on how initiatives should be prioritized during the 10-week increment?
   (c) How are your initiatives within our portfolio prioritized against the initiatives on the global prioritization list?

4. Proportionally, how many of your initiatives are on the global prioritization list?

5. Can you accept or decline initiatives that affect your portfolio?

6. How much slack is planned for each increment? Do you have capacity for "unplanned" events?

Questions related to RQ2:
"What are the primary challenges associated with utilizing a prioritization list within the case company?"

1. What do you consider to be the biggest challenge in determining the prioritization order of projects within your portfolio?

2. Are there any specific challenges or limitations that arise when the prioritization list is used as a guideline within the technology stream?
   (a) Do intro blocks counteract the prioritization of initiatives?

3. Have there been instances where the prioritization list has not effectively guided decision-making or resource allocation? If so, what were the underlying reasons?

4. What are the main challenges in allocating resources before each increment?
   (a) Are the resources sufficient to complete what you have planned for the increment?
   (b) How are resources allocated between high-priority and low-priority initiatives?
   (c) What happens if initiatives planned to be completed during the increment are not successful?
   (d) How much do your deliveries get affected by the other technology streams?

Questions related to RQ3:
"How can the case company enhance the effective utilization of its prioritization list within its project portfolio?"

1. How do you think the planning of the prioritization order could have been improved?

2. In your opinion, what are the key factors contributing to the effective utilization of the prioritization list?

3. Are there any additional tools or methods that could enhance the utilization of the prioritization list within the project portfolio?

4. Do you believe the prioritization list is the most effective approach?

A.2 Interview Guide GTM

Background

1. Can you describe your role and your responsibilities?
2. Which agile release train are you responsible for?

Questions related to RQ1:
"How is the case company currently working with its planning methods and tools to prioritize projects within the project portfolio?"

1. Before the portfolio prioritization meetings, do you provide inputs to the portfolio managers regarding the prioritization numbers your initiatives should have on GTT's large prioritization list?

2. At the beginning of each PI increment, do you use the same ranking of your initiatives as on the global prioritization list? Why or why not?

3. Do you have your own priority list for your stream where all your initiatives are included?
   (a) If yes, what is the process for determining the prioritization order? Is the 1-10 list used?
   (b) Who provides inputs on how different initiatives should be prioritized?
   (c) Is what is planned for the PI increment affected by intro blocks?
   (d) Do you plan for trains to achieve less as the SoP approaches?

4. How do you quantify the size of an initiative and how much resources it will require?

5. How do you quantify and visualize the amount of resources/capacity you have from the trains?

6. How do you calculate the workload of the trains?

7. How do you distribute the resources among the trains?

8. How are resources allocated between initiatives that are high vs low ranked in the prioritization list? Do you have any influence over it, or is it determined from above?

9. How much slack do you plan for? Do you have capacity for "unplanned" events?

10. Who are your most important stakeholders?

Questions related to RQ2:
"What are the primary challenges associated with utilizing a prioritiza-

tion list within the case company?"

1. What are the biggest challenges in developing a prioritization list for your trains?

2. What are the biggest challenges in allocating resources between the trains?

3. Are there any specific challenges or limitations that arise when the prioritization list is used as a guideline for the trains?

4. Do you find that the trains execute initiatives in the order you recommend?

5. Do you consider the workload planned for each increment to be reasonable for the trains to accomplish?
   (a) Do you have the opportunity to influence the amount of work you take on before each increment?
   (b) What happens if the planned work is not completed? Consequences?
   (c) Do you believe the trains promise to deliver more than they actually do at the end of the increment?
   (d) Do you plan to complete all initiatives regardless of their priority during a PI increment?

6. Do you experience intro blocks conflicting with deliveries from the prioritization list that need to be completed during each PI increment?

Questions related to RQ3:
"How can the case company enhance the effective utilization of its prioritization list within its project portfolio?"

1. How do you think the planning of the prioritization order for initiatives could have been improved?

2. In what ways do you think resource allocation could have been improved?

3. In your opinion, what are the most important factors contributing to the effective utilization of the prioritization list?

4. Are there any additional tools or methods that could improve the utilization of the prioritization list within the project portfolio?

A.3 Interview Guide PM

Background

1. Can you describe your role and your responsibilities?
2. Which technology stream and substream are you part of?

Questions related to RQ1:
"How is the case company currently working with its planning methods and tools to prioritize projects within the project portfolio?"

1. How does the process to conduct the prioritization list of the initiative for each increment within your sub-stream look like?
   (a) Do the different sub-streams collaborate and have dependencies between them?
2. Who is part of conducting the prioritization list?
3. Are any planning methods or tools from SAFe used?
4. Do you use the 1-10 prioritization levels list?
5. How is the prioritization list affected by the intro-block?
6. Who are your sub-streams most important stakeholders?
7. How is the technology function prioritization list utilized when conducting your internal prioritization list?
   (a) Are the initiatives prioritized in the same order?
8. How is the team then using the prioritization list conducted by the sub-stream?
   (a) What does the communication pattern look like between you and your product owners?
   (b) How are the resources divided between initiatives that are prioritized high versus low? Do you have any influence over the prioritization order of an initiative or is it decided higher up in the hierarchy?
   (c) Do you spare resources for "unplanned events"? Do you have the capacity to handle unplanned events?

Questions related to RQ2:
"What are the primary challenges associated with utilizing a prioritization list within the case company?"

1. What is the biggest challenge with conducting the prioritization list for the sub-stream?

2. What is the biggest challenge with synchronizing with the other sub-streams?

3. Are there any specific challenges or limitations that occur when the prioritization list is used as a guideline for the substreams?

4. In your opinion, is the workload for each increment reasonable?
   (a) What are the consequences if the planned workload is not finished?
   (b) Do you have any possibility of adjusting the workload that is planned for each increment?

5. Does the planned work for the intro-blocks contradict the planned work for the PI increment?

Questions related to RQ3:
"How can the case company enhance the effective utilization of its prioritization list within its project portfolio?"

1. How could the planning of the prioritization list be improved?
   (a) What is the biggest challenge with synchronizing with the other sub-streams?

2. What are the most important aspects that could contribute to an efficient utilization of the prioritization list?

3. Do you think the prioritization list is the most efficient tool?

A.4 Interview Guide PO

Background

1. Can you describe your role and your responsibilities?
2. Which technology stream and substream are you part of?

Questions related to RQ1:
"How is the case company currently working with its planning methods and tools to prioritize projects within the project portfolio?"

1. What does the process to conduct the prioritization list of the initiative for each increment within your sub-stream look like?
   (a) Do you use the global prioritization list as a guideline to prioritize your initiatives internally?
   (b) Do you use the 1-10 list to rank your initiatives?
   (c) Do you utilize any planning methods or tools from the SAFe framework?
   (d) Who is involved in determining the prioritization order of initiatives for your team?
   (e) How are initiatives planned to work on during the increment affected by intro blocks?

2. Is your work dependent on deliveries from other sub streams?
   (a) Is it clear which initiatives you are supposed to contribute to for other sub streams?

3. What does the process of creating the backlog look like?
   (a) Do the team make the tasks in the backlog in a specific order?
   (b) Do they work with the tasks in parallel?

4. How are resources allocated between high-ranked and low-ranked initiatives on the prioritization list? Do you have any influence over this, or is it determined from above?
   (a) During an increment, do you work on all initiatives regardless of their priority?
   (b) How much slack do you plan for? Do you have the capacity for "unplanned events"?

5. Who are the most important stakeholders for your team?

Questions related to RQ2:
"What are the primary challenges associated with utilizing a prioritization list within the case company?"

1. What is the biggest challenge with conducting the prioritization list for your teams?

   (a) What is the biggest challenge in syncing with the other sub-streams?

2. Are there any specific challenges or limitations that arise when the prioritization list is used as a guideline for the teams?
   (a) Do you consider the workload planned for each increment to be reasonable?
   (b) What happens if the planned work is not completed? Are there any consequences?
   (c) Do you have the opportunity to influence the amount of work you take on before each increment?
   (d) Do you know how loaded your team is?

3. Do you experience conflicts between intro blocks and initiatives from the prioritization list during a PI increment?

Questions related to RQ3:
"How can the case company enhance the effective utilization of its prioritization list within its project portfolio?"

1. How could the planning of the prioritization list be improved?
   (a) What is the biggest challenge with synchronizing with the other sub-streams?

2. What are the most important aspects that could contribute to an efficient utilization of the prioritization list?

3. Do you think the prioritization list is the most efficient tool?

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