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Integration of Creativity in the Requirement Engineering Process for Agile Software Development

A case study to understand the degree of integration of creativity

Master's thesis in Computer Science and Engineering

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CHALMERS UNIVERSITY OF TECHNOLOGY
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Abstract

The research systematically explores the integration of creativity within the Requirement Engineering process for Agile software development aiming to potentially enhance adaptability, collaboration, user-centricity, and innovative capacity of Agile software development, ultimately contributing to the successful delivery of projects that surpass user expectations in a rapidly evolving market. Drawing from systematic reviews and empirical studies, it highlights the significance of creativity in Agile software development and Requirement Engineering, addressing a gap in research within Agile Requirement Engineering in an industrial context. Case study research including a field study in the form of observation and semi-structured interviews was conducted with respondents from Capgemini Sverige AB and a company headquartered in Gothenburg, Sweden, recognized in automotive transportation and infrastructure (company Y), focusing on understanding current Requirement Engineering process, Agile software development practices, creativity perceptions, challenges, ongoing creativity practices, and innovative thoughts. Data-driven reflexive thematic analysis was employed to systematically identify, analyze, and interpret connections within the qualitative data collected and the results identified four distinctive themes: creativity perceptions and opportunities, challenges, practices, and idea integration. An evaluation survey was organized to validate our qualitative thematic coding results. Overall, the research contributes to the ongoing discourse on creativity in requirement engineering and its relevance for Agile software development. It underscores the importance of embracing creativity as a key driver of innovation and quality in Agile projects, paving the way for future research and practice in this domain.

Keywords: Creativity, Requirement Engineering, Agile software development, Case study, Thematic analysis.

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Abbreviations

Abbreviation	Description
RE	Requirement Engineering
BA	Business Analyst
UX	User Experience
UI	User Interface
UAT	User Acceptance Testing
SAFe	Scaled Agile Framework
PI	Product Increments
AI	Artificial Intelligence
KT	Knowledge Transfer
RQ	Research Question

1
Introduction

Creativity is a central topic of discussion in varied fields including education [35], engineering [13], psychology [36], aesthetics [12], and economics [29]. Most research and theory-based definitions split creativity into two components as discussed by Kaufman and James [21]. Creativity must represent something different, new, or innovative and must also be appropriate. Creativity is also broadly elaborated as noticing issues or gaps, figuring out the difficulties, ideations, and assessing solutions, and adjusting them as needed for dissemination [28]. Moreover, Runco and Jaeger [32] deliberate a bipartite standard definition of creativity. Creativity requires to be original and effective meaning novel and unique things must be effective to be creative. Therefore, defining and assessing creativity is multi-dimensional, and evolves across domains [28]. The research by Maiden et al., [25] shows that creativity differs from innovation in practice. While creativity focuses on the generation of novel ideas, innovation is defined as the practical application of results from creativity. Therefore, innovation is associated with software development, while creativity is emphasized in the context of RE.

The research conducted by Nguyen and Shanks, [30] has proposed a theoretical framework to better understand creativity in the RE process. The paper concludes that creativity is an important aspect of RE and that it can be fostered by incorporating the five elements of the framework; product, process, domain, people, and context into RE processes and methods. Further research is suggested to empirically examine how the creativity elements apply to RE and to integrate them within RE methods. As per the review of Aldave et al., [7] the software development that typically begins with the definition of RE significantly influences the final product quality. The research suggests further investigating the insight from the industry on the application and significance of creativity for RE. Also, prior research provides a review of the literature on creativity in Agile software development. Conboy et al. have identified key challenges and opportunities to enhance creativity in Agile projects. Further investigation is suggested in identifying factors, tools, and techniques that contribute to creativity in Agile projects [10]. Moreover, the research conducted by Barra et al., [16] suggests that Agile methods prioritize creating effective software over originality, but it is important to formalize creative phases to generate ideas and make options.

Existing literature on creativity in RE, while acknowledging its significance, lacks a comprehensive exploration of its application within the context of Agile software development. Previous studies, including those by Maiden et al. [25], Nguyen and

Shank [30], Saha et al. [34], and Lucia and Qusef [17] have provided insights into creativity in RE. However, these studies fall short in addressing the specific aspects of Agile development, characterized by its iterative, dynamic, and collaborative nature, which can enhance and hinder creativity in RE. Previous studies have not fully examined how these specific aspects of Agile development influence creativity in RE. To develop effective strategies for fostering creativity in Agile development, it is necessary to have a deeper understanding of how these unique characteristics impact the creative thinking process. This gap highlights the need for a systematic review and integration of creativity within the Agile RE process. Therefore, research needs to be done in an industrial context to examine the existing phenomenon, the perception of creativity, and identify the challenges, the influence, and strategies and practices for addressing creativity.

We expect in our research to study creativity in RE for Agile software development in depth to understand its ability to generate and adapt requirements dynamically and innovatively within the context of Agile methodologies. In an Agile framework, requirements are expected to evolve throughout the development process, responding to changing customer needs and market conditions [9]. Therefore, we plan to investigate the phenomenon, challenges, opportunities, and the degree to which creativity can be incorporated into the process. Specifically, our research aims to study when, where, and how the RE process of Agile software development embraces and promotes creativity. A systematic exploration of how creativity can be seamlessly integrated into the RE process within Agile frameworks is lacking, necessitating a focused research effort. The importance of studying creativity in the RE process for Agile software development lies in its potential to enhance project effectiveness and success. Agile methodologies emphasize responsiveness to change, collaboration, user-centricity, and innovation [18].

1.1 Problem Statement

The study aims to address this gap by systematically investigating hindrances and opportunities of integrating creative thinking, the influence of short sprint duration on incubation and reflection for creative thinking, the impact of exploring requirements and solutions parallel in a dynamic environment, adopting changing requirements and continuously involving end-users feedback while encouraging creativity. A case study design methodology guides the research involving Agile teams in industrial settings (Capgemini Sverige AB and a company headquartered in Gothenburg, Sweden, recognized globally for its leadership in automotive transportation and infrastructure), employing a qualitative research approach. We have used different data sources and method triangulation to enhance the validity and reliability of the findings.

1.2 Purpose of the Study

The purpose of the study is to address our overall research objective of integrating creativity into the RE process to facilitate creative requirement engineering in the agile development process. The study design investigates the existing RE process in the Agile framework, challenges to leveraging creativity into the RE process, room for expressing creativity, and the degree to which the creativity is applied to the software during the continuous process of agile software development. Specifically applied within the industrial context. Our end focus is to enable agile teams to creatively adapt to changing project needs, encourage collaborative thinking, employ creative user-centric design thinking, and produce innovative solutions that add a competitive advantage to the market with the best user satisfaction.

In summary, our research addresses the gap in the systematic integration of creativity within the Agile RE process. The significance lies in its ability to enhance creativity challenges in requirement adaptations, stakeholder collaboration, and innovative capacity of Agile software development, ultimately contributing to the successful delivery of products that satisfy users above expectations in a rapidly evolving market.

1.3 Significance of the study

The main goal of the research is to study the degree of (where, when, and how) creativity integrated into the RE of agile software process development. Creativity stands for the ability to generate novel ideas or solutions and this involves and motivates thinking outside the conventional framework. We identified studies related to the application of design thinking in RE as a problem-solving strategy in software development. But less in applying creativity specifically to agile software development. This elaborates on the significance of performing the research and the in-depth context for the research topic

RE in Agile process development is a concurrent activity that lies parallel with the process of implementation. The RE process acquires change requests that are required to be developed on frequent deadlines. This leads to the prioritization of the tasks by the team and deployment of the system functions aligned to their relevance and simplicity. A proper understanding of the requirements is important in the software development life cycle hence it affects the cost and the time estimation of the product delivery. Therefore, the significance of the research is to investigate the existing RE process in the Agile framework, the challenges to leveraging creativity into the RE process, the room for expressing creativity, and the degree to which the creativity is applied in the RE during the continuous process of agile software development. The primary intended potential audience for the research is academia. The results of the study may have a greater implication in understanding the gap between the RE process and end-product delivery requested by the end users. This exploratory study will acquire rich information on the context which the researchers

could use to produce effective solutions.

1.4 Thesis structure

The thesis is structured as follows: The background for the study that elaborates the significance of performing the study and the context for the research topic is explained in Section II, followed by the overview of the related works, situating the study within the existing body of knowledge and areas for further investigation. Section III elaborates on the design, the method, and the procedures for study design and data collection followed by the findings of the interviews to a considerable degree.

2
Related Works

In this chapter, a review of the current state of research relevant to the study is presented. An introduction to the perception of creativity in software engineering is given, together with relevant findings that concern Agile Software Development and RE aspects of creativity. Finally, the relevance of the study is given by the review of Agile, creativity, and RE.

2.1 Perception of Creativity in Software Engineering

Ulrich et al. state that creativity has inherently become a part of software development and use since the creative mindset is a pre-requisite in developing innovative software solutions [38]. Furthermore, it is proposed that companies that recognize the economic importance of creativity will have a paramount advantage in the ever-increasing global talent acquisition. This also addresses the fact that organizations will often experience organizational challenges when embracing creativity. Creativity management has been named an increasingly important factor in conducting product and service innovation within software development organizations and this involves increasing expertise in technology, strategy, evolution, and human-computer interaction. The findings have created a framework emphasizing the factors that influence creativity management inside organizations. Those research results in [38] include seven organizational factors including technology and 21 challenges connected to the seven factors. The most important finding is the research has identified requirements, human-computer interactions, and technology acceptance as common challenges under the technology factor influencing the creative context with the software development organizations for practicing creativity challenges. The findings in [16] state that a few studies have reported on the importance of creativity for software development. Though creativity is widely acknowledged as an integral aspect of software development, the same recognition does not always extend to the process of requirements engineering. Furthermore, the research results discussed in [16] also state that in a few of the prior studies creativity has been discussed concerning all the stages of software development and mostly focused on RE.

The research conducted by Mohanani et al. has identified practices and factors influencing the creativity aspects within a software development organization [28]. As per the study, brainstorming is identified as an effective way of exploring creative

ideas on project requirements. Also crowdsourcing, and idea exploration workshops are listed as practices for fostering creativity within employees. Agile software development is suggested as an approach for promoting interaction and enhancing creativity within a software development organization. Additionally, collaboration and communication are identified as the most prominent factors influencing creativity. This also mentions that software engineering has adopted different ways of assessing creativity and four of their primary studies have assessed creativity by counting the new features added, the number of conceptual ideas generated, the ratio of the improvements to the bug resolved in a code, and the subjective assessment of the novelty or the quality of the code. The findings of the research by Mohanana et al. also highlight that multiple domain experts have evaluated creativity as a product and not as a person. Additionally, sufficient information is not declared in evaluating the creativity of a process that would be important in generating innovative solutions and addressing different requirements [28].

The research conducted by Sternberg by [37] demonstrates the relevance of creativity by comparing the art of working individually and at the societal level. The creativity that arises at the societal level can lead to new scientific findings and inventions. Moreover, new products or services thus created generate jobs emphasizing the economic importance of creativity. In such a way, individuals and organizations must adapt existing resources to changing task demands to remain competitive in the market. This explanation is far more adhered with software development since its nature impacts the presence of creativity and capturing changing customer requirements. Innovative software developments often arise from collaborative efforts within the team. The research conducted by [38], indicates that the leading IS development companies such as Google and SAS have integrated creativity into their strategies for fostering innovation. This is achieved through creating creative work environments, providing clear incentives for employees, and nurturing a culture of social creativity where contributions from employees are valid. Osborn (1953) based on his experiments has developed the technique of brainstorming to encourage people to think creatively to seek possible solutions in a more constructive atmosphere [37]. As per Sternberg, [37], one of the interesting findings is that Oech in 1986 suggests that we are required to adopt the roles of explorer, artist, judge, and worrier to foster creative thinking which makes it more relevant when making thoughtful decisions during the development process. Sternberg also explains the cognitive approach to creativity. It exhibits a generative phase and an exploratory phase where these properties are used to generate creative ideas including the processes of retrieval, association, synthesis, transformation, and analogical transfers [37]. These approaches can be linked and also seem to be the essence of building creative inventions within a software development process.

2.2 Agile Software Development

The inception of the "Agile Movement" in the software industry dates back to the publication of the Agile Software Development Manifesto in 2001 by a consortium of software practitioners and consultants (Agile Manifesto). Below are four important

values that are accepted and practiced by the Agile community [8].

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change by following a plan

As per the explanation by [5] the principles of the agile movement emphasize close collaboration among software developers, prioritizing human interaction over rigid processes and tools. Teams strive to continuously deliver tested and functional software through frequent releases, aiming for simplicity and technical excellence to minimize the documentation overhead. Client and team's cooperation with negotiations takes priority over strict contracts. This is vital for maintaining a strong relationship and delivering immediate business value. Software development teams, comprising both expertise and client representatives, are empowered to make informed decisions and adapt to evolving project needs, supported by a flexible contract mechanism.

The findings by [5] also highlight the set of characteristics owned by agile software process development with its fast delivery of nature. These are characterized as per Miller's categorization [27].

- Modularity on the development process level
- Iterative with short cycles enabling fast verifications and corrections
- Time-bound with iteration cycles from one to six weeks
- Parsimony in the development process removes all unnecessary activities
- Adaptive to possible emergent new risks
- Incremental process approach that allows functioning application building in small steps
- The convergent (and incremental) approach minimizes the risks
- People-oriented, i.e. agile processes favor people over processes and technology
- Collaborative and communicative working style

2.2.1 Scrum

In recent years, the software industry has encountered numerous challenges, such as evolving customer needs, intricate software specifications, stringent project deadlines, and limitations in resources and finances. Consequently, there is a growing need for a practical approach to software development that ensures the delivery of top-notch software products within designated time frames and budgets. Scrum emerges as a methodology tailored to address these challenges by organizing software development into short, iterative cycles called sprints [26].

As per [26] the following distinguishing features of Scrum-based development include:

- Collaboration: Scrum fosters collaboration through cross-functional teams where individuals with diverse skills and experiences contribute to optimal design solutions.
- Daily Meetings: Scrum methodology incorporates brief daily meetings, known as scrum meetings, during which the product development team communicates and assesses the progress of software development.
- Product Backlog: The product backlog serves as a repository for all requirements necessary for the successful delivery of a software product. It maintains a prioritized list of features, bug fixes, and non-functional requirements.
- Sprint Backlog: The sprint backlog outlines the tasks to be completed by the development team in the upcoming sprint. Tasks are selected from the top of the product backlog based on the team's capacity and past performance
- Roles: Scrum-based development revolves around three primary roles:
  - Product Owner: This role involves defining, prioritizing, and communicating product requirements, and guiding the product development process.
  - Development Team: Responsible for executing tasks assigned by the product owner within sprint deadlines. Typically, a cross-functional team of 3 to 9 individuals carries out the envisioned product development tasks.
  - Scrum Master: The Scrum Master ensures adherence to Scrum principles and rules. They address impediments to development and facilitate process improvement for the development team and software product.

2.2.2 Kanban

Kanban is gaining significant popularity in the software industry. Kanban offers a method to visualize and control work-in-progress during software development. It emphasizes scheduling to ensure the timely delivery of software products. Organizations worldwide are integrating Kanban into their existing software development processes to enhance business agility [26].

As per [26] below characteristics distinguish Kanban from other Agile methodologies:

- Kanban Board: This tool visualizes workflow, categorizing tasks into to-do, in-progress, and completed sections to optimize work and guide workflow.
- Maximized Productivity: Kanban optimizes workflow and scheduling, minimizing idle time and maximizing team productivity.
- Continuous Delivery: Kanban promotes continuous delivery of software increments, allowing for the release of small product parts in successive iterations to meet evolving customer needs.
- Waste Minimization: Tasks are executed only when needed, reducing overproduction and eliminating wasted work and time.
- Limits on Work in Progress (WIP): Kanban aims to optimize workflow by limiting work-in-progress according to system capacity.

2.2.3 Scaled Agile (SAFe)

According to the systematic review of [31] the Scaled Agile Framework (SAFe) was created by Dean Leffingwell to adapt Agile methodologies for large enterprises [2]. SAFe incorporates practices from Scrum, Extreme Programming, Kanban, and Lean at different levels: Value stream, Program, Portfolio, and Team. At the team level, SAFe involves Agile teams, while Agile Release Trains (ARTs) are introduced at the program level to coordinate multiple teams. ARTs follow HIP (Hardening, Innovation, Planning) iterations to develop Potential Shipable Increments (PSIs) or Program Increments (PIs), which are planned during release planning days. SAFe introduces additional roles such as Agile Release Train Engineer, system teams, release management team, and portfolio management team. The core values of SAFe include built-in quality, transparency, alignment, and program execution.

The key advantages of SAFe include transparency, alignment, quality, productivity, collaboration, and time to market. A significant portion of the cases studied by [31] have reported experiencing these benefits after implementing SAFe, indicating that the framework is effectively delivering on its core values. The research also reveals a set of challenges in SAF as resistance to change, moving away from agile, Agile Release Train challenges, PI challenges, GSD challenges, and staffing product owner challenges.

2.3 Creativity and Agile Software Development

The end goal of agile software development is to provide end-user satisfaction. Therefore, a lack of proper creative RE encounters problems that are most costly to rectify [17]. Agile uses extensive customer collaboration during each sprint and therefore handling consistent requirements becomes significant [9]. The systematic literature review conducted by Aldave et al. [7] proposes that creativity needs to be followed by user engagement and by conditions such as flexibility, time, or resources to a specific context for creativity to bring innovation in Agile but not integrated in an industrial context. The focus on customer satisfaction in Agile software development may compromise creativity in the RE process. The literature review by [7] also brings out the fact that the existing agile approaches when used with a requirement analysis phase focus only on scoping and simplicity rather than problem-solving and discovery. Though the short cycles of development of the functional codes imply that concurrently the requirements and the solutions are investigated, agile does not explicitly endorse creativity [25]. It is evidenced that the short duration of sprint cycles may present challenges for the necessary incubation and reflection processes crucial for fostering creative thinking.

During the decades the perspectives on conventional software have changed and Agile software development has replaced and received notable attention [11]. The research conducted by Conboy et al. [10] states that the current Agile practices such as “self-organizing teams”, “encouraging interactions” and “participatory decision making” possess the potential to initiate creativity and exploration. But also, this

indicates that there are shortcomings of the Agile methods research in the area such as the discussion on Agile methods has only focused on the on-site customers and there is no notable attention to the on-site developers who travel to the customer's site. This is considerable in the case where customer collaboration promotes the success of the end project's goals. Pair programming mode, planning game, collective property, and presence of the client in Agile are explained as a method for promoting communication and emerging creativity [16]. One of the key findings is it suggests that the physical environment in which the work takes place can significantly influence creativity. In Agile though the open space facilitates team collaboration it may not fully address other factors such as noise level, colors, and relaxation areas that also foster creativity.

2.4 Creativity and Requirement Engineering

The RE process includes a series of activities such as discovering, analyzing, specifying, and documenting the requirements of the system that are essential for its development [17]. Systematic reviews are done on creativity techniques used in RE. The research conducted by Saha et al. provides an analysis of different creativity techniques used, their importance, and their applications [34]. This explains creativity as a success factor in the software industry and its significance in producing novelty. It states that creativity techniques and tools can be utilized to easily define the problems even if the stakeholders do not have sufficient knowledge. The findings from [34] suggest the importance of applying creativity to the RE process but specifically not on RE in agile software development. The systematic review conducted by Alam et al. [6] highlights RE as one of the challenges found in Agile and further mentions issues of creativity within the context of agility and in release as a challenge. In the findings of Lemos et al., [23], within their systematic mapping study they have identified that the role of creativity in RE is discussed in a broader way than referring to any specific activity or phase within it. One of the important findings is that incorporating creativity into the RE process involves not only the use of techniques alone but also the use of events such as workshops. This also mentions workshops as an effective means to gather requirements within a short period. However, the significant drawbacks of employing creativity in RE are mentioned due to the time and effort-consuming nature and the necessity of an expert facilitator.

Based on the research findings of Groenevel et al. [19], RE stands out as a prominent area of research within software development, particularly in terms of exploring creativity. Moreover, according to the authors, the study done by Cybulski et al. [14] engaging the practitioners in focus group discussions on creativity depicts that creative problem-solving endeavor is acknowledged by the software development community. However, the findings do not specifically focus on Agile RE. The research conducted by Maiden et al. [24] depicts that RE is not commonly acknowledged as a creative process. However, with the emergence of new systems and products stakeholders are progressively generating and innovating ideas that manifest as requirements. Further depicts that RE with its focus on elicitation, analysis, and management still requires to fully embrace this evolving trend.

The research conducted by Crawford et al. highlights that there is still the need for further investigations into the use of techniques for fostering creativity [11]. This showcases brainstorming as the most popular creativity technique for requirement identification while highlighting role-playing-based scenarios, storyboard illustrations, simulations, and visualization techniques as attempts to foster creativity within the RE process. However, the authors [11] suggest that in the field of RE, the solutions do not emerge spontaneously and it requires active inquiry, observation, exploration, and increasing creating requirements. Furthermore, the research depicts that the importance of creative thinking is expected to increase within the coming years. One of the authors' interesting findings is that requirements analysts are the ideal place to innovate since they understand the business problems and are updated with technology [11]. However, software development is inherently collaborative aiming to produce innovative, high-quality software that satisfies users through effective teamwork.

2.5 Relevance of the study

The review of the literature presents several key insights regarding the integration of creativity into Agile software development processes and RE. Agile methodologies prioritize end-user satisfaction, yet often lack proper integration of creativity in RE, potentially leading to costly issues [17]. Existing Agile approaches tend to prioritize scoping and simplicity over problem-solving and discovery, which may compromise creativity in RE [7]. Additionally, while Agile practices promote collaboration, the physical work environment may not fully support factors conducive to creativity [16]. In RE, techniques such as brainstorming are popular for fostering creativity, but their effectiveness warrants further investigation [11]. Overall, the findings highlight the importance of integrating creativity into Agile processes, particularly in RE, to ensure the development of innovative and high-quality software products. Further research is needed to explore and refine techniques for fostering creativity within Agile environments.

Therefore, within our study, we aim to investigate the perspectives of creativity within the agile requirement process in an industrial context. Our research intends to explore the extent to which creativity is integrated into the RE of agile software process development, including examining the opportunities, challenges, existing practices, and thoughts surrounding creativity. Specifically, we seek to understand the where, when, and how of creativity integration, to shed light on its role in enhancing the development of innovative and high-quality software products. This investigation is motivated by the need to address potential gaps in current practices and to provide insights for practitioners and researchers aiming to leverage creativity effectively within the Agile RE process.

3

Methods

3.1 Study Design

When designing the research method for this case study, we followed the ABC framework of research methods for software engineering research by Stol et al. [22]. According to the framework and to take a systematic approach to solving the research questions, we have conducted this case study in two parts, where one part is to conduct a Field Study (in the form of observation) and the other part as a Judgement Study (in the form of semi-structured interviews) where to elicit information from subjects for purposes of evaluation.

Observations and semi-structured interviews were conducted in parallel to each other. Under observation, we observed the participants in their natural context; working within their Agile development environments, with minimal intrusion into their work environment, and performed data collection. Semi-structured Interviews were conducted by interviewing the participants with some stimulus to extract information for understanding and evaluating the context. We also conducted a final evaluation survey to validate our thematic coding results.

This case study allowed us to study the existing phenomenon, the influence, and effect of the changes, and the relevance of pre and post-events executed inside the context. We were executing exploratory research throughout the case study since it allowed us to investigate our research questions and objectives in depth [33]. The qualitative research method was applied throughout the study design to obtain broader and richer information. The significance of the research method is that it addresses our research objective of studying the degree of where, when, and how creativity is integrated into the RE process for agile software development. Within the research, we made contributions to understand the current RE process practiced, overview the experiences on Agile Software development practices, investigate the perception of creativity within the Agile RE practices, inquire about the creativity challenges or the limitations faced within the Agile RE processes, ideation on embracing creativity and successful stories on where creativity has positively impacted on the RE or Agile development.

3.1.1 Planning the Case Study

The planning process describes the six interleaved stages in the study design process.

1. High-level Design - Formulated the initial version of the research objective and research questions. Some of the literature was studied to understand the background and previous work done in the relevant field of study (RE, agile software development, and creativity)
2. Design and Planning - Analysed different research methods available in the software engineering field of study to design the case study. Also formulated the case study protocol, informed consent, and a guideline for the interview.
3. Data Collection - Created a plan and a schedule to conduct interviews, and audio recordings and generate the transcripts.
4. Data Analysis - Evaluated available qualitative data analysis techniques, coding practices, coded transcripts, and thematic analysis.
5. Reporting - Structuring the findings from the analysis and producing conclusions supported by evidence.
6. Validity threats - evaluating the trustworthiness of the results.

3.1.2 Research Questions

The following research questions were developed to guide the study.

[**Research Question 1**]: What is the perception of creativity in Agile Requirement Engineering processes?
Motivation: Understanding stakeholders' perceptions of creativity within Agile Requirement Engineering processes is essential for recognizing its emergence, collaborative aspects, and iterative nature, thereby informing strategies to foster creativity effectively.

[**Research Question 2**]: What are the challenges in integrating creativity in Agile Requirement Engineering processes?
Motivation: Identifying and addressing challenges in integrating creativity into Agile Requirement Engineering processes is crucial for overcoming obstacles that hinder innovation, and ensuring the development of high-quality software products.

[**Research Question 3**]: What are the creativity practices employed to establish creativity in Agile Requirement Engineering processes?
Motivation: Exploring the practices used to foster creativity in Agile Requirement Engineering processes offers valuable insights into successful approaches for encouraging innovation and cultivating an environment supportive of creativity within Agile teams.

[**Research Question 4**]: What are the creative thoughts and trends that enhance creativity in Agile Requirement Engineering processes?
Motivation: Exploring thoughts and trends to foster creativity in Agile Requirement Engineering leads to the realization of innovative solutions.

3.1.3 Data Collection

In the pursuit of comprehensive data collection, consent was obtained from Capgemini Sverige AB to conduct interviews and observations within their Gothenburg office. Furthermore, to ensure the robustness and validity of our findings, identical interviews were conducted with another prominent company headquartered in Gothenburg, Sweden, recognized globally for its leadership in automotive transportation and infrastructure (Company Y).

Capgemini is a global leader in software and technology consultation with offices established in more than 40 countries. Also, they have offices situated in 13 different cities within Sweden. Capgemini (Sweden) has given consent to conduct interviews within their internal software product development teams allocated to their Gothenburg office. There are three (3) different internal software product teams working at their Gothenburg office and were allowed to interview the team members for the collection of data. There will be a minimum of ten (10) interviews conducted at Capgemini Sverige AB (please refer to Table: 3.1). Apart from this, there will be a minimum of another five (5) interviews which will be conducted at the company Y. (please refer Table: 3.2). Since one of the research students is employed at Capgemini Sverige AB, Capgemini has given consent to conduct observations on a selected team for a period of two sprints (six weeks) as part of the data collection.

3.1.4 Context of the data sources

Both of the above-mentioned companies have software development teams that focus on developing specific software products internal to their organizations. These product development teams focus on innovations and implementation of cutting-edge technologies in their software products. This scenario makes these organizations suitable candidates for our case study since they might be already using creativity in their requirement engineering process. Also, one of the research students of this master thesis is currently employed at Capgemini Sverige AB also a member of one of these internal project teams. Product development teams of both companies practice at least some form of Agile software development methodologies (Scrum, SAFe) and are comprised of the relevant roles (i.e. Scrum Master, Product Owner). As for the study, we will be conducting interviews with different team members of these teams and also planning to observe their ceremonies (i.e. Sprint Planning, Backlog grooming) to analyze to what extent, they are using creativity in their requirement engineering process.

3.1.5 Interviews

As part of the interviews, where a set of interview questions was used as a guide so that the responses given by the interviewees followed a stimulus. We conducted semi-structured interviews, where interviewees were allowed to express their ideas freely. All interviews were conducted via Microsoft Teams and were recorded and

transcribed into text format using Microsoft Teams itself. The transcript generated by the Microsoft Teams was then manually checked with the recording and corrections were made if there was any. The following set of questions was used during the interviews as a guide in conducting the interviews.

1. Understand the requirement engineering process.
   1.1. Explain the process your software development team uses for gathering, prioritizing, and managing requirements.
   1.2. Any specific tools or methodologies used to manage requirements?
   1.3. How do you ensure customer needs and business objectives/project goals are effectively captured and matched for system development?
   1.4. What common challenges or pain points were experienced during the requirement engineering?
   1.5. Any ongoing initiatives or plans to improve the requirement engineering process within your team?
2. Understand the agile way of working.
   2.1. Experience with agile software development practices?
   2.2. What specific techniques or ceremonies are used within the team (such as sprint planning, backlog grooming, or retrospectives), and do they play a significant role in managing requirements?
   2.3. How easy is it to manage and prioritize the requirements/user stories specifically within the agile framework used?
   2.4. Participation in ideation sessions as part of the agile requirement engineering process?
   2.5. If yes - What type of sessions? With whom? Did creative ideas gathered through these and helped to achieve the project goals and user's needs?
   2.6. If no - Do you believe having different ideation sessions would help you in the future to assist in managing requirements?
   2.7. Ongoing efforts or plans to refine or improve Agile practices within your team?
3. Understand the level of creativity.
   3.1. How does your Agile team view creativity?
   3.2. Current role of creativity specifically played in the requirement engineering?
   3.3. How does your team adapt to changing customer requirements? and how do you encourage/ manage creative thinking there?
   3.4. Does the iterative nature of Agile development / Concurrently explore requirements and solutions promote or hinder creative thinking?
   3.5. What challenges are perceived when working with short sprints?
   3.6. How does it manage the balance between meeting sprint deadlines and having time for reflection on requirements/phases for creative thinking?
   3.7. Have you experienced Overemphasis on user stories as a challenge/hindrance?
   3.8. How does collaboration within the Agile team contribute to or hinder creative thinking in requirement engineering?
   3.9. Do you believe that involving end-users, and their feedback in Agile projects promotes creativity in the requirement engineering process?

3.10. When there's a new requirement with a sudden market change, how does your team approach it? Do you find the space for creative thinking?

4. Challenges and success factors.
   4.1. What current practices the team has implemented to overcome these creativity challenges in requirement engineering?
   4.2. Any thoughts on how creative thinking can be ideally integrated into requirement engineering / Do you find any future trends?
   4.3. Do you believe that embracing creativity in requirement engineering will contribute to the overall innovation of the final product?
   4.4. Any successful experiences where creativity has positively impacted the requirement engineering or Agile development.

Team #	Number of Interviews	Role	Years of Experience
Team 1	7	Scrum Master (P7)	8+
		Product Owner (P5)	10+
		Developer (P2)	7+
		Developer (P8)	8+
		Developer (P9)	5+
		Developer (P10)	13+
		Test Engineer (P6)	15+
Team 2	2	Product Owner (P1)	11+
		Business Analyst (P11)	6+
Team 3	1	Scrum Master (P4)	12+

Table 3.1: list of interviews conducted at Capgemini AB.

Team #	Number of Interviews	Role	Years of Experience
Team 1	2	QA Engineer (P12)	8+
		QA Engineer (P13)	12+
Team 2	3	Developer (P3)	15+
		Developer (P14)	12+
		Developer (15)	14+

Table 3.2: list of interviews conducted at company Y.

According to our plan, we anticipated conducting approximately fifteen (15) interviews for data collection purposes. We completed ten (10) interviews in collaboration with three distinct product delivery teams at Capgemini. Additionally, we have conducted five (5) individual interviews with experts from other companies that are recognized as a leader in the automotive industry. These interviews serve to cross-validate our findings with Capgemini and further strengthen the rigor of our study.

3.1.6 Observations

Observations were conducted within Capgemini Sverige AB, in their Gothenburg office. The observed team was an internal product development team, where they were developing a time reporting tool for internal use. For the observations, the participants were observed in their natural context with minimal intrusion to their work environment [22]. The observations were carried out for a period of two sprints, which comprised the following scrum ceremonies/events/meetings.

- Sprint planning
- Daily stand-up meetings
- Backlog grooming
- Sprint reviews and demos
- Sprint retrospective
- Requirement discussions/workshops

3.1.7 Evaluation survey

We initially planned to conduct a workshop where all interviewees would collectively validate our findings. However, due to difficulties in coordinating schedules, we individually connected with the interviewees and discussed our summary and progress. We shared an online survey with them to gather feedback. Although we analysed responses from fifteen (15) interviewees, we could only contact twelve (12), as three (3) had left their teams. Nine (9) members responded to our survey. The online survey was intended to validate our thematic results and gather additional insights. We aimed to present our data analysis and confirm the accuracy of our research findings.

The questionnaire began with an overview of the thesis and progressively introduced questions based on the summary of findings across four distinct sections: agreement levels with statements concerning creativity perceptions and opportunities, challenges, practices, and creative ideas. We developed one statement for each sub-theme to validate our qualitative thematic coding results. These statements summarized each sub-theme.

Below is an example set of questions:

1. To what extent do you agree with the statement 'emergence of creativity arises with problem-solving and influenced by user-centric design focus'?
   Is there anything you'd like to add relevant to creativity opportunities and perception?

2. To what extent do you agree with the statement 'gap between technical feasibility and the business needs of the clients form ongoing changing requirements'?
   Is there anything you'd like to add relevant to creativity challenges?

We included Likert scale questions that asked respondents to rate their level of agreement on an agree-disagree scale [20]. We also included an open box under each section, allowing users to provide additional suggestions. For example: Not at all,

Somewhat, Neutral, A lot, Extremely and Not Important, Somewhat important, Important, and Very Important were the two sets of Likert scales provided for these questions.

3.1.8 Description on Data Analysis

3.1.8.1 Analysing Interview data

Thematic analysis served as our structured method for analyzing qualitative data. Its purpose was to systematically identify, analyze, and interpret the connections present within the data. Initially, we've established preliminary themes, intending to expand and enhance them as we gather additional data. Themes were obtained to align with our research questions to have a rich picture of the research objective. We followed the definitions of Braun and Clarke [3] for the analysis. It introduces thematic analysis as a valid data analysis technique due to its flexibility and transparency. The inductive approach was practiced in the analysis and it was a data-driven approach [15]. The data was analysed according to the interest and the issues being studied. As defined, thematic analysis adopted the six-phase process to maintain the rigor of the study ([15]). These phases include Data familiarization and writing familiarization notes, systematic data coding, generating initial themes from coded and collected data, developing and reviewing themes, Refining, defining, and naming themes, and Writing the report consecutively.

In the study, we have performed analysis to a degree by developing our initial themes. Prior to the analysis of the data, the interview transcribes were checked with the recorded audios for any data inconsistencies that could occur due to semantics. In the first phase of the data analysis, we were familiarized with the data. We uploaded all the transcripts into NVivo 12 for analysis. The transcripts were carefully read repeatedly to capture the interesting points. While reading the transcripts all the interesting information was highlighted. We noted down the initial ideas that are required to be explored further during coding. During this step, we repeatedly read through the transcripts to get to know the content of our data specifically beyond the surface.

The second phase of analysis assigned codes for the segments of data that represented interesting information. We generated codes to represent the underlying idea, the concept of the potentially interesting information. Therefore it was more like an analytical labeling of data. Codes were created referring to our research questions. Some of the codes were derived concerning the participants' meaning while some of the other codes were obtained concerning the underlying ideas beyond the surface [4]. Also, a codebook was extracted from the NVivo 12 including the data extracts relevant to the specific codes created through repeatedly reading the transcripts. For this initial phase of coding, we used eight interview transcripts and finally analysed the data from fifteen transcripts.

Approaching the third phase of analysis, we organized the codes into potential

themes to capture the essence of ideas and concepts presented in the data. Furthermore, the themes were mapped together to obtain a rich picture of the data. The initial theme mapping and the analysis process are expected to be refined and improved further with more data and transcript reading to extract the essence of our research objective. We also identified that this generated an overall impression of the already collected data and areas to be focused on to achieve quality output. As the researchers we discussed and conducted the coding process for the thematic analysis. This allowed us to revisit and review the data and discuss and resolve the discrepancies. Thus we expected to maintain inter-coder reliability by discussing the decisions, and agreements during the coding process. Refer to Appendix F and Appendix H for additional details about the code book and our initial theme mapping.

Steps four and five included developing and reviewing themes and refining, defining, and naming themes. These phases encouraged understanding the nature of the potential themes developed. We expected to ask questions such as the significance and the quality of these themes, the boundaries existing for these themes, and the abundance of enough meaningful data to support the themes. We continuously performed the analysis to identify that these generated codes work concerning the data extracts and also align with the data set. As discussed in the methodology, we conducted more interviews with randomly selected interviewees from a different automobile company to cross-validate and compare our research findings. Therefore we continuously performed the data analysis following 'Braun and Clarkes' definitions of reflective thematic analysis [4].

3.1.8.2 Analysing Observation data

Thematic analysis also served as our systematic method for observation data analysis. Its purpose was to systematically identify, analyse, and interpret the connections within the data collected through the observations of a single internal product team for a period of two consecutive development sprints. The analysis was conducted as a data-driven reflexive thematic analysis.

In the study, we performed the analysis by generating initial themes that align with our research questions. Prior to the analysis, the observation reports are repeatedly checked to avoid inconsistencies that can be encountered during the analysis. The observation data was recorded in a properly designed observation template form for explaining the essential information of the events. The observation reports were uploaded to Nvivo 12 for analysis. Each observation report includes data on the Agile ceremonies [1] including sprint planning, daily standups, Sprint reviews Demos, and Retrospectives. The reports are continuously checked to capture the essential interesting points that are required to explore the research questions. The interesting information was further noted down to support the analysis.

In the second stage of the analysis, interesting data segments were labeled by placing distinctive meaningful codes. Also, a code book is extracted from Nvivo including the respective codes with the related data extracts to support further analysis and interpretation. The analysis includes two different observation records serving two

completed sprints. Approaching the third stage of the analysis, we categorized the codes into our initially established themes of interviews to capture the essence of the information collected during the observation. The codes and the themes recognized that the observation data provided a solid understanding of the live phenomena during the project implementation initiating a reliable analysis. Stages four and five included reviewing and refining the contents for the themes. We intended to ask questions including the significance, quality, and boundaries existing for the themes to define the meaning of the codes.

3.2 Delimitations and Validity

After outlining the delimitations of this thesis, the subsequent section addresses potential threats to the study's validity. These threats are categorized into internal, external, and construct validity, and strategies employed to mitigate these risks are also discussed throughout the thesis.

3.2.1 Deliminations

During data collection via interviews and observations, the selection process was delimited to individuals with involvement or affiliation with Agile software development teams and internal product development teams within both organizations. Consequently, data and opinions were not solicited from entirely external sources unrelated to the selected internal product development teams. While this approach may have limited the analysis in terms of generalizability regarding creativity within internal product development teams, the inclusion of data from companies developing software for third-party clients could have enhanced it.

3.2.2 Internal Validity

In assessing the internal validity of this master's thesis, various factors were considered to ensure the reliability of the qualitative analysis. Firstly, one of the research student's involvement in one of the teams used for data collection was acknowledged, which may have influenced their interpretations. Secondly, while attempts were made to use multiple data sources like interviews and observations, participant feedback to validate interpretations was not obtained, which could affect the accuracy of the findings. Thirdly, the research methods were aligned with the research questions, but the sampling strategy relied mainly on participant availability, potentially impacting the results' validity. Moreover, efforts were made to maintain transparency in data analysis, and member checking was employed as a strategy to validate participants' responses. These limitations were considered when interpreting the study's internal validity. To conduct our final results evaluation survey, we presented the thematic results to each interviewee individually due to challenges in gathering everyone in one place. This approach ensured a concise presentation of the results, maintaining internal validity. Additionally, we included an overview of our thesis and a brief explanation of the results summary in the introduction of our online survey.

3.2.3 External Validity

The generalizability of case study findings is inherently limited by their contextual nature, cautioning against drawing broad conclusions. Nonetheless, these results offer valuable insights specific to the studied contexts, with variations potentially influenced by organizational disparities. Hence, it remains uncertain whether creativity in the requirement engineering process in agile software development is context-dependent or universally applicable. Since the requirements of engineering and agile software development are not industry-specific, the findings are not confined to the domains of the companies studied.

3.2.4 Construct Validity

Construct validity is more related to our data analysis method. We are performing thematic analysis as our data analysis method. During the analysis, we are trying to accurately identify the themes to study our underlying phenomenon. For that, we practiced the six phases for Braun and Clarke [3] definitions. We followed the phases to maintain coding consistency. Also, we discussed, evaluated, and reached agreements when forming themes and interpretations. Also we expect to perform member checking further to maintain the relevancy and the accuracy of the study.

4
Results

4.1 Overview of Analysis

No	RQ	Themes	Sub-themes
1	What is the perception of creativity in Agile Requirement Engineering processes?	Creativity perspectives and Opportunities	Emergence of creativity, Collaborative requirements, Team Collaboration, Iterative creativity, Adherence to market change, Comprehensive customer engagement.
2	What are the challenges in integrating creativity in Agile Requirement Engineering processes?	Creativity challenges	Changing requirements, Team decisions, Feedback loop integration, Sudden market changes, Sprint-based workflows.
3	What are the creativity practices employed to establish creativity in Agile Requirement Engineering processes?	Creativity practices	Continuous learning and Skill development, Requirement management and collaboration tools, Agile way of working, Transparent requirement discussions.
4	What are the creative thoughts and trends that enhance creativity in Agile Requirement Engineering processes?	Creative idea integration	Creative thoughts, Creativity trends.

Table 4.1: Themes and Sub-themes

The data analysis resulted in the production of a total of four (4) different themes. Three (3) distinctive themes were mainly developed concerning the essence of the research questions corresponding to creativity perspectives, challenges, and practices. There each of these themes produces six (6), five (5), and four (4) different sub-themes consecutively. An additional theme concerning creative idea integration produces two (2) different sub-themes initiating creative thoughts and upcoming trends aligned to requirement engineering. Accordingly, the thematic analysis produced a total of seventeen different sub-themes defining each distinctive theme.

Refer to Appendix I for the detailed organization of themes and sub-themes along with the research questions.

4.1.1 Theme One: Creativity perspectives and the opportunities

Creativity perspectives and opportunities were further divided into six sub-themes as per the table 4.1. Refer to Appendix J and N for the generation of codes from interviews and observations, respectively, aligned to RQ1.

1. **Sub-theme: Emergence of creativity**:
   Interviews: There were many opinions regarding the emergence of creativity. The perspectives on embracing creativity and achieving innovation were divergent based on different job roles. Most significant responses on creativity were received from scrum masters and product owners. Creativity arises with enhanced requirement clarifications. These are creative requirements refinements. The Agile practices facilitate creative requirement management ceremonies that promote a collaborative development process. Creativity also emerges with problem-solving. This initiates the ability to generate novel and effective solutions to problems using existing knowledge and technologies. The iterative Agile framework offers the potential for redoing and trying implementations until it generates a viable solution. This encompasses dynamic creativity in development. As per the participants' responses, creativity also arises during the pre-planning. One of the other interesting findings is that creativity depends on the context. Responses also suggest that creativity emerges with a better user-centric design focus. Developing high-level requirements and allowing the customers to manage well-planned requirements promotes the creativity aspect of Agile RE. One of the participants stated that vision and communication are the keys to creativity and innovative thinking. Also, it has mentioned that vision requires insight and time for initiating creativity and innovation. But as mentioned there were also some constraints such as client pressure and timely deliveries inhibiting the scope for creative thinking.

   P7: *"You learn those struggles and problems throughout the development process, and that's when you need to be creative. Not that the start of it. creative process has already happened during the draft of the plan."*

   P5: *"I think it depends on how what the project context is like."*

2. **Sub-theme: Collaborative requirements**:
   Interviews : As per the participant's responses, collaborative discussions with the clients and the team facilitate the scope for innovation. These add innovative input for the implementations. Concurrent customer changes enable continuous requirements refinements that reach the degree of requirement adaptability. Therefore collaborative requirements arise from successful user interactions to promote the opportunity for embracing creativity.

P6: *"it is always, creativity and your thought process because then you will know some feedback from outside of your team who are actually working on it."*

P2: *"so it will be exposed to the end user and they will use it then the more suggestion or more idea will come and we have to incorporate those changes because at the end like we are not building product for ourselves, we are building it for the end user only."*

3. **Sub-theme: Team Collaboration**:
   Interviews : Team collaboration is discussed as an activator for promoting creative thinking and innovation. As stated by the participants the collaborative design process promotes creative thinking. They are used to visualize data in an understandable format that enhances collaborative involvement. Agile is composed of cross-functional teams and these expert teams practice collaborative project management approaches that activate creative thinking. Team collaboration also generates cooperative ideas that promote continuous requirement refinements. These refinements foster creativity. Therefore team collaboration encourages requirement elaboration and space for open collaboration.

   Observations : The observation analysis highlights the significance of team discussions, gathering, and supportive rescheduling of tasks.

   P4: *"sharing your thoughts and comments and also everybody respects each other. It is like more of an open platform like while discussing we will ask questions within our team so that everybody you know reflects their opinions."*

   P8: *"We'll have someone on the call and we'll do the paid programming. We'll discuss. Then we come up in the team"*

4. **Sub-theme: Iterative creativity**:
   Interviews : Iterations are introduced as activators for quantifying creativity and achieving product goals. Some of the interviewees highlighted well-defined tasks and time as incubators for continuous project progress. The sprints within each iteration facilitate the scope for innovation. These initiate continuous product improvements and evolution that assist in feature optimization. The agility also limits pitfalls and mitigates the risks in development.

   Observations : The observation analysis showcases the significance of iterative documentation, initiating novel ideas, and maximizing and stabilizing team efforts and changes creatively and interactively.

   P1: *"Iterations gives you it helps you measure your creativity. It helps you give, and quantify your creativity."*

P2: *"I will say it's good and everyone has defined time and the task which they need to deliver during that time. I think that is the whole idea behind it to be creative."*

P4: *"When you could, you know, think about inclines, shows and also like and I mean User shoes and could also think about what could go wrong and what else I can add value there."*

5. **Sub-theme: Adherence to market change**:
   Interviews : The creative perspectives of adapting to market changes are the integration of current trends and innovative market research output with product implementation. This innovative market research adds creative value to the product and supports to compete with the existing market demands. An interesting finding is that such a market adaptation occurs only as a result of teams' positive inspiration and responses toward the change implementation.

   P2: *"It will change and it's good to be changed because whatever in the market or whatever the client or saying that might be the in the current trend".*

   P4: *"If there is any current ongoing thing that is more priority or more value add compared to the user requirement then we should always focus on the current you know scope."*

6. **Sub-theme: Comprehensive customer engagement**:
   Interviews : As per the responses, customer engagement is a motivation for innovation. This initiates requirements for clarity and enhancements. Continuous customer feedback fosters user-centric development. Better user interaction or better user testing confirms the clarity and accuracy of the requirements. Most of the participants explained the significance of forming ideation sessions with customers to enhance the creativity aspects of requirement management. They have suggested workshops, brainstorming sessions, and requirements and system validation techniques such as User acceptance testing for enhancing customer collaboration and motivating the creativity aspects of requirement gathering.

   Observations : similarly, The observation analysis with record highlights more about the favourable impacts of customer involvement and suggestions.

   P2: *"But I think the feedback is good and we try to keep like collaboration with the stakeholder, before implementation."*

4.1.2 Theme Two: Creativity Challenges

Creativity Challenges are further divided into five sub-themes as per the table 4.1. Refer to Appendix K and Appendix O for the generation of sub-themes from interviews and observations, respectively, aligned to RQ2.

1. **Sub-theme: Changing requirements**:
   Interviews : Changing customer requirements can be considered a prominent challenge explained by the participants. As per the responses the participants receive unclear requirements such as abrupt requirements in between the sprints, ambiguous requirements, flag-flying requirements, and scattered requirements throughout the iterations. These types of requirements initiate technical feasibility issues that result in implementation challenges. Such implementation challenges end with project scope creep initiating project restructuring. These challenges hinder the emergence of team creativity by imposing stringent time and task deadlines. Similarly, it also generates backlog formation gaps and criticality in accepting new requirements leading to problems in creativity. One of the participants suggests client education as a solution for assessing business and technical feasibility. This concurrently changing requirements also initiates requirements.

   Observations : The observation data analysis presents the value of standard coding, refactoring, quality requirements, and organized testing.

   P7: *"Over time the vision that the client has or the client's take on this has blurred a bit and we are somewhat fumbling around looking for requirements. So at the start there I think the directions are clear, but over time it has pivoted to making up the requirements."*

   P1: *"It puts a heavy toll on the creativity as well. Because if as soon as the scope changes your the set of tools changes and the set of ideas you're planning changes your backlog changes, everything changes."*

   P3: *"Yes, there are a lot of pain points like a lot of requirements that are not compatible with the development process or with the sort of like an I would say the feasible aspect of the requirements."*

2. **Sub-theme: Team decisions**:
   Interviews : As replied the team decisions become a challenge when it occurs conflict of interest and issues in accountability for decision making. The conflict of interest occurs as a result of individuals involving multiple interests and clashes between personal and professional interests. This situation prevents individuals from realizing their creative ideas promptly due to approval delays. Moreover, it highlights the value of team trust in supporting innovative idea generation.

   Observations : Additionally, the observation analysis presents the evaluation

of team capacity within the sprints for task execution.

P7: *"If you in general have this openness and consensus thinking about taking decisions in the team when you have these conflicts of interest, who will make the call and also, be accountable for it."*

3. **Sub-theme: Feedback loop integration**:
   Interviews : Continuous user feedback initiates unclear requirements. Customers are more engaged in a business environment than in a technical environment. Customers only focus on the specific requirement and they are always motivated to make that a reality. This generates a scope creep within the projects, adds an unnecessary burden on the development team, and similarly inhibits the efforts and time spent on producing creative artifacts.

   P7: *"client involvement is anything that goes beyond everything and that goes beyond the specific"*

   P4: *"But it is based on what kind of limitations that we have or is it possible to access them?"*

   P8: *"But if it is going behind that requirement, it's kind of like extra feature or extra work on that."*

   P3: *"I would say in a way user end-user feedback is important, but I would say it's up to some extent."*

4. **Sub-theme: Sudden market changes**:
   Interviews : Requirements arising from a sudden market change deviate from the existing workflow. Sudden changes strain human resources and knowledge gaps, limiting space for creativity. One of the significant issues is resource optimization including team capacity, team strength, and team reaction. The agile way of working including time-bound tasks also reduces the utilization of human resources and scope. Therefore some participants have identified sudden market changes as an inhibitor of creativity.

   P3:*"It hurts the feeling of creativity, I would say, but sometimes there are some market changes that we can't avoid. So we had to prioritize those."*

   P6: *"Will be different than the current working flow, but it will again depend on the teams' strength and whole team members thinking maybe team members could think it positively to get a direct requirement and delivery."*

   P8: *"But when things are new, the team even needs time to understand new stuff, and implementing the team so that time"*

5. **Sub-theme: Sprint-based workflows**:

Interviews : Requirement prioritization holds a significant role in addressing creative requirements. The requirements are prioritized within the sprints due to their concurrent evolving nature. They are prioritized either as requirement-driven prioritization or value-based prioritization. The parallel product development in sprint-based workflows also challenges creativity by inhibiting the time and resources for creativity improvements. Additionally, context switching is explained by the same participant as a hindrance to innovation. One of the major challenges in sprint-based workflows is the resource scarcity. Resource scarcity has occurred as a result of employee onboarding and technical resource limitations. Continuous onboarding has also resulted in a knowledge gap.

Observations : The data analysis provides an in-depth understanding of the Agile ceremonies cum corresponding software development activities. The results highlight the cross-functional activities, tasks in completion, estimations, agreements, requirements, and task prioritization.

P5: *"So if a new person comes in to make him grow up to that level, it takes a longer time. So that is a challenge that we face."*

P6: *"We need time to do our assigned task or complete the tickets so more meetings could also confuse us as well."*

4.1.3 Theme Three: Creativity Practices

Creativity Practises are further divided into four sub-themes as per the table 4.1. Refer to Appendix L and Appendix P for the generation of sub-themes from interviews and observations, respectively, aligned to RQ3.

1. **Sub-theme: Continuous learning and Skill development**:
   Interviews : Most of the participants have acknowledged continuous learning and skill development approaches as activators for initiating creativity within the process. Specifically, the participants have explained the significance of knowledge-sharing sessions and training programs to initiate creative and innovative thinking. Moreover, they also mentioned the importance of brainstorming sessions and other informal meetings to enhance creativity in the requirements engineering process.

   Observations : The analysis results present the continuous effort in training and learning new technologies and improving skills to supply a user-centered end product delivery.

   P6: *"I think that whenever it comes to any creativity or some learning, something new, implemented, something new or innovation everyone within the team gives positive reactions on it."*

P2: *"We have planned like every person is not expert in all the area there some area they need to explore. So in between like they are doing the training and also learning the other skills which there might be background with some other technology."*

2. **Sub-theme: Requirement management and collaboration tools**:
   Interviews : Different tools are used during the different stages of the RE process. These tools create a common platform for the participants to share their ideas, discuss requirements, and obtain feedback. This fosters a creative environment with open discussions. Also, these tools support documentation and organization of requirements. This helps to get a clear view of the requirements and hence improves creativity. Additionally, these tools also provide a visual interpretation of requirements that are easy to clarify and understand the requirements. This promotes the scope for creativity and innovative thinking. Examples of such tools include Miro Whiteboard, Confluence, rough sketches, Jira, Azure DevOps, Figma, Mindmaps, team channel, workshops, and Mural.

   P1: *"We first started putting ideas on the whiteboard. We started putting sticky notes on there and, so the whole ideation and brainstorm praise went on."*

   P4: *"If we needed some you know kind of elaboration about any you know technical aspect or you know requirement aspect we separately conduct workshops."*

3. **Sub-theme: Agile way of working**:
   Interviews : As per the responses, the agile ceremonies including sprint planning, backlog grooming, daily stand-ups, Retrospectives, and reviews facilitate creative requirement refinements and management. The responses indicated the use of Agile Scrum, Kanban, and SAFe within the Software development environments. Strong customer collaboration is an incubator for creativity. The feedback-driven iterations and different role settings strengthen the scope for creativity. Additionally, incremental QA processes take place to ensure the clarity of the requirements and product discrepancies.

   Observations : The results of the observation data analysis present a broader view of Agile practices carried out throughout a sprint. The results emphasize the importance of sprint demonstrations and retrospectives for productive end-user feedback, planning an organized set of sprint activities, and the team's involvement in ordering customer requirements.

   P7: *"Once the creative process has taken place and we see that the requirement was valid through testing."*

   P3: *"I will say like the agile methodology which we are following, it's good and it's like progressive and at the end like we are very close to like completing a version one of this product."*

P12: *"But when it comes to PI planning, I mean when it comes to PI for the iteration we have a fixed requirement that we have to implement. that's why we do have a separate Sprint for the innovation"*

4. **Sub-theme: Transparent requirement discussions**:
   Interviews : Teams enhance creativity through discussions that incorporate end users' thoughts into high-level designs, using drawings and maps. Teams perceive these discussions as efforts to enhance creativity and clarify user requirements. They are always motivated to have open discussions and value creative expression. Requirement Calling is one such type of discussion used to discuss the behavior of requirements.

   Observations : The observation data analysis motivates the personal thoughts of the employees and open- discussions on the progress of the sprint activities and useful Question and answer sessions between the team and the customers during requirement mapping and development.

   P4: *"We should have an open discussion which is like more transparent way and explain everything about what customer is wanting and this is what is the scope."*

   P8: *"we'll have like a requirement calling sometimes if a developer is working and if they are stuck with requirement and they need more on the requirement they need more information on the requirement they usually set up a call with the product owner with the team or scrum master."*

4.1.4 Theme Four: Creative Idea integration

The theme offers valuable suggestions on integrating creativity into RE based on interviewees' industrial experience, knowledge, and practice. These suggestions would contribute to the overall understanding of creativity. The theme is further divided into two (2) sub-themes as per the table 4.1. Refer to Appendix M for the generation of sub-themes from interviews aligned to RQ4.

1. **Sub-theme: Creative thoughts**:
   Interviews : Participants have pointed out the drawbacks of improper requirement documentation. Inadequate documentation can lead to misinterpretation and changing requirements. The responses suggested jotting down requirements as a way to encourage innovation and capture novel ideas. The responses also highlight the need for collaborative product ownership for clear requirements and showcased its significance in gathering diverse stakeholder perspectives, and idea generation for fostering creativity. Moreover, creative goal setting is introduced as a creative approach by the participants to drive innovation and progress. This refers to the process of creating objectives that encourage creative thinking and problem-solving capacity. Defining Minimum

Viable Product (MVP) development is another creative approach suggested to provide quick and simple implementations to facilitate early collaborations with customers. A detailed breakdown of requirements and task decomposition is introduced as an effective approach for stimulating creativity by providing a rigid foundation for discussion and identifying potential gaps. Maintaining structured requirements is suggested as a favorable approach for inspiring creative thinking and problem-solving.

P4: *"Detail discussion should be required for, you know, for the breakdown of the requirements."*

P7: *"product ownership together with the customer, the end user, whoever seemed fit to participate in this creative thinking and through dialogue or through different requirement techniques be creative."*

P6: *"Images are good, but then we have to depend on someone within the team who can explain the requirement, which is I think not a very good way of having the requirement."*

2. **Sub-theme: Creativity trends**:
   Interviews : Some participants solely provided their insights regarding trends in creative approaches within agile RE. One of the responses was that they were comfortable with the conventional RE trends. Some of the participants suggested the application of Generative AI, Copilot in RE. .

   P3: *"I think we can have and we can get a lot of help from AI these days like just GBD and all these GP's around us."*

   P1: *"For requirement gathering, I think the conventional trends are really effective so far."*

   P4: *" directly contacting someone in person, it is always good in chat."*

The analysis conducted has yielded comprehensive insights into our research objectives. The findings mainly address our research questions, with a primary focus on clarifying perspectives, opportunities, challenges, and practices related to creativity. These findings offer a broader understanding of the research questions and underscore their significance. Moreover, the analysis has revealed additional insights into the integration of creative ideas beyond the scope of our initial investigation.

4.2 Interpretation of results: Evaluation survey

An online questionnaire was distributed among our respective interviewees to validate our qualitative interview results. We received responses from nine (9) participants out of a total of fifteen (15) interviewees. The responses included the participation of team members from both the companies, Capgemini AB, and the automotive

transportation and infrastructure company residing in Gothenburg (company Y).

The response rates are shown as percentages for each question using bar charts. The results are presented theme by theme, validating the findings under each sub-theme.

4.2.1 Theme One: Creativity perception and opportunities

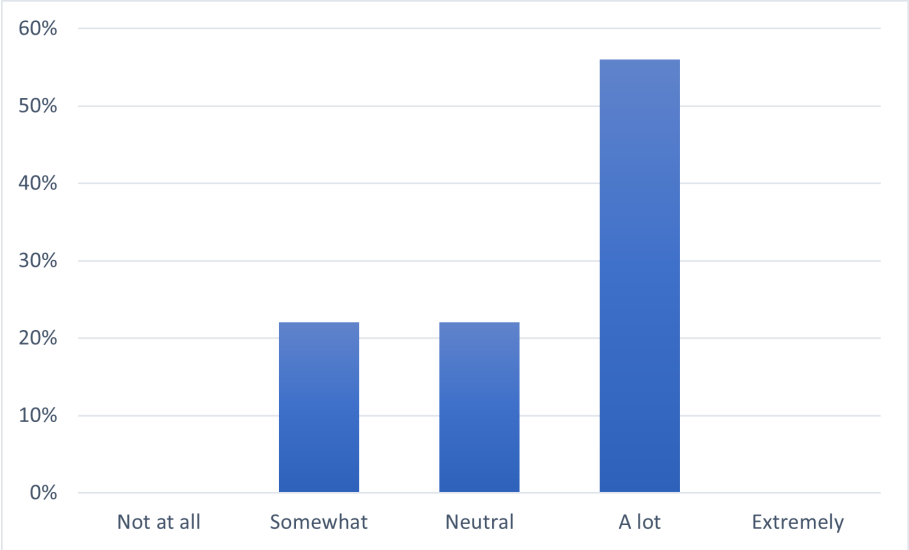

Figure 4.1: Question 1: To what extent do you agree with the statement "Emergence of creativity arises with problem-solving and affected by user-centric design focus"

As per Figure 4.1, 56% of the participants agreed that creativity could arise when there is a user-centric design with an opportunity for problem-solving. However, there are 22% of the participants were 'Neutral', and also another 22% agreed with the statement to the 'Somewhat' level.

Regarding the different levels of user experiences within team members, (Figure 4.2), 78% of the participants agreed that it will be a support for refining the requirements.

In most cases, collaborations between team members help develop creativity (Figure 4.3). However, there are 11% of participants who have mentioned that team collaboration is either 'Somewhat' important, and another 11% mentioned that they are 'Neutral'.

When discussing short sprints in Agile and their incremental nature, the responses on whether they support creativity are distributed across the provided scale (Figure 4.4). However, no one has responded that the integrative nature and short sprints will not encourage creativity.

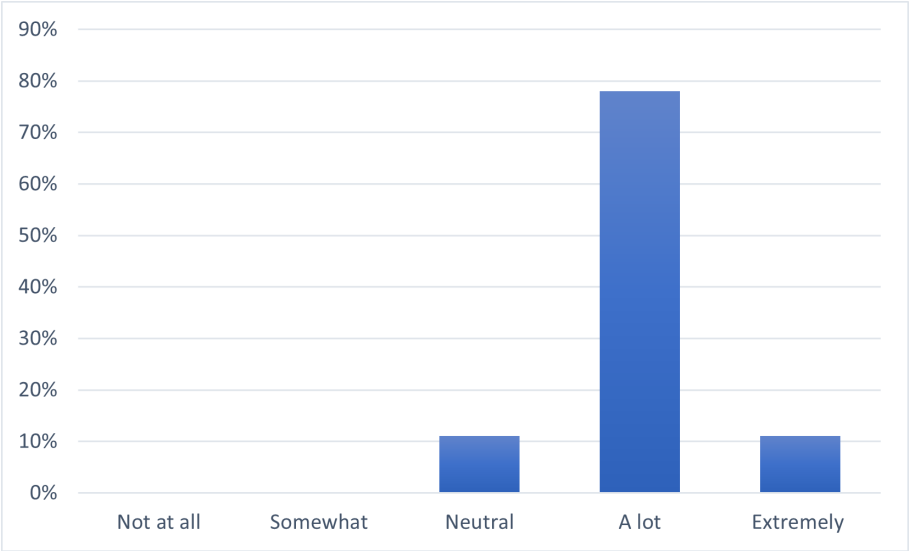

Figure 4.2: Question 2: To what extent do you agree with the statement "Different user experience levels within the team support ensuring requirement refinements"

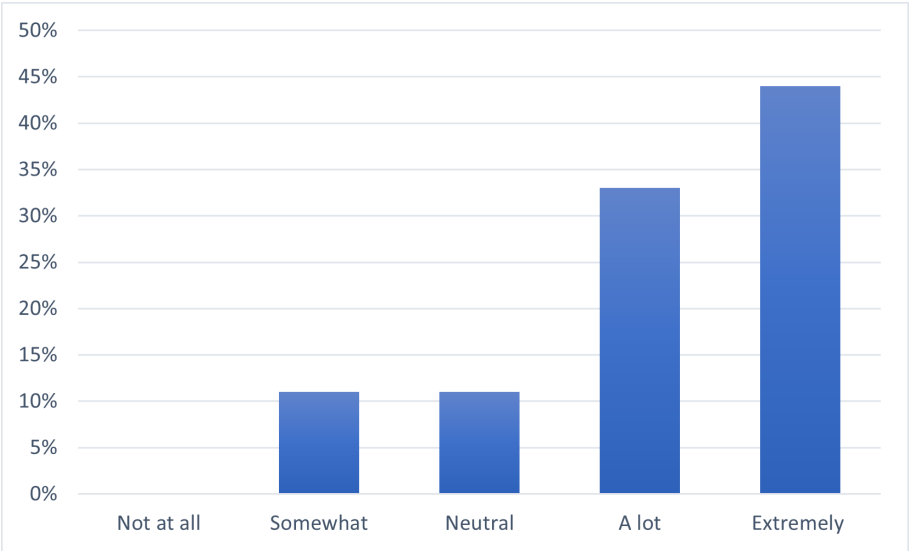

Figure 4.3: Question 3: To what extent do you agree with the statement "Team collaboration promotes creative thinking and innovation within our team or organization"

According to the survey results, team reactions and desire are other factors that influence the motivation to find new requirements concerning market changes. 44% of the respondents acknowledge this has an influence and another 56% are in a 'neutral' position. (Figure 4.5).

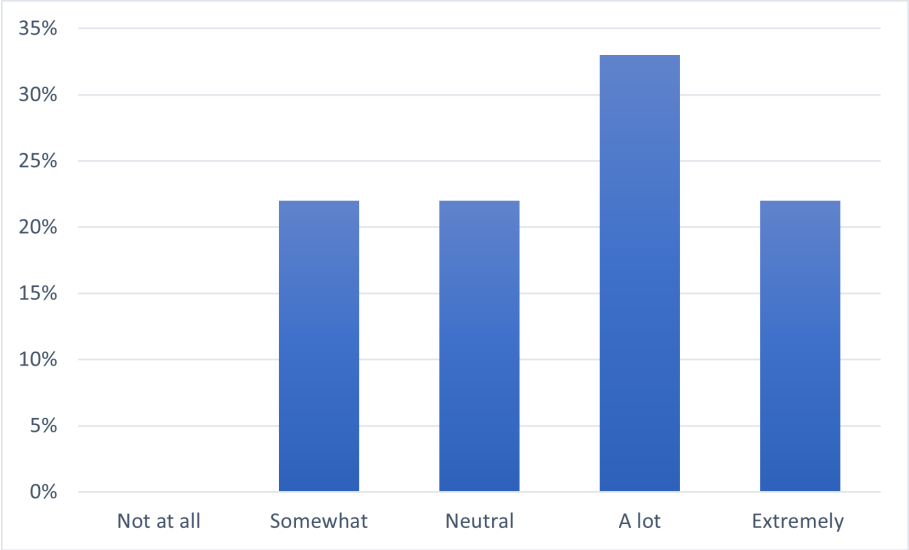

Figure 4.4: Question 4: To what extent do you agree with the statement "Short sprints focused on incremental development support in encouraging iterative creativity"

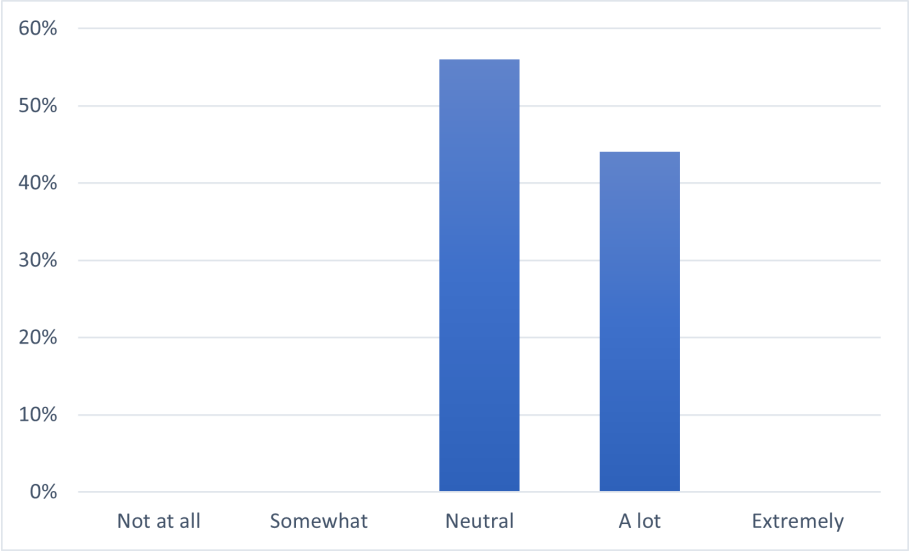

Figure 4.5: Question 5: To what extent do you agree with the statement "Team reactions and desire influence in searching for new requirements when adhering to market change"

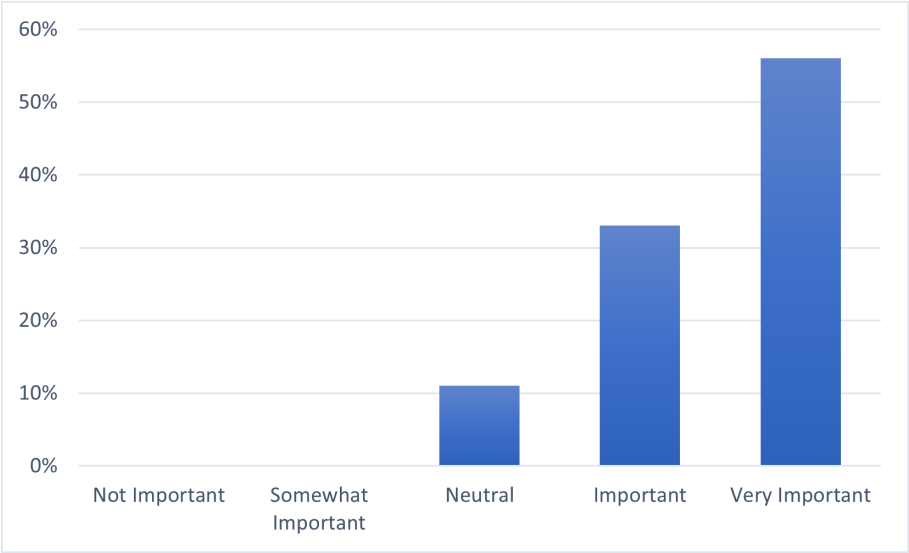

Figure 4.6: Question 6: To what extent do you agree with the statement "User Acceptance Testing (UAT) is important in maintaining a comprehensive customer engagement"

As the final point under this theme, the higher majority of the respondents have agreed that it is very important to conduct UAT to maintain comprehensive customer engagement (Figure 4.6).

4.2.2 Theme Two: Creativity challenges

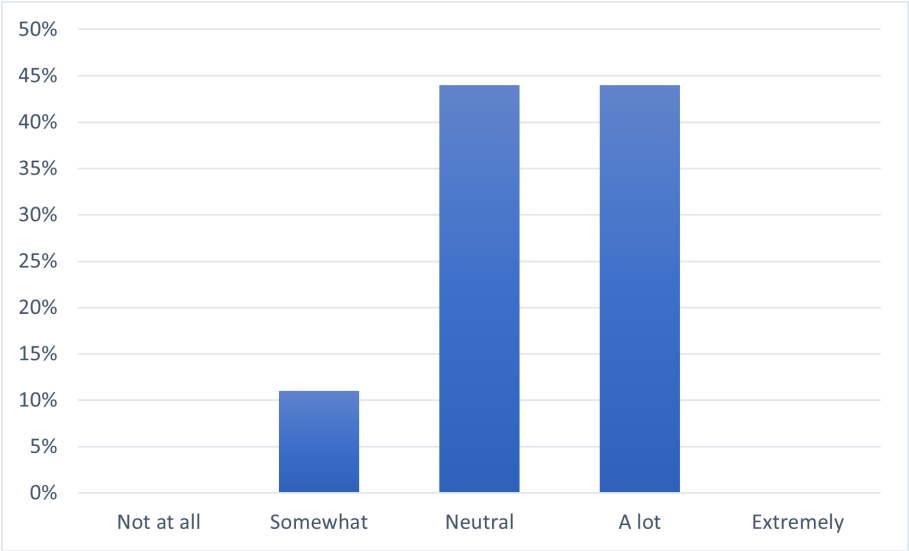

Figure 4.7: Question 1: To what extent do you agree with the statement "gap between technical feasibility and the business needs from ongoing changing requirements"

As per our findings through the study, one of the challenges for creativity was identified as the gap between technical feasibility and business needs. When surveyed, the respondents gave us mixed results where 44% were 'Neutral' and another 44% agreed to a level of 'A lot' (Figure 4.7).

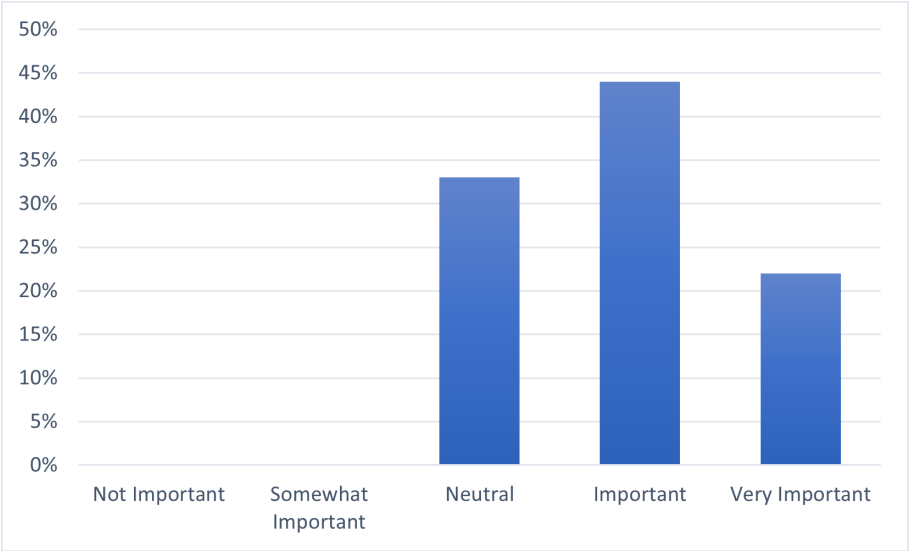

Figure 4.8: Question 2: To what extent do you agree with the statement "Conflict of interest and team's trust are important in taking team decisions in making innovation"

There are 44% of the respondents agreed to a level of 'A lot' and another 22%

'Extremely' agreed to the fact that conflict of interests and team's trust are very important in making team decisions when making innovations (Figure 4.8).

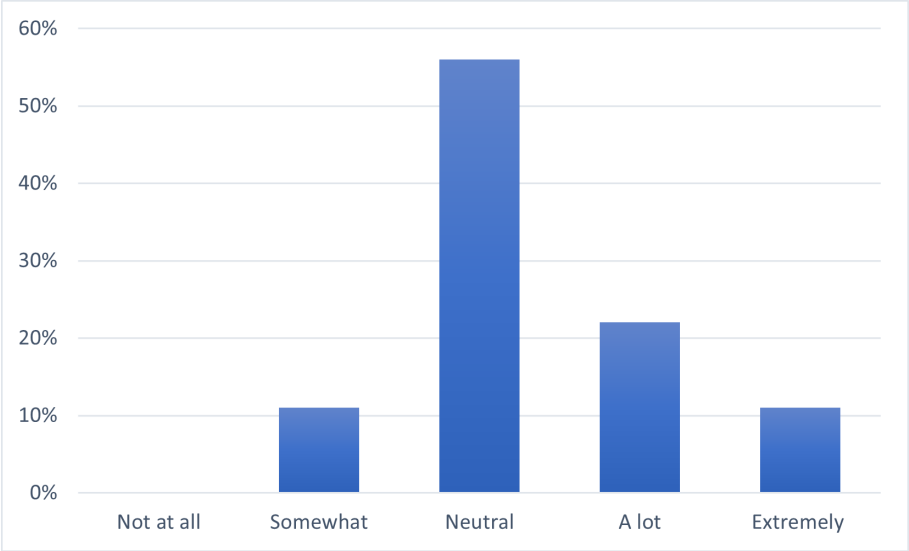

Figure 4.9: Question 3 To what extent do you agree with the statement "Customer feedback loops lead to stakeholder influence making client pressure"

When it comes to identifying stakeholder influence and client pressure through customer feedback loops as a challenge for creativity, the majority of the respondents (56%) were 'Neutral' (Figure 4.9).

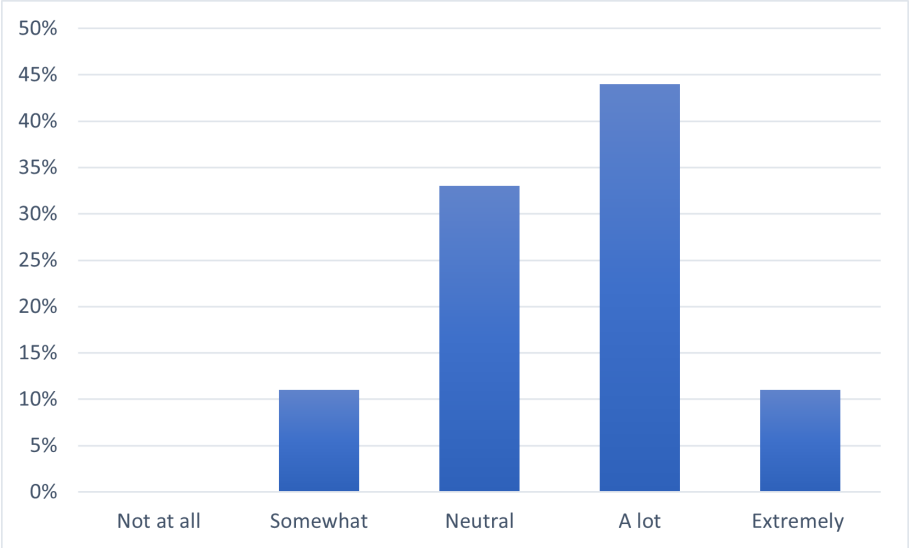

Figure 4.10: Question 4: To what extent do you agree with the statement "Sudden market changes initiate workflow deviations and time constraints for innovation"

Based on the results, the majority of the respondents indicating a high level of agreement with 44% selecting a level of 'A lot' and another 11% selecting the level

of 'Extremely', agree that sudden changes in the market can invoke workflow deviations and time constraints for innovations.(Figure 4.10).

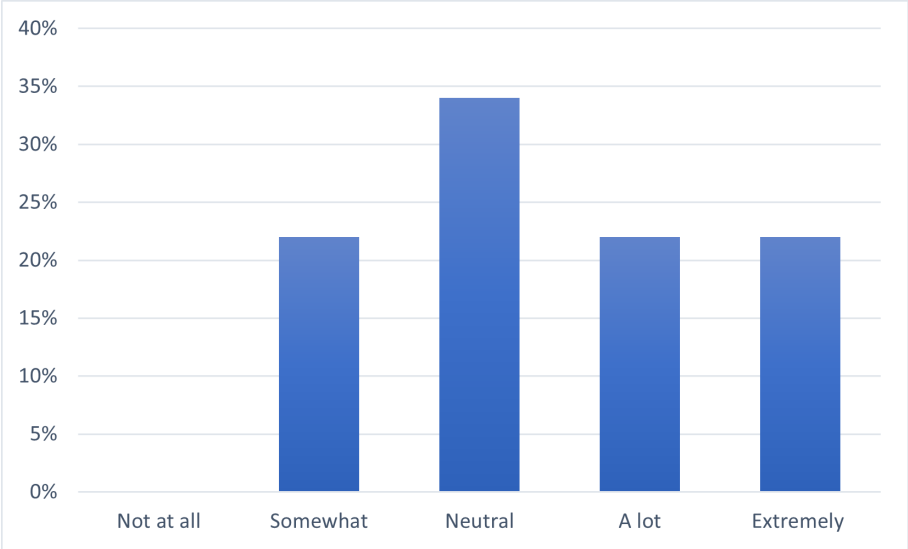

Figure 4.11: Question 5: To what extent do you agree with the statement "sprint deadlines and requirement prioritization techniques affect innovation within the sprint-based workflows"

We received 'somewhat' distributed results for sprint deadlines and requirement privatization techniques as challenges for innovation within the sprint-based workflows (Figure 4.11).

4.2.3 Theme Three: Creativity practices

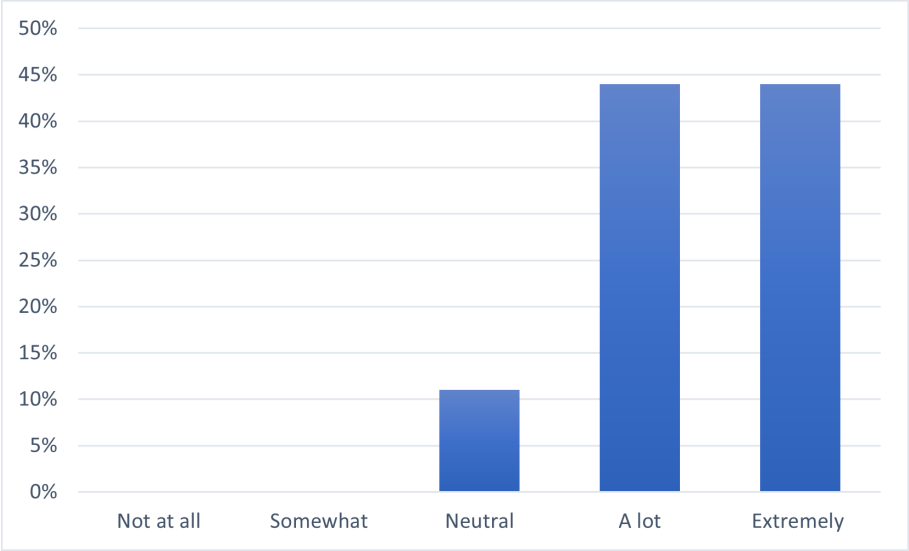

Figure 4.12: Question 1: To what extent do you agree with the statement "KTs, training, and brainstorming promote continuous learning and skill development practices"

It is very clear that KTs, training sessions, and brainstorming sessions are very important for skills development within a team from the results because 44% of the respondents have confirmed for each level, 'A lot' and 'Extremely' (Figure 4.12).

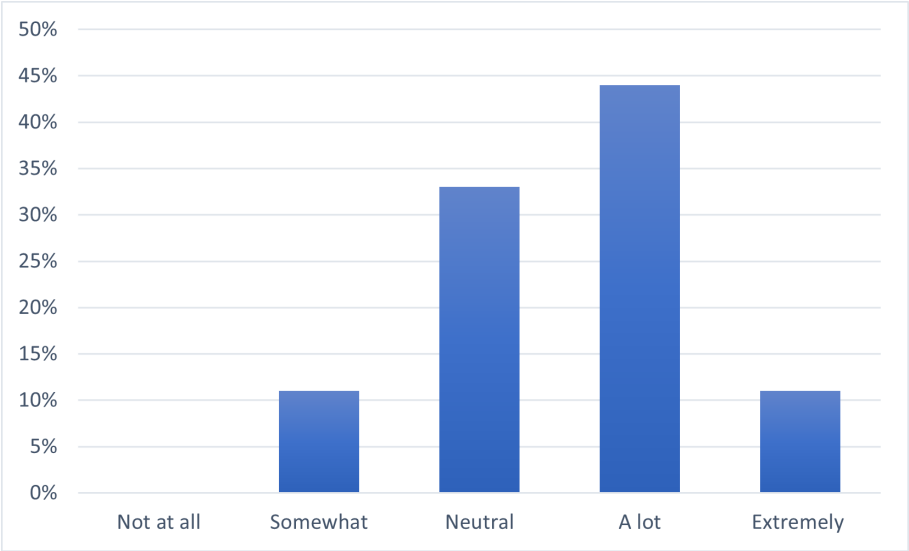

Figure 4.13: Question 2: To what extent do you agree with the statement "Requirement management and collaborative tools as Figma, Azure DevOps and Miro promote creativity"

Even though there are 33% of respondents are 'Neutral' about using collaborative

tools to manage requirements will promote creativity, the majority agree that those tools will be a help for creativity (Figure 4.13).

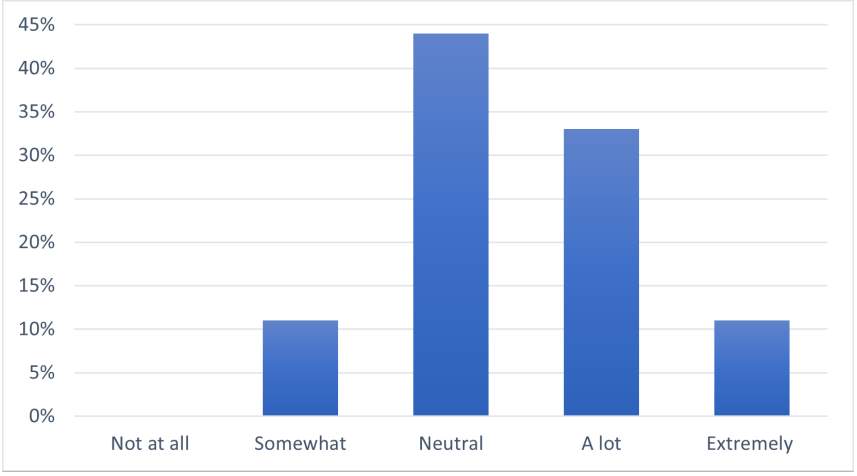

Figure 4.14: Question 3: To what extent do you agree with the statement "Effectiveness in Agile way of working (agile ceremonies, incremental QA) encourage creativity"

When discussing the level of effectiveness in the agile way of working (with various agile ceremonies, incremental QA) promotes creativity, the results are more biased towards a level of 'A lot' and 'Extremely'. However, there are 44% of respondents who are neutral with this statement as well (Figure 4.14).

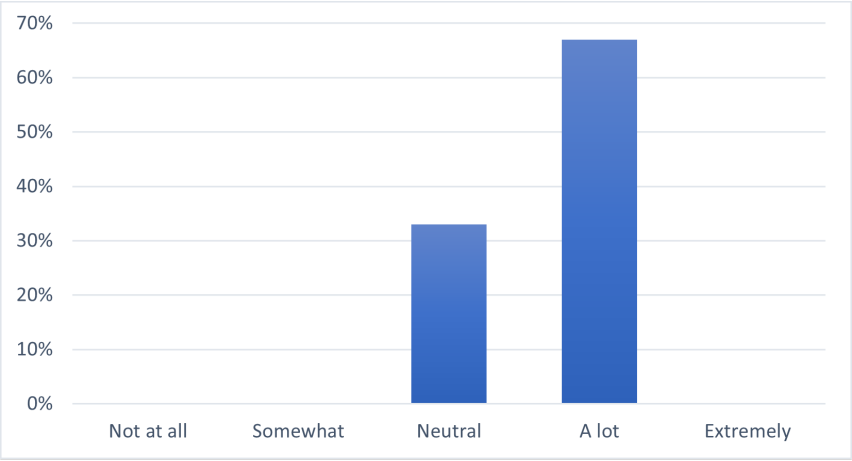

Figure 4.15: Questions 4: To what extent do you agree with the statement "Transparent requirement discussion as broad discussions and requirement calling encourage clarity"

There 67% of the respondents agree that transparent requirements and broad discussions will encourage creativity (Figure 4.15).

4.2.4 Theme Four: Creative idea integration

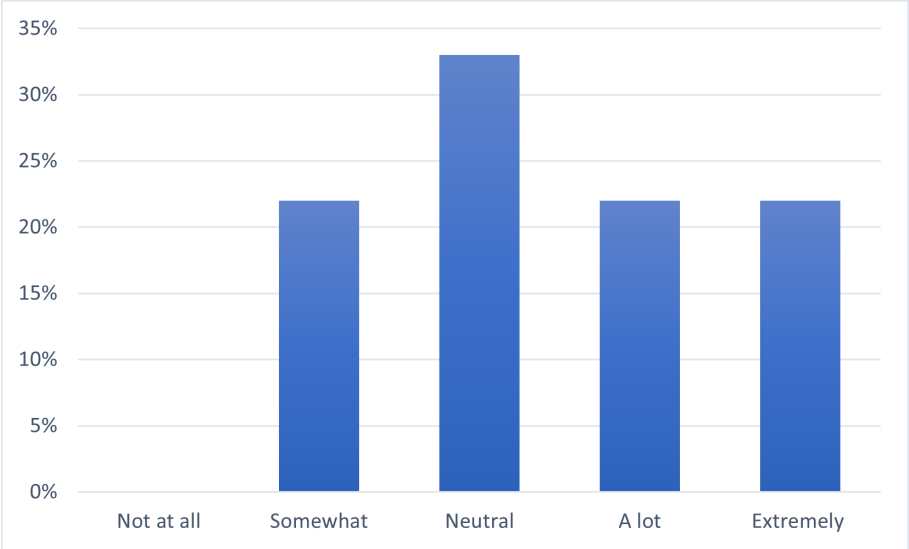

Figure 4.16: Question 1: To what extent do you agree with the statement "Detailed requirement gathering, documentation and breakdown of requirements as creative thoughts"

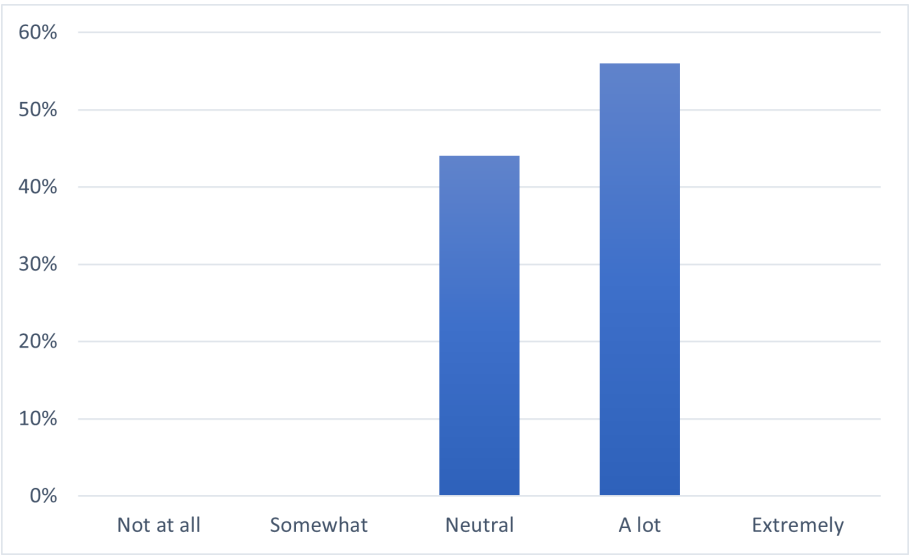

Figure 4.17: Question 2: To what extent do you agree with the statement "Generative AI, Vision, and Copilot are an upcoming trend for creative Requirement Engineering"

Regarding creative thoughts and trends, there is a mixed level of responses for detailed requirement gathering, documentation, and breakdown of requirements (Figure 4.16). And about 55% agree that Generative AI, Vision, and Copilot as a trend remaining 45% remain 'Neutral' to this statement (Figure 4.17).

4.2.5 Summary of the survey results

4.2.5.1 Theme One: Creativity perceptions and opportunities

The findings reveal that 56% of participants believe creativity emerges with a user-centric design focus and problem-solving opportunities, while 22% were neutral and another 22% somewhat agreed. Additionally, 78% agreed that varying user experience levels within the team support requirement refinements. Team collaboration was largely seen as fostering creativity and innovation, though 11% found it somewhat important and another 11% were neutral. Responses regarding short sprints and their support for iterative creativity were mixed, but no participants disagreed. Team reactions and desire were noted by 44% of respondents as influential in finding new requirements in response to market changes, with 56% remaining neutral. Lastly, the majority of respondents emphasized the importance of User Acceptance Testing (UAT) for maintaining comprehensive customer engagement.

4.2.5.2 Theme Two: Creativity challenges

The findings highlight several challenges to creativity within the Agile framework. A notable issue is a gap between technical feasibility and business needs due to ongoing changing requirements, with 44% of respondents being neutral and another 44% agreeing a 'lot'. Conflict of interest and team trust are crucial for innovative decision-making, with 44% agreeing a lot and 22% extremely agreeing. Customer feedback loops were seen as a source of stakeholder influence and client pressure, with 56% remaining neutral. Sudden market changes were identified as causing workflow deviations and time restrictions for innovation, with 44% agreeing a lot and 11% extremely agreeing. Sprint deadlines and requirement prioritization techniques presented varied opinions as challenges to innovation within sprint-based workflows. Overall the themes included medium to strong agreements related to the creativity challenges.

4.2.5.3 Theme Three: Creativity practices

The findings reveal insights into creativity practices within Agile RE. Key among these is the acknowledgment of the importance of knowledge transfer sessions, training programs, and brainstorming sessions in promoting continuous learning and skill development, with 44% of respondents agreeing a lot. While there are 'somewhat' and 'neutral' responses regarding the effectiveness of requirement management and collaborative tools such as Figma, Azure DevOps, and Miro in fostering creativity, the majority still recognize their potential as aids to creativity. Similarly, opinions are divided on the extent to which Agile practices, including ceremonies and incremental quality assurance, encourage creativity, with 44% of respondents neutral on this aspect, 33% of respondents agreeing with a lot, and 11% with a 'somewhat' response. However, there is widespread agreement that transparent requirement discussions and broad discussions contribute positively to creativity, with 67% of respondents supporting this.

4.2.5.4 Theme Four: Creative idea integration

The survey findings reflect diverse opinions on two key aspects of creative requirement engineering. While there is a mixed response regarding the effectiveness of detailed requirement gathering, documentation, and breakdown in fostering creative thoughts, with 33% of neutrality observed and 22% agreeing 'a lot' and 22% agreeing 'extremely', about 55%, of respondents, agree 'a lot' that Generative AI, Vision, and Copilot represent an emerging trend in creative requirement engineering.

4.2.6 Additional Comments

Despite the results gathered through the Likert scale questionnaire we also received open feedback from our interviewees corresponding to the summary of findings concerning each theme. We received the comments below.

4.2.6.1 Theme One: Creativity perceptions and opportunities

Comment 1: *"Teamwork and collaboration encourage creativity perception."*

Comment 2: *"Perception of creativity influences opportunity recognition. Embracing diverse ideas fosters innovation and opens the door to unexpected opportunities."*

Comment 1 supports our findings that team collaboration promotes creative thinking and innovation within our team or organization. Comment 2 reflects the generalized output of our thematic results indicating that teams acknowledge that embracing creativity offers them different opportunities within the job roles and product domains.

4.2.6.2 Theme Two: Creativity challenges

Comment: *"Navigating ambiguity, fear of failure, and societal pressure are common challenges in creativity. Embracing these hurdles as part of the creative process fosters resilience and innovation."*

According to our findings, we also revealed that ambiguity in requirements is a major challenge in product development. Similarly, we received a concrete response that fear of failure and insufficiency of teams and organizational trust could mitigate the scope for creativity and innovation. Overcoming these obstacles can create a creative environment for fostering innovation.

4.2.6.3 Theme Three: Creativity practices

Comment: *"Incorporating diverse perspectives, fostering a supportive environment, and encouraging experimentation are essential creativity practices that nurture innovation and problem-solving."*

Our findings also indicate that incorporating diverse perspectives through broad discussions, continuous learning opportunities, and the use of collaborative tools

as creative practices for fostering problem-solving and innovation. The agile way of working along with knowledge sharing and training encourages experimentation with new tools that enhance end-user expectations.

4.2.6.4 Theme Four: Creative idea integration

Comment: *"Integrating creative ideas involves synthesizing diverse perspectives, prioritizing feasibility, and fostering collaboration to realize innovative solutions."*

The comment presents a general overview of our findings. From our results, the interviewees emphasize the significance of creative goal setting, collaborative product ownership, building relationships, and creating interconnections as creative thoughts. We identified the necessity of prioritizing the feasibility since it was discussed as a challenge for fostering innovation.

5

Discussion

5.1 Mapping themes to research questions

5.1.1 RQ1: What is the perception of creativity in Agile Requirement Engineering processes?

Gaining insight into stakeholders' perspectives on creativity within Agile Requirement Engineering processes is crucial for acknowledging its emergence, collaborative elements, and iterative characteristics. This understanding informs the development of effective strategies to promote creativity.

Theme One: Creativity perception and opportunities
The majority of the collected data extracts define and conceptualize creativity. Specifically, the theme highlights different personal experiences with creativity corresponding to the achievements within their specific job roles and descriptions. The theme composes the different attitudes towards creative expression and engagement with creativity. The generated codes also reveal information on how different social, organizational, and psychological factors influence the way people adapt, think, and approach creativity. The sub-themes reveal information on the opportunities that arise with embracing creativity. Sub-themes also explore how creativity leads to innovation, the emergence of problem-solving and collaborative explorations.

1. **Sub-theme: Emergence of creativity**
   According to the findings, there is no ideal way to define creativity and it emerges automatically and pops up whenever working. Creativity is vital in software engineering development [38]. As per the findings, creativity emerges at each stage of software development and becomes crucial for end-product development. Creativity emerges with problem-solving. The teams learn and struggle through the problems during the development process and there is creativity involved. Creativity also arises with the draft. Creativity leads to innovation. This results in replacing the existing tools with advanced frameworks enhancing better user interaction. Similarly, creativity can also be in terms of what technology is used. The responses also suggest that it is hard to develop any product without creative thinking even if that is not the main focus of the product development. The user-centric design focus and thinking are two other important aspects that affect the emergence of creativity. Nicely visualized high-level design enhances a creative understanding of the

requirements without any intermediate verbal support. Embracing creativity within an organization poses challenges requiring expertise in technology, strategy, and Human-computer interaction [38]. Human resource limitation, knowledge gap, Team and organizational trust, and Team desire are some of the other challenges highlighted in embracing creativity. The emergence of creativity is also influenced by the nature of the project context and the product insight which defines the time for initiating creativity. Additionally, the organization's trust is explained as a factor in emerging creativity and innovation meaning the organization should tolerate failures and motivate for success. Creativity and innovation can also automatically emerge as a result of a team's complaint about service.

2. **Sub-theme: Collaborative requirements**
   According to the codes generated collective understanding and adaptability are important in responding to the changes and challenges during the collaborative requirement discussions. Similarly, assertiveness is also important where team members confidently express their ideas and opinions in promoting productive collaborative requirements. The results agree with the value of incorporating client input and feedback during the requirement discussions encouraging innovation and creativity. Conducting refinement sessions where requirements are iteratively reviewed contributes to fostering creative thinking. Using visual interpretations such as diagrams or prototype validations during such collaborative requirement sessions enhances creativity. Transparency is explained as a necessity to understand real needs since it enables one to see the importance of problem-solving. Release management is also concerned with ensuring that requirements are successfully implemented and delivered to the clients fostering innovation. Additionally, a sprint of work is equal to a successful creative process since the sprint goals are set. Two-way communication between the business parties and the development team creates well-balanced and achievable requirements within the team for implementation.

3. **Sub-theme: Team Collaboration**
   The teams conduct the initial conversations between the business analysts, the scrum master, and the product owner and progressively collaborate discussions with different team members and additionally conduct collaboration calls. There is no stoppage for the ideas and discussions lead to modern aspects of thinking. Everyone on the team is expected to be open up and collaborative since ultimately those types of people would bring innovation. The team members have to be open to accepting the fact that their creative ideas might not always go on the table, for production but at the end of the day depend on stakeholder interests and requirements. Teams arrange workshops, meetings, and open platforms for question-and-answer sessions to reflect on their opinions other than the refinement sessions. There is no division between seniority and junior and senior members are supportive and take responsibility for requirement refinements. Additionally, casual discussions take place in critical situations like a bug in production to verify the requirements.

4. **Sub-theme: Iterative creativity**
   Positive ideas are generated upon the effectiveness of the short sprints. The tasks are divided and thus reduce the challenge of achieving. According to the results, there is a possibility of changing the sprint's time to advocate creativity perhaps the teams would gather more creative opinions during the end of a sprint. A strong backlog motivates the teams to define deadlines and measure the team's strengths. Iterations do not limit the teams for initial discussions. It provides an opportunity to think differently, improve the requirements, and innovatively optimize the functionalities. Based on the product or project context the requirements come from different sources. The majority of the requirements come from the stakeholders and product backlog where business analysts or product owners initiate and deviate the requirements among the development team. According to Miller and Granville, Agile characteristics include modularity, iterative development, time-bound cycles, adaptability, and people orientation. [27]. Drawing from our findings most of the agile characteristics stimulate creative thinking and innovation while a few of the practices become a creativity challenge. Modularity and iterative development promote iterative creativity within sprints by enhancing transparency and reflection on requirements. Conversely, the task and time-bound nature challenges creativity within short sprints. The iterations thus mitigate the pitfalls during the process and extend the scope for creative discussions.

   Iterations facilitate the effective capturing of requirements. The sprint demonstration facilitates getting feedback, input, and requirements changes from the clients and organizing those as high-level requirements. Discussions with the stakeholders along with the UX designers provide a different index from the customer base. The PI within SAFe creates architect designs that later divide into creative stories, epic, and sub-tasks. The PI also allocates one sprint for innovation. Iteration allows teams to get knowledge of the business use cases and effectively track the functionalities developed. From a tester's point of view, the acceptance criteria designed by business analysts allow them to write effective unit tests for component tests. Iteration also provides technical improvisation. Iterations promote reflection on requirements leading to research and fulfilling end users.

5. **Sub-theme: Adherence to market change**
   Positive inspiration for change is expected since it can be a current trend that the customer would prefer. This would stimulate innovation and change the product to compete in the market and stand across competitors. Teams are prompted to think creatively and develop innovative solutions. Teams do market research to find new requirements and facilitate workshops and brainstorming to perform creative structural change. If the market changes have more priority and add values compared to users' requirements, the changes should adapt and re-plan the sprint goals. Teams are required to have a flexible and adaptive mindset. Positive team reaction and desire accelerate the rate of embracing the change.

6. **Sub-theme: Comprehensive customer engagement**
   Ideation promotes creativity by enabling discussions with the stakeholders to assess the requirements and the products. A whiteboard is an aiding tool to integrate ideas. In SAFe, the last sprints contribute to innovation by identifying stakeholders' needs and interactions. Mostly wherever the teams receive requirements, long discussions and contemporary workshops take place to recognize the goal and the capacity. Accordingly, close customer collaboration results in the birth of new ideas during the reviews thus can be developed and evaluated within a considerable time. Generally, the findings suggest feedback and frequent communication as a concise way to maintain collaboration and future developments. The feedback from external sources including end-users is integral to the development process and enhances the creativity and thought processes of individuals. It is important to incorporate those changes but going beyond the requirements may result in additional features. Moreover, UAT testing encourages feedback and requirement verification, providing real-world insights that reveal new ideas and perspectives not considered by development teams. This enables the generation of innovative solutions to address any issues. Agile focus on customer satisfaction may compromise creativity in RE [17]. Agile practices like self-organizing teams and participatory decision-making can initiate creativity, according to Conboy et al [10]. Following the study's findings, continuous customer engagement and feedback promote creativity while affecting the technical and business feasibility of the requirements causing ambiguous, scattered requirements.

5.1.2 RQ2: What are the challenges in integrating creativity in Agile Requirement Engineering processes?

Recognizing and addressing the obstacles involved in integrating creativity with Agile RE methods is essential for overcoming the barriers to innovation and guaranteeing the implementation of user-centered quality software products.

Theme Two: Creativity challenges
The theme is composed of data explaining the extent of the challenges encountered with integrating creativity during the Agile RE process. Specifically, different consequences and creativity barriers for changing requirements are highlighted along with the nature of team decisions, continuous feedback in loops, sudden market variations, and the nature of the sprint workflows.

1. **Sub-theme: Changing requirements**
   The requirements that change during the middle of a sprint are called abrupt customer requirements. These are not well-planned requirements and occur instantly. This allows the teams to be flexible and adaptable. This necessity for problem-solving can foster a creative environment in which the team members must come up with innovative solutions. There

were some opinions highlighting scattered requirements meaning the existing requirement-gathering process is scattered. These scattered requirements have allowed the teams to implement an innovative process called freezing requirements to hold the requirements when sudden requirements changes occur. One of the findings points out that it is hard to capture the requirements and over time the vision that the client has on this becomes blurred and becomes looking around for requirements. Thus the requirement ambiguity becomes a problem concerned by each of the job roles. Once the stakeholders are unclear about the most important requirements it is difficult for a BA to understand and deliver the requirements. These difficulties in capturing clear customer requirements necessitate innovative problem-solving strategies the teams must innovate novel methods for requirement elicitation and documentation. Also when the end-to-end requirements are not fixed or completed it creates a problem in the best product development and testing. Ulrich et al. highlight requirements as a factor influencing creativity [38]. According to our findings, requirement gathering, decomposition, representation, change, and refinements have a major impact on creativity. Sometimes the developers have to go back to the product owner and the business people to get those requirements more clearly with long-hour discussions to get agreed for development. Such a consequence would limit the time for planned creativity and conversely inspire new creativity features and functionalities.

In some cases even though the team has a lot of creative ideas they won't fit the client. The most challenging problem highlighted is the time and scope agreed upon sprint. Though the team gets creative ideas they can not just implement the system since it needs prioritization time and resources. This makes the team harder to complete the tasks or the user stories. Similarly, the skills gap or replacement of roles creates clarity in requirements and inhibits creativity in a changing requirement instance. The finding also highlights a scenario where the product owner does not have considerable product domain knowledge. Specifically, findings identified that some of the requirements were not documented in detail enough and were missing to carry out testing ultimately resulting in the low-quality test plan. Teams also find a lot of pain points where many of the requirements are not compatible with the development process missing the feasibility aspect of the requirements. These also lead to project and code base restructuring that becomes a challenge. There were opinions explaining everyday tasks as a process following the same steps with no creativity and innovation except the incorporation of an innovative sprint.

2. **Sub-theme: Team decisions**
   The finding mostly highlights the team collaboration with a few suggestions including the conflict of interest and accountability for decision-making. Additionally, team trust is highlighted as an inhibitor for intro-

ducing innovative products for a while till it becomes a stable member of a team. Findings also suggest effective communication between the members as a motivation for creativity with no communication blockers. Additionally, team capacity is highlighted within the sprints as a factor in planning tasks and time.

3. **Sub-theme: Feedback loop integration**
   According to the findings, continuous stakeholder feedback loops affect creativity. Once the project scope changes, the tools, ideas, planning, backlog, and everything that deals with the requirements change. The stakeholder influence within the project causes deviations and limitations in prioritization. Some of the projects and the requirements are described as having client pressure and timely deliverables whereas some are not affecting the opportunity for innovation. Once the team receives feedback that can be wild on the process and sometimes stop creativity. The teams acknowledge the importance of user feedback to some extent suggesting that its significance should be limited and negotiated to a considerable extent to initiate creativity.

4. **Sub-theme: Sudden market changes**
   Sudden market changes cause a deviation in the existing workflow, which resists the time for applying innovation. Time is highlighted as an influential agent. Creativity and innovation are accommodated mostly within the sprint if the scope permits and either change will be an overburden for the sprint. The assignment of new tasks takes an extra effort to work and time becomes a factor. Assigned tasks and meetings themselves are an inhibitor to welcoming a sudden market change and applying a creative approach. Another hindrance to implementing creativity with market change is the constrained posed by budget, team dynamics, and costs. A concrete response from participant in a project development team responded that changes harm the emergence of creativity and there are market changes that can not be avoided and thus prioritized.

5. **Sub-theme: Sprint based workflows**
   The effect of prioritization on creativity depends mostly on the project context. In projects with timely deliverables, the requirements prioritization is mostly done by the clients who expect a variation in the technical order. However, teams working with internal product teams utilize prioritization as an opportunity to convert the ideas to product development within sprints. Working with parallel products in a sprint shorter the time for development similarly minimizing the scope for creativity. When an individual has to focus on multiple concepts within an iterative process, it would lead to context switching forbidding the focus. Though the iterations are appreciated to be creative, it is said to be mainly focusing on requirements which ensures that version one of a product is in the current stage instead of being creative. According to the results, sprint

deadlines also minimize the scope of innovation within a sprint and allow time for continuing tasks.

Responses from the internal product teams mostly seem to face issues with resource limitations. They highlight two specific cases: Initially, onboarding of employees creates a knowledge gap and issues in availability. Secondly, they lack interactive feedback from live users creating discrepancies in requirements. There are also tool limitations that prevent the documentation of everything in one particular place. These would lead to scenarios where task estimations are not properly done before the sprint planning. Replacement of roles between the team members, continuous effort to complete product backlog before sprint demos, incomplete tasks within a given sprint, verbally agreed requirements with no proper documentation during requirement discussion sessions and product demos affect the efficiency of the sprint workflow and the opportunities for implementing innovative insights. As of the review by Aldave et al. Agile methodologies often favor scoping and simplicity at the expense of problem-solving and exploration, potentially compromising creativity in RE [7]. In light of our research outcomes, Agile favors scoping but there is a tendency to adhere to separated innovative sprints and workflows such as innovation week and repositories.

5.1.3 RQ3: What are the creativity practices employed to establish creativity in Agile Requirement Engineering processes?

Exploring the practices employed to promote creativity in Agile Requirement Engineering processes provides valuable insights into effective strategies for stimulating innovation and nurturing a conducive environment for creativity within Agile teams.

Theme Three: creativity practices
Different creativity practices recognized mainly during the interviews are highlighted as continuous learning and skill development practices, the importance of requirement management and collaboration tools used, practices within Agile, and transparent requirement discussions.

1. **Sub-theme: Continuous learning and skill development**
   Currently, some practices are followed by the teams to maintain the clarity of the requirements, teamwork, and innovative idea generation. Knowledge sharing among the team is one of the most frequently conducted activities. Continuous learning and training on different tools and technologies are other important efforts for fostering creativity being competitive in the market and being user-centric. Similarly, brainstorming is highlighted during every interview as an effective way of producing

creative ideas and enhancing clarity. Practices like brainstorming, crowdsourcing, and Agile software development promote creativity, according to Mohanani et [28]. Based on the research discoveries, Knowledge sharing, Collaborative calls, training, and continuous learning practices promote creativity within software development. As stated by Lucia et al.. RE involves discovering, analyzing, specifying, and documenting system requirements [17]. Per our findings, RE also involves different user experience levels and expertise. Techniques like UI/ UX designing and brainstorming are identified as effective requirement engineering techniques.

2. **Sub-theme: Requirement management and collaboration tools**
   Findings suggest that various tools and techniques are utilized to support creativity within Agile Requirement Engineering processes. Workshops, brainstorming sessions, tracking requirements in Confluence, conducting technical workshops for elaboration, and using tools like JIRA and Azure DevOps all create an environment conducive to generating new ideas and exploring innovative solutions. Additionally, collaborative platforms like Miro, and Figma and team channels like Teams facilitate communication and idea-sharing among team members. Integrating these tools and practices helps streamline the requirement-gathering and development process, fostering creativity and innovation within the team. Additionally, maintaining organized documentation is an essential practice to enhance the effectiveness of creative thinking.

3. **Sub-theme: Agile way of working**
   Agility limits the pitfalls and motivates change. Results highlight it as more adaptable with minor changes due to its non-binding nature. The agile way of working is progressive and produces one complete version of a product. Agile ceremonies are interpreted as creative efforts within the development process. Scrum teams include daily stands, sprint planning, sprint demos, and retrospectives. In addition to that SAFe teams practice product increment planning (PI) including the Kanban board. In Beck et al. 's opinion, Agile emphasizes collaboration, delivering working software, customer collaboration, and responding to change, as outlined by the Agile Manifesto [8]. Similar to the authors' perception, Agile ceremonies with incremental product deliveries foster creative thinking and innovation. Backlog refinement is described as a creative work that promotes discussion and idea initiation. Daily stands are introduced as a creative assessing task. Sprint planning is listed as a creative technical cum managerial task. Retrospectives and reviews are mentioned as the most creative agile ceremony that motivates expectations and solutions. The majority of the participants follow Scrum Agile while others follow SAFe or a variant of SAFe. Similar to the authors' perception, Agile ceremonies with incremental product deliveries foster creative thinking and innovation. Specifically, an innovation week is introduced by the SAFe teams during their product implementation planning to promote creative

thinking. This innovation week was explained as a better opportunity while a response from an internal product team member also introduced it only as a week to complete the remaining Sprint tasks. Some teams following the SAFE practices assign a separate role within a team to monitor creative ideas and maintain a commitment board. This activity can be explained as a cognitive process to promote innovation.

4. **Sub-theme: Transparent requirement discussions**
   The responses emphasize the importance of open communication and transparency in understanding customer needs and project scope. Findings also stress the value of collaboration, suggesting that gathering input from various stakeholders, such as business analysts or product owners, can lead to new ideas and features. Transparent discussion recognizes the need for feasibility assessments by developers to determine the technical possibility of implementing certain requirements. The findings highlight the importance of clarity in requirements, suggesting that while coding is a significant aspect of the process, clarity in understanding the requirements is paramount. Formation of work breakdown structure along with requirement segregation is a creative activity to move forward with development. Overall, the findings underscore the significance of clear communication, collaboration, and feasibility considerations in innovative project development.

5.1.4 RQ4: What are the creative thoughts and trends that enhance creativity in Agile Requirement Engineering processes?

Investigating ideas and trends for nurturing creativity in Agile Requirement Engineering results in the achievement of innovative solutions.

Theme: Creative idea integration
The theme is composed of creative thought and trends highlighted to achieve creative RE with Agile software development.

1. **Sub-theme : Creative thoughts**
   Creativity plays a crucial role in goal setting, especially when objectives are conveyed in a manner that aligns with the creative process. As suggested when goals pivot swiftly, driven by creative insights, it enhances the overall effectiveness and completeness of the objectives. As per respondents' suggestions, fostering creativity in product ownership involves engaging in collaborative thinking with end users and relevant stakeholders. They recommend utilizing various techniques to foster innovation and conversation. Additionally, they emphasize the importance of building strong relationships and facilitating interconnections, as these factors are integral to generating new ideas and driving innovative changes within the product.

Respondents suggest that initiating early discussions of requirements in the software development life cycle can foster creativity. By doing so, teams can identify risks and incorporate diverse perspectives, enabling them to address challenges and explore innovative solutions right from the beginning of the process. A respondent recommended against relying solely on images, as this approach necessitates having someone on the team who can effectively articulate the requirements, which may not always be optimal. Instead, suggest gathering requirements in a structured manner to ensure thorough documentation of all requirements.

A SAFe team is proposing to assign one team member to each area of expertise, such as backend development, frontend development, and quality assurance, within each team. Each individual would then be responsible for delivering outcomes within their designated domain. SAFe teams recommend establishing a distinct Jira group project named the Innovation Project. Whenever new ideas arise, the team creates a task or capability within this project and discusses them. This separate project in Jira serves as a repository for all their ideas intended for future implementation. Test engineers suggest the necessity of a stable environment to encourage creativity, in which testing can be openly conducted.

Respondents suggest that supplementary user stories improve the requirements themselves or the teams' process by employing various methods. This is important because user stories often lack sufficient information for making development decisions. Respondents emphasize the significance of anticipating potential challenges and learning from past mistakes, particularly when adhering to previous approaches. For example, an experienced individual may propose ideas based on past experiences, even if those approaches were implemented several years ago. Evaluating the shortcomings of such approaches is crucial, especially given the evolving creativity and innovation in technology. Respondents also highlight the emergence of new coding assistance tools, alongside other innovative tools. Teams now have access to improved tools that guarantee thorough documentation of features, addressing previous shortcomings. These advancements, coupled with teams' experiences, enhance their commitment to innovation.

2. **Sub-theme: Creativity trends**
   Some of the respondents suggested incorporating Generative AI technologies, and Copilot into requirement engineering to process as trends to enhance the ongoing Agile RE process while one response acknowledged the conventional trend.

5.2 Limitations and significance

We initially conducted a case study at Capgemini AB, interviewing team members from three different teams and observing two consecutive sprints. To validate and generalize our findings, we later interviewed development team members at the named company Y. Finally, we conducted an online survey, to validate our thematic coding results. Data collection solely consisted of responses from various team members, including Product Owners, Scrum Masters, software engineers, and test engineers. Customer responses were not considered. Both companies solely practiced variants of Agile; Scrum, SAFe, and Kanban board.

We observed diverse opinions among team members regarding creativity, including their perspectives on its application. This diversity stemmed from differences in job roles and project contexts between two companies involved in our study: Capgemini, which primarily engaged internal project teams, and the named company Y, which included members from project teams.

Three different teams at Capgemini AB, expected most of their team members' inspirations and ideas for requirements in developing internal software products. Also one of the teams conducted surveys in the form of interviews to gather potential research information since these teams initially gathered generic information rather than specific. The teams initially produce the products for a hypothetical client and progressively accommodate specific clients' requirements. The teams practice a research and development mechanism. These teams have considerable freedom within their development environments to convert their creative ideas into innovative solutions. The analysis revealed both opportunities and challenges associated with incorporating creativity into RE. Specifically Internal product team members at Capgemini emphasized the freedom within iterative processes, sprints, deadlines, customer collaboration, sudden market change, changing requirements, and responsiveness when adopting and promoting more so than the responses from company Y.

In contrast, interviewees from company Y are based on different project teams performing different functionalities for distinctive markets. Here the project teams interact and depend on each other. Therefore the deadlines and abundance of customer feedback differ based on the teams' role and context. Though the respondents from Company Y appreciated and initiated the approach to enhance creativity, they were also concerned about managing customer feedback loops, adapting to sudden market changes, handling evolving requirements, and navigating short sprints as hurdles to creativity.

6

Conclusion and Future works

6.1 Conclusion

The research aims to integrate creativity into the RE process within Agile development to enhance creative RE. We examined the extent and manner in which creativity is integrated into the RE process within Agile software development. The research explored the perceptions and opportunities for creativity, identified challenges in incorporating creativity, and examined current creative RE practices in Agile, particularly in an industrial context. Additionally, we investigated what creative thoughts and trends can be integrated to enhance the RE process within Agile. Our ultimate goal is to explore the degree of creativity within RE to motivate and foster collaborative and user-centric design thinking and develop innovative solutions that provide a competitive edge and high user satisfaction. Existing literature recognizes the significance of creativity in RE, but does not comprehensively examine its application within Agile software development. These studies fall short of the distinct features of Agile development, its iterative and collaborative nature that can both foster and impede creativity in RE. There is a notable lack of detailed analysis on how these specific Agile characteristics impact creativity in RE. This gap highlights the necessity for systematic research to explore the integration of creativity within the Agile RE process

The research involved conducting case study research, including a field study consisting of observations and semi-structured interviews. Respondents from Capgemini Sverige AB and a company headquartered in Gothenburg, Sweden, known for automotive transportation and infrastructure (named company Y), were engaged. The reflexive thematic analysis method was utilized to systematically identify, analyse, and interpret connections within the qualitative data collected. To validate the findings from the qualitative analysis, an evaluation survey was conducted.

The analysis yielded four main themes: creativity perceptions, challenges, practices, and idea integration. Creativity is perceived as vital throughout the software development process, emerging at each stage and playing a crucial role in problem-solving and innovation. Challenges such as human resource limitations and organizational trust can impact the emergence of creativity. Effective practices including continuous learning, the use of collaboration tools, and

discussions foster creativity. Concerning iterative creativity, Agile practices such as iterations and sprint-based workflows provide opportunities for creative discussions and technical improvisation. Challenges such as ambiguous requirements, scattered requirements, and blurred client visions pose obstacles to creative problem-solving and innovation. Conflict of interest, accountability for decision-making, and capacity planning within sprints affect creativity. Challenges with project scope change, lead to deviations and limitations in prioritization that may hinder creativity.

Overall, while Agile methodologies offer benefits such as iterative development and flexibility, they also present challenges to integrating creativity within the Requirement Engineering process. However, the study suggests that with effective teamwork, communication, and adaptation strategies, Agile and creativity can complement each other. Agile methodologies provide a framework that fosters creativity through iterative development, collaborative teamwork, and adaptability to market changes. Conversely, creativity enhances Agile practices by promoting innovative solutions, problem-solving, and continuous improvement. Therefore, Agile and creativity are intertwined and mutually beneficial in driving successful software development projects. By addressing the identified challenges and leveraging Agile principles to foster collaboration and innovation, the companies can overcome barriers and leverage creativity to deliver high-quality software products that meet user needs effectively.

Considering the different roles between the companies, at Capgemini AB, the teams primarily consist of internal project members who have considerable freedom to experiment and innovate. This internal focus allows for a more flexible approach to integrating creativity, supported by iterative processes and sprints. In contrast, Company Y operates with project teams that interact and depend on each other, catering to distinctive markets. Here, the roles are more interconnected, and the dependency between teams influences the management of deadlines, customer feedback, and evolving requirements. The dynamic market context and the need to align with various stakeholders manifest additional challenges to fostering creativity within short sprints.

Although Agile and creativity can complement each other, the degree to which they do so depends on the company context, team roles, and the specific practices employed. Though companies like Capgemini AB with internal product teams can benefit more from flexible, research-driven approaches, they encounter a deficiency in real-world client feedback which hinders embracing external user perspectives. The teams continuously face ongoing on-boarding issues, that generate a knowledge gap and a considerable time for improvements hindering the capability for continuous innovation. Company Y practices innovation week, utilizes commitment boards, and assigns creativity-related new team roles to foster creativity, but navigating diverse market demands and interdependent teams requires careful management of feedback loops and evolving requirements to avoid excessive client pressure.

6.2 Future works

This study focused on understanding the level of creativity in RE in internal software product development teams working in an agile setup. Therefore, there can be many other aspects of creativity and software development practices to explore in terms of creativity. Following are some of the areas which might be conducted in the future.

- The study can be extended or focused to different business domains under software engineering such as pharmaceutical, banking and financial, manufacturing, etc. where creativity might be an important factor for software development
- Under this research study, interviews and observations were conducted for 6 weeks (2 sprints). As a future extension, this study can be conducted to observe the evolution of creativity in agile teams and understand the impact of creative practices on the outcome.
- Since this research was conducted as a qualitative approach, in the future this research can be extended using quantitative methods which then could be an assessment of the impact of creativity practices on the outcome.
- This study can be further extended as a comparative study between different agile frameworks such as Scrum, Kanban, SAFe, Extreme programming, etc. to determine how each framework encourages or hinders creativity.
- Development of a detailed, collaborative requirement clarification platform accessible to all team members, enabling direct interaction with clients and visibility into client requirements.

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A

Appendix 1

6. The Design – Methods and Procedures

Interview questions

1. Understanding the current requirement engineering process of the above-mentioned software product development teams:

   - Can you describe the process your software product development team uses for gathering, prioritizing, and managing requirements, particularly within Agile?
   - Are there any specific tools or methodologies used to manage requirements?
   - How do you ensure customer needs and business objectives are effectively captured and matched for system development?
   - Are there any ongoing initiatives or plans to improve the requirement engineering process within your team? If so, what are they?
   - What are some common challenges or pain points experienced during the requirement engineering phase?

2. Agile Software Development Practices:

   - Can you explain your experience with Agile software development practices?
   - What specific techniques or ceremonies within Agile (such as sprint planning, backlog grooming, or retrospectives) play a significant role in managing requirements?
   - How are requirements/user stories managed and prioritized specifically within this Agile framework by your team?
   - Have you participated in ideation sessions as part of the Agile requirement engineering process?
   - How do you make sure that the creative ideas from ideation sessions match both the project goals and what users need?
   - Are there any ongoing efforts or plans to refine or improve Agile practices within your team? If so, what are they?

3. Perceptions of Creativity:

   Investigate the interviewee's understanding and perception of creativity in the context of Agile software development and requirement engineering.

   - What are the perceptions of creativity in an Agile team? (How does your Agile team view creativity?)
   - What is the current role creativity plays in Agile software development?
   - What is the current role of creativity specifically played in the requirement engineering?
   - How does your team adapt to changing customer requirements while encouraging creative thinking?

Figure A.1: Interview Guideline

B

Appendix 2

Agreement about Informed Consent and Data Protection in Interviews

Name of the Research: Integration of Creativity in the Requirements Engineering Process for Agile Software Development.

Interviewer: …… Co- research member: ……...

Name of the University: Chalmers University of Technology.

Supervisor of the Research:

Name: Jennifer Horkoff (jenho@chalmers.se)

Name of the University: Chalmers University of Technology.

The responsible persons will ensure that all data will be treated confidentially and only for the purposes agreed upon herewith:

- The interviewee agrees that the interview will be recorded and analyzed. After finishing the recoding, he or she can check the transcript later to remove single parts from the transcript.

The materials will be processed according to the following agreement about the data protection.

Recording

1. The recording of the interview will be protected in a password-protected storage media by the interviewers and erased after 3 years of study.
2. Only the interviewer and the co-member of the research group will have access to the recording for analyzing the data.
3. In addition, recording can be used for thesis writing purposes. All the members in the research group will be obliged to maintain the data protection.

Analysis and Archives

1. For the analysis, the recording will be transcribed. Names and the locations mentioned by the interviewee will be anonymized in the transcript as far as necessary.
2. In paper publications, the interview identities will be kept anonymous.

The interviewer and the co- research member hold the copyright for the interview. The interviewee may take back his or her declaration of the consent completely or partially within 7 days.

[Location, Date] …….

Interviewer ……. **Interviewee …….**

In case of an oral agreement

I confirm that, I have informed the interviewee about the purpose of the data collection, explained the details of this agreement about data protection, and obtained his or her agreement.

[Location, Date]: …… **Interviewer: …….**

Figure B.1: Interviewee - Consent Form

C

Appendix 3

Consent for interview participation

Name of the Research:	Integration of Creativity in the Requirements Engineering Process for Agile Software Development
Name of the University:	Chalmers University of Technology
Name of the Supervisor:	Jennifer Horkoff (jenho@chalmers.se)
Research member 1:	Pavithra Herath (herathp@chalmers.se)
Research member 2:	Oshan Siriwardena (kathri@student.chalmers.se)
Name of the Interviewee:	.....

The above-mentioned students are currently conducting an interview as a part of the data collection in their master's thesis research.

The research is supposed to conduct a systematic exploration on the extent of where, how and when the creativity is involved and can be integrated into the requirement engineering process within Agile frameworks. The importance of studying creativity in the requirement engineering process lies in its potential to enhance adaptability, collaboration, user-centricity, and innovative capacity of Agile software development ultimately contributing to the successful delivery of project that surpass user expectations in a rapidly evolving market. Therefore, our study aims to address this gap of creativity by systematically investigating hindrances and opportunities of integrating creative thinking with in this Agile requirement engineering framework.

The research members mentioned above is asking for the consent to interview to study and understand in-depth about the existing agile requirement engineering process and whether and how creativity is integrated within the process.

1. The research students request the interview to be recorded and analyzed for the study purposes and the recording of the interview will be protected in a password-protected storage media by the interviewers and erased after 3 years of the study.
2. Only the interviewer and the co-member of the research group will have access to the recording for analyzing the data and can be used for thesis writing purposes.
3. For the analysis the records are transcribed and names and the locations mentioned by the interviewee will be anonymized in the transcript as far as necessary.

Name of the Company:	_____
Name of the Consent Giver:	_____
Signature:	_____
Date:	_____

Figure C.1: Consent Form - Company permission for participation

D

Appendix 4

Observation Consent Form

Name of the Research:	Integration of Creativity in the Requirements Engineering Process for Agile Software Development
Name of the University:	Chalmers University of Technology
Name of the Supervisor:	Jennifer Horkoff (jenho@chalmers.se)
Observer:	Oshan Siriwardena (oshan.siriwardena@capgemini.com)
Co-research member:	Pavithra Herath (herathp@chalmers.se)

The above-mentioned students are currently conducting this observation as a part of the data collection in their master's thesis research.

The observer mentioned above is asking for your consent to observe the events of the scrum team (sprint planning, daily stand-up meeting, sprint demo & review, sprint retrospective) to study and understand in-depth about the existing agile requirement engineering process and whether and how creativity is integrated within the process.

The observer will be taking notes. The company (or the consent giver) can remove any company sensitive information from the notes taken from the observation before further processing. These notes will be used by the observer and the co-research member to analyze the process.

Observer will not be recording any images or videos as part of this research, and all results will be anonymous.

Name of the Company: _____

Name of the Consent Giver: _____

Signature: _____

Date & Location: _____

Figure D.1: Consent form- Observation

E

Appendix 5

Observational Template:

Date: Start Time:

Location: End Time:

Participants present (Roles, Background):

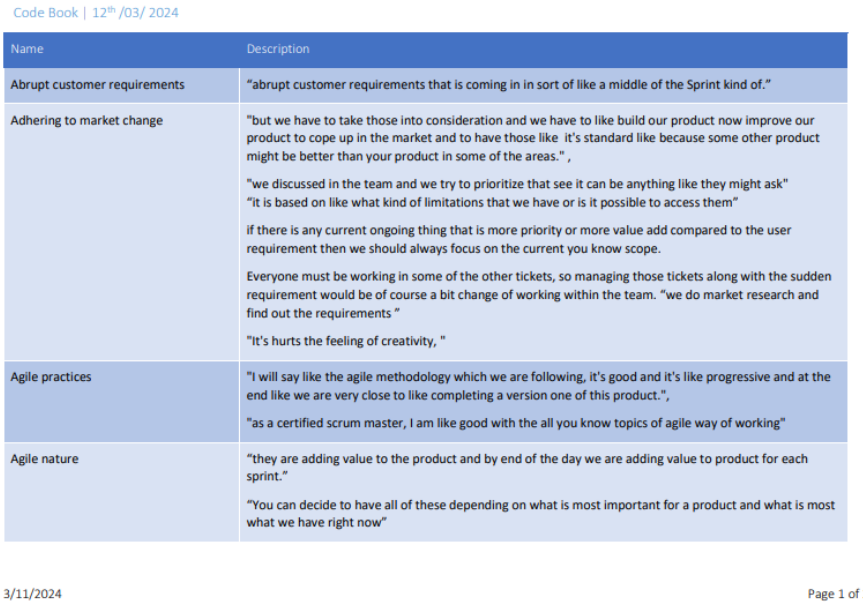
Focus of Observation:

Event	Detailed Description	Report evidences (files, conversions)
Sprint Planning		
Backlog Refinement		
Sprint Demo & Closure		
Sprint Retrospective		
Daily Standup Meeting		

Figure E.1: Report template- Observation

F

Appendix 6



Code Book | 12th /03/ 2024

Name	Description
Abrupt customer requirements	“abrupt customer requirements that is coming in in sort of like a middle of the Sprint kind of.”
Adhering to market change	"but we have to take those into consideration and we have to like build our product now improve our product to cope up in the market and to have those like it's standard like because some other product might be better than your product in some of the areas." , "we discussed in the team and we try to prioritize that see it can be anything like they might ask" “it is based on like what kind of limitations that we have or is it possible to access them” if there is any current ongoing thing that is more priority or more value add compared to the user requirement then we should always focus on the current you know scope. Everyone must be working in some of the other tickets, so managing those tickets along with the sudden requirement would be of course a bit change of working within the team. “we do market research and find out the requirements ” "It's hurts the feeling of creativity, "
Agile practices	"I will say like the agile methodology which we are following, it's good and it's like progressive and at the end like we are very close to like completing a version one of this product.", "as a certified scrum master, I am like good with the all you know topics of agile way of working"
Agile nature	“they are adding value to the product and by end of the day we are adding value to product for each sprint.” “You can decide to have all of these depending on what is most important for a product and what is most what we have right now”

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Figure F.1: Sample : Code book with Interview data extracts

Observation

Nodes

Name	Description
Availability	Team first checked the team capacity and availability for the new Sprint
Code deficiencies	Error & exceptions handling was not done properly.
Code reviews	Also the code reviews, and preparations for production release was expedited. Since a new front-end developer joined, he agreed to look into the code quality issues and agreed to refactor the code to improve code quality. Code refactoring and quality improvements with the front-end development carried out. Cypress learning and front-end code refactoring continued. Front-end code refactoring continued.
Commitment	Decided to complete few of the remaining incomplete tasks before the end of the sprint.

Figure F.2: Sample : Code book with Observation data extracts

G

Appendix 7

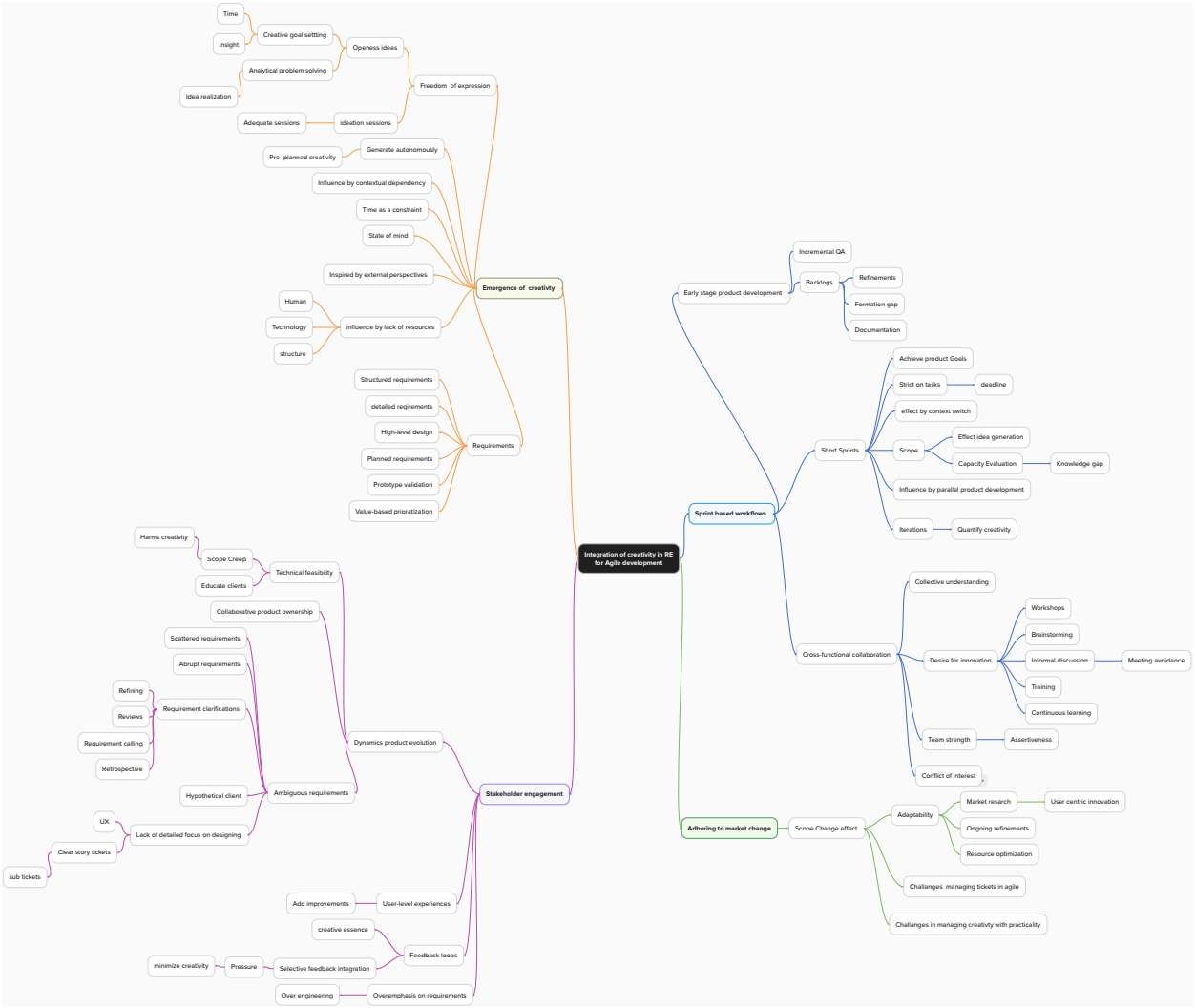

Figure G.1: Themes Mapping - Phase I

H

Appendix 8

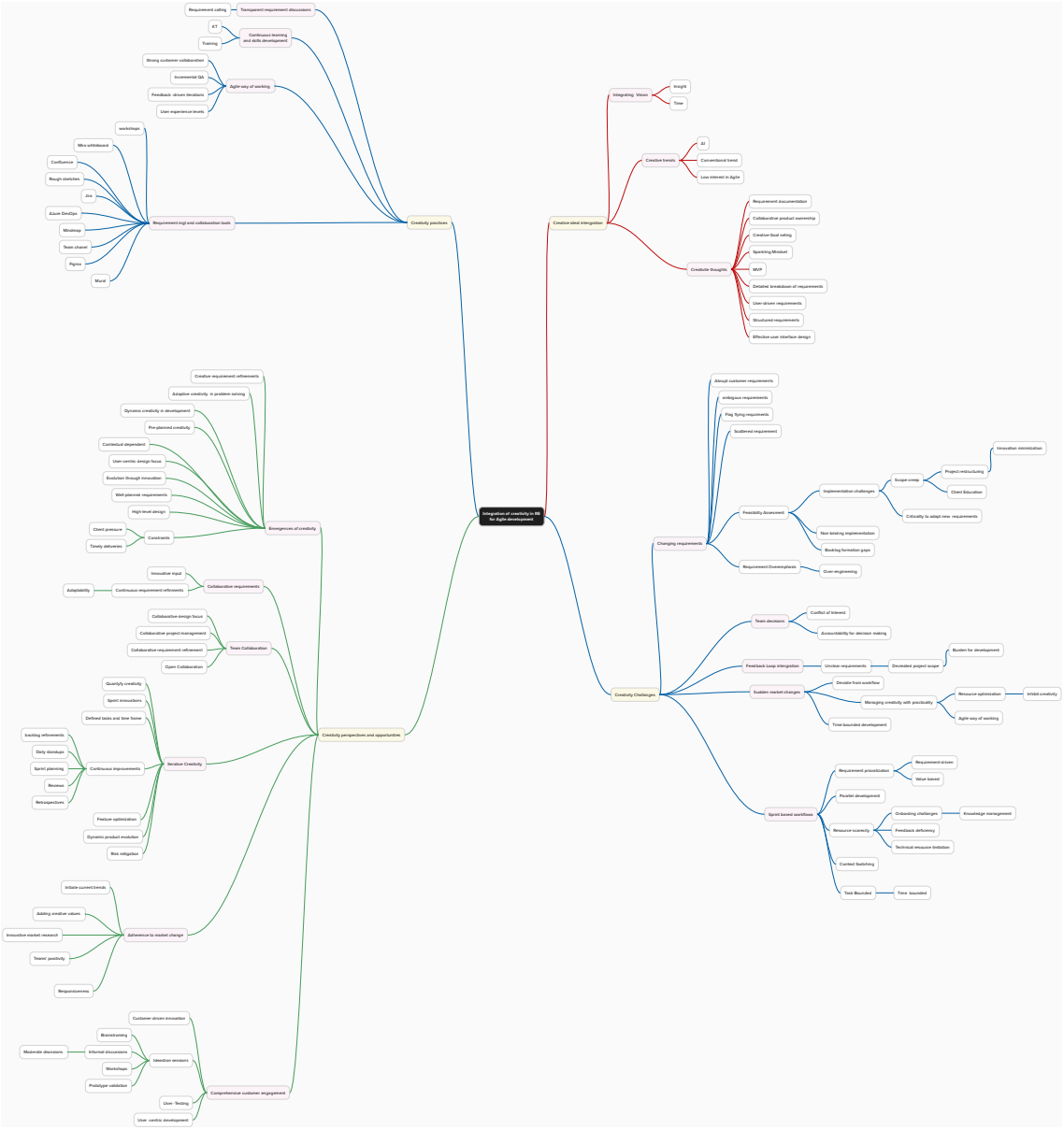

Figure H.1: Themes Mapping - Phase II

I

Appendix 9

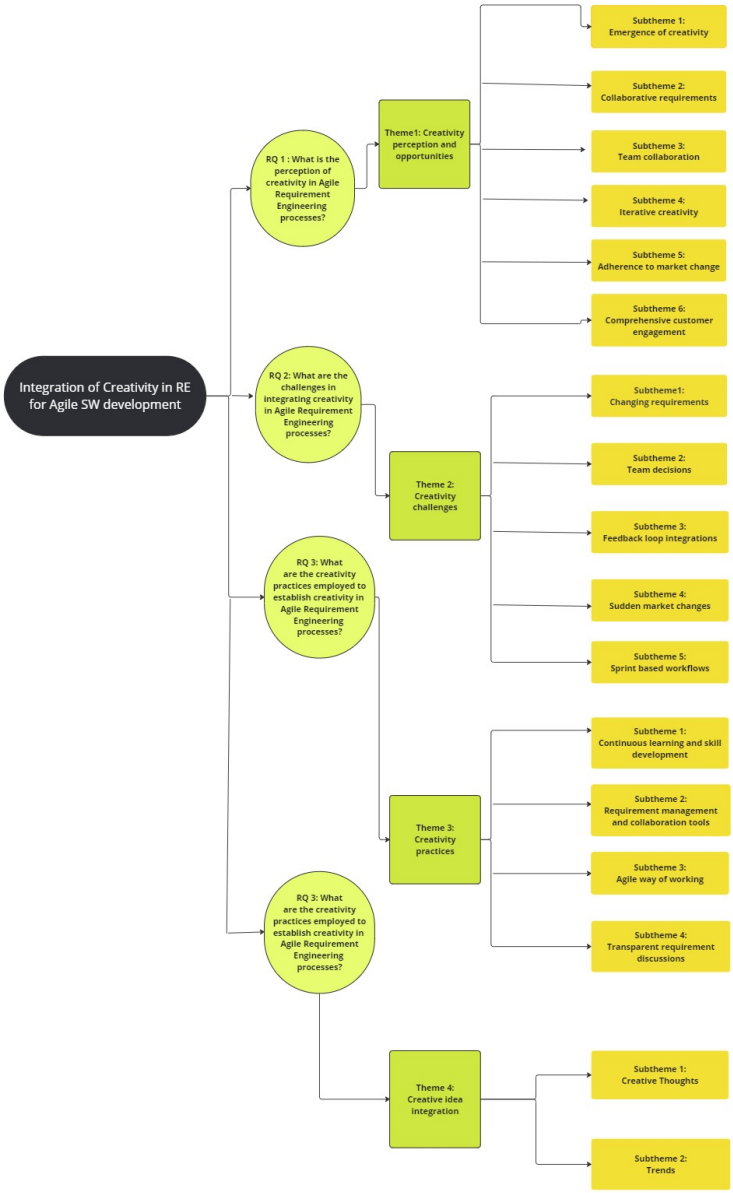

Figure I.1: Themes organization

J

Appendix 10

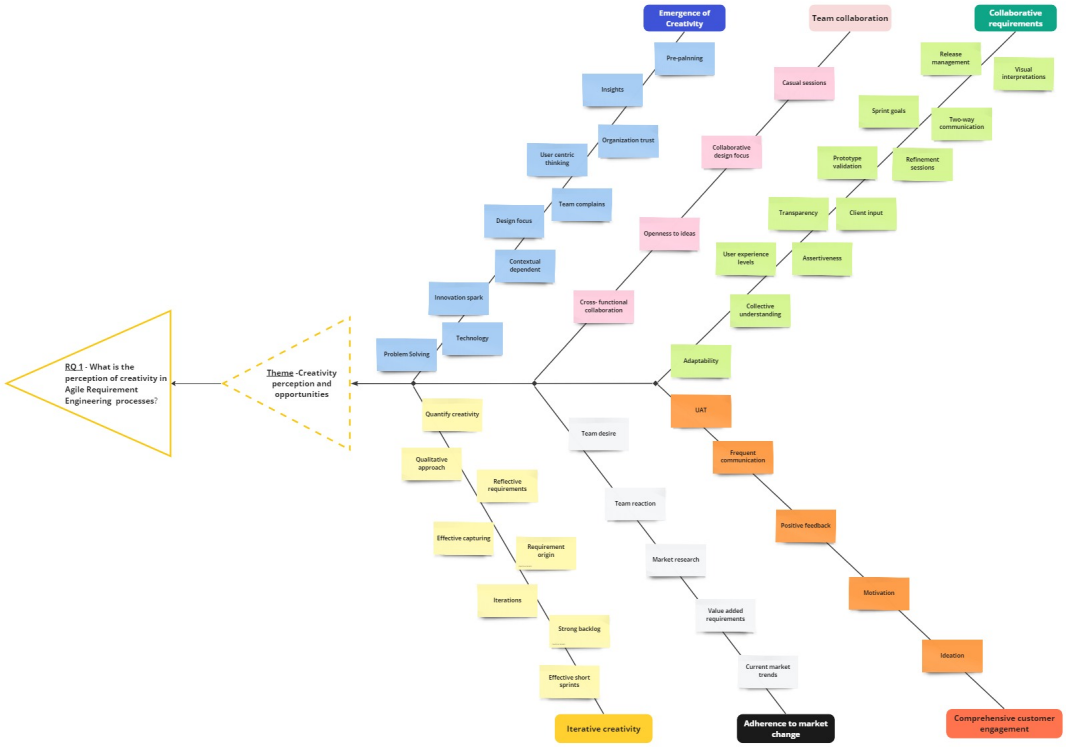

Figure J.1: Themes and codes RQ1 : Interviews

K

Appendix 11

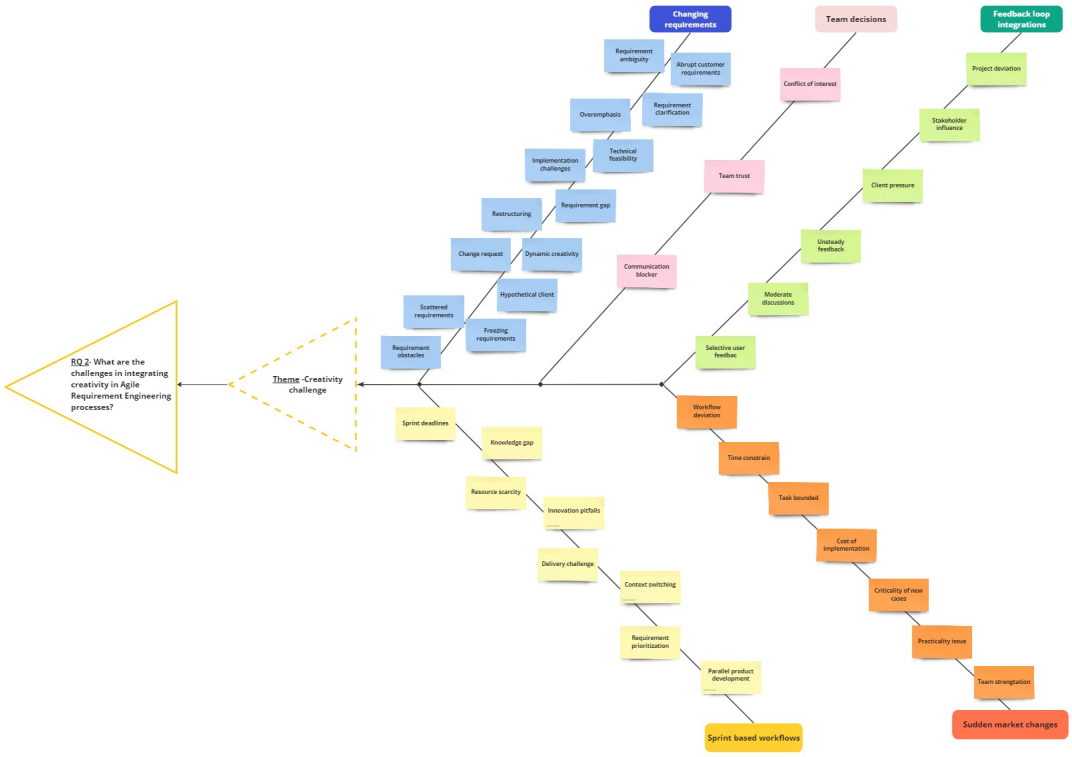

Figure K.1: Themes and codes RQ2 : Interviews

L

Appendix 12

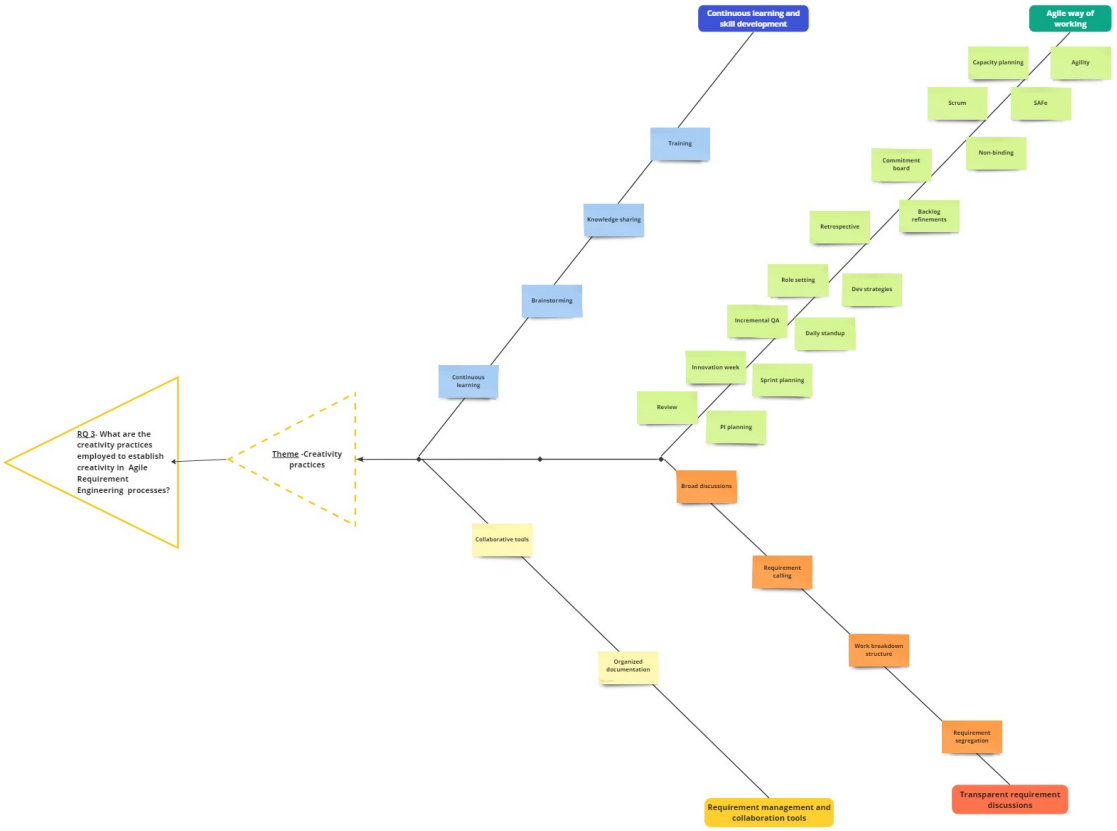

Figure L.1: Themes and codes RQ3 : Interviews

M

Appendix 13

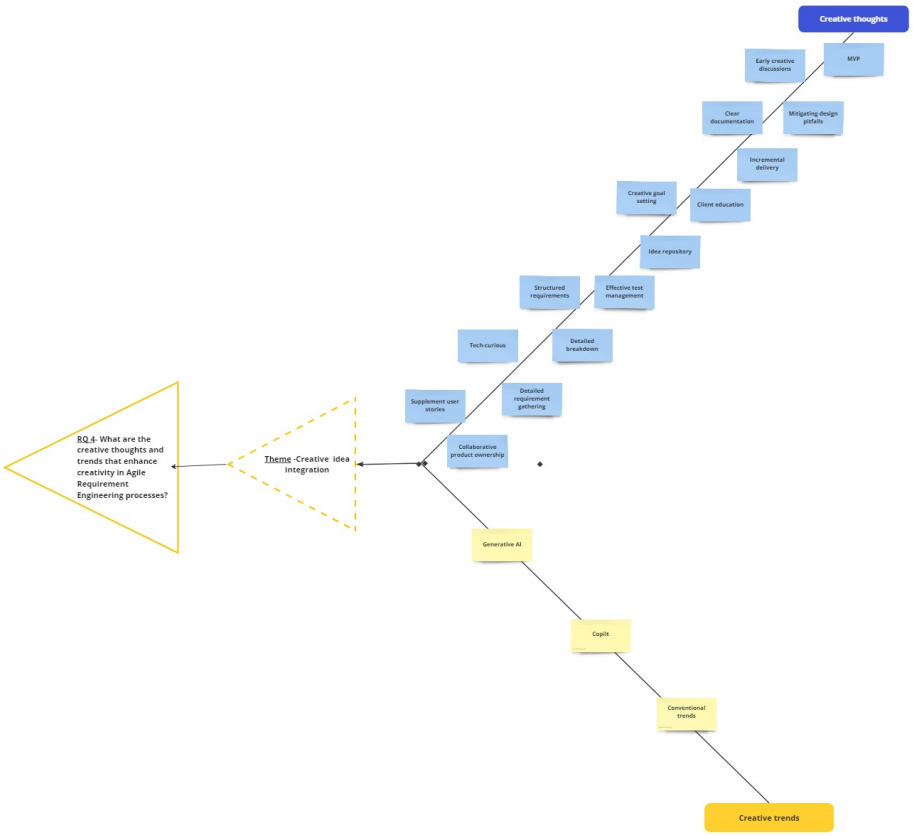

Figure M.1: Themes and codes RQ4 : Interviews

N

Appendix 14

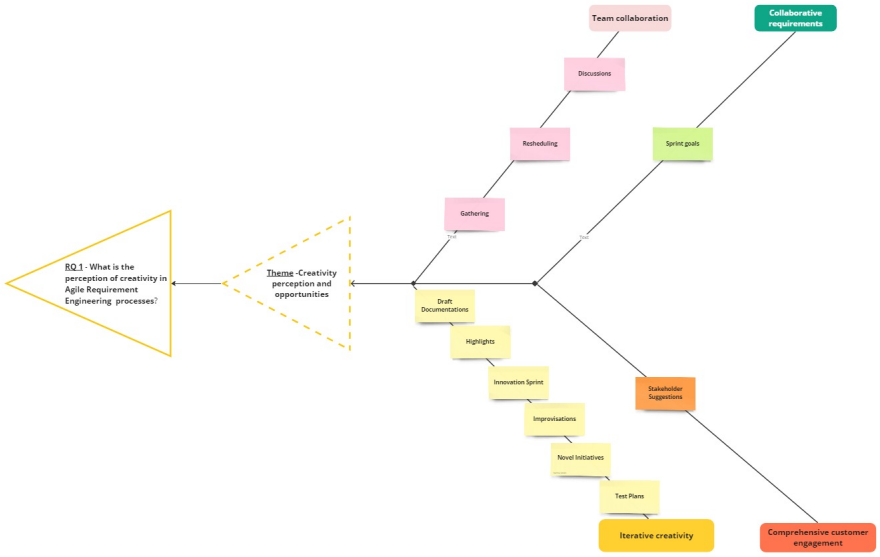

Figure N.1: Themes and codes RQ1 : Observation

O

Appendix 15

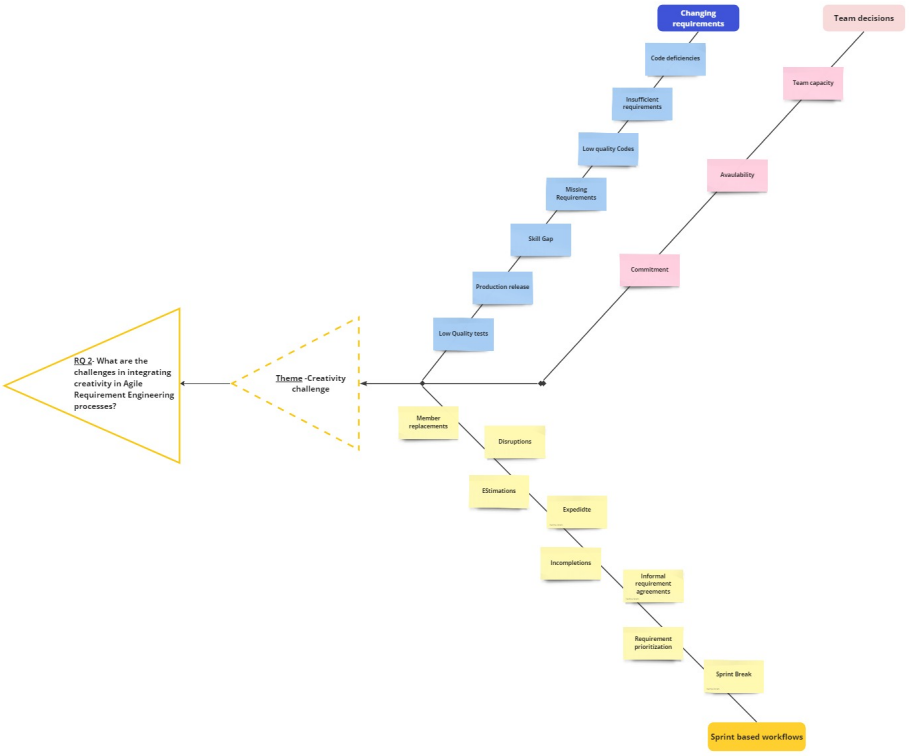

Figure O.1: Themes and codes RQ2 : Observation

P

Appendix 16

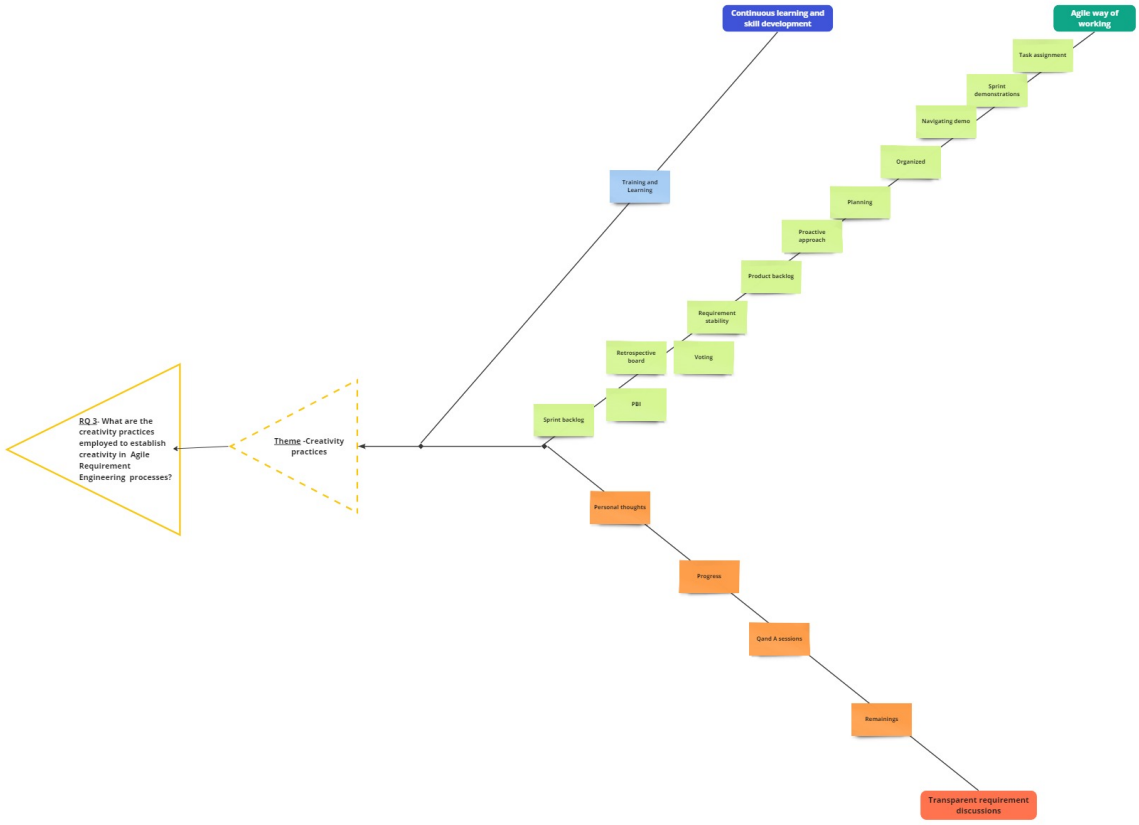

Figure P.1: Themes and codes RQ3 : Observation