CHALMERS
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Effect of individual on software development team performance

Investigating individualism of software engineers and how it could affect a software development team performance

Master's thesis in Computer science and engineering

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Abstract

Nowadays, software development companies conduct their work in teams, thus to improve team productivity, it is crucial to understand the underlying factors of an individual and the team that affects team performance. Two individual-level concepts that are frequently discussed are personality and social sensitivity. Two other team-level concepts that have been notable are psychological safety and team norm clarity. This research aims to understand these concepts in a software development team. The research question is whether personality, social sensitivity, psychological safety, and team norm clarity associate positively with software developers' self-assessed individual and team performance. Besides, this research speculates the differences between individuals who are software engineers and interaction designers, how they are different in the mentioned variables.

This research has collected surveys and interview data from practitioners (N =29) in 5 development teams working in a software development organization. The data was far too few to be able to conclude the result. However, there are traces of trends that are worth investigating further. Based on quantitative analysis, it can be concluded that extroversion in personality has a weak positive non-linear correlation with individual performance and has a weak negative non-linear correlation with team performance. The equation of independent variables to predict team performance is y=0.7757a+0.1252b+1.5556, in which individual performance(a) and imagination(b) affects the forming of the equation. Based on the interview, other factors were found to play a supporting role in personality, social sensitivity, psychological safety, and team norm clarity such as professionalism, adaptability, working style, motivation, etc. which indirectly boost the team performance.

Personality traits that affect designers' team performance most is creativity. Creativity connects to openness and extroversion, and extroversion is proved to have a significant correlation with team performance for software engineers in this research; it can be speculated that software engineers and designers have different required qualities but share extroversion as a bonus quality to improve performance.

This research highlights the need to examine, in more detail, professionalism, team structure, team maturity, and software engineers' behavior that affects a software development team performance. The findings of this study could serve as a pilot study to discover individual factors for future work.

Keywords: Software engineer, interaction designers, personality, social sensitivity, psychological safety, team norm clarity, performance, software development.

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1
Introduction

This chapter describes the concept and purpose of the study. There is the background for why this study has been made, problem statement to identify what this study does, objective describes the goal, and scopes and limitations states the boundary of the research and what can be done.

1.1 Motivation

There are many aspects of software development that are important. One model, the 4P model of IBM, describes four critical components of software development which are project, product, process, and people[1]. Most software engineering industries focus heavily on the software development process and project management to improve the performance of software engineering teams to deliver a product efficiently and effectively[2][3]. However, the behavioral aspect of an individual is scarcely investigated due to the lack of research in this field. Software development involves software engineers as well, and therefore, to maximize the performance of a team, the people aspect should be taken into account. Meanwhile, interaction designers who frequently cooperate with software engineers have been detached and excluded in the developing process, and understanding the difference between these roles with their mental capabilities and behavioral style will help to communicate better. People are essential in software development since they are involved in the development of a software product throughout its entire life cycle[1], and that is why this research focuses on the people aspect to improve work efficiency further.
There are three levels of abstraction for people structure in an organization, which are the organization, the team, and the individual[4]. All three abstraction levels are interdependent; however, there is less research that focuses on the connection between the organization, team, and individual level[4]. The individual level is unusual to investigate to understand how the performance of an individual could be affected by the individual's persona. Furthermore, a teams' performance could also be affected by an individual. Therefore this research also includes the team level. The organization-level would be intriguing to study as well; however, for brevity, this research only focuses on the team and individual level. There were not enough resources to study the organization level and interaction with other levels. Moreover, it is not clear which methodology would be suitable to study the organization level since there are many factors involved whereas the individual and team level indicators of individuals' mental capabilities and behavioral styles that could affect an individual and team performance are personality[5][6][7], social sensitivity[8][9],

psychological safety[4], and team norm clarity[4].

Personality, social sensitivity, psychological safety, and team norm clarity are interesting variables to investigate. This research focuses on these four variables listed below for several reasons. Firstly, personality is an indicator of an individual. It is comprised of five big dimensions of openness, conscientiousness, extraversion or extroversion, agreeableness, and neuroticism or imagination[5]. Personalities can indicate how individuals work and how their traits can affect individual performance, as well as team performance. It is important because many studies indicate correlations between the personality of an individual and his/her performance[5][6][7]. The effect of the personality of a software engineer is not widely known, due to the low amount of research in the people aspect in the software engineering field. Thus, understanding the personality of a person would be beneficial to understand how he/she works. However, relations between personality and its effect are not robust since there is no clear conclusion of whether personality would be a critical variable that affects human behavior[10]. Secondly, social sensitivity is the ability to identify, perceive and understand the signs and contexts in social interactions and read emotions of others[11]; it correlates to social intelligence, which in turn, can be linked to team-based problem-solving performance[12]. Working in a team, communication, and social interaction are critical factors in a successful team[9]. That is why the study of a software engineer's social sensitivity is intriguing. Thirdly, psychological safety in a team, which means that a team is a safe place for interpersonal risk-taking, is a belief shared among team members[13]. Many studies show that team performances are higher when the team members have a high psychological safety level[4][14]. Lastly, team norm clarity is a public or latent principle shared among the team members, and that regulates and governs their behavior[15]. It is rarely studied in behavioral studies or social science despite the strong effect and relation it has on a team[2]. Team norm clarity is on the team level, which would support the human behavior of an individual to conclude the effects on performance in a team. An individual can affect the performance of both the individual and team level; thus, it is crucial to measure both.

1.2 Problem statement

Nowadays, software industries focus a lot on processes and tools to improve their development, whereas the people, specifically software engineers, are being neglected[2][3]. To be able to sustain efficiency in software development, software engineers should be studied in order to become aware of their impact on software development. Besides, differences between software engineers and interaction designers should be researched to help them cooperate better.The research investigates an individual's mental capabilities and behavioral styles that could affect an individual and team performance in the software industry and compare the results of software engineers with that of interaction designers. Mental capabilities and behavioral styles could include personality, psychological safety, social sensitivity, and team norm clarity.

The research would be interesting for a manager in a software company to compre-

hend the results and analyze further how the company should adapt their working environment to fit with the software engineers to improve their performance. Apart from that, the software engineers and interaction designers could cooperate more efficiently after understanding each other.

The purpose of this study is to investigate human behavior and the correlation to team performance at Ericsson AB. Human behavior would be measured using individuals' mental capabilities and behavioral styles, such as personality, social sensitivity, psychological safety, and team norm clarity. With the result of this research, the company would be more equipped with a better understanding of how a team works and how to maximize the efficiency in an individual and a team to promote high performance.

1.3 Significance of the study

The study aims to research the effects of individuals' mental capabilities and behavioral styles, such as personality, psychological safety, social sensitivity, and team norm clarity on team performance in a software company. The correlation between those four variables and performance has not been studied in a software engineering field. The result would help the software company encourages more team dynamics to promote higher performance. It could also be beneficial in knowing where to allocate recruits to a new team so that the team could function more efficiently. Furthermore, the research compares performance results from individual and team levels, which makes it more meaningful and reliable. The outcome could also be studied further and investigated other factors such as social intelligence, aptitudes, or cognitive ability and see the effects on the team performance. This research could lead researchers to understand the significance of an individual and understanding how an individual could impact a software development team and the differences between software engineers and interaction designers on the individual and team level.

1.4 Research Questions

The research questions are divided into four parts: individuals' mental capabilities and behavioral styles effect on individual performance (RQ1), team norm clarity and psychological safety effect on team performance (RQ2), the individuals' mental capabilities and behavioral style combined with team norm clarity effect on team performance (RQ3), and lastly, all these results of software engineers compared to that of interaction designers (RQ4).

RQ1: *To what extent do the individuals' mental capabilities and behavioral style of software engineers affect individual performance?* This step is to see the effects of individuals' mental capabilities and behavioral styles, such as personality and social sensitivity on an individual's performance.

RQ2: *To what extent does the team norm clarity and psychological safety affect team performance?* The goal is to see on a team level measurement, how does it affect the team performance.

RQ3: *To what extent does the individuals' mental capabilities and behavioral style of software engineers combined with psychological safety and team norm clarity affect team performance?* This step is to evaluate the personality, social sensitivity, psychological safety, and team norm clarity correlates with team performance.

RQ4: *To what extent do the individuals' mental capabilities, behavioral style, and team norm clarity that could affect the team performance of software engineers differ from that of interaction designers?* This step is to evaluate the individuals' mental capabilities, behavioral style, and team norm clarity that could affect the team performance of software engineers and designers.

1.5 Scopes and limitations

1.5.1 Scope

The study investigates the effect of an individual on a software development team performance. Individual variables that were chosen to be investigated are personality, social sensitivity, psychological safety, and team norm clarity. There are numerous variables of an individual such as attitude, emotional intelligence, communication style, etc. however the four variables that were chosen based on previous studies that have proven that they are related to performance[2][5][12][16][17][18][19][20]. Besides, the study looks at software developers working in a software development team. Thus, it does not cover all professions. The study is conducted in Sweden; therefore, the result might apply to other organizations in the country that has a similar work culture and structure.

1.5.2 Limitations

There are certain limitations in the study where the research design has some flaws. The research narrows down the individual's impact on the individual and team level performance; however, it neglects the organization level. Due to resource limitations, the focus of the study needs to be narrowed down. The study investigates the personality, social sensitivity, psychological safety, and team norm clarity in a software development team as the primary correlation to performance. However, there could also be other factors that were overlooked or has a minor impact on performance. Those other factors could become the main factor as well, depending on how much it impacts the performance and how many were found, but the study could not identify it at the beginning. Thus another limitation to the study is that other factors are isolated and would not be used in the result. Unforeseen circumstances might also happen during the study, such as fewer participants. A measure to mitigate this situation is to be prepared in the data collection and make it available in many forms. Also, if the inevitable happens that prevents data col-

lection from gathering sufficient quantitative data, then the qualitative data should be creamy and able to support the gathered data to some degree to get a better insight into the result.

1.6 Thesis outline

The thesis is structured as follows: Chapter 2 talks about previous research and definitions in the field. Chapter 3 explains how the research was conducted. It contains information about how the surveys and interviews were performed. It also explains the analyzing process of the acquired data. Chapter 4 presents the results, and Chapter 5 provides a discussion, conclusions, and suggestions for future work.

2
Literature Review

This chapter is composed of literature reviews and related research papers that support the study. In the following sections, literature reviews on personality, social sensitivity, psychological safety, team norm clarity, and the influence of these indicators on software engineering will be shown.

2.1 Background

Nowadays, software industries focus the majority of their resources on how to improve the processes and tools that they use to work efficiently. However, the software engineers who developed the product using those processes and tools also contribute to the work efficiency.[2][3]. To be able to sustain efficiency in software development in software industries, software engineers should be studied in order to become aware of their impact on software development. The factors of an individual software engineer that are interesting to be explicitly studied are their personality, social sensitivity, psychological safety, and team norm clarity. These variables are linked to performance, which is pointed out in many papers; however, the provided papers studied the link with other professions other than the software development field. Thus, this study aims to focus on the link between software engineers' individualism and their performance.
Papers that studies the link between the individualism of software engineers and performance are 'Influence of Human Personality in Software Engineering - A Systematic Literature Review[21]' and 'Towards a behavioral software engineering[3]'.

2.1.1 Influence of Human Personality in Software Engineering - A Systematic Literature Review

This paper is a systematic literature review to understand if human personality influences the activities of software engineering professionals. The authors mainly focused on two questions: "What psychological models are used to identify traits of personality of software engineering professionals?" and "Activities performed by software engineering professionals are influenced by their personality?". In the first question, as a result, there are four mostly used models to identify traits of personality. The MTBI model uses dichotomy attitude (E-I): (I) Introversion, (E) Extroversion, dichotomy functions (S-N and T-F): (S) Sensing, (N) Intuition, dichotomy lifestyle (J-P): (J) Judging, (P) Perceiving, made up of 16 different personalities. Big Five Personality Dimensions consist of 5 personality traits, accordingly (i) In-

surgency (ii) Agreeableness (iii) Conscientiousness (iv) Neuroticism (v)Openness to experience. Five-Factor Model is a variation of the Big Five model. It has a theoretical basis of causality and measurement than Big Five Personality Dimensions but the same in factors. Some other models, such as Job Diagnostic Survey (JDS), The Personal Style Inventory (PSI), Temperament Classification Keirsey (KTS), which can also be chosen based on what was a need from them. In the second question, studies using the five-factor model were performed in an academic environment. They found no significant effects of personality on the performance of performed activities, while industry studies identified significant influences of personality.

2.1.2 Towards a behavioral software engineering

This paper emphasized the importance of understanding human factors in the software engineering field. Although there are numerous studies on techniques, methods, processes, and organizations, there are not many studies focusing on the people's side. Thus, collecting psychometric measurements can help to look into it. According to prior studies that have been done using Myers-Briggs Type Indicator(MBTI), findings show that there are significant similarities in software engineers. However, MBTI has been questioned because of its weakness in the Judging/Perceiving dimension. As a substitute, International Personality Item Pool(IPIP), which is developed based on the five-factor personality model, is a better test. The study was done by sending out web-based questionnaires to software engineers in 10 diverse companies in Sweden. The questionnaire consists of the IPIP 50-item scale and 56 questions on attitudes and working habits. After analyzing, the results show that higher levels of the personality dimension' conscientiousness' correlate with attitudes towards work style, openness to changes, and task preference.

Also, a paper that studies the link between the individualism of other professions and performance is the 'Emotional intelligence, cognitive intelligence, and job performance' [16] paper. This paper explains other individualism variables that could impact work performance in the study with other professions aside from software development industries.

2.1.3 Emotional intelligence, cognitive intelligence, and job performance

Emotional intelligence is a set of abilities that enable people to perceive and understand emotions. Recent studies have shown a potential link between emotional intelligence and performance, although the results are mixed. Recent studies come up with the Compensatory effects theory, which suggests that emotional intelligence and cognitive intelligence make independent and complementary linear contributions to job performance. Based on that, the paper seeks to look into how emotional intelligence and cognitive intelligence jointly affect job performance. The paper proposed a model that has two hypotheses. Two stages of data collection were done. The first stage is for participants to complete a series of surveys of emotional intelligence(Mayer-Salovey-Caruso Emotional Intelligence Test) and cog-

nitive intelligence(Culture Fair Intelligence Test, Scale 3, Form A). In the second stage, participants' supervisors' complete questionnaires about participants' job performance(five-item scale adapted from McCarthy and Goffin) and organizational citizenship behavior(16-item scale from Lee and Allen). As a result, emotional intelligence and cognitive intelligence are compensatory concerning task performance and organizational citizenship behavior directed at the organization. Emotional intelligence becomes a more reliable predictor of task performance and OCBO when cognitive intelligence decreases.

2.2 Personality

There are five basic dimensions of personality, often referred to as the "Big 5" personality traits[5]. The five broad personality traits described by the theory are extroversion, agreeableness, openness, conscientiousness, and neuroticism (or some calls this imagination). The 'big five' are broad categories of personality traits. While there is a significant body of literature supporting this five-factor model of personality, there are still few studies of personality on software engineers.

The personality-performance relationships have been studied widely in many disciplinary, and the results have discovered that conscientiousness is a valid predictor across performance measures in all occupations studied. Emotional stability was also found to be a generalizable predictor when overall work performance was the criterion. Though the other three Big Five traits (extraversion, openness, and agreeableness) did not predict overall work performance, they did predict success in specific occupations or related to specific criteria.[17] Thus, this study will also investigate these five personality traits of software engineers to support the personality-performance relationship. The paper that studies the personality of software engineers is 'Links between the personalities, views, and attitudes of software engineers' paper[22]. Whereas, papers that investigate the personality-performance relationship in other occupations are 'Personality correlates of nonverbal interview behavior' [23] and 'A review of the relationships between personality and performance in small groups' [7].

2.2.1 Links between the personalities, views, and attitudes of software engineers

Software engineering is a broad field with different aspects. Thus except for the technical aspect that is widely studied, the human aspect is also necessary to understand to create successful software engineering projects. This study aims to understand the connection between personality, decision making, and performance in the software engineering field by testing and creating models and analyzing test results. For the design of the empirical study, there were two parts. The first part is a personality test using the IPIP 50-item model, and the second part is a set of questions looking into views and working styles of software engineers. A pre-test was performed to improve the survey and make the time-limited within forty minutes. Then the

test was done in ten different companies with forty-seven participants. After the test results are gathered, cluster analysis was done in Statistical Package For The Social Sciences(SPSS) to form different groups, and a Student's t-test was used to determine which of the variables are essential for the formation of the clusters. As a result, there are two clusters, mainly categorized by extraversion and openness. ANOVA was done to understand how personality traits are connected with questions in part 2. Also, Generalized Linear Model was used to model the relationship between personality and attitude variables. This empirical study can be a general method for finding out the link between people and behavior, which is valuable to future researches.

2.2.2 Personality correlates of nonverbal interview behavior

The purpose of this study was to expand our investigation of nonverbal speech measures and explore several nonverbal behaviors that occur in an interview and try to relate them to interviewee individual differences. By committing interviews with thirty-nine volunteers and recording the whole process, several indicators were documented. It is concluded that interview interruptions were seen in individuals who, by self-description, were more anxious, less self-controlled, and less able to entertain many ideas at once. Individuals who described themselves as autonomous, socially comfortable by themselves, intellectually expressive, and "cerebral" (i.e., high BIT score) exhibited longer RTLs. In contrast, the quick response to interviewer questions were associated with self- descriptions of deference, succorance, and the tendency for self-abasement. This paper helps this research to design an interview that could gather meaningful responses better based on the personality of the interviewee.

2.2.3 A review of the relationships between personality and performance in small groups

The study aims to summarize the knowledge about the connection of an individual's personality and his behavior within his small group. The review covers from 1957 to 1990 and specific criteria were applied when selecting the studies. Seven factors frequently distinguished in personality are Intelligence, Adjustment, Extroversion-introversion, Dominance, Masculinity-femininity, Conservatism, and Interpersonal sensitivity. Six variables were selected to measure an individual's behavior, which are leadership, popularity, total activity rate, task activity, social-emotional activity, and conformity. Twenty-nine relationships were examined, and finally, an examination was made of the effect of four factors of research on three of the relationships. As a result, the best predictor of performance is the intelligence of personality, which has a positive relation to activity rate, leadership, and popularity. Adjustment, Extroversion, Dominance are also positively related to behavior variables, while Masculinity has low positive relation. Conservatism is negatively related to leadership but positively related to popularity.

2.3 Social sensitivity

Social sensitivity describes the proficiency at which an individual can identify, perceive, and understand cues and contexts in social interactions along with being socially respectful to others. Social sensitivity is an essential social skill and having high levels of social sensitivity can make you more well-liked and successful in social and business relationships.[24] In the software engineering field, social sensitivity and performance are being researched in 'Females in Software Engineering Teams: A Social Sensitivity Perspective' [25] paper. Other papers that mentioned social sensitivity and performance states that social sensitivity is one of the seven important factors in collective intelligence. Such papers are 'Evidence of a Collective Intelligence Factor in the Performance of Human Groups' [19] and 'Collective Intelligence and Group Performance' [20]. Also, other papers researched the correlation between social sensitivity and performance in a different occupation, such as the 'Social Sensitivity correlates with the effectiveness of team process performance: an empirical study' [12]

2.3.1 Females in Software Engineering Teams: A Social Sensitivity Perspective

Nowadays, there is a tendency for students to have techniques but lacking soft skills such as communication skills. However, previous studies have proved that the ability to use soft skills to deal with relationships and negotiate social interaction is crucial to team success. The goal of the study is to find out the relationship between group behavior, team performance, and social sensitivity, especially with the presence of female members. The design of the study was to test the participants with social sensitivity and then randomly arrange them into a group of four. These teams work during the semester on the same topic, and deliverables collected their performance. Then peer and self-evaluation and post-study surveys were used to get qualitative data. After the data was gathered, one way ANOVA and statistical significance were applied to the data to see if there is a difference in social sensitivity between the groups that have more number of females and those who do not. Moreover, the result is negative, which means adding females does not improve social sensitivity.

2.3.2 Evidence of a Collective Intelligence Factor in the Performance of Human Groups

The study aims to prove the hypothesis that group intelligence exists and can be measured to predict group performance. Individuals were randomly assigned to groups, and they, as a group, would perform different tasks. Tasks included solving visual puzzles, brainstorming, making collective moral judgments, and negotiating over limited resources. Another similar study was used to test five additional questions in different sizes of groups. The result was positive, which means that group intelligence exists. As for what caused group intelligence, three factors have a significant correlation. The average social sensitivity with group members is positively related, and the number of speaking turns by group members is negatively related;

also, the proportion of females in the group is positively related.

2.3.3 Collective Intelligence and Group Performance

Previous studies have proved that the general intelligence for individuals is a predictor for their performance. Similarly, collective intelligence for groups can be the predictor for group effectiveness. While individual intelligence within a group correlates with collective intelligence, the more robust predictor of collective intelligence is social sensitivity. Apart from that, the proportion of women in the group and the level of diversity are also related to collective intelligence. Some studies found out that intelligence can predict learning ability in individuals and groups, which means that higher intelligence tends to learn faster. For future studies, the question to be researched can be how collective intelligence can be increased, which can be observed in this research.

2.3.4 Social sensitivity correlates with the effectiveness of team process performance: an empirical study

This paper tried to prove that social sensitivity can be a crucial component in positively mediating teamwork task activities and member satisfaction. To accomplish these goals, they conducted an empirical study that investigated the effect of social sensitivity on the performance of project teams consisting of computer science and management information system students who worked on semester-long projects. They used the "Reading the Mind in the Eyes" test to determine an individual's level of social sensitivity. The study with a randomized experimental design was used in the study in which participants were tested to determine their social sensitivity scores and were then randomly assigned to teams of three participants each and then conduct a project. Four variables are social sensitivity score, team performance, teamwork activities, and team member satisfaction. After analyzing the data, the results showed a significant positive correlation with eight of the ten performance activities.

2.4 Psychological safety

According to Harvard Business School professor Amy Edmondson, who coined the term: "Psychological safety is a belief that one will not be punished or humiliated for speaking up with ideas, questions, concerns or mistakes." [26] Studies from Google[27] found out that teams which made more mistakes were more successful than others because creating an environment in which people feel comfortable to take risks is key to fostering innovation in the workplace. Psychological safety has been linked with high performance based on numerous studies in psychology. In the software development field, psychological safety and performance go hand in hand, which is explained in the 'Psychological Safety and Norm Clarity in Software Engineering Teams' [4] paper. Though psychological safety has not been widely researched in the software development field, in the psychology field, it has been studied and proven that psychological safety highly links with team performance.

Papers that support such claims are 'Psychological safety and learning behavior in work teams' [13], 'Team psychological Safety and team performance' [28], and 'High-Performing Teams Need Psychological Safety' [14].

2.4.1 Psychological Safety and Norm Clarity in Software Engineering Teams

This paper explained and discussed the definition of psychological safety and norm clarity, respectively, and investigated whether these two concepts associated positively with team performance and job satisfaction, as well as whether raising team norm clarity would strengthen the effect of the two concepts. The authors designed research in the form of online and offline questionnaires consisting of questions that have been verified to be the measurement of the variables. After gathering the data, they applied multiple linear regression analyses to find out the relationship between the variables and used confirmatory factor analysis (CFA) to test whether the data fit a hypothesized measurement model. As a result, all variables have a significant result. However, concerning the order of impact, team norm clarity is a better predictor of team performance than psychological safety.

2.4.2 Psychological safety and learning behavior in work teams

This paper tried to understand learning behavior in organizational workgroups and assumed that team structures and shared beliefs should be investigated jointly using both quantitative and qualitative methods. Learning behaviors refer to the activities conducted by team members that allow the team to improve, including seeking feedback, sharing information, asking for help, talking about errors, etc. Learning behaviors can help a team in a way that it improves the collective understanding within the team and of the environment. The study was done first by observation and interviews to make sure that the theoretical constructs can be conceptualized within the company. Then five-section surveys were sent out to the whole company and interviews between managers who were familiar with all the teams. After that, follow-up interviews were done for those who have different survey results to find out the differences behind the results. As a result, psychological safety affects learning behavior, which in turn affects team performance. Also, learning behavior mediates between team psychological safety and team performance, and team psychological safety mediates the effects of context support and team leader coaching on learning behavior.

2.4.3 Team psychological Safety and team performance - a moderated mediation analysis of psychological empowerment

Previous studies showed that teams that have high psychological safety tend to share trust among members, and the teams are more likely to inspire open discussions,

which will enhance learning within the team. The study aims to understand the relationship between team psychological safety and team performance by investigating the learning orientation and team performance relationships under different psychological safety levels. In the study, the participants come from functional teams of Indian organizations, and the variables are measured by surveys with scales to score themselves. As a result, there is a significant positive relationship between psychological safety and team performance, psychological safety, and learning orientation, learning orientation, and team performance. Also, the learning orientation was found to have a mediation effect.

2.4.4 High-Performing Teams Need Psychological Safety. Here is How to Create It

Psychological safety is an essential factor for a successful team. Recent studies found out that when people feel safe at work, they will be more open-minded and motivated. There are six ways to increase psychological safety that could be suggested to the participants in this research. First, try to get into a conflict as a coordinator instead of an advisor. Second, try to speak human to human. Third, try to anticipate reactions. Fourth, try to understand the conflict instead of blaming each other. Fifth, try to ask for feedback. Sixth, try to measure psychological safety. These six pieces of advice on psychological safety could be used to form a question during the interview on how the team handles psychological safety issues.

2.5 Team norm clarity

Harvard Business Review defines team norms as "Group norms are a set of agreements about how team members will work with each other and how the group will work overall. These agreed-upon behaviors allow the team to increase its collective team performance through healthy debate and clarity of purpose and roles." [29] Other than the 'Psychological Safety and Norm Clarity in Software Engineering Teams[4]' paper which investigates team norm clarity in a software development team, there are other few papers that link team norm clarity to team performance such as 'The effect of vision and role clarity on team performance[30]' and 'The centrality of communication norm alignment, role clarity, and trust in global project teams[31]' paper. Although these two papers do not investigate team norm clarity in the software development team, it still shows that team norm clarity plays a big role in promoting team performance.

2.5.1 The effect of vision and role clarity on team performance

The study aims to explore the impact of vision clarity, vision support, and role clarity on team performance. Vision clarity means that the goals of the project are clear and acceptable for every team member. Recent studies have shown that vision clarity helps the team members to focus on their goals and thus help to improve efficiency.

Vision support means that the vision should be supported and shared within the team, and the team members know how they should work together to accomplish the goal. Role clarity means that the team members know what they are expected to do in their job. The Hypothesizes of the study is that all three factors positively relate to team performance. The study was done on master students majoring in business from a university. First, a pilot study was done on ten students to correct the mistakes in the survey. Then the formal survey was sent out to students. As a result, it shows that visual clarity is positively related to team performance, but it showed no significant connection between role clarity, vision support, and team performance.

2.5.2 The centrality of communication norm alignment, role clarity, and trust in global project teams

Global virtual teams rely a lot on team norms because of differences in geographical dispersion, available technology, time zones, national and organizational cultures, and work practices. Recent studies have shown that role clarity has a positive impact on performance and satisfaction. The goal of this study is to understand how role clarity and trust function align with communication norms that influence global project team members' performance and satisfaction. Surveys and interviews were conducted, and as a result, role clarity mediates the relationship between communication norm alignment and individual performance. Role clarity and trust mediate the relationship between communication norm alignment and individual satisfaction.

2.6 Interaction designers and Software engineers

Interaction designers often have continuous communication with software engineers at work. Understanding the similarities and differences in mental capabilities' effect on team performance between software engineers and interaction designers can help them cooperate better and more efficiently. There is not much literature on similar subjects, but hopefully, some conclusions can be made. One of such literature is 'The Adaptable Mind in Design: Relating Personality, Cognitive Style, and Creative Performance [32]' where they explained designers personality which could be used to compare with software engineers.

2.6.1 The Adaptable Mind in Design: Relating Personality, Cognitive Style, and Creative Performance

The purpose of the study is to understand the relationships between creative personality traits, cognitive and creative performance in design. Recent studies have shown that design needs both artistic and scientific mindsets and that one's adaptability may have an influence on creativity. However, few studies have done an empirical study on these variables. In this study, the participants, 41 female beginning design students, will do a set of tasks, and their personality traits, cognitive styles, and creative performance will be assessed. The Gough Adjective Check List (ACL), scored

for Domino's Creativity Scale (ACL-Cr), was used to assess the creative traits of personality, and the Herrmann Brain Dominance Instrument (HBDI) was used to assess the cognitive styles. Moreover, for assessing performance, each participant is asked to design a three-dimensional model within a limited time, and these designs will be handed to judges to rate according to creativity. As a result, participants showing flexibility among cerebral, limbic, right, and left modes of thinking had significantly higher mean scores on creative personality than those who do not, and Creative personality traits significantly predicted creative performance on the design task. Also, flexibility between styles was significantly correlated to the creative personality.

3
Methodology

This chapter explains how the study has been conducted, how to obtain the results from software development companies, and how to analyze the collected data.

3.1 Design methods

Based on the research questions, there are four independent variables, which are the personality traits, psychological safety, social sensitivity and team norm clarity of software engineers, and the dependent variable, which is the team performance. Data collection was done in quantitative and qualitative data collection to analyze the effect of independent variables on the dependent variable. The independent variable could be less than stated in the result chapter, depending on the relevance and correlation of the variable.

The research studies the effects of an individual's mental capabilities and behavioral styles, such as personality, psychological safety, social sensitivity, and team norm clarity on team performances at Ericsson AB (CNA department). Several volunteers were recruited to do surveys and interviews.

Methods that were used

1. Preparing Phase:
    - Literature Reviews[33]
2. Collecting Data Phase:
    - Questionnaire[34]
    - Discussion
    - Interview[35]
3. Analyzing Data Phase:
    - Affinity Diagram[36]
    - Thematic analysis[16]

3.1.1 Method justification and ethical concerns

Literature Reviews[33] are for learning from what former researchers have done and how to form different questions and improve the process.

Questionnaires or surveys[34] were done by companies employees who were willing to participate in the research to collect personality, social sensitivity, psychological

safety, team norm clarity data, and there was also the self-assessment questionnaires to collect team performance data. The data collected from questionnaires were mostly quantitative, and some of them were qualitative data. The data is sensitive, and there are some confidentiality issues. Some participants might be concerned about how the data that was collected could affect them if their manager happens to see it. It could pose a problem for them in the future where their manager would judge them based on the result of this study. Therefore, to mitigate this privacy issue, the data that is collected are anonymous, and the results of each individual will not be shared with anyone. The final result of this study would be presented in charts and statistics so that no individual can be singled out. Before the data collection, the participants had to sign the consent forms, and they were informed that all the results would be anonymous with a code that only they know and that the results were not public and it was encrypted. Also, they had the right to terminate their participation at any time, and the data will be erased as per their request.

Discussions were done by the company employees who primarily work in a team to collect team norm clarity data. The data is qualitative data where the participants were gathered in a meeting room and discussed some questions. The results were written down during the process, which could invoke some confidentiality issues. Some of the data could not be kept anonymous since the process requires the participant to meet face to face. It is unavoidable to have confidentiality breaches via deductive disclosure. Therefore, there is a conflict between conveying detailed, accurate accounts of the social world and protecting the identities of the individuals who participated in the research. Thus, the data must be collected, analyzed, and reported without compromising the identities of the participants[37] to mitigate the confidentiality issue.

Interviews[35] were done to some of the company employees whose questionnaire results are interesting to study to dig deeper into extreme data. The participants answered questions from researchers, and the answers were then written down and further analyzed. The qualitative data collected could have some ethical issues similar to the group discussion technique, which is a confidentiality issue. The data collected were anonymous to everyone, and people other than the researchers would not have access to it. The collected data would not be of any harm and compromising the identities of the participants in any way [37]. The interviewees were also given consent forms to confirm that the data that is being collected can be used, and they can terminate their participation at any time.

Affinity Diagram[36] and thematic analysis were used to analyze the qualitative data collected from interviews and group discussions.

3.2 Data collection

The section presents how the data is collected, including the data collection procedure and specifications of the data that was to be collected. Besides, the surveys, interviews and discussions that were used for data collection would be introduced.

3.2.1 Data collection procedure

Before the data collection, the plan was to introduce the thesis topic to prospective participants by doing a small presentation. The presentation explains the thesis, motivation, expectations, participation activities, and benefits.

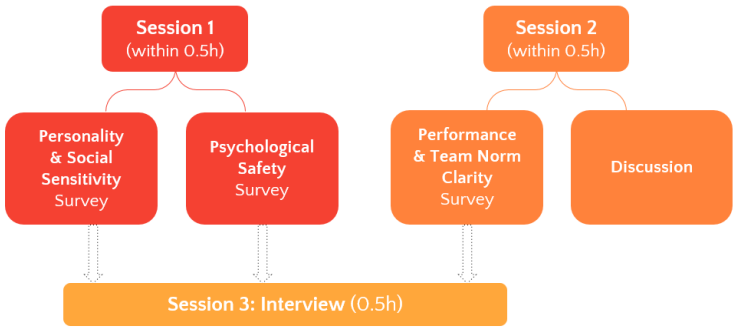

Figure 3.1: Data collection procedure

Figure 3.1 shows how the data collection is divided into three sessions. The first session was to collect an individual's mental capabilities and behavioral styles, such as personality, psychological safety, social sensitivity, and team norm clarity by using the survey. The second session was to collect performance by using the performance survey and the group discussion. The last session was the interview session.

3.2.2 Basic information gathering

Before gathering quantitative data, short sessions were held where the volunteers were asked about their necessary information or background. The information would be the inherent properties of each volunteer, which may influence team performance. For example, nationality, how long have they been working in software development, how long they have been working in the company, how long they have been working in their team, stress level at work, motivation at work, etc.

The basic information data that has been gathered is not analyzed statistically, and the reason to gather these information is to explain any possible differences in the results. For example, the "Reading the Mind in the Eyes' test for collecting social sensitivity uses the eyes of European people, and that could be hard for people out of Europe to correctly recognize. Teams that have been working for a long time may have better team norm clarity than those not. Stress level and motivation information are collected twice for each session in order to mitigate the effect of

the stress and motivation differences between the sessions since the sessions are not done on the same day.

3.2.3 Quantitative data gathering

- The surveys (example in the appendix) were used to collect quantitative data. The surveys were both on paper and online to be able to access all participants and fit the circumstances. The survey also contains a vocabulary list to help the participants understand the question better without having to guess the meaning of the word.
- Personality was measured by using the IPIP-NEO type indicator. The International Personality Item Pool representation of the NEO PI-R™ (IPIP-NEO) is one measure that has been designed to examine the broad spectrum of that which makes up personality. It examines personality over the Big 5 factors of personality, of which the five traits are extroversion, agreeableness, consciousness, emotional stability and imagination. The original test has more than 300 questions, which takes a long time to complete. Thus, the short IPIP-NEO was chosen for this thesis study. The short IPIP-NEO was designed to measure the same traits as the original IPIP-NEO, but more efficiently with fewer items. The average time to complete this short survey is within 10-20 minutes[38]. IPIP-NEO survey is performed in a five-point Likert Scale and the alternatives are very inaccurate, moderately inaccurate, neither accurate or inaccurate, moderately accurate and very accurate. The results present a score for each of the five traits, and the score ranges from 10 to 50 depending on how the participants chose.
- Social sensitivity was measured by having each participant complete the ”Reading the Mind in the Eyes’ test. The ”reading the mind in the eyes’ test was developed as a performance-based measure[39][40]. It is a task involving mental state attribution and complex facial emotion recognition from photographs where only the eye region of the face is available. The Eyes test has been evaluated in over 250 studies to date and has been found to have good reliability[41][42].
- Team norm clarity was measured using the team diagnostic survey defined by Wageman, Hackman, and Lehman[43].
- Psychological safety survey questions were pulled from Project Aristotle conducted by Google to measure a team’s success. The seven psychological safety questions were suggested by a behavioral scientist at Harvard[27]. The participants were then asked how strongly they agreed or disagreed with these seven simple questions.
- Team norm clarity and psychological safety were shown on a five-point Likert scale with the following alternatives: 1 ”strongly agree’,’ 2 ”agree”, 3 ”neither agree nor disagree”, 4 ” disagree”, and 5 ”strongly disagree”.
- To measure team performance, various information were gathered. Team performance were estimated based on the discussion and how a team measures their performance if any. The discussion was used to ascertain the information and ask how they measured their team’s performance. For example, if the

participated team does their work in a SCRUM framework and updates their burn-down chart every sprint, the researchers could ask about how they handle complexity and estimate the task to get this performance number so that this information that would be collected can be used as a standard measurement for team performance. Self-assessment surveys were used to measure individual performance and team performance if there is no record of team performance available. There are six questions that were asked in the self assessment survey and it uses a five-point Likert scale with the following alternatives: 1 ”strongly agree’,’ 2 ”agree”, 3 ”neither agree nor disagree”, 4 ” disagree”, and 5 ”strongly disagree”.

3.2.4 Qualitative data gathering

Discussion was used to allow volunteers in the same group to discuss their common issues within the group, possibly to find out what caused the differences among different groups and the cause of the different results in their team performance, if any. Then, based on the outcome of the questionnaire, the discussion also let the participants discuss into details on the inconsistency within the group, if any.

Data collection for quantitative data on personality, social sensitivity, team norm clarity, psychological safety, and performance were collected through a survey, which can be seen in the appendix. Then, the data were analyzed to choose interview candidates based on their results. Interview candidates were people with outlier results, and some candidates were from the normal distribution, which was randomly selected.

Interviews were held to collect specific data. It was done in a semi-structured way, where there were a set of questions (can be seen in the appendix) and discussions about the interviewee’s results to investigate more in-depth into the topic. Some volunteers were invited to do a few interviews. The interview was to gather qualitative data to investigate further the effects of personality, and team norm clarity of an individual would have on team performance and any other factors that might affect the team performance that might have been overlooked.

3.3 Data analysis

In this section, the details about all the variables collected were presented, and the methods for analyzing these data have been discussed.

3.3.1 The variable types

There are ten variables in this research, namely team norm clarity, psychological safety, extroversion, agreeableness, conscientiousness, emotional stability, imagination, social sensitivity, individual performance and team performance, in which individual performance and team performance are dependent variables and the rest are independent variables. The reason why personality is divided into five different

variables is that the five traits are individual from each other and the scores for each trait cannot be combined.

	Variable	Dependent or independent	Range	Type	Related RQ
Individual Level	Extroversion	Independent	10-50	Ordinal	RQ1, RQ3
	Agreeableness	Independent	10-50	Ordinal	RQ1, RQ3
	Conscientiousness	Independent	10-50	Ordinal	RQ1, RQ3
	Emotional stability	Independent	10-50	Ordinal	RQ1, RQ3
	Imagination	Independent	10-50	Ordinal	RQ1, RQ3
	Social sensitivity	Independent	0-36	Ordinal	RQ1, RQ3
	Individual Performance	Dependent	6-30	Ordinal	RQ1, RQ3
Team Level	Team norm clarity	Independent	3-15	Ordinal	RQ2, RQ3
	Psychological safety	Independent	7-35	Ordinal	RQ2, RQ3
	Team performance	Dependent	6-30	Ordinal	RQ2, RQ3

Table 3.1: Variables

Table 3.1 shows the type, range of all the variables as well as whether they are dependent variable or independent variable, and which research questions they relate to.

3.3.2 Methods for data analysis

The analysis of quantitative data was used primarily to answer each research question. The data gathered were then analyzed further using various methods to ensure the validity of the data. The data gathered from questionnaires were analyzed using the software called Statistical Package for the Social Sciences (SPSS). ANOVA was used and applied on individuals' mental capabilities and behavioral style, such as personality and social sensitivity effect on performance (RQ1), psychological safety and team norm clarity effect on team performance (RQ2), and personality, psychological safety, social sensitivity, and team norm clarity associated with team performance (RQ3) individually, thus the correlation with these variables were found. For those independent variables that are proved to have a significant correlation with the dependent variable, further analysis such as Simple Linear Regression and Spearman's Correlation Coefficient are applied to find out what kind of correlation they have. Furthermore, RQ2 has an additional analysis using Cronbach's alpha to determine the significance of team norm clarity and psychological safety on team performance. The Lenberg paper[4] investigates these two variables on performance as well. Thus the new analysis is to compare the result and discuss the outcome.

RQ3 has an additional Original Least Square Regression to find out how all the independent variables jointly predict the dependent variable. The study of the differences between software engineers and interaction designers(RQ4) was not successfully implemented due to the COVID-19 situation, so RQ4 data could not be collected. Thus RQ4 was answered using the theoretical analysis from papers and personal experience of the researchers.

Affinity diagrams were used to analyze the data collected from interviews. By writing down everything that might be related to the questions and extract the information into phrases and words, and then group and regroup them into different categories, the findings can be sorted out systematically.

The qualitative data gathered from the interview were then analyzed using thematic analysis. In the thematic analysis, the deductive approach was used where the reflected data are analyzed with some preconceived themes based on the theory or existing knowledge. Also, the semantic approach was used to analyze the explicit content of the data. There were five steps to do thematic analysis, which are familiarization of the data, coding the data, generate themes, review the themes, and define the themes. Qualitative data analysis was used to support the quantitative data result to answer all research questions as much as possible. The qualitative result could also be addressed further in results, discussions, and future studies.

4
Results

This section presents the results from the surveys and the interviews. There are 30 participants for the survey, and eight interviews conducted. The result of the surveys are shown in the statistical result, and the result from the interviews are shown in graphs and codes. The results are presented in descending order based on time, starting with the survey with all the participants. The interview results in an affinity diagram, and the last section is the thematic analysis.

4.1 Participants

The participants were recruited voluntarily. The researchers gave a presentation explaining the thesis topic and what was expected from participants. Then the participants were asked to sign a consent form to confirm their participation. The number of participants and the response rate can be seen in table 4.1. The number of the participants is 30 and 8 of them are invited to an interview individually to collect qualitative data that could support the quantitative data.

Total participant	Response rate	Interview number
30	0.967	8

Table 4.1: Participants and response rate

4.2 Survey results

In this session, the four research questions will be answered through data analysis. The main methods used in SPSS software are ANOVA, Simple linear regression, Spearman's correlation coefficient, Cronbach's alpha and Ordinary least square regression.

The reason for using ANOVA is that ANOVA can be used for understanding whether there is statistically significant correlation between two or more variables, and since in RQ1, RQ2 and RQ3 there are different number of variables, it's best to use ANOVA for all of the three questions in order to control variables.

Simple linear regression is used for understanding whether the correlation is linear and Spearman's correlation coefficient is used for understanding whether the

correlation is positive or negative. The reason for using Spearman's correlation coefficient is that the valid number of data is only 29 and it's too little for other kinds of methods.
Cronbach's alpha is used to compare with Lenberg's paper since the variables are the same for RQ2 and Lenberg's paper. Ordinary least square regression is used to understand how all the variables jointly effect on team performance, and the reason for using it is because it can mitigate the influence of outliers, which can be helpful with this amount of data.

4.2.1 Research Question 1

Research question 1 looks into the correlation between personality, social sensitivity, and individual performance. Since the IPIP personality test gives five scores of five different traits, which are extroversion, agreeableness, consciousness, emotional stability and imagination, each of the five traits will be treated as an individual variable.

One-Way ANOVA is used to explore whether two variables have a significant correlation. Scatter plots and Simple Linear Regression is also applied to see whether the two variables that have been proved to have significant correlation have a significant linear correlation or not. Spearman's correlation coefficient is used to understand whether the variables have a positive or negative correlation. Scatter plots, Simple Linear Regression and Spearman's correlation coefficient are used only for the variables that have been proved to have significant correlation with the dependent variable because if statistically they don't have significant correlation, it's hard to make any conclusion through other methods.

	Sum of squares	df	Mean Square	F	Sig.
Between Groups	83.660	11	7.605	.751	.680
Within Groups	172.133	17	10.125		
Total	255.793	28			

Table 4.2: Social Sensitivity and Individual Performance

Table 4.2 shows the relationship between social sensitivity and individual performance. $F(11,17)=0.751$, $p>0.05$, so it can't be proved to have a significant correlation between social sensitivity and individual performance.

	Sum of squares	df	Mean Square	F	Sig.
Between Groups	197.960	15	13.197	2.967	.028
Within Groups	57.833	13	4.449		
Total	255.793	28			

Table 4.3: Extroversion and Individual Performance

Table 4.3 shows the relationship between extroversion of personality and individual performance. $F(15,13)=2.967$, $p=0.028<0.05$. There is a statistically significant correlation between extroversion and individual performance.

In order to know what kind of correlation extroversion and individual performance have, scatter plots are used to see the overall tendency, and Simple Linear Regression is applied to see whether the correlation is linear or not.

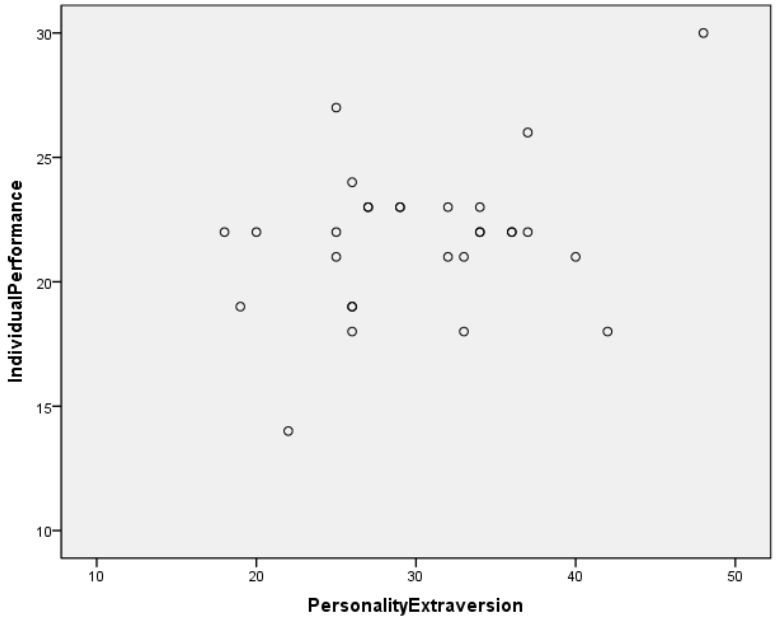

Figure 4.1: Extroversion and Individual Performance

Figure 4.1 is the scatter plots of extroversion and individual performance. As it's seen, the scatter dots are overall monotonic, which means as the score of extroversion increases, individual performance increases or decreases.

The following is the results from Simple Linear Regression:

Model		Sum of Squares	df	Mean square	F	Sig
1	Regression	30.420	1	30.420	3.644	.067b
	Residual	225.373	27	8.347		
	Total	255.793	28			

Table 4.4: ANOVA a

Table 4.4 shows the linear correlation between extroversion and individual performance. $F(1,27)=3.644$, $P=0.067>0.05$, so there is no linear correlation between extroversion and individual performance.

In order to understand whether extroversion and individual performance have positive or negative correlation, correlation analysis is used. With the small amount of data, Spearman's correlation coefficient is the best choice among all the analytical methods.

			Personality Extroversion	Individual Performance
Spearman's rho	Personality Extraversion	Correlation Coefficient	1.000	.177
		Sig(2-tailed)	.	.359
		N	29	29
	Individual Performance	Correlation Coefficient	.177	1.000
		Sig(2-tailed)	.359	.
		N	29	29

Table 4.5: Correlation

Table 4.5 shows the Spearman's correlation coefficient of extroversion and individual performance, and the correlation coefficient is 0.177. Since a positive number means positive correlation, it can be concluded that extroversion has a positive correlation with individual performance. The closer the absolute value is to 1 the more reliable the correlation is, so in this case, 0.177 indicates that the positive correlation is weak.

From the above ANOVA analysis, scatter plots, Simple Linear Regression, and Spearman's correlation coefficient analysis, it can be concluded that extroversion has a significant positive correlation with individual performance, and the correlation is not linear.

	Sum of squares	df	Mean Square	F	Sig.
Between Groups	94.736	11	8.612	.909	.552
Within Groups	161.057	17	9.474		
Total	255.793	28			

Table 4.6: Agreeableness and Individual Performance

Table 4.6 shows the relationship between agreeableness of personality and individual performance. $F(11,17)=0.909$, $p>0.05$, so there's no significant correlation between these two variables.

	Sum of squares	df	Mean Square	F	Sig.
Between Groups	123.826	13	9.525	1.083	.437
Within Groups	131.967	15	8.798		
Total	255.793	28			

Table 4.7: Consciousness and Individual Performance

Table 4.7 shows the relationship between the consciousness of personality and individual performance. $F(13,15)=1.083$, $p>0.05$, so there's no significant correlation between these two variables.

	Sum of squares	df	Mean Square	F	Sig.
Between Groups	192.543	16	12.034	2.283	.077
Within Groups	63.250	12	5.271		
Total	255.793	28			

Table 4.8: Emotional Stability and Individual Performance

Table 4.8 shows the relationship between the emotional stability of personality and individual performance. $F(16,12)=2.283$, $p>0.05$, so there's no significant correlation between these two variables.

	Sum of squares	df	Mean Square	F	Sig.
Between Groups	109.793	14	7.842	.752	.699
Within Groups	146.000	14	10.429		
Total	255.793	28			

Table 4.9: Imagination and Individual Performance

Table 4.9 shows the relationship between imagination of personality and individual performance. $F(14,14)=0.752$, $p>0.05$, so there's no significant correlation between these two variables.

As a result, for research question 1, only extroversion of personality has a weak positive non-linear correlation with individual performance, which means that when extroversion grows, individual performance grows too. However, it doesn't grow by the same ratio of extroversion. All the other variables don't have any correlation with individual performance.

4.2.2 Research Question 2

Research question 2 looks into the influence of team norm clarity and psychological safety on team performance.

Two-way ANOVA is used to see the correlation between team norm clarity, psychological safety, these two variables jointly and team performance in table 4.10. Cronbach's alpha is also used to know how consistent these variables are in table 4.11.

Source	Type III Sum of Squares	df	Mean square	F	Sig.	Partial Eta Squared
Corrected model	263.833a	22	11.992	1.791	.241	.868
Intercept	10431.914	1	10431.914	1558.294	.000	.996
TeamNormClarity	30.590	7	4.370	.653	.706	.432
PsychologicalSafety	70.289	9	7.810	1.167	.441	.636
TeamNormClarity * PsychologicalSafety	106.955	5	21.391	3.195	.095	.727
Error	40.167	6	6.694			
Total	15645.000	29				
Corrected total	304.000	28				

Table 4.10: Two way ANOVA analysis on team norm clarity, psychological safety and Team Performance

a. R Squared = .868Adjusted R Squared = .383
The result in table 4.10 shows that Sig>0.05 between team norm clarity, psychological safety and these two variables jointly and team performance, so there's no significant correlation between team norm clarity and team performance, psychological safety, and team performance, or these two combined and team performance. However, sig of these two variables jointly and team performance is closer to 0.05 than the other two, so it could be assumed that team norm clarity and psychological safety jointly have more effect on team performance than individually.

Cronbach's Alpha	Cronbach's Alpha based on standardized items	N of Items
.535	.564	3

Table 4.11: Cron bach alpha analysis on team norm clarity, psychological safety and Team Performance

Cronbach's alpha in table 4.11 shows how consistent the items are. The bigger it is, the more consistent it is. Thus, when it's bigger than 0.7, it can be considered that the consistency is good. In this case, alpha is 0.535, so team norm clarity, psychological safety, and team performance is in some way consistent.

As a result, for research question 2, neither of the variables has a significant correlation with team performance.

4.2.3 Research Question 3

Research question 3 looks into how all eight variables(extroversion of personality, the agreeableness of personality, consciousness of personality, emotional stability of personality, imagination of personality, social sensitivity, team norm clarity, and psychological safety) affect team performance.

First, one-way ANOVA is used for each independent variable and team performance to see whether they have a significant correlation or not. Then scatter plots, Simple Linear Regression, and Spearman's correlation coefficient are used to look further into the variables that have a significant correlation. After that, Ordinary Linear Regression is used to see how all variables combined predict team performance.

Since in research question 2, the correlation analysis between team norm clarity, psychological safety and team performance has been done. In the ANOVA section, only the correlation between personality(five traits), social sensitivity and team performance will be discussed.

	Sum of squares	df	Mean Square	F	Sig.
Between Groups	84.167	11	7.652	.592	.811
Within Groups	219.833	17	12.931		
Total	304.000	28			

Table 4.12: Social sensitivity and team performance

Table 4.12 shows the relationship between social sensitivity and team performance. $F(11,17)=0.592$, $P=0.811>0.05$, so there's no significant correlation between these two variables.

	Sum of squares	df	Mean Square	F	Sig.
Between Groups	240.667	15	16.044	3.293	.018
Within Groups	63.333	13	4.872		
Total	304.000	28			

Table 4.13: Extroversion and team performance

Table 4.13 shows the relationship between extroversion of personality and team performance. $F(15,13)=3.293$, $P=0.018<0.05$, so there is significant correlation between these two variables.

As it's done for extroversion and individual performance, here scatter plots, Simple Linear Regression, and Spearman's correlation coefficient is applied.

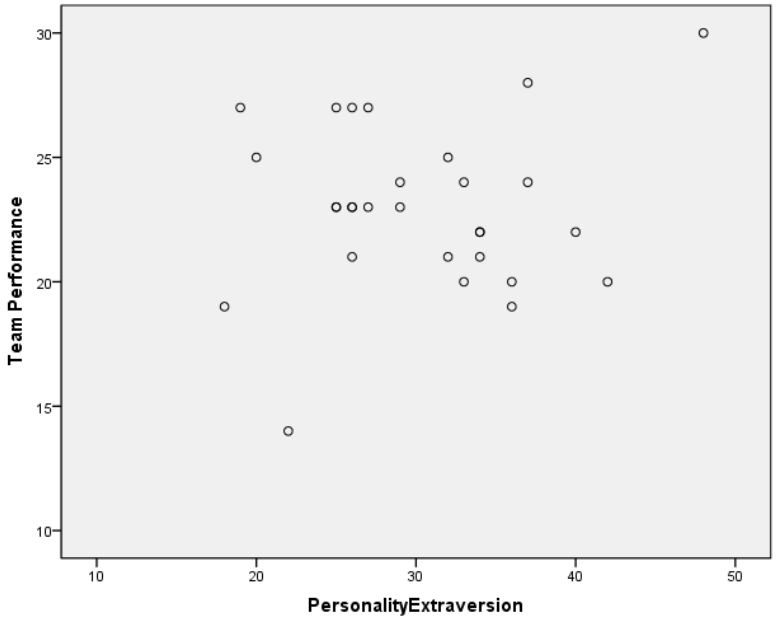

Figure 4.2: Extroversion and Team Performance

Figure 4.2 is the scatter plots of extroversion and team performance. As seen, the scatter dots are overall monotonic.

Model		Sum of Squares	df	Mean square	F	Sig
1	Regression	3.812	1	3.812	.343	.563b
	Residual	300.188	27	11.118		
	Total	304.000	28			

Table 4.14: ANOVA

Table 4.14 shows the linear relationship between extroversion and team performance. $F(1,27)=0.343$, $P=0.563>0.05$, so there is no linear correlation between extroversion and team performance.

			Personality Extraversion	Team Performance
Spearman's rho	Personality Extraversion	Correlation Coefficient	1.000	-.073
		Sig 2-tailed	.	.706
		N	29	29
	Team Performance	Correlation Coefficient	-.073	1.000
		Sig 2-tailed	.706	.
		N	29	29

Table 4.15: Correlations

Table 4.15 shows the Spearman's correlation coefficient of extroversion and team performance, and the correlation coefficient is -0.073. Since a negative number means a negative correlation, it can be concluded that extroversion has a negative correlation with team performance. The closer the absolute value is to 1 the more reliable the correlation is, so in this case, 0.073 indicates that the negative correlation is weak.

From the analysis above, it can be concluded that extroversion has a significant negative correlation with team performance, and the correlation is not linear.

	Sum of squares	df	Mean Square	F	Sig.
Between Groups	87.300	11	7.936	.623	.786
Within Groups	216.700	17	12.747		
Total	304.000	28			

Table 4.16: Agreeableness and Team Performance

Table 4.16 shows the relationship between agreeableness of personality and team performance. $F(11,17)=0.623$, $P=0.786>0.05$, so there's no significant correlation between these two variables.

	Sum of squares	df	Mean Square	F	Sig.
Between Groups	184.283	13	14.176	1.776	.143
Within Groups	119.717	15	7.981		
Total	304.000	28			

Table 4.17: Consciousness and Team Performance

Table 4.17 shows the relationship between agreeableness of personality and team performance. $F(13,15)=1.776$, $P=0.143>0.05$, so there's no significant correlation between these two variables.

	Sum of squares	df	Mean Square	F	Sig.
Between Groups	157.833	16	9.865	.810	.659
Within Groups	146.167	12	12.181		
Total	304.000	28			

Table 4.18: Emotional stability and Team Performance

Table 4.18 shows the relationship between emotional stability of personality and team performance. F(16,12)=0.810, P=0.659>0.05, so there's no significant correlation between these two variables.

	Sum of squares	df	Mean Square	F	Sig.
Between Groups	133.417	14	9.530	.782	.674
Within Groups	170.583	14	12.185		
Total	304.000	28			

Table 4.19: Imagination and Team Performance

Table 4.19 shows the relationship between imagination of personality and team performance. F(14,14)=0.782, P=0.674>0.05, so there's no significant correlation between these two variables.

From the above analysis, each independent variable and team performance is tested whether they have significant correlation, whether the correlation is linear and whether the correlation is positive or negative, it can be concluded that among all the variables, only extroversion of personality has a weak negative correlation with team performance, and the correlation is not linear.

In order to answer RQ3 from a different perspective, which is to see how all the independent variables jointly predict the dependent variable, team performance, Ordinary Least Squares regression(or OLS regression) is applied. OLS regression is a kind of linear least square method for a linear regression model, and by minimizing the sum of the squares of different dependent variables, OLS regression can predict the dependent variables using independent variables in the form of an equation[44]. With the small amount of data, OLS regression is the best choice for eliminating the effect of outliers.
In this case, the independent variables are: team norm clarity, psychological safety, personality, social sensitivity and individual performance. The dependent variable is team performance. The results are as belows:

	coef	Std err	t	P>|t|	[0.025	0.975]
Intercept	1.5556	4.362	0.357	0.724	-7.410	10.521
Individual Performance	0.7757	0.142	5.446	0.000	0.483	1.069
Personality Imagination	0.1252	0.089	1.405	0.172	-0.058	0.308

Table 4.20: OLS regression

R-squared: 0.558; AIC: 132.7; BIC: 136.8
Table 4.20 shows the equation that predicts team performance. Assume individual performance as a, imagination as b, and team performance as y; then, the equation will be y=0.7757a+0.1252b+1.5556. The reason why there are only two independent variables is that only individual performance and imagination have a significant influence on the equation. R-square is 0.558, which means that the equation explains 55.8 percent of the data, which is a good number. P of individual performance is 0.000<0.05, so individual performance is significant in forming the equation.

4.2.4 Research Question 4

The research question 4 looks into how software engineers differ from designers in RQ3. Due to the COVID-19 situation, the number of participants has dropped, and thus no designer participant is available under this circumstance. As a result, question 4 will be done by researching other similar studies.

Software engineers and designers usually collaborate during the process of software development, and that's why it's interesting to know whether there is and what the difference is between software engineers and designers. Understanding the difference will make it easier for both sides to collaborate better.

According to Kichuk, S.L., and Wiesner, W.H.[45] , the successful team in the study has higher composite levels of cognitive ability, higher Extraversion scores, higher Agreeableness scores, and lower Neuroticism scores than the unsuccessful team. Lenberg's paper[3] showed that personality correlates with team performance for software engineers. Previous studies have proved that personality as a whole can be related to team performance for both designers and software engineers.

It is generally accepted that designing is a creative process. According to Jason Meneely and Margaret Portillo[32], creativity can significantly predict performance in design, and the flexibility in thinking styles is significantly correlated to creativity. Although different personality measures are applied, and in IPIP, there is no creativity trait, openness and extroversion have a significant positive effect on creative performance[46]. Thus, it can be said that openness and extroversion have a positive effect on creativity and, thus, can predict performance for designers. Compared to software engineers, the trait that significantly affects both team and individual performance is extroversion, which is consistent with that in designers. Extroversion always means a good relationship with co-workers and more accessible communication, and for positions like designers and software engineers that require continuous communication, extroversion can be helpful. Openness has more effect on designers' performance than software engineers'; this may because keeping an open mind and accept new ideas is more of essential quality to become a good designer.

Due to the few studies in the design area about the relationship between psychological safety, social sensitivity, and team norm clarity, it's hard to compare these variables between software engineers and designers. However, since the roles and cooperate styles for designers and software engineers are different, the team norm may be different.

4.3 Interview results

4.3.1 Selection of interviewees

The principle for selecting interviewees is that participants who have extreme data, the data that has different patterns should be further invited to additional interviews. Except for that, some participants who have normal data should also be included as comparison.

In order to find the participants who have data that has different patterns, cluster analysis is done in SPSS to find out.

Cluster Number	Number of people
1	4
2	2
3	1
4	7
5	14

Table 4.21: Cluster analysis

Table 4.21 shows how the five clusters are divided. For cluster two, there are two people and for cluster three, there is only one person. Compared to other clusters that have more people in the cluster, it can be said that cluster two and three have rather rare patterns than the others. Thus, all participants that are in cluster two and three are invited for an interview, and that would be three interviewees.

Except for the data that has different patterns, one participant from cluster one, four and five each are also invited for an interview as comparison. Also, two other participants who have extreme data, such as extremely low team norm clarity are invited for an interview. All of these in total makes eight interviewees.

4.3.2 Affinity diagram result

The affinity diagram in figure 4.3 shows the result of the interviews that were conducted. The interview was done within 30 minutes for each participant with a set of questions prepared and also the interviewee's result from the survey. The result was discussed, and the researchers discovered other underlying factors that could affect performance directly and indirectly. The affinity diagram was used to group similar responses from the interviewee into categories. Some of the responses are the only ones in the category since it is interesting even though it was not mentioned often. Categories such as professionalism were mentioned numerous times by many of our interviewees. Thus it is crucial to investigate further the underlying meaning and the effects on performance. There are eight interviewees in total, and their responses are categorized into 17 categories in total. The affinity diagram is used to show that

similar topics popped out frequently in many different interviews and it helps with thematic analysis.

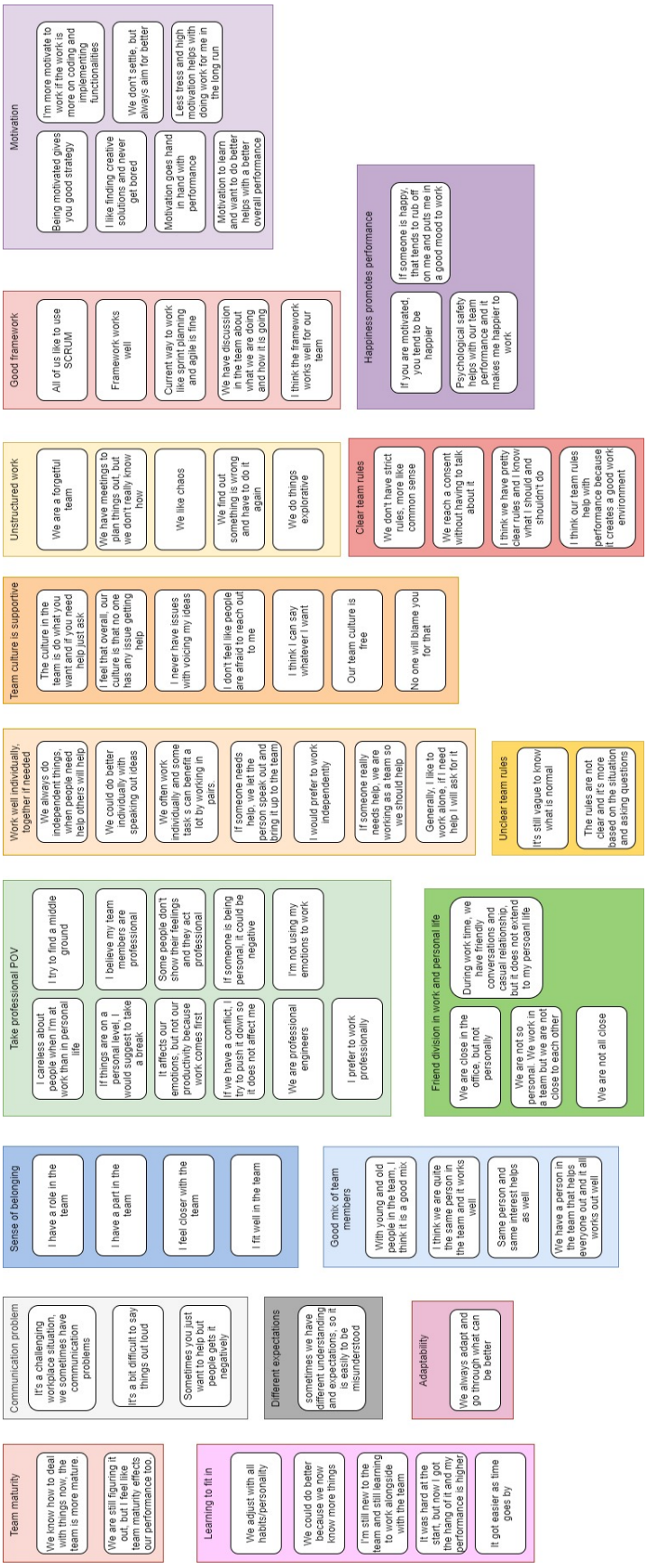

Figure 4.3: Interview affinity diagram

4.3.3 Thematic analysis result

From the interview responses in figure 4.3 that were collected, the result from the interview can be categorized and analyzed further using the thematic analysis for qualitative data. The interviewee's responses were transcribed, then color-coded to see the similarities in the response and discover the trend. The codes are then categorized further into themes that could be defined as meaningful results. Then the themes are analyzed with the research questions to see the connection or opposition.

4.3.3.1 Theme code and definition

Seventeen codes were extracted from the affinity diagram, as seen in table 4.22. These 17 codes are then categorized into themes. There are eight themes in total. These themes are then defined in table 4.23. The definition of the themes involved formulating the exact meaning of each theme and figuring out how it supports the quantitative data and the research questions.

Code	Theme
Team maturity Learning to fit in Adaptability	Adaptability
Sense of belonging Good mix of team members	Team dynamics
Motivation Happiness promotes performance	Motivation
Take a professional POV Friend division in work and personal life	Professionalism
Work well individually, together if needed Team culture is supportive	Working style
Good framework Clear team rules	Structured work process
Unstructured work Unclear team rules	Unstructured work process
Communication problem Different expectation	Performance obstruction

Table 4.22: Code categorization into themes

ID	Theme	Definition
T1	Adaptability	The ability of a team member to adapt to the new team environment and learn how to fit into the team. People do not get along 100 percent on day one, thus the more time they spend together, the more familiar they are.
T2	Motivation	How motivated a person is at work. The more motivated they are, the higher their performance.
T3	Performance obstruction	Other variables that contributes to the performance of an individual and the team.
T4	Professionalism	Working in a professional way without taking relationships and emotions into account during work. Having a professional attitude at work.
T5	Structured work process	Have a good framework for development, making the process smooth. A team member knows what to do and where to find help if needed.
T6	Team dynamics	Have a good mix of team members who understand each other. Having similar tastes or interests which support fitting into the team quicker and easier. The member feels like they belong in the team.
T7	Unstructured work process	No framework in the working process. No clear rules with a job where everything depends on the situation, and it could be a little chaotic. Doing work in an exploratory way.
T8	Working style	The team member tend to work individually on a task, and they feel that it is more productive. They would consider working with others only when they need help. The team is very supportive of each other.

Table 4.23: Theme definition

4.3.3.2 Theme analysis

T1: Based on the adaptability theme, the theme was brought up during discussions on personality. Since the interviewee does not judge people based on their personality, if there is a personality clash or if they work well with other teammates, then it would be because they learn how to work together and know how to fit into the team not to hinder the team's progress. As an interviewee had said, "We could do better because now we know more things," they learn to fit in better, and the work becomes better as time goes by. Another interviewee also mentioned, "we adjust with all habits," which indicates that they adapt to different types of people to be able to work together. It does not involve personality because of another theme that was uncovered, professionalism. People tend to be professional when they work, and they separate personal and work matters from each other. Most of the interviewees said they do not want to bring their emotions when they work, and they do not judge other people from their personal life. A person's personality when they work and when they are in their private life is very different, and they tend to stick to their professional personality at work.

T4: In a team, the team members are close to some degree, but they are not friends outside of work. "I care less about people when I am at work than personal life," said an interviewee, with this professional way of work, it might seem cold and distant. However, the work progresses smoothly, without any problems since they avoid conflict that stems from personal issues and emotions. Being socially sensitive to a team's emotions does not prove beneficial or disadvantageous to the person once they have taken a professional attitude at work. "If someone is personal, it could be negative," said an interviewee, involving emotions at work tend to be seen as immature and unprofessional. As an interviewee mentioned, "I am not using my emotions to judge," everyone treats their teammate with respect and expect to be treated as such. Thus, this professional way of working creates a barrier of protection around them to protect themselves from things non-work related to a workplace and to avoid nonsensical matters. The trust when an interviewee said, "we are professional engineers" could indicate that they believe in their team members. From this discovery, the psychological safety of a team could also stem from taking a professional attitude. Based on RQ2 results, psychological safety or team norm clarity alone does not have a significant correlation with team performance. However, these two variables combined showed some effect on team performance to some degree, although weak due to the few data points. T4 Professionalism could be a combination of team norm clarity and psychological safety that plays a small part that affects team performance.

T6: Another factor that promotes psychological safety is team dynamics. Although in RQ2 psychological safety has no significant correlation with team performance, the psychological safety could affect another independent variable in a team such as a team maturity. The team dynamic is the unconscious, psychological forces that influence the direction of a team's behavior and performance. It could be how well the team members get along with each other, having similar interests, or how much they feel like they belong in the team. These factors, such as a sense of belonging,

quoted by an interviewee, "I have a role/part in a team," make them feel safe in the team. Team dynamics are tied to the personality of the person as well. "We are the same kind of person in the team, and it works well," means that they feel like they work better with someone who has a similar personality or it could be the same interest, "the same person same interest also helps with working together."

T8: Working style and structure work are also important themes that came up in the interview quite often. Teams with high-performance scores tend to have structured work and a working style where most of the team members prefer to work individually on a task. Teamwork is where everyone in the team does their own thing, and the combination of it is the team's product. If a member needs help, they would have to raise their voice to be noticed. Social sensitivity is where a person can perceive another's emotion; however, knowing a teammate's emotion or knowing that they are facing a problem does not propel them to initiate support. Based on the interviewee's comment, "we always do things independently, others will help when someone asks for it" and "if someone needs help, let the person speak up and bring it to the team during daily meetings" supports the claim. In addition to working style themes, structured framework themes also contribute to better performance, "all of us like to use SCRUM, the framework works well," said an interviewee.

Based on T8, extroversion could play a role that contributes to this kind of working style. Extroversion indicates how outgoing and social a person is. A person who scores high in extroversion on a personality test is the life of the party. They enjoy being with people, participating in social gatherings, and are full of energy. A person low in extroversion is less outgoing and is more comfortable working by himself[18]. RQ1 results show that extroversion has a significant positive correlation with individual performance, and in RQ3, extroversion has a significant negative correlation with team performance. Most of the interviewees have a rather high extroversion score, and this was surprising when we interviewed them. From their working style preferences, most interviewees prefer to work alone, which is the opposite of an extrovert. Thus the interviewee was asked further into their experience and discovered that although they are comfortable working alone, they still enjoy being with people. Like someone who enjoys working individually, but likes to sit and work in a cafe with lots of people around. Extroversion, in this case, can be that they prefer to be in social and with people as an environment background for support just in case they need it, rather than being alone shut in somewhere by themselves.

T5: The structured framework can also promote higher team norm clarity. A team with a high score of team norm clarity claims that they know what to do, and the rules are explicitly explained, e.g., they know what to do if they face problems, what the team culture is, etc. T7: During the interview, there is also a different theme of structured work, unstructured work. This is when the team does not have a specific framework and changes the way they work to fit best with what they do. An interviewee from this team commented, "It is chaos, we do things exploratively, and it works for us. We do not feel the benefit of planning.". This team has a high team norm clarity; thus, without a useful framework to work with, if the team member

knows their role and responsibility, they can get the work done together. Although team norm clarity has no significant correlation with team performance based on RQ2 result, the structured or unstructured framework affect directly on how the team gets work done and how they perform. These two frameworks work for both teams because they have a different environment and different levels of team norm clarity and psychological safety. It is intriguing to see different ways of working and how it affects the people in the team. Although the team with a structured framework has higher performance, the team with the unstructured framework are more close to each other and are happy with their achievements.

T2: Motivation is also key to better performance. If a person is motivated with their work, they tend to do more. An interviewee agrees that motivation also contributes to better performance, "being motivated gives you good strategy, and if you are motivated, you tend to be happier." "If a team member with high motivation to learn and want to do better, the team performance can also be higher since they are willing to improve themselves to contribute to the team.", said an interviewee. However, if a team has a different motivation level, people with high motivation might put pressure on people that have the average motivation, "we have different understandings and expectations on something, and sometimes, people can misunderstand you," said an interviewee. A team with similar levels of motivation tends to work and get along better. Motivation could be another new variable to investigate for future work.

T3: Lastly, a negative theme that is different from the rest is the performance obstacles. This theme points out factors the team members have encountered that hinders team performance. Communication is key to every team. However, if a team does not communicate with each other much, it could lead to misunderstandings and different expectations of responsibility. An interviewee mentioned, "it is difficult to say things out loud" and "everyone is careful with how they deal with people," thus creating tension when they interact with each other. Although the interviewee mentioned that communication problems in the team did not affect their performance much because they still have a professional attitude when they work. However, it is still a not-so-relaxing atmosphere when they interact when it is not work-related.

4.4 Qualitative result summary

Discussion result with participated teams were not used further in the thesis due to the uncertainty and confidentiality of the data. It is due to the fact that each team has different performance measurement which makes it hard to find a standard baseline. Comparing performance from a burn-down chart with a self assessment is not feasible and it cannot be used as a standard.

Based on the thematic analysis, each theme supports an independent variable in RQ2, and RQ3 as seen in table 4.24.

	Variable	Theme	Relationship
RQ1	Personality	-	-
	Social sensitivity	-	-
	Individual performance	-	-
RQ2	Psychological safety	T4	Theme supports variable
		T6	Theme supports variable
		T3	Theme hinders variable
	Team norm clarity	T5	Theme supports variable
		T7	Theme supports variable
	Team performance	T3	Theme hinders variable
RQ3	Personality	T1	Theme supports variable
		T4	Theme supports variable
		T8	Variable encourages theme
	Social sensitivity	T4	Theme renders variable unnecessary
	Psychological safety	See RQ2	-
	Team norm clarity	See RQ2	-
	Team performance	T8	Theme supports variable
		T2	Theme supports variable

Table 4.24: Research questions and themes relation

There were no qualitative data that supported RQ1 since the interview focuses on team performance, thus RQ1 which focus on individual performance was not included. RQ2 and RQ3 has similar variables thus the qualitative data are applicable for both variables in both research questions. Psychological safety can be improved with T4:professionalism and T6:team dynamics, however, T3:performance obstacle such as communication and coordination problems could lower the psychological safety if not careful. Team norm clarity can be improved with frameworks which can be both T7:structured or T8:unstructured work depending on the members and agreement in the team. Team performance could be lowered by T3:performance obstacles which are communication problems, thus it is important to focus on how a team can work and communicate together to improve performance. Personality is supported by T1: adaptability and T4:professionalism. While T8:working style depends on the member's personality. Social sensitivity does not affect performance due to T4:professionalism. Lastly, team performance can be improved depending on T8:working style and T2:motivation.

5
Conclusion

This last chapter explains the benefits, problems, and limitations that are considered and suggestions for future work.

5.1 Discussion

Due to COVID-19, participation is less than expected. Although 54 participants were expected, the study only ends up with 30 participants, of which only 29 data is valid. This small amount of data means that the outliers will have a significant effect on the analysis and that the analysis itself may not be able to find a perfect pattern. Apart from that, when choosing analysis methods, the ones with a wide range and low accuracy will be chosen due to the small amount of data. With this inevitable error, it can not be guaranteed that the results are reliable. For the results that turned out to be proved, it can only be concluded that there are patterns for some, but the relation is not reliable. No certain conclusions can be made with the statistic result without further research. Qualitative data support some of the research questions, such as for research question 1, it has proved that extroversion has a weak positive non-linear correlation with individual performance. For research question 3, extroversion has a weak negative non-linear correlation with team performance.

Research question 2 explores similar dependent and independent variables as Lenberg at al.[4] paper. In the Lenberg paper, they explore whether psychological safety and clarity of team norms both affect software development teams' performance and job satisfaction. In Lenberg, the Cronbach's alpha value for psychological safety is 0.75, and team norm clarity is 0.71. When the value is more prominent than 0.7, it is considered that the consistency is right. In our work (cf RQ2), the Cronbach's alpha value is 0.535, which is lower than Lenberg's paper, and it is possibly due to the difference in the number of data points. Also, in the Lenberg's paper analysis suggests that team norm clarity has a more significant impact than psychological safety. In contrast, in research question 2 result shows that team norm clarity and psychological safety jointly have more effect on team performance than individually, albeit weak. However, it shines upon other factors that should be taken into account, such as professionalism. Professional attitude at work supports higher team norm clarity and psychological safety. Based on the qualitative analysis, having a professional attitude at work is expected. Thus it creates a barrier making people safe knowing that everyone here is doing their best to achieve the same goal, and

to be able to work together efficiently, a clear team norm is must so that they know their responsibility and the common sense of the team.

In addition to personality, social sensitivity, psychological safety, team norm clarity, and performance, this research also collects general data that could contribute to performance as well, such as stress level at work, motivation, and work experience. These three additional factors were collected at first to assure that the participants are motivated at work and not too stressed at work because if they were too stressed or not motivated to work at all, then the result would not matter. However, during the interview, motivation has become an interesting factor that affects the team, where a team with a similar level of motivation tends to work and get along better. Stress level could hinder the performance of an individual, which in the end could also affect the whole team if it is not dealt with early on. Lastly, work experience affects team performance, as well. A team with excellent work experience or have most of their members with many years of work experience performs higher than a newly formed team. It is interesting to see that a team with excellent work experience has members that are not close to each other, but they work well together because they seem to keep each other on arm's length. This is linked to the professional way of working, the work gets done, but the personal intimacy between team members is not high. Their team maturity is stable, and they work efficiently with lots of communication. Whereas a team that was newly formed (less than a year) and has low work experience has lower performance, however, they are still figuring out a way to work together, and the team maturity is still climbing. This team faces many problems trying to form together and how to work together efficiently, but they are more closely in terms of relationships as friends. It is still unknown whether closeness within team members supports or hinders performance. It might be different for every individual and their preference. To study further into these variables would need more resources and data collection, such as observation.

5.2 Threats to validity

5.2.1 Threats to construct validity

Inadequate preoperational explication of constructs could be a fatal threat to construct validity. The research questions might not have been well defined, and it is not novel or true. To mitigate this threat, the researcher has thought the concept through and support it with the literature of different and same field that supports the research question. The research also studies personality, social sensitivity, psychological safety, and team norm clarity in a growing field of software engineering that has few pieces of research. Thus this research is to expand the understanding of psychology and behavior of software engineers and how it affects the performance. Another threat to construct validity is researcher expectancy. The researcher can bias the results of a study in countless ways, both consciously or unconsciously. For example, researchers could be pleased if a participant answered in an interview in a way that aligns with what the research expects, thus leading to concluding that the answer that was expected is the final result. The researchers should keep a clear

mind and be neutral on what should be asked and what should not be as not to lead the interviewee to mitigate this threat. The researcher should accept the outcome as it is and not try to bend the result into what they expected.

5.2.2 Threats to internal validity

The result from the surveys and interviews could be biased due to suggestive questions. When doing data collection, surveys and interview questions must not be biased in any way that would suggest the participants answer in a favorable way to the study. Furthermore, the participants would have to survey to find out their personality, psychological safety, and social sensitivity, which is similar to self-report. There are limitations to self-reporting. The disadvantages of self-reporting are the exact reflection of that, which the participants are analyzing. It is the personality the research wants to study using self-report methods, also the personality that can influence the subject's response[47]. The researchers could maximize the validity of the measurement of personality, psychological safety, and social sensitivity of using self-reports by combining the survey with other methods, such as interviews[48]. Due to human factors in the research, there could be instability in the result obtained or some errors during the data collection process or known as the experimental mortality. During data collection, the participants might change in some way. There is a possibility where the participants might not feel like they want to participate anymore for any reason they may have, such as losing focus or attention, tiredness, stress, lose interest, etc. Losing participants or changing them in the middle could affect the result and also create an error that reduces the reliability of the research. The study needs to keep them interested, and the data collection process would not take up too much of the participants' time to mitigate losing participants as much as possible and also not forcing the participants. In addition, due to the research being studied at Ericsson AB, the volunteers we got from this company makes the selection of participants biased and not random. The bias may result in the selection of comparison groups. To mitigate this, the researcher tried to randomize the participants as much as possible, but it also has to correlate with the volunteers. However, if the randomized sample size is small, it may lead to Simpson's paradox. To ensure that the research does not lead to Simpson's paradox, the sample size has to be big enough, correlating with the population of both the company department. Else, if the sample size could not be increased, the research must collect more in-depth qualitative data that could support the quantitative data.

5.2.3 Threats to external validity

The generalizability of the study results is also another factor to consider. The research will study a group of software engineers that are working in one software company in Sweden. This group would not be able to represent the whole population of all software engineers in other companies that have different work structures and cultures. There would also be an interaction effect of selection biases and the experimental variable where the research could take precaution with the participant selection by randomly selecting participants to ensure that this would not affect the

outcome.

5.3 Conclusion

Nothing can be concluded concretely with the current data at hand. RQ1 result can be concluded that extroversion has a weak positive non-linear correlation with individual performance. RQ2 resulted in no relation found between psychological safety and team performance and no relation between team norm clarity and team performance either. However, the effect of psychological safety and team norm clarity on team performance seems promising. RQ3 result has shown that extroversion in personality has a weak negative non-linear correlation with team performance. RQ4 results were theoretical, but it has proven that software engineers and interaction designers share common traits such as extroversion to improve performance. There are traces of trends that are worth investigating further for future work. The equation of independent variables to predict team performance is y=0.7757a+0.1252b+1.5556, in which individual performance(a) and imagination(b) affects forming the equation. Based on the qualitative data, professionalism and adaptability play a big role in curbing personality in the workplace. These variables are supporting the personality variables in the workplace in RQ2 and RQ3. Personality alone might create chaos and conflicts, which hinders performance without the help of adaptability and professionalism. Working style is also worth mentioning where a software engineer's working style is interlinked with extroversion from RQ1 and RQ3. Other variables were discovered during the interview, such as team dynamics, work structure, motivation, communication, etc.

5.4 Future work

Many different data collection, observation, and interviews have been left for the future due to a lack of resources. Future work concerns a more in-depth analysis of particular psychological variables, new proposals to try different methods of data collection, or only curiosity. Many different aspects could affect the software development team's performance. Thus it would be an interesting future work to study more in other software companies in Sweden that has a similar team setting. The data that was collected for this thesis was insufficient to be able to conclude and answer the research question. However, future work could collect more data from other participants to be able to see the trends in the data and see a clear strong or weak relation between individualism(i.e., personality, social sensitivity, psychological safety, and team norm clarity) and team performance.
Some ideas for future works that could be considered in line with this thesis.

1. Gather more data such as personality, social sensitivity, psychological safety, and team norm clarity from employees at Ericsson AB. Add in observation for data collection as well if time can be spared since observation could reveal hidden variables in the workplace that plays a crucial role in a team performance, which the participants might not realize.
2. Gather more data of personality, social sensitivity, psychological safety, and

team norm clarity from employees at different software development companies in Sweden. Use the data to compare with the current data at Ericsson to discover the difference of variables at play that affects team performance, if any.

3. Consider roles in the team that hinders or support team performance, such as teams with a leader and teams that do not have a fixed leader or a team with all international and teams with only one nation. These variables such as nationality, culture, leaders, working style, behavior, etc. could affect team performance. It is worth investigating and sees the effects, if any.

Lastly, future work should consider the way of working in the future. Since the COVID-19 pandemic spread, companies are beginning to cope with the situation by finding a new way of working. People will start to work from home more, and communications will be vital than ever. With work from home situations, human interactions are limited, and that could affect the team in many ways. The team performance could be higher or lower, depending on how the particular team adapt to the situation and work together. Working styles changing could lead to a change in working behavior and the way people act towards each other. They might feel more courage to voice out their emotions through video calls or maybe just the opposite; they might keep communications to a minimum, thus leading to stress and frustration build up. All these changes that come into play will affect the software development team and their personality, social sensitivity, psychological safety, and team norm clarity. Future work for this topic could become more crucial to keep people aware of their individualism and the importance of it.

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A

Appendix 1

A.1 Surveys

A.1.1 General survey

Code name: _____

Effects of Individuals on Software Team Performance

Demographic information

Nationality: _____

General information

How motivated are you at your current job?

Not at all motivated	Slightly motivated	Moderately	Highly motivated

Current stress level at work

Not stress at all	Slightly stress	Moderately stress	Highly stress

Code name: _____

Effects of Individuals on Software Team Performance

General information

Work experience in total: _____ yrs

Work experience at Volvo: _____ yrs

A.1.2 Personality survey

Code name: _____

Personality test (IPIP short ver.)

	Very Inaccurate	Moderately Inaccurate	Neither Accurate Nor Inaccurate	Moderately Accurate	Very Accurate
1 Am the life of the party.					
2 Feel little concern for others.					
3 Am always prepared.					
4 Get stressed out easily.					
5 Have a rich vocabulary.					
6 Don't talk a lot.					
7 Am interested in people.					
8 Leave my belongings around.					
9 Am relaxed most of the time.					
10 Have difficulty understanding abstract ideas.					
11 Feel comfortable around people.					
12 Insult people.					
13 Pay attention to details.					
14 Worry about things.					
15 Have a vivid imagination.					
16 Keep in the background.					
17 Sympathize with others' feelings.					
18 Make a mess of things.					
19 Seldom feel blue.					
20 Am not interested in abstract ideas.					
21 Start conversations.					
22 Am not interested in other people's problems.					
23 Get chores done right away.					
24 Am easily disturbed.					
25 Have excellent ideas.					
26 Have little to say.					

	Very Inaccurate	Moderately Inaccurate	Neither Accurate Nor Inaccurate	Moderately Accurate	Very Accurate
27 Have a soft heart.					
28 Often forget to put things back in their proper place.					
29 Get upset easily.					
30 Do not have a good imagination.					
31 Talk to a lot of different people at parties.					
32 Am not really interested in others.					
33 Like order.					
34 Change my mood a lot.					
35 Am quick to understand things.					
36 Don't like to draw attention to myself.					
37 Take time out for others.					
38 Shirk my duties.					
39 Have frequent mood swings.					
40 Use difficult words.					
41 Don't mind being the center of attention.					
42 Feel others' emotions.					
43 Follow a schedule.					
44 Get irritated easily.					
45 Spend time reflecting on things.					
46 Am quiet around strangers.					
47 Make people feel at ease.					
48 Am exacting in my work.					
49 Often feel blue.					
50 Am full of ideas.					

Vocabulary

- Shirk — (v.) avoid or neglect (a duty or responsibility)
- Exacting — (adj.) making great demands on one's skill, attention, or other resources (synonyms: demanding, hard, tough)

A.1.3 Social sensitivity survey

Code name: _____

Social Sensitivity

1		Playful	Comforting	Irritated	Bored
2		Terrified	Arrogant	Annoyed	Upset
3		Joking	Flustered	Desire	Convinced
4		Joking	Insisting	Amused	Relaxed
5		Irritated	Sarcastic	Worried	Friendly
6		Aghast	Fantasizing	Impatient	Alarmed
7		Apologetic	Friendly	Uneasy	Dispirited

8		Despondent	Relieved	Shy	Excited
9		Annoyed	Hostile	Horrified	Preoccupied
10		Cautious	Insisting	Bored	Aghast
11		Terrified	Amused	Regretful	Flirtatious
12		Indifferent	Embarassed	Skeptical	Dispirited
13		Decisive	Anticipating	Threatening	Shy
14		Irritated	Disappointed	Depressed	Accusing
15		Contemplative	Flustered	Encouraging	Amused

16		Irritated	Thoughtful	Encouraging	Sympathetic
17		Doubtful	Affectionate	Playful	Aghast
18		Decisive	Amused	Aghast	Bored
19		Arrogant	Grateful	Sarcastic	Tentative
20		Dominant	Friendly	Guilty	Horrified
21		Embarassed	Fantasizing	Confused	Panicked
22		Preoccupied	Grateful	Insisting	Imploring
23		Contented	Apologetic	Defiant	Curious

24		Pensive	Irritated	Excited	Hostile
25		Panicked	Incredulous	Despondent	Interested
26		Alarmed	Shy	Hostile	Anxious
27		Joking	Cautious	Arrogant	Reassuring
28		Interested	Joking	Affectionate	Contented
29		Impatient	Aghast	Irritated	Reflective
30		Grateful	Flirtatious	Hostile	Disappointed
31		Ashamed	Confident	Joking	Dispirited

32		Serious	Ashamed	Bewildered	Alarmed
33		Embarassed	Guilty	Fantasizing	Concerned
34		Aghast	Baffled	Distrustful	Terrified
35		Puzzled	Nervous	Insisting	Contemplative
36		Ashamed	Nervous	Suspicious	Indecisive

Vocabulary

- Pensive	(adj.) engaged in, involving, or reflecting deep or serious thought
- Aghast	(adj.) filled with horror or shock
- Incredulous	(adj.) unwilling or unable to believe something
- Contemplative	(adj.) expressing or involving prolonged thought
- Baffled	(v.) totally bewilder or perplex
- Reflective	(adj.) relating to or characterized by deep thought; thoughtful

A.1.4 Psychological safety and team norm clarity survey

Code name: _____

Team Norm Clarity

		Strongly	Disagree	Neither	Agree	Strongly
1	Standards for member behavior in this team are vague and unclear					
2	It is clear what is, and what is not, acceptable member behavior in this team					
3	Members of this team agree about how members are expected to behave					

Psychological Safety

		Strongly	Disagree	Neither	Agree	Strongly
1	If I make a mistake in this team, it is held against me					
2	Members of this team are able to bring up problems and tough issues					
3	People on this team sometimes reject others for being different					
4	It is safe to take a risk in this team.					
5	It is difficult to ask other members of this team for help.					
6	No one on this team would deliberately act in a way that undermines my efforts					
7	Working with members of this team, my unique skills and talents are valued and utilized.					

A.1.5 Performance Survey

Code name: _____

Self-assessment: Team performance

		Very Inaccurate	Moderately Inaccurate	Neither Accurate Nor Inaccurate	Moderately Accurate	Very Accurate
1	The team produce quality work					
2	My team is productive					
3	This team delivers according to schedule					
4	This team delivers according to budget					
5	My team communicates efficiently with others, e.g. product owner, line manager, and other teams					
6	The team could become more efficient					

Self- assessment: Individual performance

		Very	Moderately	Neither	Moderately	Very
1	I produce quality work					
2	I am productive					
3	I deliver according to schedule					
4	I deliver according to budget					
5	I communicate efficiently with others, e.g. my team members, product owner, line manager, and other teams					
6	I could become more efficient					

A.2 Interview questions

1. General questions
   - How do you feel about working on a team?
   - Do you prefer teamwork or working independently?
   - What do you like and don't like about the team?
2. Personality questions
   - Talk about a time when you had to work closely with someone whose personality was very different from yours.
   - How well do you think you work together?
   -
3. Social sensitivity questions
   - Do you think you have high social sensitivity?
   - Can you perceive your teammate's emotions?
   - Does knowing your teammate's emotions hinder/help you to work better/worst?
   - Do you think to have high social sensitivity will help with your work?
4. Psychological safety questions
   - Do you feel like you fit into the team?
   - Do you feel a wall with the other team members?
   - Do you feel ostracized?
   - Have you ever had difficulty working with a manager or other team members?
5. Team norm clarity questions
   - Do you know the team rules?
   - Do you feel like you don't know anything about the team?
   - How is the team culture?
   - Do you agree with the set up of how the team works?
6. Performance questions
   - How well do you think you work together?
   - Tell me about a challenging workplace situation that you had to deal with.
   - What strategies would you use to motivate your team?
   - Are you pleased with your performance in the team/with yourself?
   - Do you think you can perform better? Why? How?
   - Describe a change you recently made that improved the performance of your work.
   - On a scale of 1-10, how would you rate your performance in your most recent position?