Does Personality impact Requirements Engineering Activities?

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Abstract—Context: Requirements engineering (RE) is an important part of Software Engineering (SE), consisting of various human-centric activities that require frequent collaboration of a variety of roles. Prior research has shown that personality is one such human aspect that has a huge impact on the success of a software project. However, a limited number of empirical studies exist focusing on the impact of personality on RE activities. Objective: The objective of this study is to explore and identify the impact of personality on RE activities, provide a better understanding of these impacts, and to provide guidance on how to better handle these impacts in RE. Method: We used a mixed-methods approach including a personality test based survey (50 participants) and an in-depth interview study (15 participants) with software practitioners from around the world involved in RE activities. Results: Through personality profiles, we found a majority of the practitioners scored as statistically significant (high-scored) on agreeableness and conscientiousness traits and average on extraversion and neuroticism traits. Through analysis of the interviews, we found a range of impacts related to the personality traits of software practitioners’, their team members’, and external stakeholders. These impacts can be positive or negative, depending on the RE activities, the overall software development process, and the people involved in these activities. Moreover, we found a set of strategies that can be applied to mitigate the negative impact of personality on RE activities. Conclusion: Our identified impacts of personality on RE activities and mitigation strategies serve to provide guidance to software practitioners on handling such possible personality impacts on RE activities and for researchers to investigate these impacts in greater depth in future.

Index Terms—Personality, requirements engineering, software engineering, human aspects, socio-technical grounded theory

1 INTRODUCTION

Personality is a human aspect with no one universally accepted definition. Although many theories have been developed related to personality, it is commonly referred to as individual differences [1]. Our preferred definition is based on Mischel et. al. [2], who defines personality as "a set of individual differences including personal habits, skills, memories, behaviours and social relationships that can be affected by the socio-cultural development of individuals".

Personality clashes or incompatibilities can affect the efficacy of collaboration and lead people to perform less effectively [3] [4] [5]. Investigating the impact of personality in software engineering (SE) has been an ongoing topic over many years [6] [7] [8]. Various studies have examined the impact of the personality of software practitioners in the context of SE in general, and for specific SE activities or contexts, such as development [9], pair programming [10], testing [11], software team composition [12], team climate [13] to name a few. A majority of these studies have focused on software practitioners involved in software development or testing in industrial settings. Some have used undergraduate/postgraduate students as participants [14] [15] [16] [17]. Many studies were limited to particular organizations, countries, and geographic areas [13] [18]. Based on the key findings of our previously conducted systematic literature review (SLR) on impacts of human aspects on requirements engineering (RE) [19], we identified personality as an important human aspect that needs to be further investigated in relation to RE. RE activities, such as eliciting, analysing, prioritizing, managing software requirements play a vital role in SE and good requirements are considered to be one of the most critical and challenging parts of SE. Arguably, RE activities can be considered the most human-centric and socio-technically intensive activity in SE as they require extensive collaboration and understanding of the individuals involved [20]. However, from the literature, we identified that there are very limited studies that directly focus on the personality of the software practitioners involved in RE activities [19]. Hence, we want to gain a more comprehensive understanding of how the personality of individuals influences RE activities in SE. Our broad research question is: How does the personality of software practitioners influence requirements engineering activities?

To answer this research question, we conducted a mixed methods study involving a personality test based survey of 50 software practitioners involved in RE activities, followed by 15 in-depth interviews with those willing to discuss their experiences in-depth. To gather their personality profiles, we used the standard IPIP NEO-120 Personality test based on the well-known five-factor model (FFM) of personality. We used the ranking scores defined in IPIP NEO-120 test to analyse personality test data [21] and socio-technical grounded theory (STGT) for data analysis to analyse the interview data [22]. The main contributions of this study are as follows:

- We identified some of the possible impacts of personality on RE activities related to software practitioners, their team members and their external stakeholders (customers/clients/end-users);
We developed a set of guidelines for software professionals, software teams and stakeholders, as well as academic and industry researchers, who want to better understand the impact of personality on RE activities (both positive & negative) and how they might go about mitigating the negative impacts; and

- We identified a set of recommendations for future research into the impact of personality on RE activities.

2 RELATED WORK

2.1 Measuring Personality of Individuals

Numerous personality models have been formulated based on various personality theories to assess the personalities of individuals by characterizing human behaviours into a set of traits [23] [24]. The Five-Factor Model (FFM) is one of the most widely accepted personality models by the psychologists and now used in several SE studies on personality [25] [9]. The FFM integrates all personality characteristics into five main traits. These traits are Openness to experience, Conscientiousness, Extroversion, Agreeableness and Neuroticism. These five traits represent one’s personality at the broadest level of abstraction, and each trait summarizes a large number of trait, more specific personality characteristics [26]. The five main traits can be explained as follows [27];

- **Openness to Experience**: relates to individuals’ intellectual, cultural or creative interests. Statistically significant (high-scored) individuals on openness to experience tend to be imaginative, broad-minded and curious. In contrast, those at the opposite end of this spectrum usually show a lack of aesthetic sensibilities, favouring conservative values and preferring routine.

- **Conscientiousness**: refers to individuals’ focus on achievements. High-scored individuals tend to be hard-working, organized, able to complete tasks thoroughly on time, and reliable. Low-scored individuals on conscientiousness relate to negative traits such as being irresponsible, impulsive and disorganized.

- **Extraversion**: relates to the degree of sociability, activity, talkativeness, and assertiveness. A person is considered an extravert if they are friendly, comfortable in social relationships, active, assertive and outgoing. The opposite end of this spectrum shows a lack of social involvement, shyness, and prefer to be alone more than extraverted people. But, this does not mean that they are unfriendly or antisocial; rather, they are reserved in social situations.

- **Agreeableness**: refers to positive traits such as cooperativeness, kindness, trust and warmth; agreeable individuals value getting along with others. Low-scored individuals on agreeableness tend to be sceptical, selfish and hostile.

- **Neuroticism**: refers to the state of emotional stability of individuals. Low-scored individuals on neuroticism tend to be calm, confident and secure, whereas high-scored individuals on neuroticism tend to be moody, anxious, nervous and insecure.

These traits can be narrowed down to what is known as “facets” which consists six per trait (altogether 30 facets). The facets help to increase the precision and scope of FFM, thus enabling more accurate predictions [28]. Numerous instruments were developed to operationalize FFM. Among them the International Personality Item Pool (IPIP) is a freely available personality assessment instrument developed based on FFM. IPIP-NEO 120 is one of the short versions of the IPIP instrument and designed to measure the five personality traits including 30 facets efficiently. This short version possesses acceptable measurement of reliability and most recent studies focus on using IPIP-NEO 120 version due to its acceptable reliability and practicality [21] [29] [30]. Hence, we have used IPIP-NEO 120, the personality assessment instrument in our research study that is based on FFM (figure 1) [21].

2.2 Personality research in Software Engineering

A considerable amount of studies have been conducted aiming to identify the impact of personality in software engineering domain and significantly increased after 2002 [6]. The systematic mapping study conducted by Cruz at al. [6], analysed 90 articles published between 1970 - 2010, and identified that 83% of research reported empirical findings on the role of personality in SE where pair programming and education were most recurring research topics. Soomro et al. [31] conducted an SLR on the effect of the personalities of software engineers and how it is associated with team climate and team performance. The findings reported a relationship between software engineers’ personality and team performance, and revealed that software team characteristics significantly impact software team performance. Another SLR was conducted by Barroso et al. [32], focused on the influence of personality in SE, and found that the most extracted primary studies focused on software designers’ and programmers’ personalities. Sallehe et al. [10] investigated the effect of personality traits in pair programming on higher education with five formal experiments. They identified that “openness to experience” significantly differentiates paired students academic performance. An empirical study by Kanji et al. [11] investigated the impact of personality of software testers by collecting personality profiles of 182 software practitioners. 45.1% of them were software testers and the rest were programmers. The results indicated that software testers scored high on the “conscientiousness” trait than other software practitioners.
Xia et al. [33], conducted a study with software professionals to identify the relationship between project managers’ personalities and team personality composition and project success by investigating 28 completed software projects with 346 software professionals. The results indicated that project manager personality and team personality affect the success of software projects. They suggest focusing on relationships between personality and SE activities as their study only demonstrates the link between personality and overall project success. Kosti et al. [14] and Acua et al. [34] conducted empirical studies by collecting personality profiles of SE students. They identified significant relationships of personality with work preference and job satisfaction respectively. Further, they suggested conducting the research for real-world software teams.

Vishnubhota et al. [13] investigated the relationship between personality and team climate focusing on software professionals in agile teams. The findings indicated a significant positive relationship between certain personality traits and team climate factors. Mendes et al. [35] conducted a survey study with 63 software engineers investigating the relationship between decision-making style and personality within the context of software development. They identified seven statistically significant correlations between decision-making style and personality and built a regression model considering the decision-making style as the response variable and personality factors as independent variables.

Requirements Engineering (RE)-related activities in SE are considered to be highly human-centred as they involve working with a diverse range of people such as stakeholders, software development team members, and other requirements engineers [36] [37] [38]. From our prior SLR study [19], we identified that the impact of various human aspects needs to be studied more related to RE, and personality was identified as one such human aspect that has been considered often in SE studies, but RE has been considered as just one part of it or mainly limited to requirements elicitation [39] [12] [40] [41]. Being motivated by our SLR, we surveyed 111 software practitioners involved in RE activities to better understand the perspective of human aspects, including personality. There we found the software practitioners’ personality needs to be considered when they are involved in RE activities [42]. Having identified the importance of personality and its potential impact on RE as a key area worth investigating in our prior studies [19] [42], acknowledging the research gap in this area motivated us to design and conduct this study to answer our above-mentioned research question.

3 Research Methodology

This study aimed to understand participants perspectives on the impact of personality when involved in RE activities.

3.1 Study Design

Figure 2 shows the design of our study. We applied a mixed-methods approach when conducting this study. Mixed here refers to both qualitative and quantitative approaches being utilized. Our previous studies [19] [42] identified personality as a human aspect that software practitioners believe greatly impacts RE activities. To obtain an in-depth understanding of the impact of personality on RE, we designed a personality test-based survey and an interview study targeting software practitioners involved in RE activities.

3.1.1 Personality test-based survey

The first step in our data collection was to obtain personality profiles of software practitioners involved in RE activities aiming to get a large scale idea of personalities of people doing RE activities and to see if any particular personality trait facets get mentioned a lot in the interviews referring to its impact on RE. We used the standard IPIP-NEO 120 test for personality assessment (section 2.1). It consists of 120 items/statements, and participants are required to indicate how each statement best describes them. For example, the first statement is "I worry about things", where participants should indicate how much it related to themselves via a Likert scale from "very inaccurate" to "very accurate". Apart from the personality test, the survey consists of several demographic questions such as their age range, gender, country of residence, education qualifications, and work experience to identify their involvement in RE activities. We collected their employment details such as job role/title, a summary of their main job responsibilities, how often they are involved in RE activities, and their domain and software development methods. An open-ended question was used to collect their overall opinion on the impact of personality on RE activities. We used the Qualtrics platform to design and distribute the survey (appendix A).

3.1.2 Interview-based study

The second stage of our data collection used an interview-based study to get an in-depth understanding of the impact of personality on RE activities. To do this we designed a semi-structured interview schedule consisting of three sections. The first section collected detailed demographic information about the participants, including their involvement in RE activities. The second section collected the participant’s views on the influence of personality in RE activities. The views on the influence of their personality, their team members’ personalities and their external stakeholders’ personalities were focused on related to RE activities and how they mitigate any negative influences of personality (if any) when involved in RE activities. The last section asked participant opinions on the impact of other human aspects besides personality on RE activities (if any) based on their experiences. Our semi-structured interview schedule can be found in appendix B.

3.1.3 Pilot study

After designing the interview-based study and personality test-based survey, we conducted a pilot study with two software practitioners from our professional networks to validate the clarity and understandability of the questions; the time reported to complete the studies and to get their suggestions on improving both studies. Both provided feedback on the survey and interview study, where we modified the questions to improve the clarity based on their suggestions, and finalized the survey and interview studies.
3.2 Data Collection

The target population of our study was software practitioners involved in RE activities. After obtaining the required ethics approval¹, we advertised our study on social media (LinkedIn, Twitter) and within our own professional networks. Participation was voluntary, and we recruited 15 practitioners with experience in RE activities worldwide. The personality test-based survey was carried out as a pre-interview questionnaire which took around 15-20 minutes to complete. Then, the semi-structured interviews were carried out, with each interview lasting 50-60 minutes. Due to the pandemic, all the interviews were conducted online, and were audio recorded. Table 1 shows the detailed demographic information of the participants.

We wanted to compare personality traits of those involved in RE activities. As we had obtained only 15 personality profiles of the software practitioners interviewed, we advertised our personality test-based survey on the Prolific platform [43]. We used the built-in options in the prolific platform to filter participants based on our target audience. We applied the filter options for participants’ employment status as “full-time”, employment-sector as “information technology”, and industry as “software” and specifically mentioned that we are looking for software practitioners involved in RE activities to obtain our target participants. We recruited 35 participants via Prolific. Each of them were rewarded 8.72 AUD after completing the survey. This resulted in a total of 50 personality profiles to analyse.

3.3 Data Analysis

Both qualitative and quantitative data were collected from our study. Quantitative data analysis was carried out with the data collected through personality test-based survey. We followed the standard statistical analysis method mentioned in IPIP-NEO 120 personality test to analyze personality test data via Microsoft Excel. The qualitative data analysis was carried out with interview data. We used socio-technical grounded theory (STGT) for data analysis [22], which is particularly suited for analyzing open-ended data. We transcribed the interview sessions using otter.ai with the consent of the participants and stored & analyzed the data using NVIVO. The data collection and analysis were iterative where we conducted ten interviews in the first iteration and five in the second iteration (table 2). We followed the open coding approach to generate concepts and categories with constant comparison and memoing techniques in STGT. Thus, we wrote memos to record key insights while following the open coding activities. Below is an example of a memo that we recorded related to the negative impact of the neuroticism dimension on RE activities. We have discussed these insights generated from memoing in section 5.

Memo on “Negative impact of neuroticism trait on RE activities”: The majority of the interview participants (n = 12 out of 15) mentioned that the neuroticism characteristics of the people negatively impacts RE. They mentioned that when people involved in RE activities are “anxious”, “insecure”, “overthinking”, “moody”, and “reserved”, it negatively impacts RE activities, specifically in requirements elicitation. All these adjectives emphasize the neuroticism trait, indicating that it negatively impacts RE activities. Interestingly, many of them mentioned these related to their team members or customers’ characteristics and did not particularly mention their own neuroticism characteristics. E.g., INT01, a lead business analyst, mentioned that their team members’ “anxious” and “overthinking” behaviour creates confusion between customers and the team in requirements elicitation, resulting in getting incomplete requirements during the project. However, they tend to explain the impact related to their team members’ characteristics rather than their own characteristics, which also can occur due to the nature of their individual personalities. Hence, the relationship between software practitioners’ personalities and their team members’/customers’ personalities can also be further investigated related to RE/SE.
4 FINDINGS

4.1 Demographics of the participants

Our study consists of a personality test-based survey (50 software practitioners) and an interview study (15 software practitioners). The majority of the participants were male (66%), with ages ranging between 31 to 40 years (40%). The most common roles are software engineer (40%), followed by IT project manager (12%) and business analyst (10%), where the majority of the participants (60%) possess a bachelor’s degree in computer science or software engineering. Table 1 summarises all the demographic information of the participants. The majority of the participants were from the United Kingdom (20%), followed by South Africa (12%), Australia (8%) and Sri Lanka (8%). An equal number of participants (34%) have 1-5 years and 5-10 years of work experience in the software industry, whereas 28% have more than ten years of work experience. When specifically considering interview participants (15 software practitioners), their work experience in the software industry expands from 3 to 26+ years. Most of them have been fully involved in RE activities throughout these years. Table 2 provides detailed demographic information of the interview participants. Most participants (68%) use agile software development methods, such as scrum, kanban, and XP, and 20% use both agile and traditional (waterfall) software development methods. The rest of the 12% only use traditional (waterfall) software development methods. Among the majority who use agile software development, 55% use scrum, and the rest use other methods such as kanban, XP and lean software development. The participants have experience in a variety of project domains where the majority of them (28%) were finance domain, followed by health (24%), transport & logistics (18%), IT (10%), government services (8%), manufacturing (8%), education (6%), real estate (4%), IoT & telecommunication (4%), utility services (4%), and insurance (2%).

Our target participants were software practitioners involved in RE activities. We confirmed this by asking participants to rate how often they were involved in major RE activities when they completed the personality test-based survey. An equal percentage of participants (38% each) indicated that their involvement in RE activities such as eliciting/analyzing/prioritizing/ managing software requirements is almost every day or a couple of times a week. 20% of the remaining participants mentioned that they were involved in these RE activities a couple of times a month. In contrast, only 4% of the participants mentioned their involvement in RE activities is rare. We also provided a set of major RE activities to identify further how much the participants were involved in RE as a part of their job. As shown in figure 3, the majority of the participants are either always or very often involved in these RE activities. Among them, the majority (72%) are always or very often involved in requirements management throughout the project. 68% of participants either always or very often collaborate with stakeholders to elicit requirements and to document them in software requirements specifications. 64% of the participants always or very often participate in requirements prioritization, whereas 62% always or very often lead requirements analysis and verification. The least amount of participants mentioned that they were never involved in these given RE activities, which is a maximum of 4% for activity “lead requirements analysis & verification”. For all the other RE activities given, only 2% of participants mentioned that they were never involved in those activities. We also asked them to mention other job responsibilities they are involved in, where 10% are involved in the implementation and 4% in testing/bug fixing, architecture designing and creating user guides after feature development as the tasks apart from the given list of activities. It shows that we were able to recruit our target participant group for this research study.

4.2 Personality Characteristics of the practitioners involved in RE activities

We collected 50 personality profiles from software practitioners involved in RE activities. We used the standard
IPIP-NEO 120 personality assessment test, designed based on FFM, as our personality test (section 2.1). It includes 120 items/statements that help to analyze a person’s personality, referring to five broad dimensions and 30 facets (figure 1). A sample personality profile of a participant can be seen in Appendix C. By analyzing the 50 personality profiles that we have collected, we identified that although every individual possesses a mix of personality traits, some personality traits are statistically more significant among others. As shown in Figure 4, agreeableness (78%) and conscientiousness (70%) are identified as statistically significant (high-scored) personality traits among the majority of our participants. An equal number of participants (50%) each have a high and average score related to the openness to experience trait. The majority of the participants have an average score in their extraversion and neuroticism traits, where 72% are average in extraversion and 80% are average in neuroticism. The ‘high’, ‘average’ and ‘low’ categories depicted in Figure 4 are decided based on each individual’s scores through analyzing their personality tests. We identified that the majority of the participants have high agreeableness and conscientiousness traits and average extraversion and neuroticism traits. None of the participants is low in agreeableness, conscientiousness, openness to experience and extraversion traits, and only one participant (2%) is identified as low in neuroticism.

Each personality trait consists of six facets that can be used to describe each personality trait in detail. Hence, an individual’s personality can be described with five personality traits and thirty facets. As shown in figure 5, most of the facets related to agreeableness, conscientiousness and openness to experience are significantly high among participants. In contrast, the majority of the facets related to extraversion and neuroticism have average scores. Considering the agreeableness trait, the most common trait among the participants, its’ straightforwardness (88%), cooperation (84%), and altruism (82%) facets are significantly high in the majority of the participants compared to sympathy, trust and modesty facets. This shows that the participants’ personalities related to agreeableness can be best described as straightforward, cooperative and altruistic individuals.

Considering conscientiousness, participants obtained high scores in competence (86%), dutifulness (84%) and achievement striving (80%) facets, making it the second highest personality trait that can be seen among the participants. However, compared to facets of the other three personality traits, most of the facets of agreeableness and conscientiousness are scored high among participants, indicating that these two personality traits are the most common traits among the participants. Among the facets of openness to experience, the trait that has an equal percentage of high and average scores, ideas/intellect (74%), feelings/emotionality (68%), aesthetics (66%), and values/liberalism (62%) facets have high scores compared to the imagination and adventurousness facets.

However, none of the facets of openness to experience reach the level of scores of agreeableness and conscientiousness. This indicates that participants tend to have more openness to experience behaviours than extraversion and neuroticism, but not as high as agreeableness or conscientiousness behaviours. Referring to the facets of extraversion trait, only cheerfulness (70%) and assertiveness (68%) are considerably high among participants. In contrast, friendliness, gregariousness, activity level and excitement-seeking can be seen as average-scored facets among the participants. Neuroticism is the trait where most facets have average scores among the participants, indicating that neuroticism behaviour is mainly average among participants. Among their average neuroticism behaviour, the majority of the participants seem to be impulsive (70%), vulnerable (68%), angry (64%) and self-conscious (64%). Compared with other personality traits, it can be identified that a considerable amount of participants are low in neuroticism facets such as depression (30%), vulnerability (12%), anger (12%), and anxiety (8%). In contrast, the majority of the others facets are hardly seen in a low category. By analysing these 50 personality profiles, we identified that the participants tend to be statistically significant in high agreeableness, conscientiousness, openness to experience than in extraversion and neuroticism.

### 4.3 Impact of personality in RE activities

We conducted 15 detailed interviews with a range of software practitioners involved in RE activities. Their demographics are summarised in Table 2. Through this we obtained in-depth insights into the impact of personality on...
Through in-depth analysis of people you’re working with to do your best. Eventually it with various personalities, that affects a lot for you and the people involved in requirements engineering activities. INT05, a software engineer & application consultant, explained "I think you can gather requirements from end users irrespective of their personality" - INT05 [lead human-centered designer/information architecture] rather than it is isn’t the case when team members or their own.

Most of our interview participants experienced the impact of personality when doing RE activities irrespective of the people involved – their own personality, team members’ personalities, or clients/customers/end users’ personalities “I think you can gather requirements from end users irrespective of their personality” - INT05 [lead human-centered designer/information architecture] rather than it is isn’t the case when team members or their own.

Referring to the impact of personality on RE activities, we identified that the impact can be either positive or negative on the outcome of the RE activities, the overall outcome of the project, and/or the performance of the team and people involved. For example, according to INT05, a software engineer & application consultant, personality highly impacts the most important RE activity: "my personal opinion in the requirement engineering, the personality mainly impacts on the requirements gathering part, which is the most important part, not the other side.. giving required output...". INT13, a lead business analyst, explained that personality impacts the individual performance as well as the performance of the team: "personality makes a huge difference for a person as well as for the team because when they are involved in requirements engineering activities with various personalities, that affects a lot for you and the people you’re working with to do your best. Eventually it improves our performance”. Through in-depth analysis of the interviews, we have identified that these positive and negative personality impacts can be further explained related to software practitioners’ personalities, their team members’ personalities and their clients/customers/end users’ personalities.

- **Impacts related to software practitioners’ individual personality**

Participants identified various personality characteristics and how these characteristics positively or negatively impact them when they are involved in RE activities. Table 3 summarizes these participant reported impacts, relating impact to individual personalities, and highlighting whether it is positive (+) or negative (-). We have also identified that these characteristics can directly or indirectly be mapped to the five personality traits/dimensions and their facets. Some important aspects are discussed as follows:

**Ability to ‘work the way around’**: The majority of the participants (13) mentioned that their ability to ‘work the way around’ has a large impact when involved in RE activities. Individuals with this characteristic know how to get things done to achieve what they need to. They do this by prioritizing their work while working with their team members and customers. This personality facet characteristic helps them to work with different customers during requirements elicitation in order to obtain the actual software system requirements. It also helps them in their dealings with internal team members (other developers and project managers) when translating specifications into technical tasks to reduce future system complications. For example: “so now I am dealing with him in a very different way. I make things simple for him. I only asked him the key questions first and then gradually gathered requirements with smaller discussions” - INT12 [Senior project manager].

"But When you take it positively, when you know how to get the thing right at the first phase, you can reduce that number of errors, bugs, complications on whatever that is to come with the dev team when giving specifications as technical tasks”- INT13 [Lead BA/Scrum master].

**Hardworking nature**: 6 participants mentioned that their hardworking nature personality facet positively impacts them when they are involved in RE activities. Through this hardworking nature, they can provide the best solution to their customers, resulting in high customer satisfaction.
and completing their work tasks within the scheduled time, saving budget and time. It also results in delivering reliable work quickly and highlights that they can identify more requirements via their hardworking nature, leading them to dig deeper in the relevant domain.

“I will be doing more research on the area and then get back to them with some sort of a plan, then carry out the work with the team. At the end, they are very happy about the work” - INT02 [BA/Project manager].

The above two characteristics can be directly mapped with the conscientiousness trait, where the “ability to work the way around” is related to the competence facet and “hardworking nature” is related to the achievement-striving facet.

Considerate of others: 14 participants said that their personality facet of concern towards others involved in RE/SE-related activities impacts them when they are involved in RE activities. Consideration towards other team members leads them to focus on their allocated tasks and solve conflicts between customers and the team when involved in RE activities. Moreover, it helps to gather opinions from everyone, which leads us to get the best solution among them. “I am highly concerned about my team members, I personally talk to them to get their opinions and present them in the team discussions. It helps us to produce the best solution for our customers” -INT08 [Software engineer].

Concern towards their customers helps them better to understand their behaviours and change the requirements elicitation techniques accordingly. For example, if the customer tends to be more reserved and is not expressive of what they need, changing the requirement elicitation technique will help get the best outcome:

“As a lead, I tend to consider their behaviours, so that I can apply relevant requirement elicitation technique for them. For example, we had a very reserved client, not talking much, so we changed our way of collecting requirements, and it was a success. We only asked main points in the meeting and when we need more information, we emailed him” - INT12 [Senior project manager].

Cooperative nature: Participants highlighted that their personality facet of a cooperative nature is beneficial when they are involved in RE activities, both within their team and with their customers. Cooperativeness greatly impacts requirements specification, prioritization, and handling of requirement changes, taking the team and the clients to one page:

“It did not help do requirement engineering unless you have qualities such as cooperativeness, it is really helpful when we prioritize the requirements and handling requirement changes in later phase” - INT04 [Business Analyst].

These characteristics can be directly mapped with the agreeableness dimension, where the “considerate of others” can be referred to as altruism and “cooperative nature” can be directly referred to as compliance/ cooperation.

Enjoy in-depth conversations: Individuals who have a personality facet of enjoy having in-depth conversations said that it positively impacts them when they carry out RE activities. It was mentioned that without having in-depth discussions with the customers, getting actual requirements is difficult. In-depth discussions connect the team with the customers from the ground level, leading to fewer conflicts in the later part of the project. It is also helpful to know in and out of the project, which will assist in handling change requests from the development team:

“If you want to know, understand the system they want, then you have to have a long fruitful conversation with the clients, you can’t just sit and expect them to give you the requirement. I always enjoy having long conversations with them, and then I know what they actually want” - INT10 [Business Analyst].

Willingness to try new things: Many participants mentioned that they are always open to trying new things, and their personality facet of having an exploratory nature has a high impact when they are involved in RE activities. They said it enhances the individual learning about the projects, improves the project’s design with advanced functionalities and increases customer satisfaction with new approaches, which will benefit them:

“I am always open to try new things, specially when designing each project. Mostly, it has positively affected to my team and customers, they are very satisfied with new functionalities” - INT14 [Business Analyst].

Both of these characteristics indicate that individuals with the openness to experience trait positively impact RE activities where the “enjoy in-depth conversations” can be mapped with ideas/intellect facet and “willingness to try new things” can be mapped with actions/adventurous facet.

Ability to interact with various roles: 9 participants mentioned that their personality facet of an ability to interact with various people/roles greatly benefits them when involved in RE activities. Interactions with internal and external parties are required. The ability to interact with various people greatly impacts the success of a particular task. For example, individuals with high interaction skills are needed to initiate conversations with customers, which will be helpful in having a positive connection with the customers, and result in getting good support from them throughout the project.

“It is needed when you start conversations with your clients, creates some kind of bond with them. If you have a good bond with your clients, they will support you with everything. So having high interaction skills, I think, it is like one of the strong skills that you need as in personality” - INT04 [Business Analyst].

Prefer to control/take the lead: It was mentioned that individuals’ personality facet of a preference to take control or take the lead has a mixed impact when they are involved in RE activities. For example, when dealing with a difficult customer who is having issues with the team, it is important to take the lead and intermediate with them. This is by directly contacting the customers to identify issues and provide immediate solutions required to maintain the continuation of the project without having interruptions for the final output. It also ensures that everyone in the team gets a voice:

“I will directly contact them and interact with them. Try to identify the problem and make sure it will not impact our work and the final project” - INT03 [IT development & re-engineering lead].

However, we identified that this personality facet sometimes negatively impacts developers when carrying out RE activities. For example, if there is an over-controlling lead in the team, it will directly impact the team’s performance. It reduces team members’ interest in the project and they
TABLE 3: Impact of personality related to software practitioner’s individual personality

| Characteristic | Impact on RE/SE | Related Facet | Personality Dimension/Trait |
|---------------|-----------------|---------------|----------------------------|
| Ability to work the way around | (+) Handling various customers during requirements elicitation<br>(+) Get the actual requirements<br>(+) Ability to deal internal team members (developers) when translating specifications to technical tasks<br>(+) Reduce future complications/ errors/ bugs<br>(+) Solving issues in requirement changes | Competence/ Self-efficacy (C1) | Conscientiousness |
| Hard-working nature | (+) Ability to deliver reliable work quickly<br>(+) Providing the best solution to the customers, result in high customer satisfaction<br>(+) Completion of tasks within the time line saving budget & time<br>(+) Getting more requirements via digging deeper in the domain | Achievement-striving (C4) | Conscientiousness |
| Being Systematic | (+) Following a periodic plan helpful in allocate tasks in the team<br>(+) Being methodological leads successful task completion<br>(+) Working with a plan leads to not missing out requirements | Self-discipline (C5) | Conscientiousness |
| Desire for successful task completion | (+) Successful elicitation & analysis of requirements<br>(+) Ability to complete tasks within deadlines<br>(+) Increase the accuracy of the work | Competence/ Self-efficacy (C1) | Conscientiousness |
| Considerate of others | (+) Lead team members to focus on their allocated task<br>(+) Solve conflicts between customers and the team members<br>(+) Help to gather everyone’s opinion, leading towards getting the best solution<br>(+) Help to understand customer behaviours and change the elicitation techniques accordingly | Altruism (A3) | Agreeableness |
| Cooperative nature | (+) Helpful in requirements specification and prioritization<br>(+) Helpful in managing requirement changes<br>(+) Make it easier to get the team and the customers into one page | Compliance/ Cooperation (A4) | Agreeableness |
| Trusting others | (+) Trusting the team members will lead to improve their work performance<br>(+) High-level of trust ensure strong collaboration with customers, result in getting complete requirements<br>(+) Trusting the development team, result in getting the best possible solution for customers | Trust (A1) | Agreeableness |
| Helpfulness | (+) Lead to solve difficulties in the design/ solution with ease<br>(+) Getting more expert inputs to deal with last minute change requests<br>(+) Improve the overall success of the project, result in successful project execution | Altruism (A3) | Agreeableness |
| Enjoy in-depth conversations | (+) Having in-depth discussions with customers lead to get actual requirements<br>(+) Connects the team with the customers from the ground level, leading to having less conflicts in later part of the project<br>(+) Helpful to know in-and-out of the project<br>(+) Ability to handle change requests from the development team | Ideas/ Intellect (O5) | Openness to Experience |
| Willingness to try new things | (+) Enhance the individual learning about the project<br>(+) Improve the design of the project with advance functionalities<br>(+) Increase customer satisfaction with new approaches | Actions/ Adventurousness (O4) | Openness to Experience |
| Imaginative nature | (+) Helpful in foresee what kind of model/ interface best suit for collected requirements<br>(+) Increase the creativity of the final outcome of the project<br>(+) Ability to identify hidden/ unexpressed requirements by the customers<br>(+) Ability to identify interactions between collected requirements | Fantasy/ Imagination (O1) | Openness to Experience |
| Ability to interact with various roles | (+) Initiate and continue to have successful conversations with the customers<br>(+) Create a positive connection with customers, result in getting customer support through out the project<br>(+) Getting more requirements via approaching different level of customers<br>(+) Ability to get the required inputs and outputs from various involved parties of the project<br>(+) Increase the easiness of working within the team | Warmth/ Friendliness (E1) | Extraversion |
| Prefer to control/ take the lead: | (+) Handling difficult customers with direct involvement to identify and solve issues, reducing the conflicts with the team<br>(+) Helpful in maintaining the continuation of the project without having interruptions for final output<br>(+) Ability to ensure that everyone in the team get a voice<br>(+) Reduce the others’ interest towards the project, result in completing tasks just to get by | Assertiveness (E3) | Extraversion |
| Being curious | (+) Able to do a good job with gathering requirements<br>(+) Ability to gather detailed requirements<br>(+) Curious mindset increases the individuals’ level of involvement in each task | Excitement-Seeking (E5) | Extraversion |
| Getting anxious | (-) Create confusions between customers and internal team<br>(-) Inability to understand what customer actually need due to anxiousness<br>(-) Inability to complete tasks on time, affecting the individual and team performance | Anxiety (N1) | Neuroticism |
| Insecure feeling | (-) Direct impact on individual and team performance when involved in RE/SE tasks<br>(-) Increase the conflicts between team members<br>(-) Reluctant to stepping out from conform zone, reducing the chances to learn | Vulnerability (N6) | Neuroticism |
start to complete the tasks just to get by which will eventually impact the project’s outcome, leading to customer dissatisfaction: "However, if you try to over control them, it will definitely impact as others will just do the tasks and it will be clearly seen in their performance" - INT06 [Technical team lead]. These characteristics can be mapped onto the extraversion dimension where the “ability to interact with various roles” can be referred to friendliness and gregariousness facets, and “prefer to control/ take the lead” can be referred to as the assertiveness facet.

Getting anxious: Individuals with a personality facet of getting anxious tends to have a negative impact when they are involved in RE activities. Individuals’ confidence level, deadlines, and reluctant to change make them anxious, result in creating confusion between customers and the internal team, not understanding what customers actually need and inability to complete tasks on time which will eventually affect their performance: "I know personally, within my experience, I know that there are times when I’m just anxious, because, probably, I’m not confident about the work, maybe I think I’ve not done my homework well, so it does affect my performance” - INT10 [Business Analyst].

Insecure feeling: Individuals’ personality facet of having insecure feelings also has a negative impact when they are involved in RE activities. A feeling of insecurity comes from their self-doubts, seeing other team members’ performance, or when doing changes to their allocated tasks. It will also directly impact their performance and the team’s performance, increasing the conflicts between team members. Overall, it will impact the outcome of the project: "A few years back, I was kind of insecure because I have self-doubt of myself, seeing all my colleagues working as pros, so you tend to feel insecure, and it really impacts my work. I couldn’t give what the team is asking from me” - INT07 [Software engineer]. Both of these characteristics can be directly mapped onto the neuroticism dimension, where the majority of the participants mentioned that it has a negative impact when doing RE activities. The “getting anxious” characteristic can be directly referred to anxiety facet, whereas the “insecure feeling” can be referred to vulnerability facet.

- Impacts related to software practitioners’ team members’ personality

Almost every participant provided insights on how the personality of their team members impacts them when they are involved in RE activities. This included how the team members’ personalities positively or negatively impact RE activities, the overall outcome of the project and their team performance. We have identified several personality characteristics that positively influence RE activities that every participant wants to see within their team members and some negatively impacted characteristics that they want to mitigate from their team members. Table 4 summarizes the set of important characteristics, mapping with respective personality dimensions/traits and facets accordingly and discussed as follows;

Friendly/ outgoing nature: Team members with a personality facet of having a friendly/ outgoing nature positively influences the team when dealing with customers. They are the key people who initiate and conduct discussions with customers, making them comfortable with the team to provide actual, in-depth requirements. Having friendly team members are helpful in dealing with customers with constant requirement changes and providing unrealistic or impractical requirements where they can lead the team in such circumstances to reduce the conflicts between the team and the customers. Moreover, they are beneficial in keeping the team’s energy and carrying forward the teamwork positively: "I have been observing this particular team member of my team who is always friendly and has some energy around him. He works with customers in a very friendly manner. So we didn’t have many conflicts with the customer because he handles them” - INT01 [Lead BA].

"The outgoing members in the team can really drive the rest of the team, keeping the energy of the team” - INT04 [Business Analyst]. However, it was also mentioned that a team member’s friendly/ outgoing nature personality facet can sometimes negatively impact them when they are involved in RE activities. This can reduce the customers’ involvement in RE activities where they might not get enough opportunity to express their opinions. This may lead to incomplete requirements, creating requirements gaps and conflicts between the customers and the team.

"when the client is not getting enough chance to speak because this person is very friendly and always talking. So it can also impact creating gaps between the team and the clients” - INT10 [Business Analyst].

Leading & controlling nature: Leading & controlling nature team members has a mixed impact when involved in RE activities where sometimes their personality facet of a leading & controlling nature impacts positively. For example, according to INT02, who is working as a business analyst & project manager, mentioned that it is a really important aspect to manage the internal team and lead the whole team towards one goal: “So when people are less working as a team, I find it is important to have that one person in the team who is working as a team leader, managing the team and taking them to one page” - INT02 [Business analyst/Project manager].

However, many participants pointed out that they have experienced negative impacts of having team members with a leading & controlling personality facet, such as losing interest in the project, internal team conflicts, and not getting the best outcome due to over-power others’ opinions: (E.g. "we are working on one particular project, and we were doing equal contribution. But, he tried to stamp out my opinions. So, you tend to lose interest” - INT08 [Software engineer]).

These characteristics relate to the extraversion dimension, where ‘friendly/ outgoing’ nature can be mapped onto the friendliness facet, whereas ‘leading & controlling’ nature can be mapped onto the assertiveness facet.

Coping with others: Team members’ personality facet of an ability to cope with others has a positive impact when they are involved in RE activities. It specifically impacts the teamwork and overall performance of the team as when team members are willing to cope with others to work; they come up with the best outcome. Moreover, managing the team and handling the customers is easier when the team is willing to cope with others:

"The members should be able to cope with others, you know, that improve our work, and we were able to give what client exactly
### TABLE 4: Impact of personality related to software practitioners’ team members’ personality

| Characteristic                        | Impact on RE/SE                                                                 | Related Facet          | Personality Dimension |
|---------------------------------------|--------------------------------------------------------------------------------|------------------------|-----------------------|
| Friendly/ outgoing                    | (+) Initiate and conduct the discussions with customers                        | Warmth/                | Extraversion          |
|                                       | (+) Helpful in getting actual, in-depth requirements                          | Friendliness (E1)      |                       |
|                                       | (+) Helpful in dealing with constant requirements changes, unrealistic & impractical by customers |                       |                       |
| Leading & Controlling nature         | (+) Reduce the conflicts between the team and the customers                   | Assertiveness (E3)     | Extraversion          |
|                                       | (+) Keeping the energy of the team and carry forward the work work            |                        |                       |
|                                       | (+) Reduce customer involvement in RE due to not getting enough opportunity to expression their opinions |                        |                       |
|                                       | (+) Getting incomplete requirements, creating requirements gaps               |                        |                       |
|                                       | (+) Help to manage the internal team & lead the whole team                    |                        |                       |
|                                       | (+) Other team members loss of interest towards the project                    |                        |                       |
|                                       | (+) Not getting best outcome due to over-power others’ opinions               |                        |                       |
| Curious nature                       | (+) Ability to dig-deeper into requirements                                    | Excitement-Seeking (E5)| Extraversion          |
|                                       | (+) Ability to resolve complicated requirements                               |                        |                       |
|                                       | (+) Increase the team engagement                                              |                        |                       |
|                                       | (+) Opportunity to learn new things (e.g. technology, domain)                |                        |                       |
| Coping with others                   | (+) Coping with other team members result in coming up with the best outcome | Compliance/Cooperation (A4) | Agreeableness |
|                                       | (+) Easy team management                                                      |                        |                       |
|                                       | (+) Easy to handle customers                                                  |                        |                       |
|                                       | (+) Easier to connect with the customers to get the requirements and synchronize them with various user levels |                        |                       |
| Trustworthiness                      | (+) Leads to deliver projects on time without delays                          | Trust (A1)             | Agreeableness         |
|                                       | (+) Helps to resolve internal conflicts within the team                        |                        |                       |
|                                       | (+) Getting complete requirements due to the trust between customers and the team |                        |                       |
|                                       | (+) Ability to get the customer involvement throughout the project           |                        |                       |
|                                       | (+) Reduce conflicts between the team members                                 |                        |                       |
| Considerate nature                   | (+) Improve the working comfort within the team, result in improving the progress of the team’s work | Altruism (A3)         | Agreeableness         |
|                                       | (+) Supportive team members, helping in completing the tasks correctly on time |                        |                       |
| Organized nature                     | (+) Helpful in completing projects with strict budget and timelines           | Order/ Orderliness (C2) | Conscientiousness    |
|                                       | (+) Impacts the quality of the deliverables because they lead the to work with a plan |                        |                       |
|                                       | (+) Always prepared, so that they can ask more related questions from the customers |                        |                       |
| Responsible nature                   | (+) Successful project delivery as they tend to complete their tasks well on time | Duitfulness (C3)       | Conscientiousness     |
|                                       | (+) Helpful in critical releases as they tend to work with the team until the work is done |                        |                       |
|                                       | (+) Successful project implementation, increasing customer satisfaction        |                        |                       |
| Less impulsiveness                   | (+) Not jumping into conclusions at the initial state of requirements gathering | Deliberation/ Cautiousness (C6) | Conscientiousness |
|                                       | (+) Less complications of budget and schedule due to less number of changes in the later phase of the project |                        |                       |
| Wanting to do the best               | (+) Identify best possible ways to provide the solution (the perfect solution) | Competence/ Self-Efficacy (C1) | Conscientiousness |
|                                       | (+) Less number of errors/ missing requirements                              |                        |                       |
|                                       | (+) Provide the best solution to the customers, increasing their satisfaction  |                        |                       |
| Willingness to discuss               | (+) Helpful to carry forward the project into the same direction              | Ideas/ Intellect (O5)  | Openness to Experience |
|                                       | (+) Reduce conflicts between team members as well as with the customers       |                        |                       |
|                                       | (+) Helpful in requirements specification and prioritization                   |                        |                       |
| Willingness to change                | (+) Prefer to change lead to explore, do experiments and change the approaches accordingly | Actions/               | Openness to Experience |
|                                       | (+) helpful in creating innovative ideas                                      | Adventurousness (O4)   |                       |
|                                       | (+) Lean new technologies and techniques, to create best solutions            |                        |                       |
| Open-mindedness                      | (+) Ability to think out of the box, result in creating unique solutions      | Fantasy/ Imagination (O1) | Openness to Experience |
|                                       | (+) Ability to think beyond given requirements                               |                        |                       |
|                                       | (+) Getting alternative ways of completing difficult tasks/ requirements      |                        |                       |
| Moody & anxious behaviour            | (+) Tend to overthink about requirements from the initial phase, result in incomplete requirements gathering | Anxiety (N1)           | Neuroticism           |
|                                       | (+) Lead to create confusions between the team and the customers              |                        |                       |
|                                       | (+) Increase conflicts within internal team members                           |                        |                       |
| Easily getting annoyed               | (+) Leads to loose important customers as they tend to interact with them in aggressive/ rude manner | Angry Hostility/ Anger (N2) | Neuroticism           |
|                                       | (+) Creates lots of conflicts between team members                            |                        |                       |
|                                       | (+) Leads to impact overall performance of the team                           |                        |                       |
| Insecure feeling                     | (+) Team members insecure feeling lead them trying new technologies in the projects, result in overall outcome of the project | Vulnerability (N6)     | Neuroticism           |
|                                       | (+) Stick with their preferred development areas, result in not getting the best solution |                        |                       |
|                                       | (+) Increase the team conflicts as they are not cooperating with others        |                        |                       |
expected” - INT11 [Lead BA].

**Trustworthiness:** Trust is needed within the team and with the customers and this personality facet impacts the team positively when involved in RE activities. Trustworthiness of the team members leads to delivering the projects on time without delays. It helps to resolve internal conflicts within the team for the leads and the management. Trust between the team and the customers leads to getting complete requirements as customers tend to be more open when they trust the team:

"some kind of trust as well, we trust that they will deliver their tasks on time so that we can complete our project on time. Actually, that happened in most of my projects” - INT07 [Software engineer].

Both “willingness to discuss” and ‘ trustworthiness” characteristics can be mapped with the agreeableness dimension, where these two characteristics can be linked with cooperation and trust facets, respectively.

**Organized nature:** Organized team members are very important when they are involved in RE activities. It helps to complete projects with strict budgets and timelines as the team is well prepared and organized, impacting the quality of the deliverables. A personality facet of an organized nature leads the team to work with a plan and is always prepared:

"you need to be organized so that your team has a plan and can work for it. In that project, we were able to complete it on time" -INT09 [Lead human-centred designer].

**Responsible nature:** Responsible team members are also a key to successful project delivery as they tend to complete their tasks well on time. Team members with a responsible nature personality facet are important when there are critical releases, as they tend to work with the team until the work is done. For example, INT07, a software engineer, mentioned that he had experienced the consequence of having an irresponsible team member who was always postponing the schedule, resulting in poor project implementation and customer dissatisfaction:

"We suggested some features, and he was like, he will do later, and he is postponing the schedule, but never implementing a good project, and the customer was not happy at the end” - INT07 [Software engineer].

These characteristics can be mapped onto the conscientiousness dimension, where the “organized nature” can be mapped to the orderliness facet, and the “responsible nature” can be mapped to the dutifulness facet.

**Willingness to discuss:** Team members’ who have a willingness to discuss personality facet have a positive impact on RE activities. Their willingness to have discussions within the team helps to maintain the project scope with time. For example, when all the members do not appear to be in the same direction, it would be great to have team discussions constantly to drive the team within the project scope:

"as a team, moments where we don’t appear to be all are going in the same direction, we will have conversations often and lead the team to complete what is within the scope” - INT09 [Lead human-centred designer].

**Willingness to change:** Team members’ willingness to change personality facet also positively impacts them when they are involved in RE activities. This leads them to explore more, do experiments and change their approaches accordingly. For example, when there is a technology change (upgrade) within the team, these team members accept the change as they are willing to explore and learn new things:

"if you are actually doing requirement engineering, you need to have the ability to change, you should know how to go forward with new technologies, techniques and you have to have that desire to learn and cope with new things” - INT05 [Software engineer & application consultant].

The characteristics of “willingness to discuss” and “willingness to change” can be mapped onto the openness to experience dimension, which can be related to the ideas/ intellect facet and actions/ adventurousness facet, respectively.

**Moody & anxious behaviour:** 7 participants mentioned that moody & anxious personality facet team members negatively impact them when they are involved in RE activities. They tend to overthink requirements (e.g. how will we implement this?) in the first phase, not focusing on gathering complete requirements. They may also create confusion between the team and the customers and conflicts among internal team members:

"if a person is moody or anxious, that may negatively impact carrying out requirement engineering activities, like they will be anxious and think about implementation work all the time so that they may miss important requirements” - INT02 [Business analyst & Project manager].

**Easily getting annoyed:** RE activities have been negatively impacted due to team members who are easily annoyed when they are involved in RE activities. This personality facet leads them to loose valuable customers as they tend to interact with customers in a rude/aggressive manner. Also, it creates lots of conflicts among the team members. When questioned about their less cooperation with the team, they easily get annoyed, which will eventually impact the team’s overall performance:

"there was a guy; he was very aggressive towards the problems and the people, he will get angry at customers. So the customers didn’t want to work with him” - INT05 [Software engineer & application consultant].

Both characteristics can be related to the neuroticism dimension where “moody & anxious behaviour” can be mapped with anxiety and “easily getting annoyed” can be mapped with anger facets, respectively.

- **Impact related to clients/customers/end users’ personality**

Twelve participants mentioned that clients/ customers/ end users’ personalities positively or negatively impact them when they are involved in RE activities, while the rest (3) mentioned that they do not believe that clients/ customers/end-users personalities have an impact when they are involved in RE activities. However, their insights are limited and quite similar to what they have expressed about the impact of their team members’ personalities on RE activities. Some of the key findings related to the impacts of customers/clients/end users’ personalities on RE activities are discussed as follows;

**Willingness to collaborate:** This can be mapped onto the cooperation facet in the agreeableness dimension, where customers’ interest in working collaboratively with the team has a mixed impact on conducting RE activities. It helps to
have a good discussion with the customers’ where practitioners can understand what they actually need and gather accurate, complete requirements. It reduces the number of requirements changes in the later phase of development as they are involved in the project from the beginning:

“it’s very important in requirement engineering to have good discussions with the users; when they are working with us together, we can understand what they want, we can get all the requirements” - INT03 [IT development & re-engineering lead]. However, it was also mentioned that the customers’ collaborative nature can sometimes negatively impact RE activities. Due to their collaborative nature, they can often change the requirements, resulting in disruptions to the ongoing work and frustrating the software team.

“I have sometimes experienced their over-connection with the team disturbing our work. You know, they want to involve in everything, and then they keep changing and demanding, sometimes it is frustrating at the end of the day” - INT14 [Lead BA].

Working with a plan: Customers who always work with a plan impact RE activities positively, making the work easier for software practitioners. These customers have already thought of the requirements and know what they want, which leads the software practitioners to get clear requirements:

“So it’s always great to work with clients who have planned what they want, they’ve thought it through, and we get the requirements easily” - INT10 [Business Analyst].

“I worked with a foreign customer who is very organized, she has planned everything from the beginning, you know, she is like, we want these, these, very clear and it is easy for us. We can directly get the requirements and start the work” - INT15 [Senior software engineer].

This characteristic can be mapped with the self-discipline facet in the conscientiousness dimension.

Willingness to change: Customers who do not always stick to their beliefs and are open to change tend to positively impact work when they are involved in RE activities. Customers with this personality facet are helpful in changing requirements due to technical feasibility. They are open to considering suggestions from software teams, such as changing impractical requirements. This characteristic can be mapped with the actions/adventurousness facet in the openness to experience dimension:

“There are some clients who are happy with what we suggest; they understand technical difficulties and accept changes. then we also try to give our best” - INT12 [Senior project manager].

Expressive nature: Customers with an expressive nature personality facet positively impact the carrying out of RE activities. It helps the team to get clearly defined requirements from the customers’ end, and practitioners do not want to put extra effort into digging deep into the requirements to find out more about missing requirements. They are not reluctant to say what they want and always work for it:

“if your customer is an expressive person, you really don’t have to push them to give you information or detailed requirements. Because they would go out of their way to share it with you” - INT10 [Business analyst].

However, it was also mentioned that this expressive nature personality facet can sometimes impacts negatively as it leads to project scope creep. This characteristic can be related to the activity level facet in the extraversion dimension:

“customer who knows what he wants, keep expressing, keep demanding that this needs to be done and followed by B, C, D, and that could lead to scope creep, and we have to deal with those situations” - INT10 [Business analyst].

Reserved nature: Having a reserved customer usually negatively impacts the team when they are involved in RE activities. The software practitioners involved with customers with this personality facet need to put extra effort into gathering requirements, which will also be time-consuming. The reserved customers tend not to provide their opinions, leading to incomplete requirements and conflicts with the software team members. This can be mapped with the self-consciousness facet in the neuroticism dimension:

“users with high emotionally and reserved, usually, they only say about one aspect at one time, so lots of time has to be given” - INT03 [IT development & re-engineering lead].

“I think sometimes they didn’t at least raise their voice and ask questions or give their opinion. We didn’t know whether complete what they expected and there were lots of confusions” - INT06 [Technical team lead].

The interviewed practitioners who believe there was no impact of customers’ personality on RE explained the reasons for their opinions. This included that they need to do their job and should not get affected by the behaviours of external parties:

“they are external parties, and we cannot get affected by their behaviours” - INT05 [Software engineer & application consultant].

“it’s nothing major, you know, related to clients, no major complex, I think it is a minor thing, and our job is to give what they want” - INT06 [Technical team lead].

However, they consider their personality and team members’ personalities to be important and these do impact RE activities compared to their customers’ personalities.

4.4 Mitigation strategies to reduce the negative impacts

Some practitioners shared the strategies that they use to mitigate the negative impact of personality in RE activities. These mitigation strategies (MS) are used from the initial phase of the requirement engineering to the later phase of the projects and are mainly used within their teams. Not all of the strategies may be useful, or even applicable, in different contexts and for different teams, but sharing them here collectively will help practitioners understand what might work for them in their contexts. A summary of key mitigation strategies they reported are as follows:

MS 1: Changing the task allocations: The majority of the interviewed practitioners (10 out of 12) mentioned changing task allocations of the team members as their initial strategy to mitigate the negative impact of personality on RE activities. This can be done by resetting team responsibilities and assigning tasks that fit their personality. For example, INT04, a business analyst, mentioned that sometimes resetting the whole team’s responsibilities and bringing the team back to a different state is important to deal with the negative impacts of the personalities of the team. INT09, a lead human-centred designer, mentioned that assigning tasks that fit team members’ personalities would be beneficial in
gathering requirements without conflicts: "I think because a lot of my work tends to involve interviewing people to gather requirements, some of the more introverted team members are sometimes shy about talking to other people, especially since they’re not confident in dealing with senior stakeholders and gathering their requirements. And sometimes, they’re not confident in speaking to users. So in that degree, a more extrovert personality is good for those types of tasks" - INT09.

Creating a working environment to reduce conflicts by applying different approaches to deal with differently opinionated people internally and externally also helps to mitigate negative impacts. However, it was highlighted that changes to the task allocations should be done with proper consideration: "We ended up giving her a different role...she had done something similar in her previous role. So it was probably something where she felt a little bit more comfortable" - INT12 [Senior project manager].

MS 2: Conducting detailed discussions: Some of the participants (INT04, INT07, INT09, INT12 & INT15) mentioned that conducting in-depth, cordial conversations with team members help reduce the negative impacts of personality on RE activities. It helps identify the disconnections within the team, understand each team member’s problems and bring everyone on the same page, resulting in solving team conflicts and making them complete the tasks within the scope: "my initial strategy is, identifying that there was a disconnection between the team and trying to just sit everyone down around the table and go a team, moments where we don’t appear to be all going in the same direction, we will have conversations often, and lead the team to complete what is within the scope" - INT09 [Lead human-centred designer].

MS 3: Right utilisation of diverse personalities: Ten out of twelve participants also mentioned that the ‘right’ utilization of various personalities in the team as one of the strategies used by practitioners to reduce the negative impact of personality on RE activities. They highlighted the importance of having a variety of personalities in their team. If they do not, it can also have a negative impact: "if everyone within the team is an extrovert, you just end up with people talking over each other, and it is not good for the project either" - INT09 [Lead human-centred designer].

MS 4: Disseminate responsibilities: A few senior practitioners (INT01, INT12 & INT15) shared that disseminating responsibilities and making the team members accountable for allocated tasks is another strategy practitioners use to mitigate the negative impacts of personality on RE activities. By doing this, they try to give the team members a sense of accountability, so they tend to work together to complete the allocated tasks successfully. It improves team collaboration and, eventually, team performance as well: "When we have meetings where we agree on what to do, I take action items, hold people to account, give them the responsibility and then they will work together to do things correctly" - INT12 [Senior project manager].

MS 5: Increase collaborations: Some participants (INT01, INT07, INT09, INT12, & INT15) highlighted that increasing collaboration is another strategy that can be used to mitigate the negative consequences of personality on RE. Here, they tend to increase the collaboration among team members by inculcating mutual trust and assigning tasks together to find a solution: “try and instil a higher level of mutual trust and collaboration. That’s always my first strategy, and most of the time that works” - INT09 [Lead human-centred designer].

MS 6: Asking for management/higher-level support: Seeking management or higher-level support when necessary is another strategy practitioners use to mitigate the negative impact of personality on RE activities (INT01, INT02, INT04, INT08 & INT13). Especially in situations such as dealing with anxious/ insecure team members or dealing with tough customers, seeking management or higher-level support would reduce the negative impact on RE activities and the overall project. However, it was also highlighted that developers should be able to identify and ask for support at the correct time before it is too late to be resolved: "I made an inquiry to my project manager and also my immediate supervisor about this concern, because that particular resource was very anxious and heavily thinking, that made the customers kind of guilty and started not to reveal the requirements actually" - INTO1 [Lead BA].

MS 7: Removing certain personalities in rare cases: A few participants (INT01, INT09 & INT11) mentioned that treating according to the situation is one of their strategies used to mitigate the negative impacts of personality on RE activities. This can vary from handling issues smoothly within the team and taking the necessary breaks to remove a person from the team. However, the ability to identify the correct situation is a must, and practitioners should take action accordingly: "it had been a commercial situation, or would you just remove that person from the project, which is essentially what I did in that situation... But my strategy is always to try and solve it in the first instance, where I try to solve it with the team smoothly. If the situation is not under control, then I have to act accordingly, and it’s very rare that it happens” - INT09 [Lead human-centred designer].

5 DISCUSSION

In this section, we discuss the key findings of our study, related to personality test-based survey and in-depth interviews along with an overview of the impact of personality in RE activities based on the roles involved, such as software practitioners, their team members or customers/clients/end users.

5.1 Key findings

Firstly, by analyzing the 50 personality profiles and data from 15 interviews, we have identified that personality characteristics of the people involved in RE activities impacts the successful completion of RE activities. From the personality profiles, we have identified that the majority of software practitioners involved in RE activities are statistically significant (high-scored) in agreeableness and conscientiousness characteristics. This indicates that these practitioners have a strong interest in others’ needs and well-being, are pleasant, sympathetic, cooperative, reliable, hardworking, set clear goals, and pursue them with determination. Extraversion and neuroticism characteristics are found at an average level (average-scored), indicating that some enjoy time with others while others prefer to spend time alone. This also means that stressful and frustrating
situations are somewhat upsetting to them. However, they can generally get over them and cope with the situations. An equal percentage of practitioners are found in either high or average levels related to openness to experience characteristics indicating that 50% of them enjoy novelty, variety, and change as they are curious, imaginative, and creative, and the other 50% of the practitioners’ thinking is neither simple nor complex. They prefer tradition but are also willing to try new things.

Secondly, by analyzing our in-depth interviews, we have identified various personality characteristics related to software practitioners’ personalities, their team members’ personalities and customers’ personalities. The majority of these characteristics can be mapped onto the five personality dimensions and related facets in the five-factor model (IPIP NEO-120). With that, we also identified how these personality characteristics are reported to impact RE activities and the overall software development process. As shown in figure 6, we have summarized the key impacts of personality related to software practitioners’, their team members and customers’ personality characteristics. These impacts can be positive or negative and are categorized into three areas; namely impacts related to requirements engineering (RE-related), impacts related to the overall software development process (overall SE-related) and impacts related to people involved in RE/SE (human-related).

Although extraversion characteristics – such as friendliness, outgoing and active nature – are important in building a good relationship with customers, it is not the most important characteristic for RE activities (section 4.3). It was only considered as one such plus point, and other characteristics such as cooperativeness, open mindedness, and hardworking nature are considered far more important (section 4.3). “extraversion is not necessary; it’s a plus trait; if you have it, it’s good. But, if you don’t, then it’s perfectly fine; you still can do good in requirements gathering” - INT04 [Business analyst]. Similarly, it was identified that the majority of neuroticism characteristics such as anxiousness, insecure feeling, and anger negatively impact software practitioners and external stakeholders when involved in RE activities as well as the overall software development process. However, it was also mentioned that the right utilization of neuroticism characteristics of software practitioners can be beneficial as they tend to be deep thinkers who might help the design phase.

Apart from personality, we also identified several other factors that affect the identified positive or negative impacts. The majority of our practitioners (11) mentioned individual’s culture as an important factor as they consider culture having a strong connection with individuals’ personalities. The work experience of the practitioners, their project domain and empathy have been mentioned as other factors that impact when involved in RE activities. Here, the work experience and project domain are interrelated as it was mentioned that more experience increases the exposure to areas/domains where individuals can handle various impacts of their previous experiences. Empathy was usually referred to when dealing with external people such as customers/clients/ end-users when involved in RE activities. It was highlighted that empathizing with them makes the involvement in RE activities easier: “even to create the empathy because that has a huge factor I have seen, even
myself in this learning curve, I practice being empathized with our clients, because they are dealing with other things, especially in the health sector and I think getting requirements are much more easier then “ INT13 [Lead BA]. Our study also identified several mitigation strategies that can be used to reduce the negative impact of personality on RE/SE activities. Seven mitigation strategies were identified that could be applied to software teams, and the use of these strategies can vary with the project phase (section 4.4). For example, MS 4: disseminating responsibilities, can be used in the initial phases of the project to make the team members accountable for each task and reduce incomplete tasks at the end.

5.2 Recommendations

Based on the findings from our study, we have identified several key challenges in the area of personality impacting RE, which need more focus. We have framed these as a set of recommendations, shared below, for software practitioners involved in RE activities and the wider SE research community for further research into the personality impact of RE/SE.

1. Need for a balanced mix of personalities within software teams: According to our study findings, there is no 100% positive or negative impact of personality characteristics on RE activities. The majority of participants mentioned that having balanced personality characteristics in the team will help deliver the best output. Having the right mix of personalities in a team would make the whole software development process successful, including RE activities. Hence, it is important to pay more attention to having a diversity of personalities within the teams by software practitioners and team leads/ project managers, while the SE/RE researchers can conduct more research on identifying the best personality combinations for software development teams while identifying approaches to mitigate the negative impacts.

2. Focusing on impact of personality along with culture: We identified that along with personality characteristics, most software practitioners mentioned that it is important to consider the culture of the people involved in RE activities as it impacts individual personality. For example, it was mentioned that the culture of a particular country has a major impact on people’s personalities. Some prefer to work with guidelines, and others prefer to work without rules and guidelines. These characteristics depend on their culture. Hence, it is important to further investigate the relationship between personality and culture through multinational research. It would be interesting to study individuals from various cultures/ mixed cultures and analyze their implications in a global context.

3. Apply and further investigate mitigation strategies: We also identified a set of mitigation strategies (MS) used by software practitioners to reduce the negative impact of personality when involved in RE activities. We have identified seven mitigation strategies (section 4.4) that are used during RE related activities, and these strategies are mainly for software team members. Hence, we recommend carrying out more research studies identifying and investigating mitigation strategies that can be used for other software development activities and various contexts, for the benefit of industry practitioners.

4. Focusing on the impact of personality on individual and team performance: According to our practitioners, one of the major impacts of personality is their individual and team performance. They have mentioned that different personalities impact their overall work performance, and the impact can be positive or negative related to personality characteristics. Hence, we suggest further investigating the impact of personality on individual and team performance, focusing on RE activities to identify the relationship between personality and performance when involved in RE activities.

5. Consideration of the impact of other factors when involved in RE activities: While investigating the personality impact on RE activities, we identified a few other factors that could positively or negatively impact RE activities along with personality. As mentioned in recommendation 2, culture is the most mentioned aspect. Apart from that, practitioners have mentioned other human aspects such as empathy, geographic distribution, gender, communication skills, and other factors such as project domain and work experience. A very limited number of practitioners pointed out the impact of these aspects (one or two practitioners), and some of the practitioners believe that there is no impact of gender and age on RE activities: “I’ve worked with people of different genders and ages, I don’t believe that has a big impact” -INT08 [Software engineer]. However, we recommend investigating these aspects in further empirical studies to get a more detailed understanding of the impact of these aspects on RE activities.

6. Performing empirical case studies in different software organizations: Since our findings are mainly based on our in-depth interview study, we suggest conducting more empirical case studies, revealing personality characteristics of individuals in various software teams in various software organizations globally to understand better how industry practitioners and organizations handle these impacts and come up with better approaches to improve the positive impacts and mitigate the negative impacts.

6 Limitations and Threats to Validity

Threats to external validity: Our data collection does not possess an equal distribution of participants worldwide and does not represent the entire community of software practitioners involved in RE activities. The majority of interview participants are from Sri Lanka, Australia and India. The details of all the participants and their organizations have been kept confidential as per the human ethics guidelines followed in this study. Hence, the findings of our study may be biased toward participants’ organizations and their country of residence and limit generalizing to the entire global SE community. However, in practice, such generalization is unlikely achievable [44].

Regarding participants’ job roles, there were 14 job roles/titles, and the interpretations of these roles can differ based on the organization. In the personality test-based survey, we used a set of key RE-related job responsibilities to rate the practitioners’ involvement (“Never” to “Always”) to see their involvement in RE activities. The majority of the participants were always or very often involved in given
key-related job responsibilities. Interview participants described them in detail, indicating that we collected data from our target participants. Since our main focus was to gather personality profiles using the survey, we included limited demographic questions with the standard personality test with all the instructions to complete the personality test.

In the interview study, we mainly focused on asking in-depth questions about participants’ involvement in RE activities and their perspectives and experience on the impact of personality when involved in RE activities. The participants have various experiences related to various domains where their involvement in RE may vary with the context. Hence, we suggest conducting more empirical case studies focusing on different software organizations to investigate its impact on RE activities along with personality (section 5.2 - recommendation 6).

**Threats to internal validity:** Following the STGT for qualitative data analysis, we have generated concepts and categories based on the codes. All these codes, concepts and categories were collaboratively discussed and finalized by all the authors to overcome any potential biases.

Using payment for data collection of the personality test-based survey can also be a threat to the internal validity of the research as there maybe fake responses when using participants recruitment platforms. However, we have decided to use the Prolific tool after careful consideration following [43] and to avoid collecting fake/incomplete responses, we only approved the payments for the participants after examining their responses to check whether they belong to our target participant group and if only they responded to each question (e.g. selected the ones with proper open-ended responses).

We have provided all the standard instructions for the personality test and explained the personality-related terminologies during interviews with the participants. However, participants’ understanding of personality can vary and based on that the experiences they share during the interview may differ. The impacts of personality that we have identified may depend on their understanding of personality and the mitigation strategies we have proposed to deal with the negative impacts of personality may depend on how they involve in such situations. These may also depend on particular contexts that they involve in or their organizations. Hence, by conducting more empirical case studies with software practitioners, more data can be collected related to organizations and contexts where software practitioners are involved in RE activities. This can eventually improve our findings.

## 7 Conclusion

The findings of our study contribute to identifying the impact of personality of software practitioners, their team members and their external stakeholders (customers/clients/end-users) on RE activities. By analyzing personality profiles, we have identified that the majority of participants are high-scored in conscientiousness and agreeable nature, and average in extraversion and neuroticism nature. The scores of the facets related to each personality dimension vary, and almost all the facets related to agreeableness and conscientiousness scored high among participants. In the extraversion dimension, only cheerfulness and assertiveness are considerably high-scored, and all the other facets are average among participants, whereas, in neuroticism, almost all the facets have an average score among participants. This shows that the majority of the practitioners are highly determined, hard-working, cooperative, sympathetic individuals who have a strong interest in others’ well-being. It also indicates that the majority of them are neither highly extravert nor introvert individuals and tends to be that they enjoy time with others, but also time alone. An equal percentage of high and average-scored participants were identified related to openness to experience nature. Regarding the openness to experience facets, the ideas/ intellect, feelings, aesthetics and values/liberalism are high-scored facets compared to imagination and adventurousness facets indicating that there is a balanced mix of high and average personality characteristics related to openness to experience dimension among the practitioners.

Through in-depth interviews, we have identified various personality impacts on RE activities due to software practitioners’ individual personalities, their team members or customers/clients/end-users personalities. These impacts are mainly found as positive and negative impacts and categorized as the impact on the RE activities (RE-related), impact on the overall software development (overall SE-related) or impact related to people involved in RE/SE (human-related). From these impacts, it shows that the majority of personality characteristics such as conscientiousness, agreeableness, openness to experience and extraversion positively impact on these three aspects and neuroticism characteristics negatively impact on these aspects. We have also identified a set of mitigation strategies that can be applied to reduce the negative impact of personality when involved in RE activities and the importance of focusing on other factors such as culture, work experience, project domain and empathy along with personality. The findings of this study will be beneficial for understanding the impact of personality on RE activities. Whether agile or traditional, it is important to have a balanced/diverse software team to complete RE/SE-related activities successfully. However, it would be interesting to observe various software teams in the industry to see how they handle these situations in real world scenarios to make the project success.

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