The Influence of Human Aspects on Requirements Engineering: Software Practitioners’ Perspective

DULAJI HIDELLAARACHCHI, Faculty of Information Technology, Monash University, Australia
JOHN GRUNDY, Faculty of Information Technology, Monash University, Australia
RASHINA HODA, Faculty of Information Technology, Monash University, Australia
INGO MUELLER, Faculty of Information Technology, Monash University, Australia

Requirements Engineering (RE) is a process that requires high collaboration between various roles in software engineering (SE), such as requirements engineers, stakeholders, developers, etc. Their demographics, views, understanding of technologies, working styles, communication and collaboration capabilities make RE highly human dependent. Identifying how such “human aspects” – such as motivation, domain knowledge, communication skills, personality, emotions, culture, etc – might impact RE would help us to improve the RE activities and SE in general. The aim of this study is to understand current industry perspectives on the influence of human aspects on RE. We surveyed 111 software practitioners involved in RE activities, and our findings show that 86.4% of participants agree, that the success of RE greatly depends on the people involved in it. Software practitioners consider motivation, domain knowledge, attitude, communication skills and personality as highly important human aspects when involved in RE. A set of factors, we categorize as human/social and technical, were identified as software practitioners’ motivation factors when involved in RE activities, where the majority of are motivated due to human/social factors. Furthermore, our findings suggest that software practitioners’ personality characteristics should also be paid more attention to as they are important when conducting RE effectively.

CCS Concepts: • Software and its engineering → Requirements engineering.

Additional Key Words and Phrases: Human aspects, Requirements engineering, Software engineering

ACM Reference Format:
Dulaji Hidelllaarachchi, John Grundy, Rashina Hoda, and Ingo Mueller. 2021. The Influence of Human Aspects on Requirements Engineering: Software Practitioners’ Perspective. ACM Trans. Softw. Eng. Methodol. 1, 1 (August 2021), 27 pages. https://doi.org/10.1145/1122445.1122456

1 INTRODUCTION

Requirements Engineering (RE) tasks play a fundamental role in software development, and it is recognized as a critical part of software engineering (SE) to ensure fit-for-purpose and quality software products [40]. RE-related activities include eliciting, analysing, documenting, validating and maintaining software requirements [39] [45]. According to Sommerville [46]: "RE is the process of establishing services that the customer requires from a system and the constraints under which it..."
In practice, RE is nowadays considered to be an iterative process in which the activities are interleaved with other SE tasks [46]. Like every other team activity, software engineering depends on individual performances and harmony among team members. According to Wick, there needs to be an effective collaboration of individuals with appropriate technical skills and complementary soft skills [50]. In general, software developers and requirements engineers need to work effectively together within the team and with external stakeholders who are often very different in terms of their human aspects to software developers.

**Human aspects** in software engineering are considered as human-related aspects that can become make-or-break issues in software projects [25]. Researchers have investigated human aspects such as personality [8][10], emotions [12], motivation [48][20], gender [42], culture [44], communication issues [15][6], human errors [5], attitude [18], team climate [47] and others in various SE contexts and identified their impact on SE for better or worse. From the systematic literature review (SLR) we recently conducted [25], we identified that human aspects, and their impact on RE-related activities are still an area with relatively limited attention. The majority of the studies are academic-based, shows the need for more industry-focused studies. While motivation and personality have been studied in SE [13], [19][20], these are two human aspects that are not investigated well in RE. Hence, we are focusing on those two aspects in our further studies. But before that, we wanted to understand the industry perspective on the influence of various human aspects on RE-related activities to know whether our findings in the systematic analysis and our current research focus are in line with real-world experiences of software practitioners. Hence, we conducted a survey study with the aim of understanding the industry perspective on the impact of human aspects on RE based on their experiences during their RE-related work. The main contributions of this research are as follows:

- Obtaining a comprehensive understanding of how various human aspects of the individuals involved in the RE-related activities impact RE-related work from 111 software practitioners involved in RE-related tasks;
- Identifying a set of key factors that motivate individuals to perform RE-related tasks effectively and achieve good outcomes;
- Identifying a set of key factors that make software practitioners less effective when involved in RE-related tasks and achieving poor outcomes;
- Identifying individual characteristics that are important to have among software team members to conduct RE-related activities effectively; and
- A set of recommendations on the importance of various human aspects and their impact on RE which will be beneficial for both academia and industry practitioners where they can pay more attention to incorporate them and do more detailed investigations.

The rest of this paper is organized as follows. Section 2 introduces the research questions of this research, and section 3 details the research methodology we used, including our survey design, procedures and how data was analysed. Findings are presented in section 4, and section 5 provides the discussion and key threats to the validity of the research. Finally, section 6 discusses key recommendations, section 7 presents key related work in the research area, and Section 8 concludes this paper.

## 2 RESEARCH QUESTIONS

The main objectives of this research are to investigate the industry perspective of the impact of various human aspects on RE-related activities, identifying what factors motivate them to perform effectively, what factors make their performance less effective and what individual human characteristics are important in conducting effective RE. To achieve the objectives mentioned above, we
have developed the following research questions for this study.

**RQ1. What human aspects may influence an individuals’ performance when involved in RE-related tasks?** A set of human aspects was identified from the literature as impacting on RE activities via our SLR [25]. Hence, this research question focuses on understanding the industry perspectives of these aspects empirically and more comprehensively through software practitioners involved in RE activities.

**RQ2. What are the factors that motivate individuals to perform RE-related activities effectively?** From our SLR, we identified that “motivation” as one of the human aspects that has been less investigated in RE. Hence, this research question focuses on identifying software practitioners’ perspectives on motivation, what factors affect their motivation, and its’ impact when involved in RE-related activities.

**RQ3. What are the individual human characteristics that are important when conducting RE-related activities effectively?** This research question focuses on identifying individual human characteristics that respondents think are important to help conduct RE-related activities more effectively, by considering both an individual’s characteristics and the characteristics they expect to see in their team members.

### 3 RESEARCH METHODOLOGY

To achieve the aim of the research, We employed survey research with a mixed-method approach, as we wanted to reach out to a broader population of software practitioners to know their perspectives on the influence of human aspects on RE[52] [31]. The following subsections detail our survey design, including the steps we followed.

#### 3.1 Population and sample selection

The target population of our survey is software practitioners involved in RE-related activities, and therefore, we used a non-probabilistic purposive sample in the study. Two rounds of data collection were carried out, and in the first round, the survey was advertised in social media groups (LinkedIn, Twitter and Facebook) focusing on software practitioners involved in RE, where 61 practitioners completed the survey with usable results. Similar to the study [27], for our second round of data collection, the survey was advertised through the Amazon Mechanical Turk (AMT), where a total of 50 software practitioners completed the survey with usable results. The Amazon Mechanical Turk platform has built-in options to filter participants for participant selection and customize a monetary incentive for each participant. Particularly, we applied the participant filter options of “Employment Industry - Software & IT Services” and “Job Function - Information Technology” to ensure that we reached our desired target population. Participation in the first round of the survey was voluntary and without remuneration. The participants who completed the survey via AMT were given a reward of 6.40 AUD after completing the survey.

In total 111 software practitioners participated in the survey. The majority were male (63.1%), with ages ranging between 26 to 35 years (56.8%). The most common roles are software engineer (28.8%) and business analyst (18.0%), and the most commonly repeated education level is a university degree in software engineering or computer science (58.5%). Table 1 summarises these statistics. Most of the participants have 1 to 5 years of work experience in the software industry (54% of participants). The majority (45.9%) use agile software development methods, such as scrum, kanban,
XP, crystal, and combinations such as scrumban. 37.8% of the survey population follows traditional (waterfall) software development methods, and 15.3% follow both agile and traditional methods.

3.2 Survey Design
The survey was designed to elicit participants’ perspectives on the impact of various human aspects when involved in RE-related activities. To elicit these responses, the survey was designed with both closed and open-ended questions where most of the closed-ended questions used a Likert scale with five possible responses from "Not at all important" to "Extremely Important". The survey consists of 22 questions, split into 4 main sections as follows.

3.2.1 Personal Information. : The personal information section collected demographic information about the participants, including their gender, age ranges, country of residence and educational qualifications. The survey was anonymous and did not record any personally identifying details. Only the individuals interested in participating in the next phase of the research provided their contact details (name and email address) which were kept separately prior to the data analysis.

3.2.2 Employment Information. : The questions in this section were targeted to elicit participants’ details on their current employment, including their job role/title, main job responsibilities and the amount of experience they have. Moreover, we asked about the type of software development methods that they are mostly involved in, where they can select from given options (traditional, agile or both) and mention the exact methodologies they follow.

3.2.3 Performance in Requirements Engineering. : The third section consists of questions that are focused on their broad view on the factors they consider as important in measuring the performance of the individuals involved in RE-related activities, their opinion on the influence of human aspects on their performance, and what human aspects should be taken into consideration to measure the performance of individuals involved in RE-related activities. This section also focused on identifying factors that motivate them to perform RE-related activities effectively and factors that might make them less effective when performing RE-related activities.

3.2.4 Characteristics of the people involved in RE-related tasks. : The final section of the survey focused on eliciting participants’ experiences on how individual characteristics of the people involved are important when conducting RE-related activities. Here, we wanted to identify their experiences considering their individual human characteristics as well as their team members’ human characteristics. Hence, we used the same characteristics in separate questions. The characteristics listed were based on the well-known "Five Factor Model" of personality, which is one of the most popular models to describe individual characteristics (personality), grouping them into five broad dimensions, Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness to Experience [21] [29]. As our next stage of the research is planned to focus on personality influences on RE-related activities, at the end of the survey, we asked their willingness to participate in the next stage, and if they are interested in participating, we asked to provide their contact details, which are kept separately from their survey answers.

3.3 Data Collection
The planning for running this survey was performed between October 2020 and December 2020. During this phase, we defined the survey goals, variables and designed the questionnaire as mentioned in section 3.2. We also performed a pilot study on a selected sample of software practitioners from our networks to verify the clarity and understandability of the questions, the time reported to

https://monash.az1.qualtrics.com/jfe/form/SV_6SGsvkdA9RXDA1f
complete the survey and to get their suggestions on any opportunities for improvements of the survey. The survey was sent to 3 software engineers who are currently involved in RE-related activities and 3 academics who have prior experience in the software industry performing RE-related activities. All of them provided feedback on the survey questions, and based on that, we modified the questions. More definitions were added to some questions, and rewording of several questions were made to make the questions more clear.

After obtaining the required ethics approval for this survey (Reference Number: 26219), our first round of data collection was performed between December 2020 and February 2021. The survey was conducted online via Qualtrics and advertised the link in social media groups (LinkedIn, Twitter, Facebook). After this first round, we wanted to try and cover gaps in location, role, gender, age and experience from the voluntary first round participant pool. To try and do this, for our second round of data collection, we advertised our survey via Amazon Mechanical Turk (AMT) between March 2021 to April 2021 and collected data from a further 50 software practitioners (Section 3.1). As the survey was distributed worldwide, we received responses from many countries, as shown in Table 1. Due to our professional networks, the majority (42%) came from Sri Lanka, and a significant number of others were from the USA, Brazil, Italy, etc.

### 3.4 Data Analysis

Our survey elicited both qualitative and quantitative data. Microsoft Excel was used to analyse the quantitative data and to organise qualitative data for the analysis. For the qualitative data analysis, we used Socio-Technical Grounded Theory (STGT) for Data Analysis, where we followed open coding to generate concepts and categories with constant comparison of various open text answers [26]. For example, for the question "In your opinion, what are the factors that motivate you to perform effectively in requirements engineering activities? Please explain briefly why", we received analysable open text answers from 102 participants. As shown in figure 1, open coding was applied in open-text answers and codes such as collaboration among stakeholders, frequent customer visits, engage with stakeholders were combined to create the concept "customer/client/stakeholder engagement", Table 1. Participants’ Demographics

| Education Information of the Participants |
|------------------------------------------|
| University degree in Software engineering/ Computer science | 58.5% |
| University degree in other IT field | 21.6% |
| Associate degree/ diploma in Software engineering/ Computer science | 5.4% |
| Associate degree/ diploma in other IT fields | 1.8% |
| Other university degree/ associate degree/ diploma | 12.6% |

| Job roles of the Participants |
|------------------------------|
| Software Engineer | 28.8% |
| Business Analysts | 18.0% |
| Senior Software Engineer | 9.0% |
| IT project Manager | 5.4% |
| Senior Business Analysts, IT Consultant, Senior Quality Engineer | 4.5% each |
| Software QA Engineer, IT System Administration & Development | 3.6% each |
| Senior Consultant, Product owner, Software Architect, IT Specialist, Tech Lead | 2.7% each |
| IT Director, Computer Scientist | 1.8% |
| IT intern | 0.9% |

| Countries of the Participants |
|------------------------------|
| Sri Lanka | 42% |
| USA | 18% |
| Brazil | 9% |
| Italy | 8% |
| Canada | 3.6% |
| Sweden | 2.7% |
| Australia, Indonesia, UK, France | 1.8% each |
| Saudi Arabia, Suriname, Singapore, Austria, Thailand, Kenya, Germany, Spain, Albania, Ecuador | 0.9% each |
4 FINDINGS

In this section, we present the key findings from our survey analysis related to each research question. Survey questions can be found in Appendix A.

4.1 What human aspects influence the performance of the individuals involved in requirements engineering-related activities (RQ1)

In the systematic literature review we recently conducted [25], we identified a set of human aspects that researchers have focused on to identify their potential impact on RE-related activities, where the majority of the prior studies were based on academia. By conducting this survey, we wanted to identify the industry perspective on which of these human aspects software practitioners in the industry consider highly important when involved in RE-related activities.

As shown in figure 2, considering its' influence in RE, participants agree that some human aspects are extremely/very important when involved in RE-related activities. From the given list of human aspects in our survey, motivation (90.9%) and domain knowledge (90.7%) were mentioned as highly important aspects by a large number of our survey participants. Attitude (88.3%), communication skills (82.9%), and personality (56.8%) were other human aspects where a considerable amount of
participants mentioned as very/extremely important. From the 111 participants, 100 of them had experience in working with geographically distributed teams – among these, only 26% mentioned that geographic distribution of the individuals is an influencing aspect on performing RE-related activities. In the studies [24] and [34] that specifically focus on challenges in RE during global software development, they have mentioned that social and cultural aspects of RE need to be taken into consideration as there are a significant amount of risks and challenges specially in RE-related activities in global software development. Emotions (32.4%) and cultural diversity (18.9%) were also rated as moderately important human aspects, where the majority of the participants mentioned gender and age as what they felt were the least important human aspects when carrying out RE-related activities, with percentages of 6.3 and 11.7 respectively.

Apart from the given list of human aspects derived from [25], we wanted to know if there are any other human-related aspects that our survey participants consider as important referring to its’ influence on RE-related activities. N=33 participants mentioned several other human-related aspects that they consider as important when conducting RE-related activities. Four of them repeated the same aspects that we have already given in the list, such as domain knowledge, culture, listening (communication skill) and working time zone (geographic distribution), whereas the rest came up with other human-related aspects, including experience, flexibility/adaptability, mental state, collaboration/interaction, language, marital status/family, creativity, leadership skills, empathy, health, independent thinking, race & religion, ethnic background, out of the box thinking, designing thinking mindset, ability to context/task switch, directness, availability, sobriety, pessimism and ability to learn. The experience was mentioned by several (4 times), and flexibility/adaptability, collaboration/interaction, and language were mentioned 3 times by the participants. Marital status, creativity, leadership skills and design thinking mindset were mentioned twice, and the other aspects were mentioned by one participant. In their open text answers, several participants explained why their mentioned human-related aspects are important and how they influence their performance.

Fig. 2. Human aspects that influence the performance of individuals in RE-related activities

ACM Trans. Softw. Eng. Methodol., Vol. 1, No. 1, Article . Publication date: August 2021.
when involved in RE-related activities. For example; R54, a senior business analyst mentioned, "marital status and kids should have included in the list as I believe it is quite impactful especially with the current WFH situation". R73, an IT consultant explained the influence of having independent thinking as "independent thinking is, as in most software roles, a huge factor. The ability to think on their feet and do so effectively, without leaning on other members of the team is a key attribute". As shown in the above examples, many participants gave brief explanations, and some of them just indicated the human aspects without providing any reasons.

4.2 What are the factors that motivate individuals to perform requirements engineering-related activities more effectively (RQ2)

We wanted to investigate what factors motivate software practitioners to perform RE-related activities and which human aspects if any, motivate them to perform RE-related activities. We have analysed our participants’ responses, and the results we obtained are summarised below.

- **Participants’ involvement in RE-related activities**

The participants of the survey stated that they are involved in various RE-related activities, and their level of involvement varies for each activity. As shown in Figure 3, the majority of the participants are either always or very often involved in different RE-related activities. These activities include collaboration with stakeholders to elicit requirements, documenting software requirements specifications according to standard templates, lead requirements analysis and verification, participate in requirements prioritization and manage requirements throughout the project. From the participants’ answers, the majority are involved in requirements prioritization (72%), lead requirements analysis and verification (66.7%) and manage requirements throughout the project (64.8%). 57.7% are involved in documenting software requirements specifications, and 54% always or very often collaborate with stakeholders to elicit requirements. Only 3.6% of participants mentioned that they have never been involved in one of these RE-related activities.

- **Factors important in measuring the performance of people involved in RE-related activities**

When measuring the performance of the individuals involved in RE-related activities, various factors are considered. Based on the literature, we have given a list of the most common factors to rate them according to their importance [17] [9]. As shown in figure 4, the majority (87.1%) of
our survey participants agree that all these factors are extremely/very important in measuring the performance of the people involved in RE-related activities. Among them, the correctness of the requirements identified (97.3%), the clarity of the identified requirements (92.8%), and the completeness of the requirements identified (91.9%) were mentioned as the highest important factors when measuring individuals’ performance. The ability to respond to requirements changes (87.4%), ability to incorporate customer feedback (84.7%), ability to incorporate software team feedback (83.8%), and ability to interact with others involved in RE (72.1%) were also rated as important factors of measuring the performance in RE respectively. Apart from the given list of factors, we wanted to know if there are any other factors that the software practitioners consider as important when measuring the performance of the individuals involved in RE activities. Hence, we included a follow-up open-ended question asking, "Are there any other factor(s) apart from the above list that you use to measure individual performance in requirements engineering activities, please mention:“, where the majority mentioned "None". Only N=3 participants mentioned other factors such as, being able to validate requirements/designs, ability to understand true requirements from users, and the good knowledge of the business (system) as a whole.

Factors motivating individuals to perform RE-related activities effectively

From our data analysis, we have identified that various factors motivate software practitioners to perform RE-related activities effectively. Moreover, using open-ended responses, many explained why certain factors are important and how they impact their motivation to perform effectively. As discussed in section 4.1, we identified the importance of human aspects during RE, and among them, motivation is rated as the highest influential human aspect when performing RE. With the analysis of open-text answers to the question “In your opinion, what are the factors that motivate you to perform effectively in requirements engineering activities? Please explain briefly why?” we identified a set of factors that influence individuals’ motivation. We categorized these motivation factors as human/social factors and technical factors. The factors directly related to the people involved in RE-related activities are categorized as "human/social factors", and the factors related to technical outcomes of the RE-related activities are categorized as "technical factors". As shown in figure 5, the left-hand side (LHS) of the diagram presents the human aspects influencing RE as rated by the participants. The right-hand side (RHS) shows the factors that affect motivation when involved in RE-related activities. Although domain knowledge, attitude, emotions and communication skills were reported as human aspects, our analysing of open-text answers also identified these as motivation-affecting factors. Hence, they appear on both sides of the diagram. Moreover, according to the participants, the majority of the factors positively affect their motivation and some factors have the ability to both positively and negatively affect their motivation when involved in RE-related activities, as indicated in figure 5.

As shown in Table 2, the majority of our survey participants mentioned Team collaboration as their key motivation factor to perform RE-related activities more effectively. They also mentioned that better engagement within the team, proper response/support from the team, a friendly team environment, interaction with the team members and having diverse, empowered teams all help to motivate them to perform RE tasks more effectively. Moreover, many have explained why it is important to have good team collaborations. For example, R28, a business analysts mentioned, "When I get to collaboratively work with all required team members (Example: Doing a design sprint can easily solve a problem)", explaining the importance of team collaboration in solving a problem. Apart from easy problem solving, participants have mentioned several other reasons such as, the ability to conduct RE tasks better, and on-time product delivery in line with customer expectations for considering team collaboration as an important motivation factor. Personal satisfaction is another key motivation factor. Our participants mentioned that self-satisfied work, doing something
Fig. 5. Human aspects influencing RE; identified through quantitative analysis (LHS), and in depth breakdown of motivation factors; identified through qualitative analysis (RHS)

useful, positive appreciation, recognition from the organization, salary & incentives, promotions and understanding their importance/worth, make them more motivated to perform their RE tasks effectively. **Customer/client/Stakeholder engagement** was also considered as another key motivation factor. Respondents mentioned that good relationship & close contact with clients, their frequent visits, commitments and collaborations make them motivated and will benefit them getting correct, clear requirements more quickly. For example, R21, a senior business analyst explained how customer/stakeholder engagement motivates him/her as "Collaboration and positive culture among overall stakeholders.-This gives us the motivation to do a proper job and be happy and satisfied within the process. Furthermore, participants consider having good **communication skills** also motivate them to perform RE-related activities more effectively. Reasons stated include that they believe clear, friendly and direct communication with their team, clients or organization can help solve problems more easily and increase their work efficiency.

**Individual’s interest** towards the project, including its domain, requirements, novel features, interest in working with the team, and interest in what they do, make software practitioners more motivated. As a result, this will increase the quality of their RE-related task performance. Apart from these, **customer satisfaction**, the **experience of individuals**, **job satisfaction**, the **attitude** of the team, client or top management, and receiving **feedback** from the clients or the team were other commonly mentioned motivation factors by our survey participants. For example, R68, a senior specialist mentioned "successfully implementing correctly prioritized requirements in a release results in happy stakeholders and a better functioning organization overall" as his/her main motivation while involved in RE activities. Considering the technical factors, **domain knowledge** was considered as a key motivation factor by the majority of respondents. They mentioned that having the required knowledge for the project, competency in project subject motivates them to think about requirements differently, and gives them time to pay more attention to the details of the project. **Clarity of the requirements** is another motivation factor where this was explained
### Table 2. Impact of the motivation factors on RE-related tasks

| Category                        | Motivation Factor                          | Impact on RE/SE                                                                 | Responses |
|---------------------------------|--------------------------------------------|--------------------------------------------------------------------------------|-----------|
| **Human/social Factors**        |                                            |                                                                                |           |
|                                | Team collaboration                          | Friendly collaboration will make the process fun and effective                 |           |
|                                |                                            | Proper support & opinion of the team will easily solve the problems by making decisions and solutions together Cooperation among team will increase the ability to work well by helping each other, result in final product in lined with customer expectations | 25        |
|                                |                                            | Working with the team will be helpful in doing RE clearly, making the product delivery on-time |           |
|                                |                                            | Working with like-minded individuals leads to less problems                   |           |
|                                |                                            | Helps to come up with better solutions with the collaboration of diverse people |           |
|                                | Personal satisfaction                      | Salary, incentives, promotions, recognition motivate individuals to achieve any goal | 15        |
|                                |                                            | Self-satisfaction of doing something useful will make practitioners finish their work correctly |           |
|                                |                                            | Positive appreciation may helpful in further development                      |           |
|                                | Customer/Client/Stakeholder engagement     | Good relationship with client, help in getting all the requirements clearly    | 11        |
|                                |                                            | Frequent visit of the clients increase the opportunities to involve with them  |           |
|                                |                                            | Understand them and advantage of gathering more requirements                  |           |
|                                | Communication skills                       | Good communication skills increase the clarity with the clients                | 10        |
|                                |                                            | Increase the ability to communicate directly which will make the work efficient |           |
|                                |                                            | Helps to work with clear mindset                                             |           |
|                                |                                            | Improve the ability to discuss the steps without any fear and obtain clear descriptions on what the system suppose to do which is essential for good performance |           |
|                                |                                            | Helpful in identifying the problems easily                                   |           |
|                                | Individual’s interest                      | Helps to achieve goals & increase the quality of the service                 | 10        |
|                                |                                            | Makes the practitioners create novel highly practical features               |           |
|                                | Customer satisfaction                      | 100% satisfied customers impact on the organization & its’ functions          | 7         |
|                                |                                            | Increase the practitioners’ desire on developing features wanted by the customers |           |
|                                | Experience of individuals                  | Having more experience increase the quality of service which will be impact on the final product | 6         |
|                                | Job satisfaction                           | Leads to happiness & satisfaction which motivates to do new activities        | 6         |
|                                |                                            | Complete the tasks successfully                                              |           |
|                                | Attitude                                  | Attitude of the team/client/top management motivate to work collaboratively  | 3         |
|                                | Receiving feedback                         | Customer/team feedback make people do something better                       | 3         |
|                                |                                            | Increase customer/team engagement                                            |           |
|                                | Positive work environment                  | Make the practitioners do their job properly                                 | 3         |
|                                |                                            | Increase the satisfaction with the process                                    |           |
|                                | Negotiation skills                         | Important to have between the team & clients or negotiate among different approaches to achieve specific goals | 2         |
|                                | Striving for perfection                    | Increase the perfection in all tasks                                          | 2         |
|                                |                                            | The job gets done with the best ability and there will be no flaws in the tasks |           |
|                                | Emotions                                  | Specially impact when deadlines are close and desperately want to finish tasks | 2         |
|                                | Discipline in work                         | Improve the ability to function without rely on others                       | 1         |
|                                |                                            | Make the fellow practitioners relief and focus on their own work            |           |
| **Technical Factors**          | Domain knowledge                           | Having required domain knowledge leads to think about requirements in a different way | 13        |
|                                |                                            | Make practitioners pay more attention to the details                         |           |
|                                |                                            | Get the clear idea on what need to be implemented                            |           |
|                                | Clarity of requirements                    | Helps to understand requirements and perform the analysis well                | 9         |
|                                |                                            | Massively reduce the pain, effort, disruption in the later phases of the software development cycle |           |
|                                | Comprehensive requirements engineering     | Impact on the improvements of the features Helps to reveal true requirements  |           |
|                                |                                            | Perform RE activities properly by considering all the requirements           | 8         |
|                                |                                            | Make the rest of the development cycle easier                               |           |
|                                |                                            | Helps to deliver the product on-time                                         |           |
|                                | Accessibility to the resources             | Perform RE activities effectively with the easy access to the information     | 6         |
|                                |                                            | Having good prototype tools increase the ability to create designs quickly    |           |
|                                |                                            | Make practitioners efforts work and work                                   |           |
|                                | Good outcomes                              | Good end results make the clients satisfied                                  | 4         |
|                                |                                            | Improve the determination to see things workout at the end                   |           |
|                                | Complexity of the requirements/scope       | Make it more interesting to the software practitioners                       | 2         |
|                                |                                            | Improve their sense of satisfaction                                         |           |
|                                | Deadlines                                  | Make practitioners sign-off from the tasks, which will generate revenue     | 2         |
|                                | Documentation skills                       | Make the work easier by writing quality requirements                         | 2         |
|                                |                                            | Helps to avoid issues with team members                                      |           |
|                                | Design methods                             | Improve the understandability of the requirements via more visual than descriptive | 1         |

As clear, well-thought-out requirements motivating them to perform effectively, resulting in better requirements analysis, improvement of the features, and massively reducing the pain, efforts or disruption later phases of the software development cycle. **Comprehensive requirements engineering** is considered as a motivation factor where participants mentioned that performing RE-related activities properly motivates them to consider all the requirements making the rest of the software development tasks easier, and helps to deliver the product on time. **Accessibility to the**
resources such as tools, information or new technology also helps to motivate many respondents to perform RE more effectively. For example, it was mentioned that having good prototyping tools leads them to create their candidate designs more quickly for feedback, resulting in more effective RE performance. Good outcomes, including smooth project executions and clearness of the solutions, act as a motivation factor as they lead to greater customer satisfaction. The Complexity of the requirements/project scope also motivates many surveyed practitioners as it results in increasing their interest and satisfaction in their projects’ RE-related tasks. Meeting deadlines of the projects motivates some practitioners as these will generate the revenues for the project, where some get motivated with writing quality requirements (documentation skills) and mentioned that it makes their work easier.

Apart from the above mentioned motivation factors, there are some additional motivation factors mentioned by a few participants. Positive culture, emotions, negotiation skills, strive for perfection, and discipline in work was mentioned by one or two participants that have been categorized under human/social factors. We had to remove some open-text answers due to less/no explanations, where participants have only mentioned one or two words such as “morale, management support, professional involvement, good leads and etc. Considering all the identified motivation factors, the majority of the participants (59.5%) are motivated by human/social factors whereas, 40.5% of participants get motivated by technical factors. The participants explained how these reasons would impact on performing RE-related tasks, and the success of the overall project. Table 2 shows a summary of the identified motivation factors and their impact on RE that will directly or indirectly affect the outcome of the overall project.

- Factors that make individuals less effective when involved in RE-related activities

We identified a set of factors that lead to individuals having less effective performance when involved in RE-related activities. We also categorized these factors into similar two groups; human/social and technical while identifying, that the majority are related to the human/social category. Our findings are shown in Table 3, and we discuss the most common responses for each category below.

Communication issue is the most reported factor (23 responses), where participants have mentioned that lack of effective communication or miscommunication in the team or with clients can be a great hindrance, making their performance less effective. For example, R110, a senior analyst mentioned, “There are some customers/users, that are not effective in communication and cannot describe their needs. This type of person requires more time and effort to capture the right information”. They explained that it would highly impact their requirements gathering work as they won’t be able to get clear requirements from the clients. The Nature of the clients/stakeholders/customers is another factor that makes the practitioners less effective. Our survey respondents mentioned that clients who are difficult to handle, inexperienced clients, uncommitted clients, confused stakeholders or negativity in customers could impact their effectiveness negatively. For example, R20, an associate tech lead, mentioned, "When the customer has no idea about what he/she really wants", make them less effective. Moreover, it was reported that when there is a lack of commitment from clients, it is hard to elicit their requirements. According to participants, the right handling of clients is very important for effective RE task performance as well as for the project. It was explained that having clients who constantly scrutinize the team is unhelpful, but it will be worse to keep them completely out of the project as the earlier their feedback is received, the less costly to incorporate it into the project.

Team behaviour was considered as another factor making performance less effective when there is no unity among the team, no cooperation or irresponsible people in the team. For example, R77, a software engineer has mentioned, "Sometimes, I feel unproductive if I have to work with
Table 3. Factors that make individuals less effective when involved in RE and its impact

| Category | Factor | Impact on RE/SE | Responses |
|----------|--------|-----------------|-----------|
| Human/social Factors | Communication issues | Lack of communication/miscommunication of the team/clients impacts on gathering correct requirements | 23 |
| | Management issues | Does not get clear requirements | |
| | | Have to spend more time and effort to capture right information | |
| | | Not giving recognition for hard work makes people demotivated | |
| | | Wrong assumptions of the management makes the projects complicated | |
| | | Lack of encouragement provided results in less interest towards the project | |
| | Nature of the clients/stakeholders/customers | Difficult to handle clients/ inexperienced clients make RE-related tasks slow and time consuming | 16 |
| | Team behaviour | Lack of commitment of the clients makes the requirements elicitation hard, result in negative outcomes | |
| | | No unity among team/ no cooperation result in inability to carry out RE properly | |
| | | Make the software practitioners not to work at all | 13 |
| | Heavy workload | Prevent from concentrating on work properly | |
| | | Increase less interest towards the tasks | 3 |
| | Interaction with demotivated people | Demotivated people do not give their best to the process | |
| | | Difficult to get their commitment | 3 |
| | Negative attitudes | Negative attitude of the people around prevent from working | |
| | | Increase the issues in the progress | 3 |
| | Over desire to satisfy customer | Doing more than required to solve the problem can put the actual requirements at a risk | |
| | | Create a lot more work | 3 |
| | Individuals' nature | Various personalities of the individuals may leads to difficulties in working | |
| | | Conservative nature may impact on taking risks, trying new things and making their ideas stand out | 3 |
| | Personal issues | Personal issues such as health, problems in family members make the distractions from the work | |
| | Distracting working environment | Distracting working environment | |
| | | Prevent on having proper concentration on work | 2 |
| | | Decrease the interest towards work | 2 |
| Technical Factors | Unclear requirements | When requirements are listed without specifying the actual need, it will be difficult for the practitioners to derive the requirements | 18 |
| | | Make the requirements gathering process hard and less effective | |
| | | May not contribute to any revenue generation | |
| | Less domain knowledge | Make RE-related tasks slow and impact on the features of the products | 14 |
| | | Can be a hindrance to the individuals career as well as fulfilling customer demands | |
| | | Increase the inability to explain the necessity and needs of the requirements | |
| | Lack of resources | Not having proper tools, required information or new technologies, for RE related tasks can be slow and less effective | |
| | | Tasks may remain unfinished | 9 |
| | Constant requirement changes | Time-to-time requirements changes by the clients make the process less effective | |
| | | Sudden and unreasonable requirements make the project harder to implement | 9 |
| | Issues in the design & the method | Unnecessary charts, poor user stories will make the process less effective | |
| | | Not following proper RE process may impact on the project outcome | 8 |
| | strict deadlines | May make the software practitioners' job tougher | |
| | Unimportant Requirements | Impact on the quality of the product | |
| | | When there is no revenue generation/ value of the feature is not seen, makes the individuals ineffective when involved in RE | 3 |

"people that don’t put as much effort into what they do like me". Moreover, participants reported that having the above team behaviours may impact negatively on the effectiveness of communication, productivity, and leads to negative RE task outcomes. Apart from these human/social factors, there are some technical factors that participants mentioned, as factors that make them less effective when involved in RE. Among them, **unclear requirements** and **less domain knowledge** are the highest reported factors. Participants have explained that when clients specify the requirements properly and list them without knowing actual needs, it will be difficult to derive requirements which make them less effective. Considering the domain knowledge, it was mentioned that when practitioners do not have sufficient knowledge of the domain, it will make RE-related tasks slow and impact on features of the product. **Lack of resources** and **constant requirement changes** are another two factors that negatively impact on participants RE task effectiveness. When there are not enough resources, such as people, proper tools, information or use of appropriate technologies, it may make RE-related tasks slow and less effective. Moreover, constant changes of the requirements...
such as late or major requirements changes by the clients, sudden, unreasonable changes of the requirements, or changes that come in the middle of major implementation work, will impact on the effectiveness of RE-related tasks and create problems with the project budget and outcomes.

4.3 What individual human characteristics are important to conduct Requirements Engineering-related activities more effectively (RQ3)

We identified that the majority of the participants think that success of RE-related activities depends on the people involved in the process, and their different characteristics affect RE-related activities in various ways. We asked our survey participants to rate their agreement with the statement, "The success of the requirements engineering process greatly depends on the people involved in the requirements engineering activities as their performance varies from one another", 45% of the participants strongly agreed, while 41.4% of them agreed with the statement. 11.7% rated it as somewhat agree while 0.9% was neutral about the statement. Only 0.9% mentioned that they somewhat disagree with the statement whereas no one has disagreed or strongly disagreed to it. For the statement, "Differences in characteristics, behaviours, personal habits, skills of the people involved in the requirements engineering activities affect the requirements engineering process", 31.5% of participants strongly agreed, whereas 36.9% agreed to it. 27% rated it as somewhat agree whereas 4.5% of participants were neutral about it. No one disagreed with the statement as there was 0% for somewhat disagree, disagree and strongly disagree. Our survey respondent software practitioners thus believe that the success of RE-related activities greatly depends on the people involved in the process and their characteristics considerably affect its success. This statement is related with one of the most commonly used definitions of personality [37] [14], and indirectly indicates that software practitioners agree that the personality of individuals involved in RE has an impact on the success of it. As we wanted to identify what are the key individual human characteristics that are important to the people who involved in RE-related activities, we used a set of individual characteristics from the well-known "Five Factor Model" of personality, representing five broad personality dimensions that describe a range of characteristics of individuals. We have considered ten characteristics and

![Fig. 6. Individual characteristics that are important to conduct RE activities effectively](image-url)
asked the participants to refer to themselves and rate the importance of the characteristics when conducting RE-related activities. As shown in figure 6, among the characteristics, **enthusiasm about what they do** is the one that is rated as of the highest importance, with 52.3% as extremely important and 33.3% as very important.

The second highest important characteristic is **display intellectual curiosity**, with a rating of 41.4% as extremely important and 42.3% as very important. **Strive for high achievements** is another important characteristic with percentages of 42.3 (extremely important) and 40.5 (very important). Next in line is **willing to try new things** as 50.5% of participants have mentioned it as extremely important whereas 30.6% of them mentioned it as very important. **Having kind, generous, trustworthy, helpful qualities** is also rated as extremely important by 37.8% and very important by 35.1%. **Enjoy interacting with people** is also an important characteristic when performing RE activities effectively, where 30.6% rated it as extremely important and 41.1% as very important. Characteristics such as **willing to compromise** and **prefer following a plan over spontaneous behaviour** tend to be moderately important, with the ratings of 25.2% and 23.4% as extremely important, respectively. According to the participants, characteristics such as **have a tendency towards negative emotions** and **get stressed out easily** are not that much important when performing RE activities. 33.3% of participants have rated get stressed out easily as not at all important while 18.9% rated having a tendency towards negative emotions as not at all important. All the other above mentioned characteristics were rated with very low percentages as not at all important. For example; only 0.9% rated strive for high achievements as not at all important whereas enthusiasm about what they do, willing to try new things, enjoy interacting with people were mentioned as not at all important by only 1.8%, which indicates that majority of the individual characteristics are highly important in performing RE-related activities effectively. We also wanted to identify what are the important human characteristics that software professionals expect to see from their team members when involved in requirements engineering-related activities. Hence, we used the same set of characteristics and asked them to rate each considering its importance to have in their team members. The results are quite similar to the importance of their individual human
characteristics described above. However, some software practitioners seem to believe that all the given characteristics are highly important to have in their team members compared to having only some themselves.

As shown in figure 7, 86.5% of the participants mentioned, that the **enthusiasm about what they do** is extremely or very important whereas 85.6% mentioned **strive for high achievements** is extremely or very important to have in their team members. **Display intellectual curiosity**, and **willing to try new things** were also rated as extremely or very important characteristics with percentages of 78.4 and 76.6 respectively. **Enjoy interacting with people** and **have kind, generous, trustworthy, helpful qualities** were then rated as extremely or very important characteristics with 75.7 and 74.8 percentages respectively. Participants consider **prefer following a plan over spontaneous behaviour** and **willing to compromise** are equally important characteristics as 60.4% of participants rated both as extremely or very important. Considering the last two characteristics, 31.5% mentioned the **get stressed out easily** is extremely or very important whereas, 30.6% of the participants mentioned **have a tendency towards negative emotions** is extremely or very important. This indicates that software practitioners consider the last two aspects important to have in their teams but not as important to have themselves. Apart from the above-mentioned characteristics, we found some additional characteristics that software practitioners consider as important to have in people involved in RE-related activities via their open-ended survey responses. The majority mentioned that the listed human characteristics are enough, but some suggested a few other characteristics such as **being confident**, **attentiveness**, **patience**, **good empathy**, **cultural sensitivity**, **tardiness**, **good listening skills** and **adaptability** as important characteristics to have within the people involved in RE-related activities.

5 DISCUSSION

As presented in the above section, the findings of the study help to understand software practitioners’ perception of the impact of human aspects on RE-related activities in software engineering. Table 4 summarises the key findings from our survey relevant to each section. From the SLR we conducted, we identified a need for industry-focused studies to know software practitioners’ perspectives on the influence of human aspects in RE-related activities. Hence, with this study, we have identified a set of human aspects that are important to consider when involved in RE, according to software practitioners (Table 4 - Key finding (KF) 3). As motivation and personality are studied in SE but not well investigated in RE [25], we are focusing on these two human aspects in our future studies. Revealing that our current research focus aligns with the perspectives of software practitioners in the industry, motivation and personality were identified as highly important human aspects when involved in RE-related activities. We have identified that software practitioners get motivated by various factors when they are involved in RE-related activities. Some of these, they claim, will impact on their effective performance. We categorized these factors into two types, named human/social factors and technical factors where most of the motivation factors reported by our survey respondents are human/social factors (Table 4 - KF6, KF7, KF8). For example; **team collaboration** was considered as the factor that motivates individuals the most. They said that better interactions within the team lead to better problem solving, and high-quality product delivery.

All these factors may impact effective RE as well as overall software development outcomes. While these factors motivate individuals to perform RE-related activities effectively, some factors were claimed by the survey respondents as factors that make individuals and teams less effective when performing RE-related activities. Some mentioned that these are the opposites of motivation factors where **lack of proper communication** is considered as the major factor that makes individuals less effective. Apart from that, we identified various factors that make the software practitioners less effective when involved in RE-related activities (Table 3). These were claimed to make RE-related
### Table 4. Key Findings (KF) of the study

| Key Findings | Section |
|--------------|---------|
| KF1 Software practitioners believe that human aspects influence the performance of individuals when involved in RE-related activities | 4.1 |
| KF2 The types of human aspects we provided the participants to select were literature based. Even though they were given the opportunity to provide any other options, majority was agree with the given human aspects | 4.1 |
| KF3 Motivation, Domain knowledge, Attitude, Communication skills and Personality were identified as highly important human aspects considering its influence on their performance while Emotions, Cultural diversity, Geographic distribution as moderately important aspects. Age and Gender were mentioned as least important aspects which indicates these two aspects make least influence on their performance | 4.1 |
| KF4 When measuring the performance of the individuals involved in RE-related activities, the correctness, completeness and clarity of requirements are considered to be highly important. | 4.2 |
| KF5 Majority of the factors that motivate individuals to perform RE effectively are human/social factors | 4.2 |
| KF6 Software practitioners get highly motivated by team collaboration, personal satisfaction, customer/stakeholder engagement, communication skills, individual’s interest when involved in RE-related activities. | 4.2 |
| KF7 Technical factors such as domain knowledge, clarity of requirements, comprehensive RE, accessibility to the resources, good outcomes, complexity of requirements, deadlines, documentation skills & design methods are also motivate software practitioners when involved in RE-related activities. | 4.2 |
| KF8 These motivation factors impact on performing RE-related activities effectively and increase the quality of final product or service provided | 4.2 |
| KF9 Apart from the opposites of the motivation factors, nature of the clients/stakeholders, team behaviour, constant requirements changes, heavy workload, management & personal issues make the software practitioners less effective | 4.2 |
| KF10 Majority of the software practitioners believe that RE-related tasks greatly depends on the people involved in the process and the differences in their characteristics, behaviours impact on RE-related tasks | 4.3 |
| KF11 Software practitioners think that their individual characteristics such as enthusiasm, intellectual curiosity, strive for high achievements, willingness to try new things, enjoying interacting with people, and having qualities like kindness, trustworthiness, and generosity are highly important to conduct RE activities effectively. | 4.3 |
| KF12 Majority of the software practitioners also think that characteristics such as having tendency towards negative emotions or get stressed out easily are not that much important to conduct RE activities effectively | 4.3 |
| KF13 Software practitioners also consider that the given characteristics are highly important to have in their team members. | 4.3 |

activities slower, less accurate and less productive. Various human aspects appear to have the ability to make an individuals’ performance effective or less effective when involved in RE-related activities. As we wanted to identify industry perspectives on personality, considering our future research focus, based on our SLR [25], a set of questions were focused on their individual and team personality, that explained as individual characteristics. According to our surveyed software practitioners, the individuals involved in RE should be highly enthusiastic about what they do, display intellectual curiosity, strive for high achievements, be willing to try new things, enjoy interacting with people, and have kind, generous, trustworthy, helpful qualities. The practitioners consider that having these characteristics are highly important for themselves as well as for their teams. Among the list of characteristics, willingness to compromise and prefer following a plan over spontaneous behaviour was said to be moderately important, whereas having a tendency towards negative emotions and getting stressed out easily are considered the least important characteristics. However, when comparing themselves and their teams, software practitioners tend to consider
that having all these characteristics are important in their team-mates if not all themselves (Table 4 - KF11, KF12, KF13).

5.1 Threats to Validity

It is important to focus on the validity of the research, and we have identified potential threats to the validity of our study. Considering threats to external validity, though we shared the survey on social media and AMT aiming to obtain worldwide participation, we could not achieve it and found that the majority of the participants (42%) were from Sri Lanka (Table 1). Hence similar to the study [35], our findings may also be biased and limit generalizing to the entire global software engineering community. However, in practice, such generalization is unlikely achievable. Among threats to the internal validity, We identified that, although 207 participants started doing the survey and only 118 participants completed it fully. The target audience of the survey was software practitioners working in the industry. Due to that, we had to remove 7 participants who have completed the survey as they were students (undergraduates/postgraduates) or IT teachers or lecturers. As a result, we had to consider only the answers of the remaining 111 participants who completed the survey. Though the survey was designed with both closed and open-ended questions, some participants have not provided complete answers to the open-ended questions. We got some short responses that were not clear or usable in our analysis. For example, R44 (Business Analyst), mentioned "conflicts" as a factor that makes him/her less effective. But it was not clear whether he/she referred to conflicts with the team or clients, conflicts on what, which was another practical issue when analysing open-ended questions in surveys as we were unable to clarify it. All the answers to the questions including open-ended questions were analysed by the first author. The data and the analysis were shared among the research team (authors of this study) and discussed each phase of the analysis with the team to mitigate the bias.

6 RECOMMENDATIONS

Based on the findings of the survey, we have identified several key challenges in the area of human aspects on RE, which need to be focused more, and we framed these as a set of recommendations as below to the software practitioners involved in RE-related activities, and SE research community for further research in human aspects on RE.

1. Various human aspects of the individuals involved in RE should be paid more attention and incorporated when conducting RE-related activities: According to the responses of the software practitioners, they believe that various human aspects highly influence their performance when involved in RE-related activities. From the list of human aspects we provided based on our literature analysis; the majority are considered to be highly important by the software practitioners, thinking its influence on performing RE-related activities. (e.g. Motivation, domain knowledge, attitude, communication skills and personality). Some are considered moderately important (e.g emotions, cultural diversity, geographic distribution), whereas human aspects such as gender and age were considered to be the least important aspects. Hence, it is important that these human aspects should be paid more attention by software practitioners when involved in RE-related activities and SE/RE researchers to conduct more research on incorporating these aspects for the improvement of the RE tasks.

2. Correctness, completeness and clarity of requirements need to be considered more when measuring the performance of the individuals involved in RE-related activities: 87.1% of participants mentioned that all the given list of factors are extremely/very important in measuring the performance of the individuals involved in RE-related activities. Among them, the correctness of the requirements identified, the clarity of the requirements, and the completeness of the requirements identified were rated as the highest on measuring the individuals’ performance.
This implies that these factors should be paid more attention when involved in RE-related activities (4.2).

3. More detailed investigations are needed to identify the key motivation factors that impact the performance of individuals when involved in RE-related activities: We have identified a set of factors that motivate individuals when performing RE-related activities. According to the respondents, team collaboration, personal satisfaction, customer/stakeholder engagement, domain knowledge and clarity of requirements are some of the most important factors that motivate them to perform RE-related activities effectively (Table 2). However, further detailed investigations are needed to identify just what their impact is on individual and team RE task performance, as well as their impact on RE/SE outcomes in general. We have identified these factors via analysing our open-ended survey questions. Since some answers are limited with only providing motivation factors and some are not well explained, more studies with detailed investigations on motivation factors impact on RE would generate more findings. The survey reports respondents’ opinions, and studies are needed to see if these opinions are the same as actual impacts on RE-related activities and SE project outcomes. For example, age and gender were ranked the lowest by respondents in their opinion, but it might actually turn out these are highly influential after all.

4. Better understand the factors that make the performance of individuals less effective when involved in RE-related activities: We recommend considering human aspects and motivating factors that improve RE-related activities. We also recommend considering the key factors that make the individuals less effective when perform RE-related activities and mitigating them to improve the RE process. Our survey findings suggest that communication issues, management issues, nature of the clients, behaviour of the team, unclear requirements, constant requirements changes, less domain knowledge and lack of resources are all some major factors that make individuals less effective at RE-related tasks. As explained in Table 3, as these factors impact the overall SE process, more attention should be paid to mitigate them in order to reduce their consequences. As above, our survey reports respondents’ opinions about these, and thus further studies are also needed to see if these opinions are the same as actual negative impacts on RE-related activities and overall SE project outcomes.

5. Importance of focusing on people’s characteristics/behaviours/skills individually and as a team: Our software practitioners surveyed agreed that characteristics of the people involved in RE-related activities are important in order to conduct the process more effectively. Moreover, software practitioners considered that the majority of these characteristics listed in section 4.3 are highly important to have within themselves as well as within their team members. As these characteristics resemble individual personality traits, this suggests that the personality of the people involved in RE-related activities are important and there is potential for further studies that focus on the influence of personality traits on RE-related activities in SE.

7 RELATED WORK
We summarise previous research that relates to our research area of this survey. Section 7.1 describes studies related to human aspects in software engineering, and section 7.2 describes studies conducted related to human aspects in requirements engineering.

7.1 Human aspects in Software Engineering
Variety of human aspects have been shown to have an impact on different stages in the SE process. The majority of these studies have focused on the impacts in the software design and implementation stages. According to the systematic literature review (SLR) conducted by [41], in these development stages, designers and coders have been focused on in 94% of their identified papers. A number of systematic studies have been conducted targeting the identification of various human aspects of
software engineers, such as motivation, creativity, personality, behaviour, gender equity, human values, self-management barriers and self-compassion. Cruz et al. [1] in their systematic mapping study, reviewed research on personality in SE. They analysed many published empirical and theoretical studies related to the role of personality on different aspects of SE. Based on their findings, pair programming, education, software engineers’ personality characteristics, and team effectiveness related to personality were identified as the most focused on areas.

Xia et al. [53] conducted a large scale study with software professionals to identify the relationship between project manager personality and team personality composition and project success. For this, they have investigated 28 completed software projects which contain 346 software professionals. To conduct this study, DISC personality test has been used and correlated the outcomes of the test with project success scores measured in six different dimensions: schedule, effort, risk, issue, quality, and customer satisfaction. The results indicate that project manager personality and team personality affect the success of software projects and suggest to focus on relationships between personality and software engineering activities as their study only demonstrates the link between personality and overall project success. Another empirical investigation was carried out by Kanij et al. [30] investigating the personality traits of software testers. They collected personality profiles of 182 software practitioners using IPIP test. 45.1% of them were software testers and the majority of the rest were programmers. The results indicate that software testers are higher on conscientiousness factor than other software practitioners.

Mendes et al. [36] conducted a study investigating the relationship between decision-making style and personality within the context of software project development where they conducted a survey and collected data from 63 software engineers. They have 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. Vishnubhotla et al. [49] investigated the relationship between personality and team climate which only focused on software professionals in agile teams in a telecom company. They have considered FFM model for personality traits and the factors related to team climate (team vision, participative safety, support for innovation and task orientation) within the context of agile teams working in the telecom company. The findings indicated that there is a significant positive relationship between certain personality traits and team climate factors. The study also suggest to consider other human aspects in addition to personality traits to investigate their relationship between team climate.

In [4], a conceptual framework of programmer’s creativity has been proposed and it incorporates personality traits of the programmers into this framework, as programmers’ personality traits impact on their creativity intention. This framework is a theoretically established one based on three human aspects; personality traits, knowledge collection behaviour and creativity intention. After empirical analysis of the framework, the results are expected to support the theoretical base, which is considered human aspects positively impact on programmers’ creativity. Lenberg et al. [33] conducted an SLR focusing on various human behavioural aspects in SE with the objective of creating a common platform for future research in the area. They suggested a new research area as behavioural software engineering (BSE) and presented a definition of BSE as “the study of behavioural and social aspects of SE activities performed by individuals, groups or organizations”. The results of their research indicated that BSE is an emerging research area where the majority of researches are based on software engineers, teams or organizations in general. They found that specific phases or activities in SE have not yet been frequently considered. Moreover, they identified that there is an imbalance of studies that focused on human aspects, as most of the studies considered communication, personality and job satisfaction related to software engineers.
They suggest that researchers should explore more human aspects and consider their impact on different SE activities.

In [16], an empirical study was conducted to investigate on how software testers can be motivated. Semi-structured in-depth interviews were conducted with 36 practitioners in 12 software organizations in Norway. Set of motivational and demotivational factors influencing software testing personnel were identified and proposed that combining testing responsibilities with variety of tasks engagement increase the satisfaction of testers which eventually increase their motivation. Sach et al. [43] also focused on motivational factors in software development where 23 software practitioners were engaged for a workshop on motivation and collected data to investigate motivational factors that affect on their software development practices. Based on their results, they claim the people factor is the most commonly listed motivational factor for the software practitioners, compared to other factors such as financial, autonomy, learning and etc. In [23], a systematic review was conducted to identify theory use in studies investigating the motivations of software engineers. By analysing 92 studies related to motivation in SE, they found that many studies have focused on motivation of software engineers, but not explicitly underpinned by existing motivational theories. However, the findings of the reviewed primary studies showed a clear relationship with these theories.

Gender is another human aspect that is emerging in importance in SE research and practice. In [42], a case study was used to investigate gender equality in the SE context, a national software academy (NSA). This research tried to identify the experience of gender equality over three years in NSA and discussed measures to be implemented in future research to raise awareness and reduce the gender gap among all levels at the NSA. In the study [51], human values were measured related to SE where they investigated the influence of human values in the software production decision-making process. The researchers considered human values as a mental representation and investigated them based on three levels – system level, personal level and instantiation level. Three human values prototypes were identified for software practitioner, the intrinsically-driven socially-concerned practitioner, the autonomous nonconforming risk-taker and the fun-loving extrinsically-driven practitioner. The researchers claimed that this approach should be used more widely so that researchers don’t miss values in future research. A systematic mapping of human cognitive biases in software engineering was carried out[38]. This showed that software engineers are susceptible to a range of biased decision making at different phases of development. They highlight a lack of good mitigation techniques and limited theoretical foundations for interpreting biases in this area. They suggest some techniques to mitigate bias, but also highlight the need for further studies of biased human decision making in SE, including in RE.

### 7.2 Human aspects in Requirements Engineering

Much of SE is in many aspects a human-centred activity [28]. Requirements Engineering (RE) is arguably the most human-centred activity in SE, requiring people who involve in RE needing to work closely and effectively with diverse stakeholders, software development team members, and other requirements engineers[3, 22]. In terms of studies that focused on the effects of human aspects on RE-related tasks in particular, [3] focused on effective communication as a critical success factor during requirements elicitation. However, this study was limited to global software development (GSD) and identified that effective communication plays a significant role in requirements elicitation specifically for GSD teams. It was found that geographical distribution, time zone, cultural diversity and physical differences were reasons for miscommunication when conducting requirements elicitation in GSD. Another SLR conducted in the GSD domain focused on identifying critical challenges in successful implementation of RE-related tasks [54]. Their analysis indicates that lack of effective communication, lack of knowledge sharing and awareness, lack of
collaboration and organizational change are common critical challenges related to RE-related tasks in GSD. In their study [32], Khan and Akbar performed an SLR and an empirical investigation on motivation factors for the requirements change management process in GSD. They explored the motivators that contribute to requirements change management by extracting 25 motivators and finally developed taxonomies of identified motivators such as accountability, clear change management strategy, overseas site’s response, effective requirement change management leadership, etc. Aldave et al. [2] conducted an SLR to identify the influence of creativity on requirements elicitation within agile software development. They found that enhancing creativity in requirements elicitation can be implemented successfully in agile based software projects, specifically, user interface development projects. Moreover, they identified that creativity is an important aspect in SE which brings innovation to the project. Despite their findings, they say that more research is required to understand the influence of creativity in RE, as their study was limited to just the requirements elicitation phase in agile software development. In [7], it is focused on classifying effective personalities for web development in requirements elicitation. Their research revealed that there is a relationship between human personalities and RE in web development and need more research that consider more human aspects and their impact on RE-related tasks.

Most of these systematic and empirical studies have focused on various human aspects related to SE in general, or predominantly design, development, agile teams and GSD contexts. The studies that focused on RE have mainly been limited to GSD, web development domain or a particular phase in the RE process; usually requirements elicitation. Cheng and Atlee [11] discussed current and future research directions in RE. They claim that identifying human behaviour in RE is an open and very challenging problem and it has become a key emerging area for RE researchers. As longer-term actions that would help the RE community of research, they state that RE researchers should think beyond current RE and SE knowledge and collaborate with other disciplines to improve RE-related tasks, including identification of better methods to model human behaviours in RE.

8 CONCLUSION

This investigation contributes to understanding the industry perspective on the influence of human related aspects in RE-related tasks. The study results show that software practitioners greatly agree with the majority of human aspects provided based on the literature, and among them motivation, domain knowledge, attitude, communication skills, and personality were considered as highly important aspects. Emotions, cultural diversity, geographical distribution were considered as moderately important, whereas gender and age were mentioned as the least important aspects. Moreover, it is identified that when measuring the performance of individuals involved in the RE-related activities, the correctness of the requirements identified, clarity of the requirements, and completeness of the requirements were given the highest importance by the software practitioners.

This study also focuses on identifying factors that motivate individuals to perform RE-related activities effectively, and their impact on the RE/SE process. Hence, we have identified a set of motivation factors by analysing open-ended questions, and categorized into two major groups; human/social factors and technical factors. Among them, the majority were human/social factors, and the impacts were mentioned related to either RE or SE in general. Among human/social factors, team collaboration, personal satisfaction, customer/stakeholder engagement, communication skills, individual’s interest, customer satisfaction, experience of individuals, job satisfaction were some of the commonly identified motivation factors, whereas some were specifically mentioned by one or two participants. Considering technical factors, commonly identified motivation factors were domain knowledge, clarity of requirements, comprehensive RE, accessibility to the resources, and good outcomes, whereas the complexity of the requirements, deadlines, documentation skills, and design methods were mentioned by one or two participants.
The results of the study also show that there are factors that can make the individuals less effective when involved in RE-related activities and some of them are just opposites of motivation factors such as communication issues, unclear requirements, less domain knowledge and lack of resources. Other factors that make the individuals less effective include management issues, nature of the clients/stakeholders, team behaviour, constant requirements changes and issues in the design and the method, which were commonly mentioned by the participants. We found that individual characteristics, which represent their personality is also important in conducting RE-related activities effectively, and software practitioners consider it is important to have these characteristics (section 5.3) within themselves as well as within their team members. The findings of this study will be beneficial for understanding the industry perspective of the influence of various human aspects on RE-related tasks. The research community can get the idea of what software practitioners think and conduct studies that will benefit the industry. Meanwhile, software practitioners can be taken due consideration of these findings, when forming & managing teams, and conduction RE-related activities.

ACKNOWLEDGMENT

This work is supported by Monash Faculty of IT PhD scholarships. Grundy is supported by ARC Laureate Fellowship FL190100035 and this work is also partially supported by ARC Discovery Project DP200100020.

REFERENCES

[1] 2015. Forty years of research on personality in software engineering. Vol. 46. Elsevier Science Publishers B. V. 94–113 pages. https://doi.org/10.1016/j.chb.2014.12.008
[2] Ainhoa Aldave, Juan M. Vara, David Granada, and Esperanza Marcos. 2019. Leveraging creativity in requirements elicitation within agile software development: A systematic literature review. Journal of Systems and Software 157 (2019), 110396. https://doi.org/10.1016/j.syssoftcir.2019.110396
[3] Zahid Ali, Muhammad Yaseen, and Salman Ahmed. 2019. Effective communication as critical success factor during requirement elicitation in global software development. vol 8 (2019), 108–115.
[4] A. Amin, M. Rehman, S. Basri, and M. F. Hassan. [n.d.]. A proposed conceptual framework of programmer’s creativity. In 2015 International Symposium on Technology Management and Emerging Technologies (ISTMET). 108–113. https://doi.org/10.1109/ISTMET.2015.7359011
[5] Vaibhav Anu, Wenhua Hu, Jeffrey Carver, Gursimran Walia, and Gary Bradshaw. 2018. Development of a Human Error Taxonomy for Software Requirements: A Systematic Literature Review. Information and Software Technology 103 (2018). https://doi.org/10.1016/j.infsof.2018.06.011
[6] Fares Anwar, Rozilawati Razali, and Kamsuriah Ahmad. [n.d.]. Achieving Effective Communication during Requirements Elicitation - A Conceptual Framework. In Software Engineering and Computer Systems, Jasni Mohamad Zain, Wan Masieri bt Wan Mohd, and Eyas El-Qawasme (Eds.). Springer Berlin Heidelberg, 600–610.
[7] Z. Askarinejadamiri. [n.d.]. Personality requirements in requirement engineering of web development: A systematic literature review. In 2016 Second International Conference on Web Research (ICWR). 183–188. https://doi.org/10.1109/ICWR.2016.7498465
[8] Anderson S Barroso, Jamille S Madureira da Silva, Michel S Soares, and Rogerio PC do Nascimento. 2017. Influence of Human Personality in Software Engineering. (2017).
[9] Mohammad Bokhari and Shams Siddiqui. 2011. Metrics for Requirements Engineering and Automated Requirements Tools.
[10] Luiz Fernando Capretz and Faheem Ahmed. 2010. Why do we need personality diversity in software engineering? Vol. 35. Association for Computing Machinery. 1–11 pages. https://doi.org/10.1145/1734103.1734111
[11] Betty H. C. Cheng and Joanne M. Atlee. [n.d.]. Current and Future Research Directions in Requirements Engineering. In Design Requirements Engineering: A Ten-Year Perspective, Kalle Lyytinen, Pericles Loucopoulos, John Mylopoulos, and Bill Robinson (Eds.). Springer Berlin Heidelberg, 11–43.
[12] Ricardo Colomo-Palacios, Terje Samuelsen, and Cristina Casado-Lumbraeras. 2019. Emotions in software practice: presentation vs. coding. IEEE Press, Montreal, Quebec, Canada. 23–28 pages. https://doi.org/10.1109/SEmotion.2019.00012

ACM Trans. Softw. Eng. Methodol., Vol. 1, No. 1, Article . Publication date: August 2021.
[13] S. J. O. Cruz, F. Q. B. da Silva, C. V. F. Monteiro, P. Santos, I. Rossilei, and M. T. dos Santos. [n.d.]. Personality in software engineering: Preliminary findings from a systematic literature review. In *15th Annual Conference on Evaluation & Assessment in Software Engineering (EASE 2011)*, 1–10. https://doi.org/10.1049/ic.2011.0001

[14] S. J. O. Cruz, F. Q. B. da Silva, C. V. F. Monteiro, P. Santos, I. Rossilei, and M. T. dos Santos. [n.d.]. Personality in software engineering: Preliminary findings from a systematic literature review. In *15th Annual Conference on Evaluation & Assessment in Software Engineering (EASE 2011)*, 1–10. https://doi.org/10.1049/ic.2011.0001

[15] Christopher J. Davis, Robert M. Fuller, Monica Chiarini Tremblay, and Donald J. Berndt. 2006. Communication Challenges in Requirements Elicitation and the Use of the Repertory Grid Technique. *Journal of Computer Information Systems* 46, 5 (2006), 78–86. https://doi.org/10.1080/08874417.2006.11645926

[16] Anca Deak, Tor Stålhamne, and Guttorm Sindre. 2016. *Challenges and strategies for motivating software testing personnel*. Vol. 73. Butterworth-Heinemann. 1–15 pages. https://doi.org/10.1016/j.infsof.2016.01.002

[17] Khaleed El Enam and Nazim H Madhavji. [n.d.]. Measuring the success of requirements engineering processes. In *Proceedings of 1995 IEEE International Symposium on Requirements Engineering (RE’95)*. IEEE, 204–211.

[18] Robert Feldt, Richard Torkar, Leferis Angelis, and Maria Samuelsson. 2008. Towards Individualized Software Engineering: Empirical Studies Should Collect Psychometrics. In *Proceedings of the 2008 International Workshop on Cooperative and Human Aspects of Software Engineering (Leipzig, Germany) (CHASE ’08)*. Association for Computing Machinery, New York, NY, USA, 49–52. https://doi.org/10.1145/1370114.1370127

[19] A. César C. França and Fabio Q. B. da Silva. 2010. *Designing motivation strategies for software engineering teams: an empirical study*. Association for Computing Machinery, Cape Town, South Africa. 84–91 pages. https://doi.org/10.1145/1833310.1833324

[20] César França, Helen Sharp, and Fabio Q. B. da Silva. 2014. *Motivated software engineers are engaged and focused, while satisfied ones are happy*. Association for Computing Machinery, Torino, Italy. Article 32 pages. https://doi.org/10.1145/2652542.2652545

[21] Lewis R Goldberg. 1992. The development of markers for the Big-Five factor structure. *Psychological assessment* 4, 1 (1992), 26.

[22] A. Gregoriades, Shih Jae-Eun, and A. Sutcliffe. [n.d.]. Human-centred requirements engineering. In *Proceedings. 12th IEEE International Requirements Engineering Conference*. 2004. 154–163. https://doi.org/10.1109/ICRE.2004.1355673

[23] Tracy Hall, Nathan Baddoo, Sarah Beecham, Hugh Robinson, and Helen Sharp. 2009. *A systematic review of theory use in studies investigating the motivations of software engineers*. Vol. 18. Association for Computing Machinery. Article 10 pages. https://doi.org/10.1145/1525880.1525883

[24] Jo Hanisch and Brian Corbitt. 2007. Impediments to requirements engineering during global software development. *European Journal of Information Systems* 16, 6 (2007), 793–805. https://doi.org/10.1057/palgrave.ejis.3000723

[25] D. Hidellaarachchi, J. Grundy, R. Hoda, and K. Madampe. 2021. The Effects of Human Aspects on the Requirements Engineering Process: A Systematic Literature Review. *IEEE Transactions on Software Engineering* (2021), 1–1. https://doi.org/10.1109/TSE.2021.3051898

[26] Rashina Hoda. 2021. *Socio-Technical Grounded Theory for Software Engineering*. *arXiv preprint arXiv:2103.14235* (2021).

[27] Jirayus Jiarpakdee, Chakkrit Tantithamthavorn, and John Grundy. 2021. *Practitioners’ Perceptions of the Goals and Visual Explanations of Defect Prediction Models*. (Florence, Italy).

[28] Michael John, Frank Maurer, and Björnar Tessem. 2005. Human and social factors of software engineering: workshop summary. *ACM SIGSOFT Software Engineering Notes* 30, 4 (2005), 1–6.

[29] John A Johnson. 2014. Measuring thirty facets of the Five Factor Model with a 120-item public domain inventory: Development of the IPFP NEO-120. *Journal of Research in Personality* 51 (2014), 78–89.

[30] Tanjila Kanij, Robert Merkel, and John Grundy. 2015. An Empirical Investigation of Personality Traits of Software Testers. In *Proceedings of the Eighth International Workshop on Cooperative and Human Aspects of Software Engineering (Florence, Italy) (CHASE ’15)*. IEEE Press, 1–7.

[31] Mark Kasunic. 2005. Designing an Effective Survey. (2005).

[32] Arif Ali Khan and Muhammad Azeem Akbar. [n.d.]. Systematic literature review and empirical investigation of motivators for requirements change management process in global software development. *Journal of Software: Evolution and Process* n/a, n/a (n.d.), e2242. https://doi.org/10.1002/smr.2242

[33] Per Lenberg, Robert Feldt, and Lars Góran Wallgren. 2015. Behavioral software engineering: A definition and systematic literature review. *Journal of Systems and Software* 107 (2015), 15–37. https://doi.org/10.1016/j.jss.2015.04.084

[34] A. Lopez, J. Nicolas, and A. Toval. [n.d.]. Risks and Safeguards for the Requirements Engineering Process in Global Software Development. In *2009 Fourth IEEE International Conference on Global Software Engineering*. 394–399. https://doi.org/10.1109/ICGSE.2009.62

[35] Kashumi Madampe, Rashina Hoda, and John Grundy. 2020. A Multi-dimensional Study of Requirements Changes in Agile Software Development Projects. *arXiv preprint arXiv:2012.03423* (2020).
The Influence of Human Aspects on Requirements Engineering: Software Practitioners’ Perspective

[36] Fabiana Mendes, Emilia Mendes, Norsaremah Salleh, and Markku Oivo. 2021. Insights on the relationship between decision-making style and personality in software engineering. *Information and Software Technology* 136 (2021), 106586. https://doi.org/10.1016/j.infsof.2021.106586

[37] Walter Mischel. 2008. *Introduction to personality: toward an integrative science of the person* (8th ed. ed.). Hoboken, NJ: John Wiley & Sons, Hoboken, NJ.

[38] Rahul Mohanani, Iflaah Salman, Burak Turhan, Pilar Rodriguez, and Paul Ralph. 2018. Cognitive biases in software engineering: a systematic mapping study. *IEEE Transactions on Software Engineering* (2018).

[39] Dhirendra Pandey and Vandana Pandey. 2012. Importance of Requirement Management: A Requirement Engineering Concern. *International Journal of Research and Development* - *A Management Review (IJRDMR)* 1 (2012), 2319–5479.

[40] D. Pandey, U. Suman, and A. K. Ramani. [n.d.]. An Effective Requirement Engineering Process Model for Software Development and Requirements Management. In 2010 *International Conference on Advances in Recent Technologies in Communication and Computing*. 287–291. https://doi.org/10.1109/ARTCom.2010.24

[41] Laleh Pirzadeh. 2010. Human Factors in Software Development: A Systematic Literature Review. (2010).

[42] Hélène de Ribaupierre, Kathryn Jones, Fernando Loizides, and Yulia Cherdantseva. 2018. *Towards gender equality in software engineering: the NSA approach*. Association for Computing Machinery, Gothenburg, Sweden. 10–13 pages. https://doi.org/10.1145/3195570.3195579

[43] Rien Sach, Helen Sharp, and Marian Petre. 2010. *Continued involvement in software development: motivational factors*. Association for Computing Machinery, Bolzano-Bozen, Italy. Article 44 pages. https://doi.org/10.1145/1852786.1852843

[44] Hina Shah, Nancy J. Nersessian, Mary Jean Harrold, and Wendy Newssetter. 2012. *Studying the influence of culture in global software engineering: thinking in terms of cultural models*. Association for Computing Machinery, Bengaluru, India. 77–86 pages. https://doi.org/10.1145/2160881.2160894

[45] Jawed Siddiqi and M. Shekaran. 1996. Requirements Engineering: The Emerging Wisdom. *IEEE Software* 13 (1996), 15–19. https://doi.org/10.1109/MS.1996.506458

[46] Ian Sommerville. 2016. *Software engineering* (tenth edition, global edition. ed.). Harlow, Essex Boston : Pearson Education Limited.

[47] Arjumand Bano Soomro, Norsaremah Salleh, Emilia Mendes, John Grundy, Giles Burch, and Azlin Nordin. 2016. *The effect of software engineers’ personality traits on team climate and performance*. Vol. 73. Butterworth-Heinemann. 52–65 pages. https://doi.org/10.1016/j.infsof.2016.01.006

[48] N. Unkelos-Shpigel and I. Hadar. [n.d.]. Leveraging Motivational Theories for Designing Gamification for RE. In *2018 IEEE/ACM 11th International Workshop on Cooperative and Human Aspects of Software Engineering* (CHASE). 69–72.

[49] Sai Datta Vishnubhotla, Emilia Mendes, and Lars Lundberg. 2020. Investigating the relationship between personalities and agile team climate of software professionals in a telecom company. *Information and Software Technology* 126 (2020), 106335. https://doi.org/10.1016/j.infsof.2020.106335

[50] Carolyn Tanya Wick. 1999. *The importance of team skills for software development*. Text. https://open.library.ubc.ca/collections/831/items/1.0051486

[51] Emily Winter, Steve Forshaw, and Maria Angela Ferrario. 2018. *Measuring human values in software engineering*. Association for Computing Machinery, Oulu, Finland. Article 48 pages. https://doi.org/10.1145/3239235.3267427

[52] Claes Wohlin, Per Runeson, Martin Höst, Magnus C. Ohlsson, Björn Regnell, and Anders Wesslén. 2012. *Experimentation in software engineering*. Springer Science & Business Media.

[53] X. Xia, D. Lo, L. Bao, A. Sharma, and S. Li. [n.d.]. Personality and Project Success: Insights from a Large-Scale Study with Professionals. In *2017 IEEE International Conference on Software Maintenance and Evolution* (ICSME). 318–328. https://doi.org/10.1109/ICSM.E.2017.50

[54] M. Yaseen, S. Baseer, and S. Sherin. [n.d.]. Critical challenges for requirement implementation in context of global software development: A systematic literature review. In *2015 International Conference on Open Source Systems & Technologies (ICOSST)*. 120–125. https://doi.org/10.1109/ICOSST.2015.7396413

A SURVEY QUESTIONS

Section 01: Personal Information

(1) How old are you?
(2) How would you describe your gender?
  - Male
  - Female
  - Prefer to self-describe as:
  - Prefer not to answer
(3) Country of your residence?
(4) Educational background: (choose one option)
• University degree in software engineering/computer science
• University degree in other IT fields:
• Associated degree/diploma in software engineering/computer science
• Associated degree/diploma in other IT fields:
• Other university degree/associate degree/diploma

Section 02: Employment Information
(1) What is your current job role/job title?
(2) What type of software development methods you have majorly involved in? (select all that apply)
• Traditional (waterfall)
• Agile (please specify):
• Other (please specify):
(3) Your current job responsibilities include: (please rate the following based on your involvement): close-ended question with the likert scale from "Never" to "Always".
• Collaborate with the stakeholders to elicit requirements
• Documenting software requirements specifications according to standard templates
• Lead requirements analysis and verification
• Participate in requirements prioritization
• Manage requirements throughout the project
(4) If you think there are any other job responsibilities that you involved in apart from the above list, please specify them:
(5) Your experience in carrying out requirements engineering related tasks:
• No experience
• Less than 1 year
• Between 1 to 5 years
• Between 6 to 10 years
• More than 10 years

Section 03: Performance in Requirements Engineering
(1) How important are the following factors in measuring the performance of the people involved in Requirements Engineering? (Please choose one option for each factor): close-ended question with the likert scale from "Not at all important" to "Extremely important".
• The correctness of the requirements identified
• Completeness of the requirements identified
• Clarity of the identified requirements
• Ability to respond to the requirements changes
• Ability to incorporate customer feedback
• Ability to incorporate software team feedback
• Ability to interact with others involved in requirements engineering
(2) Are there any other factor(s) apart from the above list that you use to measure individual performance in requirements engineering activities, please mention: (If not, please mention "none")
(3) Please indicate to what degree you agree or disagree with the following statements
"The success of the requirements engineering process greatly depends on the people involved in the requirements engineering activities as their performance varies from one another"
• Strongly agree
• Agree
• Somewhat agree
• Neither agree nor disagree
• Somewhat disagree
• Disagree
• Strongly disagree
"Differences in characteristics, behaviours, personal habits, skills of the people involved in the requirements engineering activities affect the requirements engineering process"
• Strongly agree
• Agree
• Somewhat agree
• Neither agree nor disagree
• Somewhat disagree
• Strongly disagree
(4) In your experience, to what extent do the following human aspects influence the performance of the people involved in requirements engineering? (Please choose one option for each factor): close-ended question with the likert scale from "Not at all important" to "Extremely important".

- Personality
- Motivation
- Gender
- Cultural diversity
- Emotions
- Domain knowledge
- Attitude
- Age
- Communication skills
- Geographic distribution

(5) If there are any other human aspect(s) apart from the above list that influences the performance of the people involved in requirements engineering activities, please mention:

(6) In your opinion, what are the factors that motivate you to perform effectively in requirements engineering activities? Please explain briefly why.

(7) In your opinion, what are the factors that make you ineffective when involved in requirements engineering? Please explain briefly why.

Section 04: Characteristics of the people involved in the RE process

(1) Please rate this question based on which of your personal human characteristics are important to conduct requirements engineering activities effectively. (Please choose one option for each factor): close-ended question with the likert scale from "Not at all important" to "Extremely important".

- Enjoy interacting with people
- Are enthusiastic about what they do
- Display intellectual curiosity
- Are willing to try new things
- Strive for high achievements
- Prefer following a plan over spontaneous behaviour
- Have kind, generous, trustworthy, helpful qualities
- Are willing to compromise
- Have a tendency towards negative emotions
- Get stressed out easily

(2) Please rate this question based on which of your team members human characteristics are important to conduct requirements engineering activities effectively. (Please choose one option for each factor): close-ended question with the likert scale from "Not at all important" to "Extremely important".

- Enjoy interacting with people
- Are enthusiastic about what they do
- Display intellectual curiosity
- Are willing to try new things
- Strive for high achievements
- Prefer following a plan over spontaneous behaviour
- Have kind, generous, trustworthy, helpful qualities
- Are willing to compromise
- Have a tendency towards negative emotions
- Get stressed out easily

(3) If you think there are any other key human characteristics that are important for the people involved in the requirements engineering process, please specify them;

(4) What are the requirements engineering activities that you have considered when answering to the above question? (eg: requirements elicitation, analysis, specification, validation, management)

(5) Are you willing to participate in a personality test in our next phase of the project to identify your personality traits that may influence the performance on the requirements engineering activities? (Yes/ No)

(6) Please provide the following information to contact you for the personality test in future: (Name/ Email address)

(7) Any other feedback on this survey?