# REQUIREMENTS ENGINEERING (RE) PROCESSES IN AGILE PROJECTS AT MALAYSIAN SOFTWARE COMPANIES: A ROADMAP

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**A project report submitted in partial fulfilment of the requirements for the award of Master of Information Systems**

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# DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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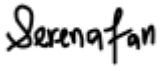
| Signature | : |  |
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# APPROVAL FOR SUBMISSION

I certify that this project report entitled "**REQUIREMENTS ENGINEERING (RE) PROCESSES IN AGILE PROJECTS AT MALAYSIAN SOFTWARE COMPANIES: A ROADMAP"** was prepared by **FAN SIEW LING** has met the required standard for submission in partial fulfilment of the requirements for the award of Master of Information Systems at Universiti Tunku Abdul Rahman.

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# ABSTRACT

Requirements engineering (RE) is the engineering discipline concerned with the establishment of requirements which will form the base of the software development process. In the recent years, with the popularity of Agile methodology framework in the software industry market, to work iteratively and to accommodate for change, the traditional requirements engineering process has also evolved and geared toward the agile philosophy. This brought about changes to the requirements engineering processes such as requirements elicitation, requirements analysis, requirements specification and requirements validation. This study looks into the application and challenges faced by agile software practitioners across the world, and measures them against outcome from the survey participated by software practitioners working in Malaysia software companies. Using a combination of secondary study and the survey results, a proposed roadmap is constructed to provide a guide for software practitioners in Malaysia to adopt agile requirements engineering and to mitigate those challenges highlighted from the survey. The proposed roadmap is then reviewed by software company representatives to gather insightful industry practices. Though there is limited research pertaining to agile requirements engineering in Malaysia, the results seem to suggest similarities between the challenges faced and the best practices to assist in mitigating those challenges. In adopting those best practices in the proposed roadmap, it is hoped that this can assist Malaysian agile software practitioners navigate those obstacles.

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# LIST OF SYMBOLS /ABBREVIATIONS

| | |
|---|---|
| ADDAM | Agile Design Data Modelling |
| APAC | Asia-Pacific |
| ASD | Agile Software Development |
| CASE | Computer Assisted Software Engineering |
| CRM | Customer Relationship Management |
| FMCG | Fast-Moving Consumer Goods |
| IEEE | Institute of Electrical and Electronics Engineers |
| MPP | Microsoft Project Plan |
| MNC | Multinational Corporation |
| MVP | Minimum Viable Product |
| NFR | Non-Functional Requirement |
| PI | Program Increment |
| PMO | Project Manager Officer |
| PMP | Project Management Plan |
| RE | Requirements Engineering |
| IT | Information Technology |
| UTAR | Universiti Tunku Abdul Rahman |

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# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

Requirements Engineering (RE) is a key foundation for many agile based projects in software development. Agile Requirements Engineering practices enables the software development team to develop on an incremental basis, iteratively, and deliver the products in a shorter time compared to traditional RE. Thus, there is an emerging trend in the adoption of Agile practices in software development projects.

It should be noted that not all companies are fully practising agile, these companies are seen to adopt the agile practices which best suits their needs and the project scope, which may not necessary mean collectively adapting to agile entirely.

However, in the adoption of agile framework in projects also comes with its own set of challenges. This paper will review how companies from various parts of the world and from varying industries and sizes, adopt the agile requirements engineering processes and the types of challenges which they face.

This research presents a proposed roadmap on the general Requirements Engineering processes, namely; requirements elicitation, requirements analysis, requirements specification and requirements validation to address the common challenges faced by software practitioners in Malaysia, in minimising the negative impact towards the project outcome.

### 1.2 Problem Statement

Inayat et. al. (2015) identified 8 challenges which were brought upon by the implementation of agile requirements engineering, though further research context may be required to elaborate on the issues. In Schon et. al. (2017), the research studied the judgement of 26 experts in the field of agile software development (ASD) in identifying 20 challenges pertaining to agile requirements engineering and further narrowed down to 6 key challenges concluding that in understanding the value of agile and transitioning into the agile framework is still a concern for organisations.

Curcio et. al. (2018) also recognised that agile software practitioners face various obstacles in areas such as requirements elicitation, change management, measuring requirements and software requirement tools. Rasheed et. al. (2020) uncovered challenges

faced in a comprehensive overview of agile models from the perspective of requirements engineering. Additionally, Ambreen (2018) concluded that although requirements elicitation, analysis and management were recognised as main areas of studies pertaining to requirements engineering, despite the importance of requirements verification and validation, there is a lack of studies in these areas.

These studies, although not from Malaysia, reported that there are challenges and limitations of adopting Requirements Engineering processes, namely requirements elicitation, requirements analysis, requirements specification and requirements validation in development projects that follow the Agile practices.

In 2008, an exploratory study was conducted by Solemon, Sahibuddin and Abdul Azim Abd Ghani (2008), the study looks into identifying requirements engineering problems faced by 63 Malaysia software development companies. The study concluded that most of the requirement problems faced by the companies were related to requirements-based rather than the initial hypothesis that these might be organisational-based. Additionally, the study was not able to ascertain the actual root cause of the problem. More recently, Rahman et al. (2014) studied requirements engineering practices and challenges in the Malaysia public sector from the viewpoint of the stakeholders. 5 requirements engineering challenges from the stakeholder perspectives were identified; namely miscommunication with developer, misunderstanding during agreement process, misalignment of requirement with the business process, conflict with manager and conflict with developer; concluding a communication gap between stakeholder and development team (Rahman et al., 2014). In a more recent study by Hussain, Abdullah and Mkpojiogu (2016), it was concluded that the software developers at the Universiti Utara Malaysia Information Technology (UUMIT) centre showed encouraging feedbacks in practising RE despite some practices associated with RE were not carried out as frequently.

It is seen that, despite the increase of interest pertaining to requirements engineering, the research studies involving the requirements engineering in Malaysia is still limited, and this research hopes to contribute to the exploration of requirements engineering topics in Malaysia and provide a pathway for future works to take place.

## 1.3 Project Aim

The project aims to investigate how Requirements Engineering is used and applied in projects that adopt Agile processes, in software companies located in Malaysia.

## 1.4 Project Objectives

1) To examine the application of Requirements Engineering processes in Agile-based projects.
2) To synthesize the challenges, limitations and impacts of Requirements Engineering processes in Agile-based projects.
3) To conceptualise a roadmap to mitigate the challenges in Agile-based projects
4) To validate the proposed roadmap via semi-structured interview with software company representatives.

# CHAPTER 2

## LITERATURE REVIEW

### 2.1 Overview of Requirements Engineering

Requirements Engineering (RE) is the engineering discipline that involves the process of establishing stakeholder needs and wants and developing them into a set of detailed requirements that becomes the base in developing the system. The detailed requirements should encompass the needs of the business and operational requirements. It is an essential part in planning the system and in ensuring that the system is built for the purpose it is meant to be.

Over the years, requirements engineering has evolved from being an early lifecycle activity preceding analysis, design, coding and testing to an activity that gets revisited multiple times throughout various parts of the lifecycle (Bencomo et.al, 2022). Ambreen et al (2018) further concludes that since year 2000, there has been a rise in interest pertaining to empirical research in RE; with requirements elicitation, analysis and management being identified as leading topics of concern.

### 2.2 Examining the role of Requirements Engineering in Software and Systems Engineering

In software and systems engineering, requirements engineering (RE) is broadly defined as the beginning of the lifecycle activity, originally meant to precede analysis, design, coding and testing. The traditional RE uses the waterfall model. This was originally only adopted at the beginning of the software development with no iterations.

Additionally, there is much focus on traditional structure to be predictive while Agile centers around being adaptive to change (Elshandidy and Mazen, 2013). Elshandidy and Mazen (2013) further concludes that as the awareness of organisations shifts from resenting these changes to embracing and making the necessary adjustments to adapt accordingly, this may further increase the chances of success of a given project.

## 2.3 Agile Manifesto

Agile philosophy is an approach based upon on 4 key values and 12 principles. The 4 key values of the Agile framework as stated on the Agile Manifesto are “individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation and responding to change over following a plan” (Beck, et al., 2011). These values are highly essential in implementing Agile and are the building blocks of the Agile approach.

Additionally, the 12 principles in Agile assist in creating and guiding the software development approach which is centred upon the client and aligning with business-driven objectives to adapt to the changing market environment and user requirements. Additionally, these are stated in the Agile Manifesto (Beck, et al., 2011) as:

1. Achieving customer satisfaction through early and continuous software delivery.
2. Accommodating changing requirements throughout the development process.
3. Continuous delivery of working software.
4. Constant collaboration between the developers and stakeholders throughout the project.
5. Trust, support and motivate the stakeholders involved.
6. Face-to-face interactions as most efficient and effective method of communication.
7. Primary measure of progress is a working software.
8. Supporting a consistent sustainable development pace using Agile approach.
9. Enhancing agility through attention to technical details and design.
10. Simplicity.
11. Encouraging great architectures, requirements and designs through self-organised teams.
12. Regular team reflections at intervals to tune and adjust accordingly.

## 2.4 Types of popular Agile approaches available

Over the years, with the evolution of technology and rapid growth of the software industry, more and more of the software industry has come to adopt the Agile Methodology as their software development technology. In comparison to the traditional methodology, the agile methodology is more people focused and customer centred, both working in collaboration to adapt to changes. The major characteristics of the agile methodology are the adaptive approach, balancing flexibility and planning, and people oriented (Shaikh and Abro, 2020).

One of the popular agile methodologies is Scrum. It is a framework of responsive processes that is used to manage the software development for software projects (Adi and Permana, 2015). Its core method is using a single team management framework. This framework focuses on getting the work done while embracing changes in requirements, goals and situations. As agile methodology focuses on iterative and incremental development, the application of scrum manages this by splitting the project duration into smaller and shorter cycles, known as 'sprints' (Wiegers and Beatty, 2013). The team is able to manage large complex projects by breaking them down into sprints. Sprints allows the team to deliver high quality work at frequent intervals while providing the flexibility to adapt and change as the situation requires.

Kanban is another popular framework of agile process that centers on the visualization of the work process and maximizing the work efficiency using Kanban boards (Rehkopf, n.a). This framework was initially adapted from Lean manufacturing and uses a system of physical cards to signal the progress of the project and to limit work-in-progress stages within the process workflow (Karunanithi, 2016). Kanban centers on continuous workflow process to continuously deliver updates or releases when they are ready, and then move onto the next work item on the Kanban board to start on the next task. This workflow is flexible and can be modified at any time to adapt to new work items or removal of work items or to adjust to the team's capability. This framework process uses a Kanban board, it can be an actual physical board or a virtual board, that is used in helping the project team to visualize work and optimize the flow of work among the team (Radigan, n.d.). Historically, the kanban systems can be traced back to the late 1940s when it was first introduced and implemented by Toyota as it was striving to honor its commitment to boost its manufacturing processes by making incremental improvements towards increasing its manufacturing performances (Karunanithi, 2016).

Another proven agile methodology framework which is popular with software development is Extreme Programming (XP). XP puts the ownership of the development at the hands of the customer. The principal responsibility to prioritize the content backlog, product issues and making decisions on accepting the proposed change of requirements is on the customer (Wiegers and Beatty, 2013).

These are three types of popular agile methodology widely practiced in the software development industry. Though, the choice of agile framework to adopt is dependent of various other factors, such as organisational culture and behaviour, project scope, project duration and project requirements, it should be noted that these frameworks are flexible and can be scaled to adapt accordingly.

## 2.5 Comparison with Agile versus Traditional Approach

Aguilar et al. (2017) defines that the main objective of requirements engineering is to ensure that the users need are fully satisfied; therefore, several methods and techniques will need to be used to help achieve this objective. Depending on the complexity of the project or the software, developers will choose to use the traditional, agile or even a hybrid of both approaches to meet this objective. Aguilar et al. (2017) further suggests that agile approach is feasible solution in situations where the software development requirements are fuzzy or ever-changing, as this approach allows the team to be more adaptive and responsive towards the change at any point of the project life cycle.

Although, it should be noted that in both the traditional and agile approach, requirements engineering shares many similarities in the processes involved, namely requirements elicitation, requirements analysis, requirements specification and requirements validation, the main difference between these two approaches are the adoption of requirements engineering during the software project development stage.

With the comparison of three popular agile frameworks, against the traditional waterfall approach, it can be seen that there is much flexibility in using agile, and multiple iterations which are revisited constantly throughout the development life cycle whereas in contrast, the traditional requirements engineering is only adopted at the first phase of the development. In the traditional approach, the customer is only involved at the initial planning stage, while agile strongly recommends a constant and strong communication channel with the customer regardless of the project lifecycle stage.

## 2.6 Requirements Engineering Application in Agile Software Development

Although many software development teams practice Agile methods, this does not mean that they are fully adopting RE practices, as this is still relatively new within the software development industry. There is no one standard process to abide by in RE as each situation may require a different approach depending on the scale of the team, scope of the project, business needs and industry. Wiegers (2013) listed a breakdown of good practices for RE which is categorized into 4 components; elicitation, analysis, specification and validation, these approaches are sub-disciplines under the requirements development stage of RE.

### 2.6.1 Requirements Elicitation

Firstly, unlike traditional RE, agile RE emphasizes a lot on the customer involvement from the very beginning in the requirements. The first stage, in requirements elicitation, focus group discussions, brainstorming, observation of user tasks and questionnaires are conducted with the customer, and sometimes across cross functional teams to clearly define the vision and scope of the project.

In Bjarnason, Wnuk and Regnell (2011), one of the RE agile practices adopted is having cross-functional development teams with representatives from each teams holding the responsibility to define the requirements. In Melegati et al. (2019), the software start-ups in Brazil apply requirements elicitation by putting together a solid product team who is responsible for understanding both the users and the market, and will steer the development of the product accordingly.

Ramesh, Cao and Baskerville (2008) studies that face-to face communication is preferable over written specifications, by way of using user stories with short descriptions in defining the requirements at a high level. The 16 organisations whom participated in the study reported that intensive interaction between the customers and developers removes any unnecessary and time-consuming documentation and approval processes, as these requirements will evolve over the project cycle (Ramesh, Cao and Baskerville, 2008). This is echoed in Sourav, Spoletini and Ferarri (2021), where 83% of respondents reported using group interaction techniques in elicitation requirements; such as conducting meetings and workshops.

Furthermore, 62% respondents reported that the central figure in providing the requirements was the customer in Sourav, Spoletini and Ferarri (2021). Sometimes the use of business analyst can replace the active involvement of the customer, as an essential stakeholder to assist in procuring the users' critical requirements as shown in a study by

Naicker and Maharaj (2020). In a case study conducted by Carina, Joao and Joao (2020), Brazilian start-ups ecosystems practise the use of surrogate users to represent scenarios and persona techniques during the initial stage. As the startup evolves, and acquires its first customers, formal elicitation techniques such as customer interviews and surveys are adopted.

It should be further noted that in the empirical research by Sourav, Spoletini and Ferarri (2021), their analysis concludes that during the elicitation process, there is an evolution of the original idea, this frequent occurrence also redirects the focus of the requirements and the roles, creating additional functionalities which were not in the original plan including non-functional requirements.

### 2.6.2 Requirements Analysis

Secondly, the requirements analysis stage, this is a fundamental process in RE, as the high priority requirements are implemented first, with low ranked requirements at risk of not being implemented.

In large-scale RE, the company in the case study by Bjarnason, Wnuk and Regnell (2011) uses the agile value of one continuous scope flow, by combining all the inflow of requirements into a list of features which are then constantly revisited for reprioritisation and to agree on development based on the availability of resources. Better communication also allowed the team to efficiently and effectively identify the detailing of the gradual and iterative requirements and user stories (Bjarnason, Wnuk and Regnell, 2011). Important criteria in prioritisation ranking can range from opportunity costs, business value and dependence (Naicker and Maharaj, 2020) and primarily business values (Ramesh, Cao and Baskerville, 2008).

Viewpoints can guide the requirement prioritisation process; ‘using iterative development, adaptation, increments of project, collaboration and emergence’ to produce high quality projects (Rasheed et al., 2021). During the analysis, the ‘complexity, completeness, ambiguity and contradictions’ are closely scrutinised and resolved with inputs from the stakeholders (Naicker and Maharaj, 2020). The company commitment during the analysis and requirements process is indispensable, this is proven in da Silva et al. (2014).

In O’Driscoll (2016), the study suggests that the requirements analysis should be done using data driven initiative, using Agile Design Data Modelling (ADDAM) process. This process starts in the first stage, where the primary problem is identified; the second stage where modelling the existing system is used as a communication technique from the business stakeholders to the developers; next third stage, envisioning how the problem can be resolved

and deliver the best business value; fourth stage developing a data model that is a representative of what the proposed solutions system should be, and finally, fifth stage where the evaluation takes place throughout the entire process (O'Driscoll, 2016).

### 2.6.3 Requirements Specification

Wiegers (2013) explains that primary concern of requirements specification is to translate the user needs into written requirements and diagrams to store them in a well organised format for review and use by the intended audience.

Additionally, Bjarnason, Wnuk and Regnell (2011) indicates that most interviewees believe that in the process of confirming and documenting the detailed requirements at the point when it is required during the development stage, leads to a solid and stable requirements finalisation with lower possibility of further changes. Bjarnason, Wnuk and Regnell (2011) further implemented an integrated RE practice, enabling the activities of the required engineering tasks to be done concurrently with other development activities, an example is detailing and formal documentation of requirements to be worked upon simultaneously as the design and development of the feature. The case company implemented the approach of documenting the detailed requirements using user stories and acceptance criteria (Bjarnason, Wnuk and Regnell, 2011).

User stories is also the most commonly used technique in the cross-case analysis of six companies done by Medeiros et al. (2018), sharing that requirements specification that is close to what will be developed potentially leads to reduction of time and effort needed to gather information for coding, testing and maintenance.

In contrast, requirements specification was treated as an ad-hoc process in very small software enterprises seen in Quispe et al (2010), this was discovered when the findings indicating that the project specifications are met, however the client did not find the solution posed to be satisfactory.

### 2.6.4 Requirements Validation

Wieger (2013) outlines this process as the review of documentation of the specifications and the development of acceptance tests and criteria that satisfies the business objectives. This is a subjective process and most organisations choose to overlook or place minimal importance on requirement validation process. It is a process of obtaining a formal agreement on the specified requirements from all and any stakeholders, from customer, analyst, project managers, domain experts, end user, system engineers, developers, system test engineers, and

even designers who have been involved in the development and implementation process (Maalem and Zarour, 2016).

In Quispe et al (2010), the validation process is mainly done by the developers with their team in very small software enterprises. Additionally, in Melegati et al. (2019), where requirements validation is considered a crucial stage for start-ups, most interviewees responded that some kind of requirements validation is done with little or no development with techniques implemented such as wireframing, minimum viable product (MVP), mock-ups, prototyping and others.

In Naicker and Maharaj (2020), most requirements input was provided by the business analyst who may lack understanding of the business process, with limited information on how and who was working on requirements validation.

### 2.6.5 Summary of the Application of Requirements Engineering

| **2.6.1 Requirements Elicitation** | |
|---|---|
| **Examples of RE application** | **Sources of Reference** |
| • cross-functional development teams | (Bjarnason, Wnuk and Regnell, 2011) |
| • putting together a product team | (Melegati et al., 2019) |
| • face-to face communication | (Ramesh, Cao and Baskerville, 2008) |
| • intensive communication between customer and developers | (Ramesh, Cao and Baskerville, 2008) |
| • use of business analyst to replace the customer involvement | (Naicker and Maharaj, 2020) |

Table 2.1: Examples of requirements elicitations and sources of reference

| **2.6.2 Requirements Analysis** | |
|---|---|
| **Examples of RE application** | **Sources of Reference** |
| • combining inflow of all requirements into one list | (Bjarnason, Wnuk and Regnell, 2011) |
| • criteria of prioritisation include (but not limited to) opportunity costs, business value, dependency | (Naicker and Maharaj, 2020) & (Ramesh, Cao and Baskerville, 2008) |
| • using viewpoints to guide prioritisation process | (Rasheed et al., 2021) |
| • closely scrutinise 'complexity, completeness, ambiguity and contradictions' and resolve with stakeholder inputs | (Naicker and Maharaj, 2020) |
| • company's commitment to the process | (da Silva et al. ,2014) |

Table 2.2: Examples of requirements analysis and sources of reference

### 2.6.5 Summary of the Application of Requirements Engineering (Cont.)

| **2.6.3 Requirements Specification** | |
|---|---|
| **Examples of RE application** | **Sources of Reference** |
| • confirming and documenting the requirements at the point when it is required leads to solid finalisation | (Bjarnason, Wnuk and Regnell, 2011) |
| • integrate RE practice - concurrent RE tasks | (Bjarnason, Wnuk and Regnell, 2011) |
| • documenting using user stories and acceptance criteria | (Bjarnason, Wnuk and Regnell, 2011) |
| • user stories | (Medeiros et al., 2018) |
| • treated as ad-hoc process | (Quispe et al, 2010) |

Table 2.3: Examples of requirements specification and sources of reference

| **2.6.4 Requirements Validation** | |
|---|---|
| **Examples of RE application** | **Sources of Reference** |
| • done by developers, instead of customers | (Quispe et al, 2010) |
| • performed by business analyst | (Naicker and Maharaj, 2020) |
| • using techniques such as wireframing, minimum viable product (MVP), mock-ups, prototyping and others. | (Melegati et al., 2019) |

Table 2.4: Examples of requirements validation and sources of reference

## 2.7 Challenges and Limitations

An early exploratory survey documenting the state of the actual practice of software professionals in requirements engineering (RE), namely software requirements elicitation, requirements specification, document development and specification validation was done in 2003, concluding that during that period, the waterfall lifecycle model was still popularly in use (Neill and Laplante, 2003).

In more recent international survey with responses of representative from 92 different organisations, published in 2017, it has revealed that most organisations have come to adopt RE in their agile projects (Wagner et al., 2017). Though the survey was not designed to explore RE in the Agile methodology, it has provided insights which suggests that although there was a considerable number of projects claiming to adopt agile by utilising Scrum or Extreme Programming framework, the survey supports the findings that to some degree, these companies seem to have deviated from the agile context (Wagner et al., 2017).

The results of a study on empirical research in RE by Ambreen et al. (2018) further concluded though there has been a rise in the interest of empirical research in RE since 2000, there is still a need to study RE in different contexts to further evaluate the current practices and implementations applied.

This snapshot indicates that though RE was already available for some time, the mindset of the software professionals had only recently shifted from the waterfall model to the agile model. As such, further exploration can be done to understand how agile RE is being implemented in software development projects, and how these practices can be adapted to apply in the context of software development companies.

### 2.7.1 Requirements Elicitation

There is a need for deeper scrutiny of RE processes using agile in software development and how these practices help resolve the limitation of the traditional RE processes. It should be noted that there is a risk of inadequate requirements elicitations at this stage depending on the effectiveness of the communication or due to the lack of customer involvement or lack of customer understanding of the agile processes. Dependency on the customer understanding and abstract of the product functionality also poses as a challenge during the elicitation process (da Silva et al., 2014). The Agile Manifesto (Beck, et al., 2011) highlights the need for constant cooperation and collaboration between the stakeholders and developers throughout the entire project life cycle and the most effective method to communicate is face-

to-face communication. However, this does not take into consideration, the level of commitment which the customer might be willing to invest into the communication.

### 2.7.2 Requirements Analysis

AL-Ta'ani and Razali (2013) discusses that high quality requirements can be obtained when the requirements prioritisation process is facilitated in an effective manner. Various factors such as environment, process and project need to be taken into consideration when formulating a framework for requirements prioritisation process.

The use of requirements analysis helped the organisation to address the issue of tendency of overscoping, where the business team requests an unrealistically large number of features, which is then not prioritised accordingly; leading to over-commitment by the development team without proper planning (Bjarnason, Wnuk and Regnell, 2011). Ramesh, Cao and Baskerville (2008) highlight the need for iterative RE, as a continuous requirements analysis during each development cycle as an appropriate approach for a dynamic business environment or evolution of the technology leading to change in requirements. This further corroborates with the agile value, the flexibility to respond to changes and to adapt accordingly (Beck, et al., 2011).

Scoop creep is a major challenge and occurs when the client requests modifications but does not supply adequate resources to support the project development, this evidence is seen in Quispe et al (2010) diagnostic study on very small software enterprises. Furthermore, da Silva et al. (2014) showcases where the lack of company involvement during the requirements analysis process resulted in the 'absence of domain and product experts', suggesting that it is vital to ensure that client is fully involved during the requirements analysis process.

### 2.7.3 Requirements Specification

An empirical study by Ramesh, Cao and Baskerville (2008), identified prototyping as the quickest method to assist the customer in communicating a prioritised list of critical features, as the customer is able to provide feedback based on the prototypes used in the demonstration to further refine and modify the requirements specifications. Though prototyping is a notable strategy in requirements specification in helping the customer to identify and ascertain requirements, it needs further investigation to determine if this strategy is executed by the majority of organisations adopting agile RE processes.

Another empirical study done by Rodrigues et al. (2018), investigated how the use of informal specification techniques may lead to potential problems such as information omission, misinterpretation and ambiguities in the requirements and concluded that one of the limitations in the specification process is the lack of knowledge on formal specification, making it difficult to apply it in practice.

Although user stories are the main specification technique in Medeiros et al. (2018), amongst the top concerns is that the user stories are ambiguous, newer team members have difficulties in writing useful stories and that the level of information in the user stories are inadequate.

In the case of Quispe et al (2010), there needs to be further exploration to conclude if the ad-hoc process of requirements specification has contributed to the loss of requirements, or incomplete specifications arose due to lack of communication with the clients or any other reasons. Although agile promoted the importance of producing a working software as compared to written documentations, this may pose many issues when there are missing, conflicting or ambiguous requirements, Rasheed et al. (2021) suggests that there is a need to maintain formal documentation to be used in the integration of change of requirements and to keep track of those changes.

### 2.7.4 Requirements Validation

In regard to requirements validations, this area has been mostly overlooked as optional or performed on ad-hoc basis due to the lack of data to be obtained pertaining to this area of RE. Rasheed et al. (2021) further notes that the lack of clear tools or techniques limit the application of requirements validation in software development.

In the research study conducted by Naicker and Maharaj (2020), prototyping was not widely used during the validation process in the South African software development companies.

### 2.7.5 Summary of Challenges and Limitations faced in practising Agile RE

| **2.7.1 Requirements Elicitation** | |
|---|---|
| **Challenges faced** | **References** |
| • Effectiveness of communication<br>• Lack of customer involvement<br>• Dependency on customer understanding | (Beck, et al., 2011)<br>(da Silva et al., 2014)<br>(da Silva et al., 2014) |

Table 2.5: Challenges faced in requirements elicitation and sources of reference

| **2.7.2 Requirements Analysis** | |
|---|---|
| **Challenges faced** | **References** |
| • Unrealistically larger number of features (overscoping)<br>• No adequate resources to support modifications (scoop creep)<br>• Lack of company involvement - absence of product experts | (Bjarnason, Wnuk and Regnell, 2011)<br>.<br>(Quispe et al, 2010)<br>(da Silva et al., 2014) |

Table 2.6: Challenges faced in requirements analysis and sources of reference

| **2.7.3 Requirements Specification** | |
|---|---|
| **Challenges faced** | **References** |
| • Subject lack of knowledge about formal specification<br>• Ah-hoc process documentation<br>• Incomplete specifications given<br>• Ambiguous user stories and inadequate details | Rodrigues et al. (2018)<br>(Quispe et al, 2010)<br>(Rasheed et al., 2021)<br>(Medeiros et al., 2018) |

Table 2.7: Challenges faced in requirements specification and sources of reference

### 2.7.5 Summary of Challenges and Limitations faced in practising Agile RE (Cont.)

| **2.7.4 Requirements Validation** | |
|---|---|
| **Challenges faced** | **References** |
| • Lack of tools or techniques<br>• Lack of use of prototyping | (Rasheed et al., 2021)<br>(Naicker and Maharaj, 2020) |

Table 2.8: Challenges faced in requirements validation and sources of reference

## 2.8 Conclusion

With many organisations moving towards adopting agile RE in software development projects, each approach that is taken in regards to the requirements development stage, namely requirements elicitation, requirements analysis, requirements specification and requirements validation varies depending on the context and domain of the organisations involved.

Although there is a wide acceptance by the organisation to follow the RE agile approach, however, there still exists some challenges and limitations faced during the requirements development, Both the team and organisation can take steps to mitigate these challenges to fully embrace the benefits of working with agile RE.

# CHAPTER 3

## RESEARCH METHODOLOGY

### 3.1 Introduction

This section will detail the methodology which is used to carry out the research crucial to this study. The research design is spread across 3 stages, and each stage will be further elaborated with the type of research methods and research instruments adopted for use.

### 3.2 Research Questions

Subsequent to identifying the objectives, this research should answer the following tentative research questions:

1) How is Requirements Engineering (RE) practices applied in the Agile-based projects?
2) What are the challenges or limitations that software engineers face in the adoption of RE?
3) What are the recommendations to mitigating RE in Agile-based projects?

### 3.3 Research Design

The research design for this research will be segmented into 3 stages. This research area will be focusing on the use of RE in Agile-based projects. In particular, the research scope will be centred on software development companies located in Malaysia.

The first stage will consist of exploratory research in the form of secondary data, this will form the foundation of the literature review and provide the base of the current requirements engineering processes in agile based projects. Next, in the second stage, it will be the collection of primary data which will be collected using a quantitative survey. The proposed roadmap will be constructed based on the data collected and subsequently analysed in the first and second stage. Moving on, in the third and final stage, primary data in the form of semi-structured interview will be gathered to present feedback on the proposed roadmap.

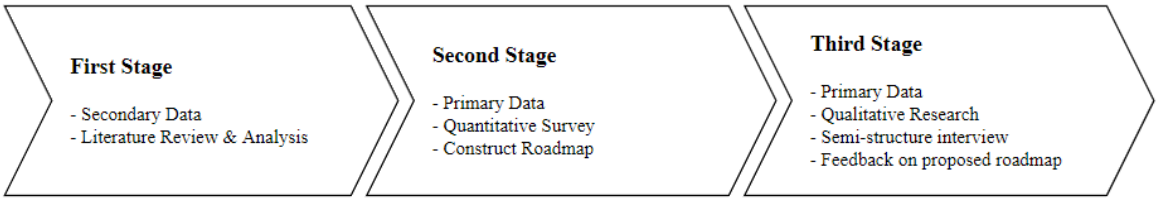


Figure 3.1 Research Design by Stages

## 3.4 First Stage – Secondary Data - Literature Review and Analysis

In the first stage, this research examined in greater detail to gather literature review using journals, studies or books that was conducted or written by other researchers to better understand the application of RE which was adopted in Agile-based projects. This will be in the form of exploratory research which aims to provide deeper insights into and regarding the understanding of the topic (Malhotra, 2020). Though some data may come from varying sources through the years, a greater precedence is given to refer to prior researches that have been published in the more recent years so that the conclusions of these researches are still relevant in the current environment. Data collected from other studies and publications are referred to as secondary data as these are analysed and concluded based on the primary data source. There are several advantages in using secondary data such as the collection process is rapid and easy, without involving high costs and within a short amount of time (Malhotra, 2020).

Using secondary data means there is no direct contact with the respondents or subjects. As such Johnston (2014) clarifies that careful reflection and critical evaluation of secondary data is required to ensure that there is an appropriate match between the research question and existing data. As a rule, it would be best to examine the secondary data available before proceeding with the data collection of the primary data. When the secondary data has been exhausted, then the primary data comes into the picture to complete the collection of data required for the research (Malhotra, 2020).

Secondary data are a great method to identify trends and patterns, which can be further analyse to fulfil the research objectives. In analysing the challenges and limitations faced by different organisations in the practice of requirement engineering in Agile based projects, there is a need to have a deeper understanding of requirements development processes. The organisations practising Agile software development have to be fully

committed in advocating the use of these processes to encourage all the stakeholders involved to adhere to the good practices.

A common recurring theme is the lack of customer involvement or commitment towards the requirements development process, and this gap is subsequently taken up by the developers who may not have the necessary background or sufficient knowledge pertaining to the user requirements to be able to adequately fill in the gap.

Organisations have also noted that limitations in terms of resources, and that ranging from time, budget, scope and human resources is a factor that deters them from fully adapting RE practices.

Another issue is the lack of proper standard guidelines pertaining to the process of elicitation, analysis, specification and validation of the requirements. This is particularly difficult as the Agile approach focuses on being flexible and adaptive of the situation and business environment. However, arguments that having a formal guideline in place can help better encourage the organisations in knowing how to work more effectively and efficiently during the requirements development process.

This is seen as Gottesdiener (2007) recommends that the adoption of a requirements-driven approach, in adapting to good practices can lead to a successful agile development. Misra, Kumar and Kumar (2006) also suggest that technical factors which contributes to the success factors of agile software development can be traced back to flexibility of the changes in requirements and development as supported by Agile processes.

## 3.5 Second Stage – Primary Data – Quantitative Survey

The type of primary data to be collected for this research is descriptive quantitative. The questionnaire will be using closed ended questions, giving the respondents a range of predetermined responses for them to select. The predetermined selections of responses will be structured using the Likert Scale. The Likert scale to use will range from Very Unimportant (1) to Very Important (5) and Strongly Disagree (1) to Strongly Agree (5), to help gauge the understanding of the respondents' agreement on the designated questions. The primary data collection will be in the form of numerical data.

This project will be using an online survey to engage with these individuals in collecting the required data. This is a form of self-administered survey and is best used to reach out to a large number of participants within a short amount of time and also at a low cost. This will be done using a Microsoft Forms link or a QR code linking to the Microsoft

Forms. This questionnaire will be fully in English and be restricted to those software practitioners in Malaysia.

### 3.5.1 Second Stage – Primary Data – Target Respondents

To reach out to the target respondents, firstly using Muru-ku.com, a platform for Malaysian start-up data, a list of potential companies which fits the definition are compiled, together with the contact information such as e-mail or phone, as this will be used to contact the target respondents. Kindly refer to Appendix A for the listing of companies.

Target respondents should ideally have worked on at least 1 Agile-based project, and may come from varying position such as Software Engineer, Project Manager, Software Architect or Technical Lead. They can be from various industries such as Information Technology, Education and E-Commerce.

The initial email of the survey invites was sent out to 100 start-up companies (Appendix B), however, there was very little to no response from these companies; and this was further supplemented through reaching out to friends, friends of friends, who may know of someone working in the Information Technology industry. The initial target sample size is a minimum of 30 participants for this online survey, which would have been sufficient sampling data for analysis, however due to varying reasons such as lack of participation, lack of agile RE experience and time constraints, the initial respondents numbered at 26, before further reducing to 12. The sample of 30 was based on the guideline that having 30 observations would be deemed sufficient to conduct signification statistical analysis as per Central Limit Theorem (CLT) (Sharma, 2020).

Although the estimated employment size of Information and Communication Technology sector in Malaysia is 1.16 million persons, as at 2020 (Department of Statistics Malaysia, 2021), due to time, constraints and also concerns of the covid-19 pandemic, this research was not able to fully cover the recommended sample size 1% which would have been difficult to obtain without additional resources in the form of assistants and budgets. The total employees of this sector may not be fully related to software development but it provides some sort of indicator as to the size of current industry in Malaysia and how this it projected to grow even larger.

### 3.5.2 Second Stage – Primary Data – Ethical Clearance

It is a requirement by UTAR, that before any survey can be conducted to any external parties, a request for Ethical Clearance must be submitted and evaluated for approval. For this research, a letter of invitation (to the survey) was attached together with the Ethical Clearance request form for approval from the relevant committee-in-charge. The approval for this research was received on 2nd November 2021 (please refer to Appendix A).

3.5.3 Second Stage – Primary Data – Questionnaire

The Questionnaire was also finalised for survey after undergoing several revisions. Kindly refer to the attached Questionnaire in Appendix C. There are several components in the Questionnaire: -

1) Introduction
2) Personal Data Protection Notice (as provided by UTAR)
3) Participation Screening
4) Demographics
5) Likert Scale – Very Unimportant (1) to Very Important (5)
6) Likert Scale – Strongly Disagree (1) to Strongly Agree (5)
7) Open Ended Questions

To ensure that the respondents for the survey are suitable, the below questions have been included as part of the participation screening to ensure that they are at least involved in agile based projects and that they work in organisations or team which are adopting requirements engineering in their projects. If any of the respondents select no for either Question 7 or Question 8, the survey would thank them for their participation and end accordingly. If yes is selected for both questions, then, they will proceed with the remainder of the survey.

**Question 7**

*Have you been involved in Agile based projects within your organisation?*

**Question 8**

*Does your organisation/department/team adopts Requirements Engineering in your projects?*

To further verify if the respondents are aware of agile, Questions 10, 11 and 12 has been constructed with multiple answer selections.

**Question 10**

*What does an Agile approach value?*

**Question 11**

*Which of the following is not a principle of the manifesto for agile software development?*

**Question 12**

*Some of the agile frameworks are?*

The Likert Scale have been constructed based on the analysis of the secondary data, through the application of agile RE and the challenges of RE. The most common or critical issues were highlighted, and then constructed into sentences suitable for Likert scale.

Data that is accumulated and analysed in the first and second stage is then used, in the construction of the proposed roadmap in the form of a checklist. This serves as a guide for software practitioners in Malaysia to practice agile RE.

### 3.6 Third Stage – Primary Data – Qualitative Research

Within the third stage, this is done in the form of semi-structured interview which serves as a feedback avenue from experienced software practitioners in Malaysia with 10-15 years of working experience pertaining to the proposed roadmap. Keller and Conradin (n.d.) explains that with semi-structure interviews, there is a smooth flow of focused yet conversational 2-way communication, enabling the interviewer the flexibility of having a set of questions prepared ahead of time and also the person being interviewed the flexibility to branch off the conversation into additional details as necessary.

For this stage, 2 interviews shall be conducted for the purpose of providing valuable insight relating to working with agile RE, and feedback on the constructed roadmap. Their feedback would help providing varying perspective and to ensure that the application of the checklist is indeed suitable and appropriate to be practiced in the real working environment.

## 3.7 Summary

The research methodology using a 3-stage process through a combination of the secondary data gathered through literature review and the primary data collected through the online survey, to assess and to create a conceptual roadmap for software companies located in Malaysia, aims in helping to mitigate the challenges and problems they face in implementing Requirements Engineering (RE) in their Agile-based projects. Using a mixed method of quantitative and qualitative prove more comprehensive and inclusive for data collection and analysis.

# CHAPTER 4

## SURVEY FINDINGS AND ANALYSIS

### 4.1 Introduction

This online survey was distributed to a total of 100 potential respondents, mainly software related companies, through the list of software companies as compiled from Muru-ku.com and also reaching out friends and requesting for assistance in distributing the survey to their acquaintances whom may be of the right target respondent for this survey. The initial response rate was about 26%, which was promising and close to the minimum target of 30 participants for the survey.

However, it should be noted, through the process of participation screening the respondents to ensure that they have valid experience working in Agile based environment and also incorporate the use of Requirements Engineering in the course of their work; this was done through question 7 and 8 (as shared below), this has reduced the number of valid respondents contributing to this research from 26 respondents to 12.

**Question 7**

*Have you been involved in Agile based projects within your organisation?*

**Question 8**

*Does your organisation/department/team adopts Requirements Engineering in your projects?*

While the low level of response seemed to indicate that the general interest of the Malaysia IT industry within this field of study is not as promising or merely the lack of familiarity, this can be a potential topic for further discussion or research. However, for the purpose of this research, the limited number of responses will continue to be used for analysis.

## 4.2 Demographic Information and Analysis

The demographic information for the study is to better understand the background of the companies whom the respondents are working for and the background of the respondents. This may or may not have correlations to how the respondents replied the survey, however, this will give a better understanding of their work experience and credibility upon the responses provided to the survey.

### 4.2.1 Company / Industry

Most of the respondents come from companies working in the Information Technology industry, with 8 out of 12 respondents with 1 from Financial Services industry, 1 from Consumer Products or Services and 2 from Other Industries.

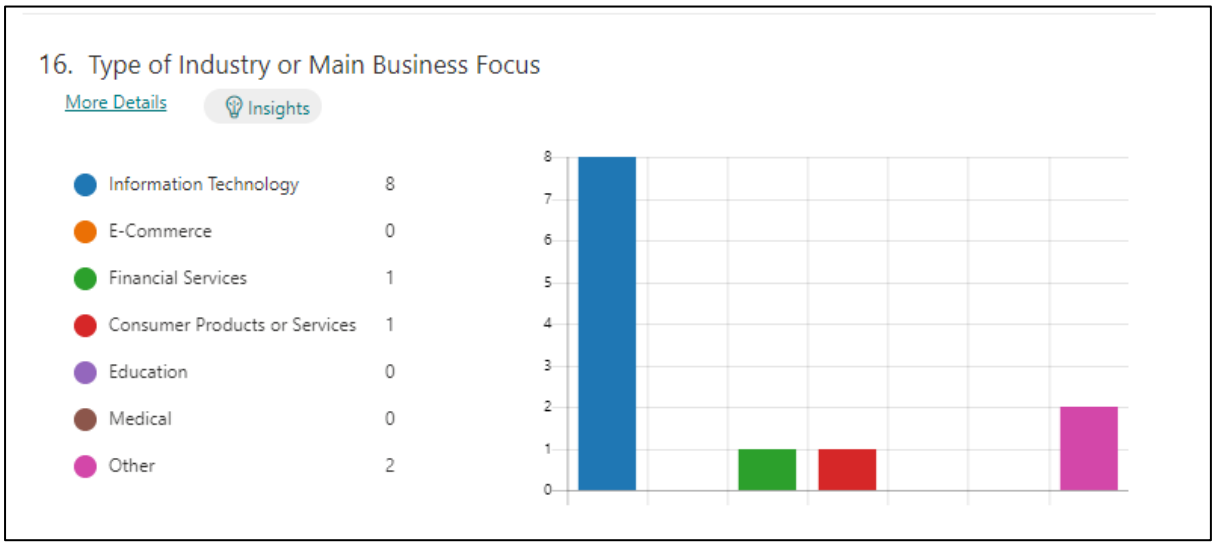


Figure 4.1: Type of Industry or Main business focus

### 4.2.2 Background of Respondents

This survey has also included several carefully constructed questions aiming to discover the background of the respondents and the type of roles and work environment they came from.

Firstly, a majority of the respondents, 9 out of 12 are qualified graduates with a bachelor's degree with another 3 respondents whom are graduates with a master's degree as their highest level of qualification. They are from varying level of work experience, with the majority of 9 respondents having less than 5 year of work experience, 1 respondent with 5 to 10 years, 1 respondent holding 10-15 years of experience and one respondent with more than 20 years of experience.

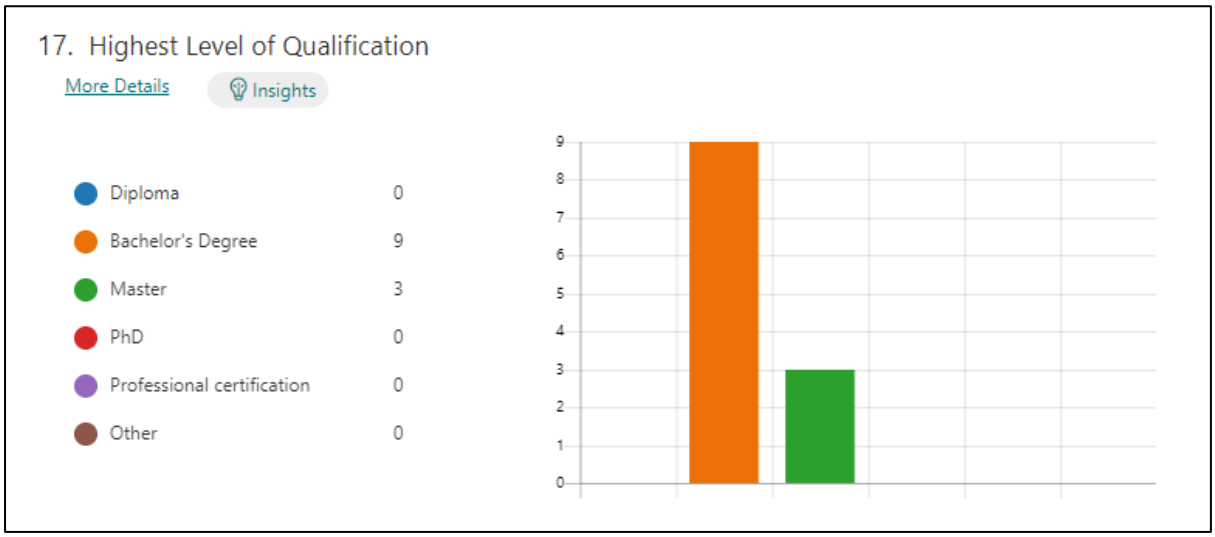


Figure 4.2: Highest level of qualification


Figure 4.3: Number of years of working experience

Secondly, a large majority of the respondents can be considered essential team contributors in an Agile team, as they are software engineers, 2 technical lead or team lead and 2 under others. The size of the project teams which the respondents have participated in ranges from less than 5 to greater than 20, showing diversity in the sizes of the project groups.

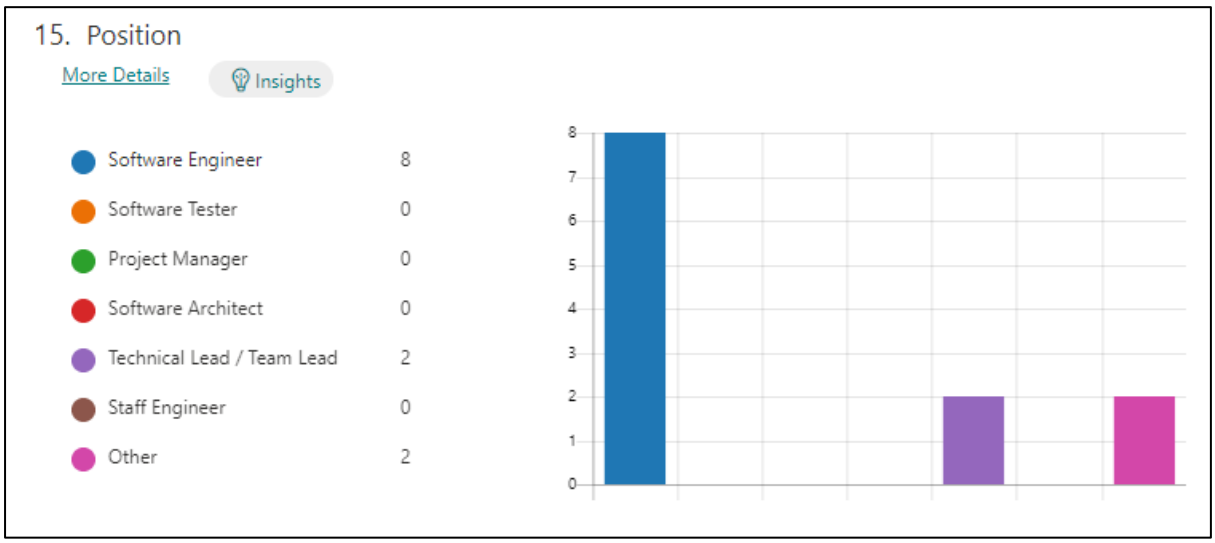


Figure 4.4: Current job position

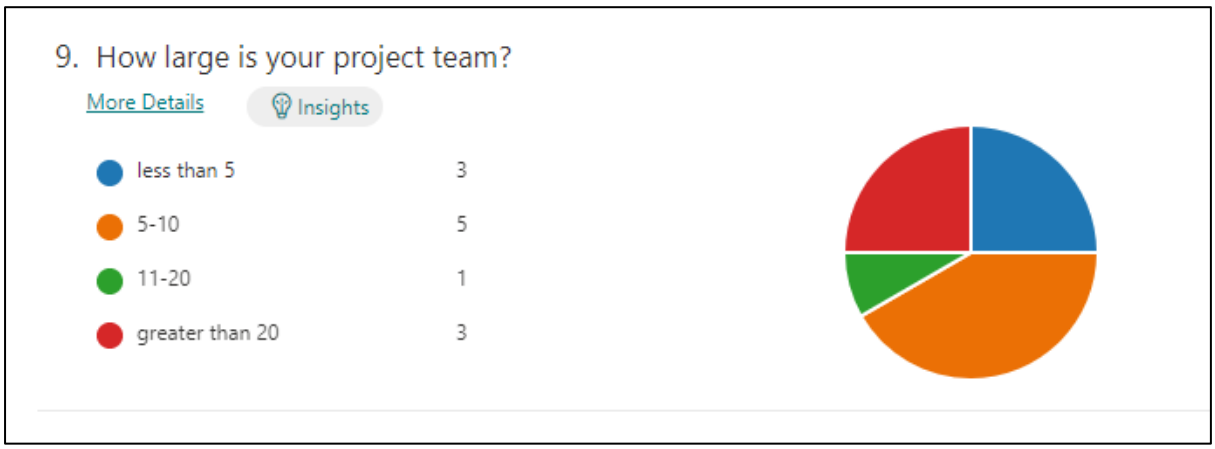


Figure 4.5: Size of project team

Furthermore, to ensure that the respondents are aware of scope of the survey, several questions were designed and included in the start of the questionnaire as participation screening. Based on the responses gathered, it was concluded that all the respondents do have some basic level of understanding what is Requirements Engineering and also Requirements Engineering processes.

**Question 5**

*Do you know the concept of Requirements Engineering?*

**Question 6**

*Are you familiar with the Requirements Engineering processes: Requirements Elicitation, Requirements Analysis, Requirements Specification and Requirements Validation?*

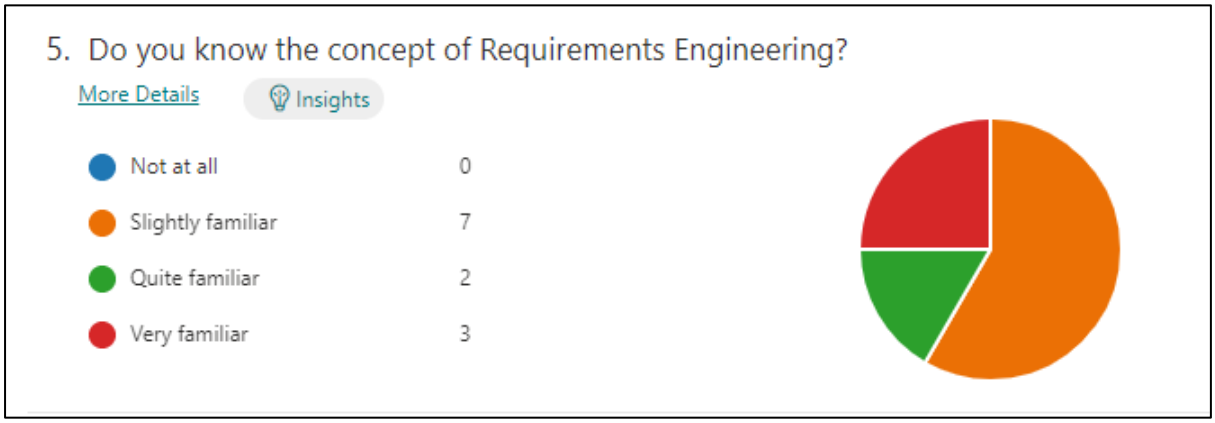


Figure 4.6: Familiarity with concept of Requirements Engineering

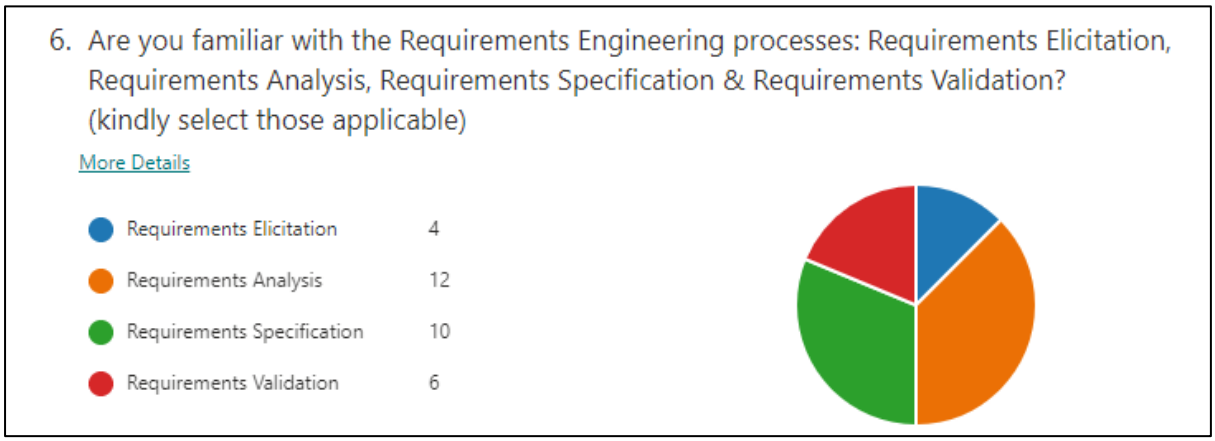


Figure 4.7: Familiarity with Requirements Engineering processes

### 4.2.3 Company Culture

Furthermore, Scrum appears to be the most favourable Agile methodology to be adopted in work, followed by Kanban and Extreme Programming. Over 9 respondents come from an organisational culture that has an established set of Requirements Engineering standards/protocols.

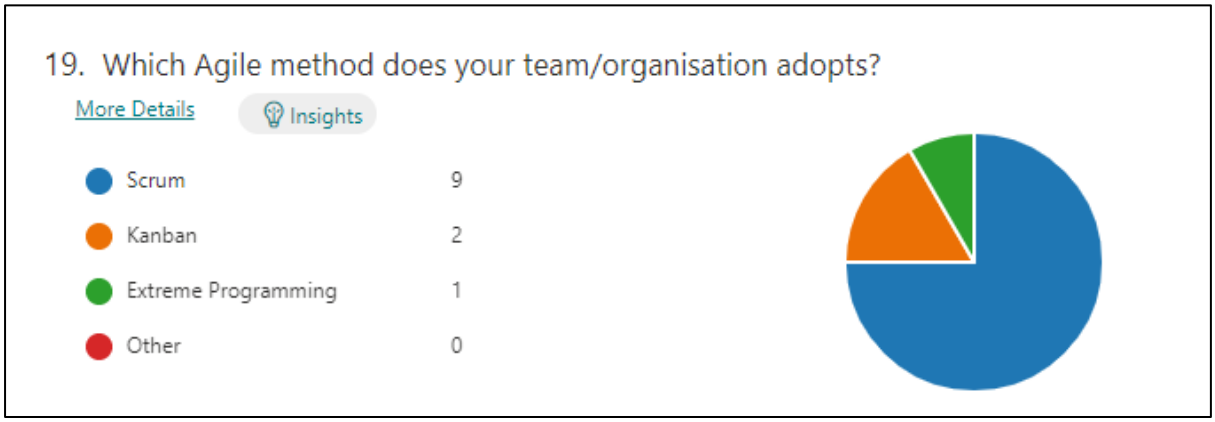


Figure 4.8: Preferred adoption of Agile method by team/organisation

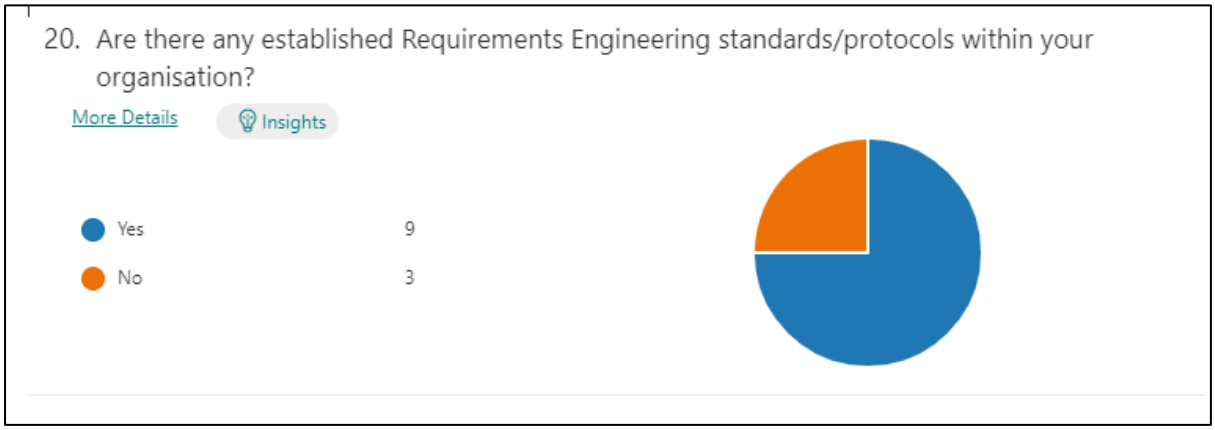


Figure 4.9: Established requirements engineering standards/protocols within the organisation

### 4.3 Application of Requirements Engineering Processes in Agile Projects

Referring to the design of the questionnaire, there were 2 types of Likert Scale question. The first Likert Scale constructs the questions to understand the application of Requirements Engineering processes in Agile based projects by the respondent and the type of techniques or practices which they have adopted to be in-line with the Agile manifesto. It should be noted that this a 5-level Likert Scale with responses ranging from 1 Very Unimportant, 2 Unimportant, 3 Neutral, 4 Important and 5 Very Important.

The majority of participants consider business concerns as a main driver for requirements elicitation in Agile projects, with a total of 10 respondents (out of 12 respondents) selecting 5 Very Important and 4 Important. Therefore, outlining the objectives of the project and making sure that it aligns with the business concerns should be a priority as this becomes the base reference for elicitation process. Additionally, 10 participants also rated the importance of requirements elicitation in Agile projects among 4 Important and 4 very Important, further emphasizing the reliance of Agile projects in utilising requirements elicitation.

Among some key methods in conducting the elicitation process can be seen in the following questions such as rating the need for a feasibility study, importance of face-to-face communication and using requirement elicitation techniques in capturing requirements. In all three questions, more than 9 respondents out of 12 rated these as 4 Important and 5 Very Important on the Likert scale. This is further corroborated in another question pertaining to the most frequently used requirements elicitation techniques with 34% using facilitated meetings, 24% case scenarios, 21% user stories, 14% interviews and another 7% other types of techniques.

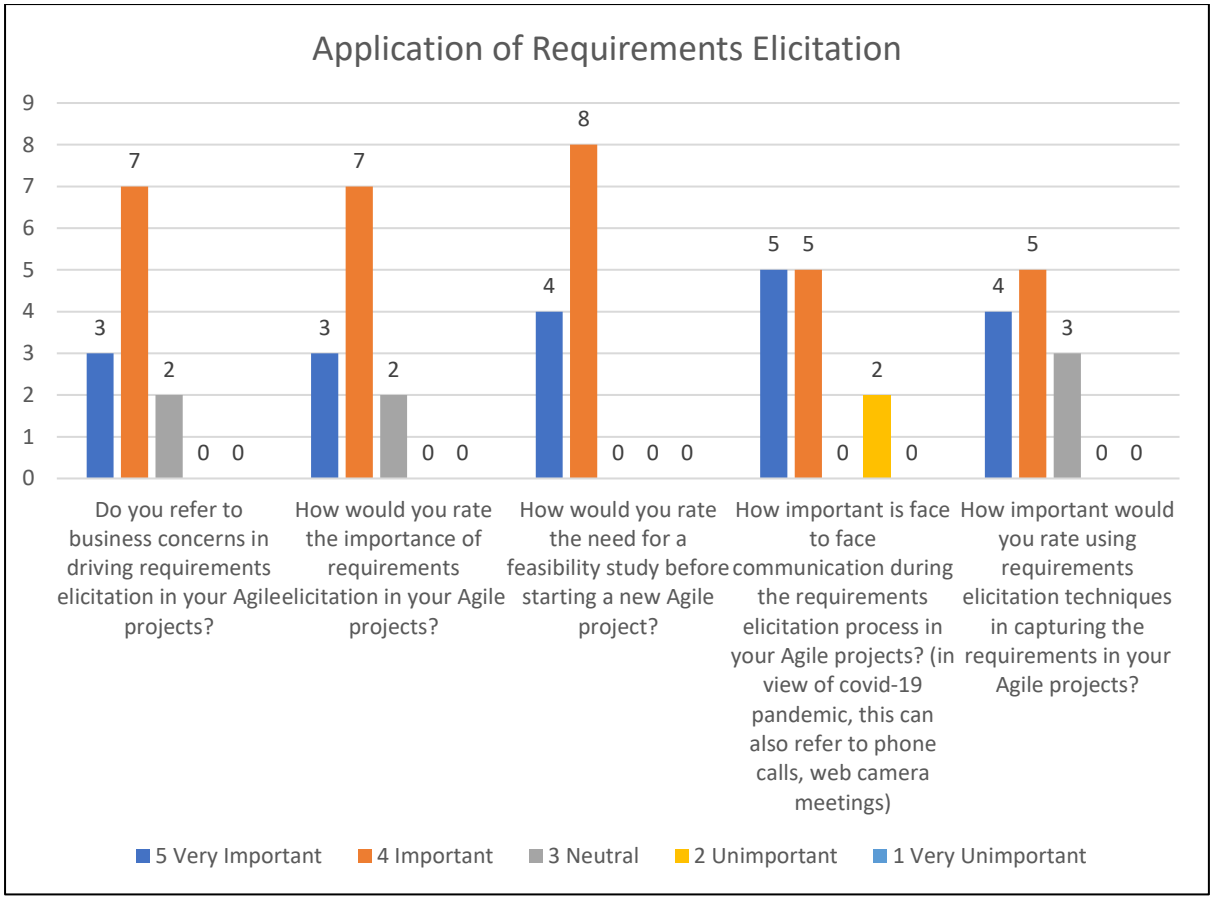


Figure 4.10: Application of Requirements Elicitation

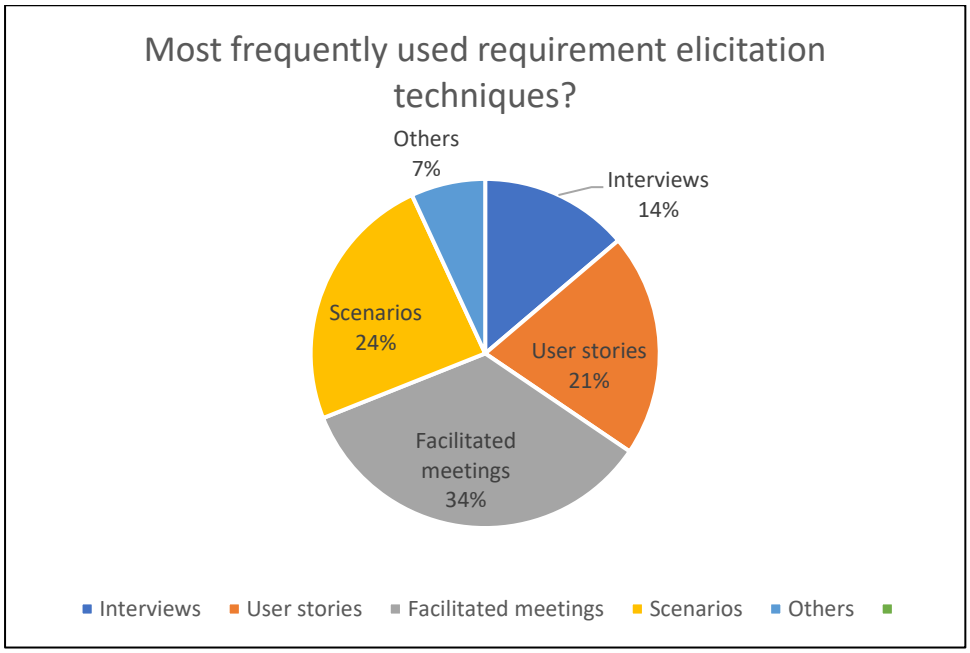


Figure 4.11: Most frequently used requirements elicitation techniques

Secondly, in the application of requirements analysis, the majority of survey respondents rated the importance of requirements analysis in Agile projects as 4 Important and 5 very Important, further affirming that this is a process that is an essential part of an Agile project. There is also common feedback that the respondents generally have some sort of checklist that is used during the requirements analysis process.

From the survey, 9 out of 12 respondents also rank requirements prioritisation as a vital step. This is further affirmed when 8 respondents select the use of criteria in assisting the prioritisation process, with the remaining 4 respondent taking a neutral stance in the use of criteria.

Additionally, it must be taken into consideration the critical need of having the stakeholders' commitment during this process, as highlighted by the majority of respondents rating it from 4 Important to 5 Very Important. The use of storyboards, diagrams or some sort of technique during the analysis process is also deemed of high important as seen through survey feedback.

To further understand how the respondents and their team manage the change of requirements, that occurs after the initial requirements release, a multiple-choice question was used, acknowledging that there are many options which the project team may choose to work with, depending on the complexity and scope of the changing requirements. As such, the outcome of this question, concluded that 45% of the respondents updates the product backlog, with 32% only choosing to work if there is a change request submitted, 18% workaround by regularly changing requirements specification.

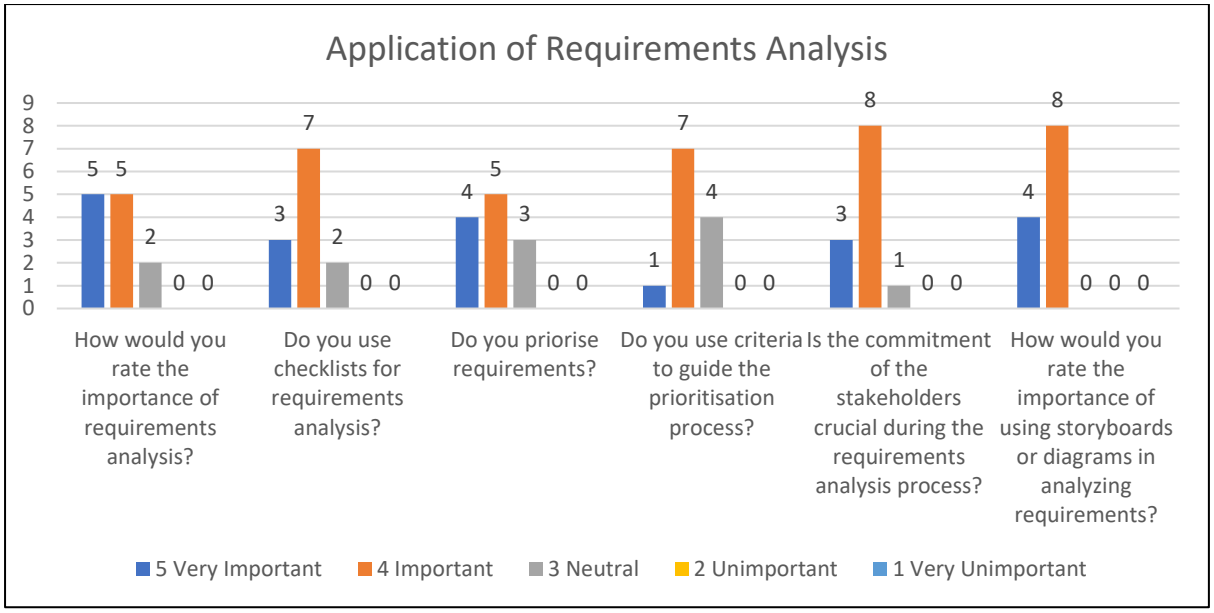


Figure 4.12: Application of Requirements Analysis

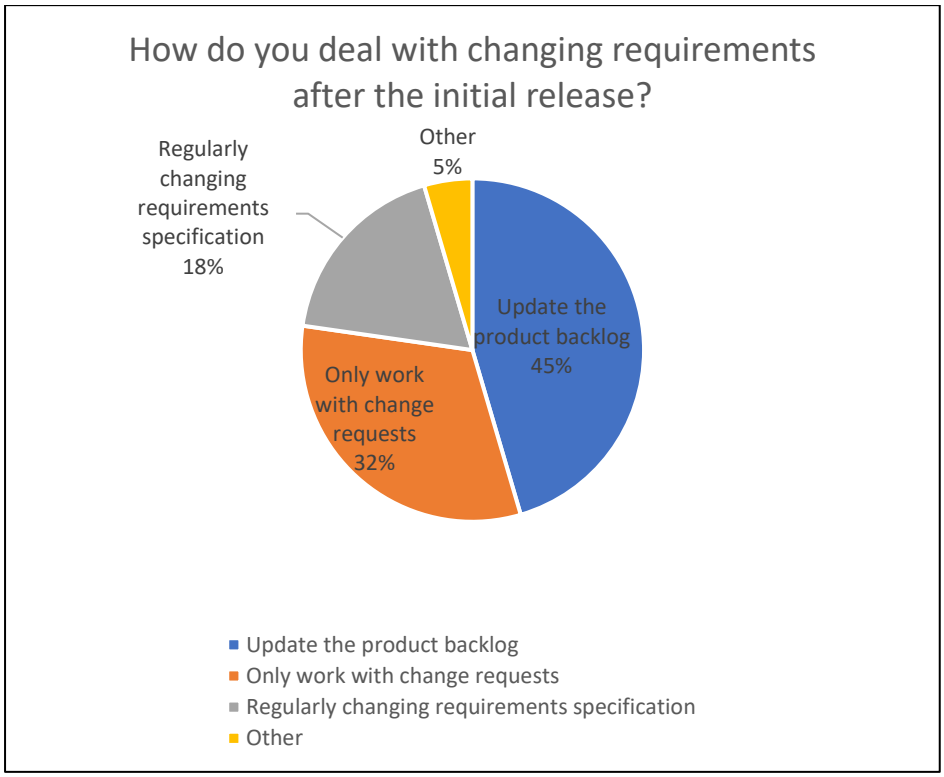


Figure 4.13: Dealing with changing requirements after the initial release

In the third process, requirements specification, it shows that between 10 to 11 respondents are in agreement that the they applied the use of proper documentation in their Agile projects and that the documentation procedure is done with inputs from consulting with the stakeholders of the project. In consideration of having a set of predefined policies to guide the requirements specification process, the majority of 10 respondents rate it as 4 Important and 5 Very Important. However, when referring to the need of having a sort of standard template for the specification process, 5 out of 12 are not certain or rate it as unimportant.

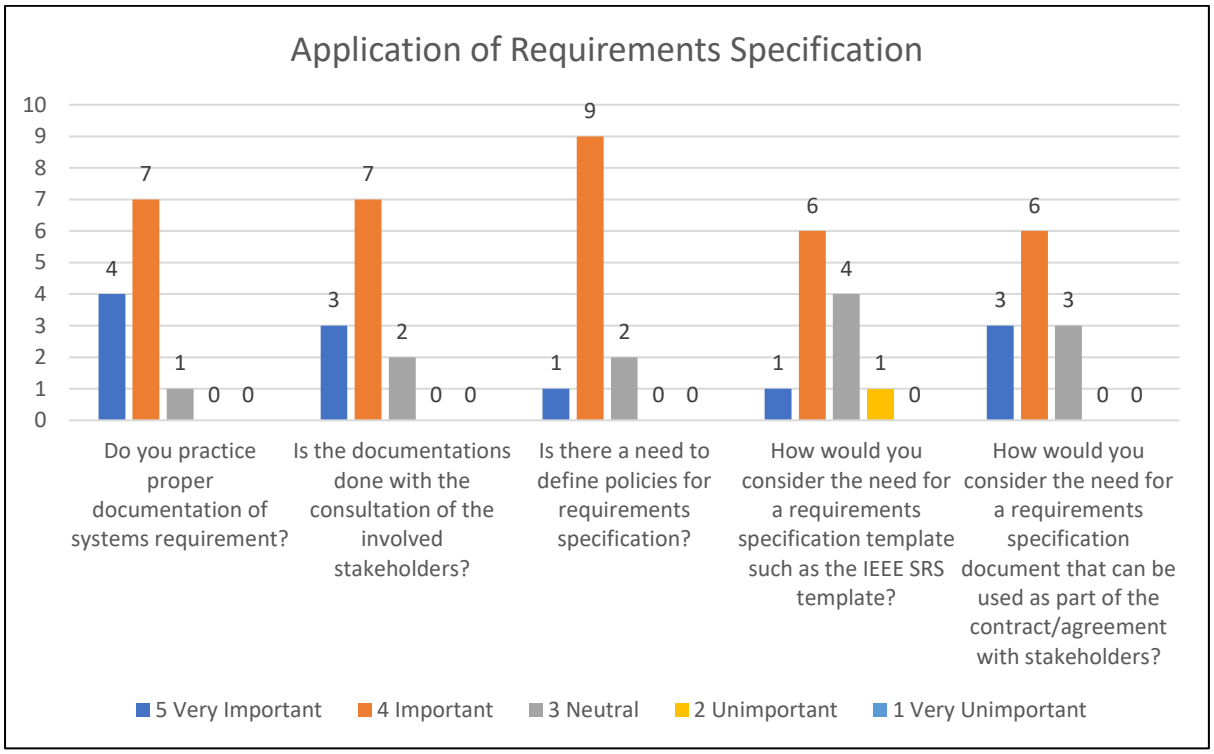


Figure 4.14: Application of Requirements Specification

The fourth and final process is the application of requirements validation. When considering if requirements validation is a significant part of the Agile process, all 12 respondents ranked it as 4 Important and 5 Very Important. Additionally, it can be seen that generally the respondents conduct reviews to ensure that the documentation of the require meets their expectations. This further corroborates with the following question pertaining to the importance of having formal requirements inspection, which resulted in a majority of 8 respondents answering as 4 Important and the balance 4 respondents selecting 5 Very Important. Using checklist during the requirements validation process is also deemed a crucial point, as agreed upon by the majority of the respondents. Also, note that all 12 respondents rank either 4 Important or 5 Very Important when it comes to performing the verification before the validation process is conducted for Agile based projects. A common technique used for requirements validations is prototyping, this opinion is also shared, with 10 respondents rating is as 4 Important and another 2 rating it as 5 Very Important.

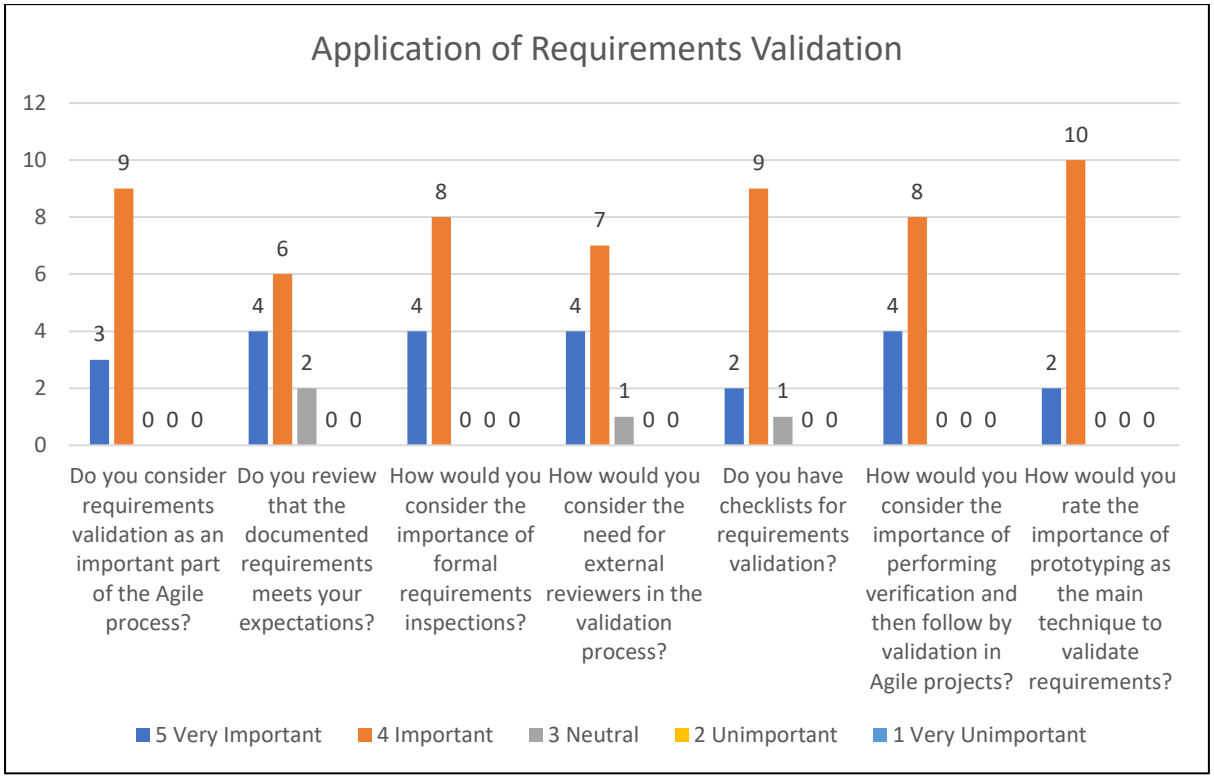


Figure 4.15: Application of Requirements Validation

## 4.4 Challenges of Requirements Engineering Processes in Agile Projects

This section will focus on analysing the results of the second Likert scale, which concentrates on comprehending the actual challenges which the software practitioners in Malaysia face, in the course of implementing requirements engineering processes in Agile based projects.

### 4.4.1 Resistance Factors in adopting Requirements Engineering in Agile Projects

Using the resistance factor approach, adapted based on Mohd. Hairul Nizam Md. Nasir, Ahmad and Hassan (2008), the total influence level score for each challenge or resistance, in adopting Requirements Engineering in Agile projects.

$$T(fn) = \sum_{n=13}^{n=1} L(fn).W(fn)$$

***T(fn)*** is the total influence level scores attributed to factor (f); sum of the score rated by the respondent in accordance to the number of responses to the levels of influence of each factor, multiplied by the weightage score.

***L(fn)*** is number of responses to factor (*f*) as rated by the respondent according to the influence level.

***W(fn)*** is the weightage score attributed to factor (*f*) according to influence level as assigned below.

***fn*** refers to the factor number.

***n*** refers to the number of resistance factors. There is a total of 13 factors.

Respondents are provided with 5 predetermined options for each resistance factor, ranging from 1 Strongly Disagree, 2 Disagree, 3 Neutral, 4 Agree, and 5 Strongly Agree. Each option is considered as an influence level, (L), and is then attached to a weightage score, with each level defined uniquely.

| Influence Level, ***L*** | Weightage Score, ***W*** |
|---|---|
| 1 Strongly Disagree | 1 |
| 2 Disagree | 2 |
| 3 Neutral | 3 |
| 4 Agree | 4 |
| 5 Strongly Agree | 5 |

Table 4.1: Value of Influence Level (***L***) and Weightage score (***W***)

### 4.4.2 Summary of the total influence score for the 13 challenges/resistance factors as rated by the 12 survey respondents

| *fn* | Resistance Factors | Strongly Disagree (1) | Disagree (2) | Neutral (3) | Agree (4) | Strongly Agree (5) | Weighted Score, *T(fn)* |
|---|---|---|---|---|---|---|---|
| F1 | On-going communication of requirements are a problem in the Agile projects | 0 | 1 | 3 | 4 | 4 | 47 |
| F2 | I find it challenging to gather requirements during the requirements elicitation process. | 0 | 0 | 4 | 8 | 0 | 44 |
| F3 | Lack of customer / end users' involvement have negative impacts to the Agile project process. | 0 | 0 | 1 | 5 | 6 | 53 |
| F4 | Inadequate or ambiguous requirements are considered as serious problems in the Agile projects. | 0 | 0 | 0 | 8 | 4 | 52 |
| F5 | I face conflicting and frequent changing requirements problem in Agile projects. | 0 | 0 | 4 | 6 | 2 | 46 |
| F6 | I face changing requirements problem in Agile projects. | 0 | 0 | 3 | 8 | 1 | 46 |
| F7 | Underscoping or overscoping of requirements leads to negative impacts in Agile projects. | 0 | 0 | 1 | 7 | 4 | 51 |
| F8 | Lack of documentation leads to a negative impact in Agile projects. | 0 | 0 | 1 | 6 | 5 | 52 |
| F9 | Traceability of requirements are a problem in Agile projects. | 0 | 2 | 1 | 7 | 2 | 45 |
| F10 | Proper record keeping of changes in requirements are a challenge in Agile projects. | 0 | 0 | 2 | 7 | 3 | 49 |
| F11 | Inadequate validation have negative impacts in Agile projects. | 0 | 0 | 0 | 6 | 6 | 54 |
| F12 | Requirements validations leads to a consistent product quality in the outcome of Agile projects | 0 | 0 | 0 | 9 | 3 | 51 |
| F13 | Participation of stakeholders have a positive impact in Agile projects. | 0 | 1 | 1 | 4 | 6 | 51 |

Table 4.2: Summary of the total influence score for the 13 challenges/resistance factors as rated by the 12 survey respondents

### 4.4.3 Ranking of the 13 challenges/resistance factors from the highest to the lowest

From the table, it can be seen that the top 3 challenges are inadequate validation, lack of customer/user' involvement and inadequate or ambiguous requirements leading to negative impacts or causing critical problems in the Agile projects. As the majority of the survey respondents have rated these as 4 Agree and 5 Strongly Agree, in representing these responses using the resistance factor will help provide another level of depth as to the overall level ranking of these challenges. The top-ranking challenges will be further addressed in the proposed roadmap through certain steps on the checklist to help mitigate these issues as highlighted by the survey respondents. Figure 4.15 shows the results of Table 4.3 represented in a bar chart for a clearer visual representation.

| Process | *fn* | Resistance Factors | Weighted Score, *T(fn)* |
|---|---|---|---|
| Validation | F11 | Inadequate validation have negative impacts in Agile projects. | 54 |
| Elicitation | F3 | Lack of customer / end users' involvement have negative impacts to the Agile project process. | 53 |
| Analysis | F4 | Inadequate or ambiguous requirements are considered as serious problems in the Agile projects. | 52 |
| Specification | F8 | Lack of documentation leads to a negative impact in Agile projects. | 52 |
| Analysis | F7 | Underscoping or overscoping of requirements leads to negative impacts in Agile projects. | 51 |
| Validation | F12 | Requirements validations leads to a consistent product quality in the outcome of Agile projects | 51 |
| Validation | F13 | Participation of stakeholders have a positive impact in Agile projects. | 51 |
| Specification | F10 | Proper record keeping of changes in requirements are a challenge in Agile projects. | 49 |
| Elicitation | F1 | On-going communication of requirements are a problem in the Agile projects | 47 |
| Analysis | F5 | I face conflicting and frequent changing requirements problem in Agile projects. | 46 |
| Analysis | F6 | I face changing requirements problem in Agile projects. | 46 |
| Specification | F9 | Traceability of requirements are a problem in Agile projects. | 45 |
| Elicitation | F2 | I find it challenging to gather requirements during the requirements elicitation process. | 44 |

Table 4.3: Table showing the ranking of the 13 challenges/resistance factors from the highest to the lowest score

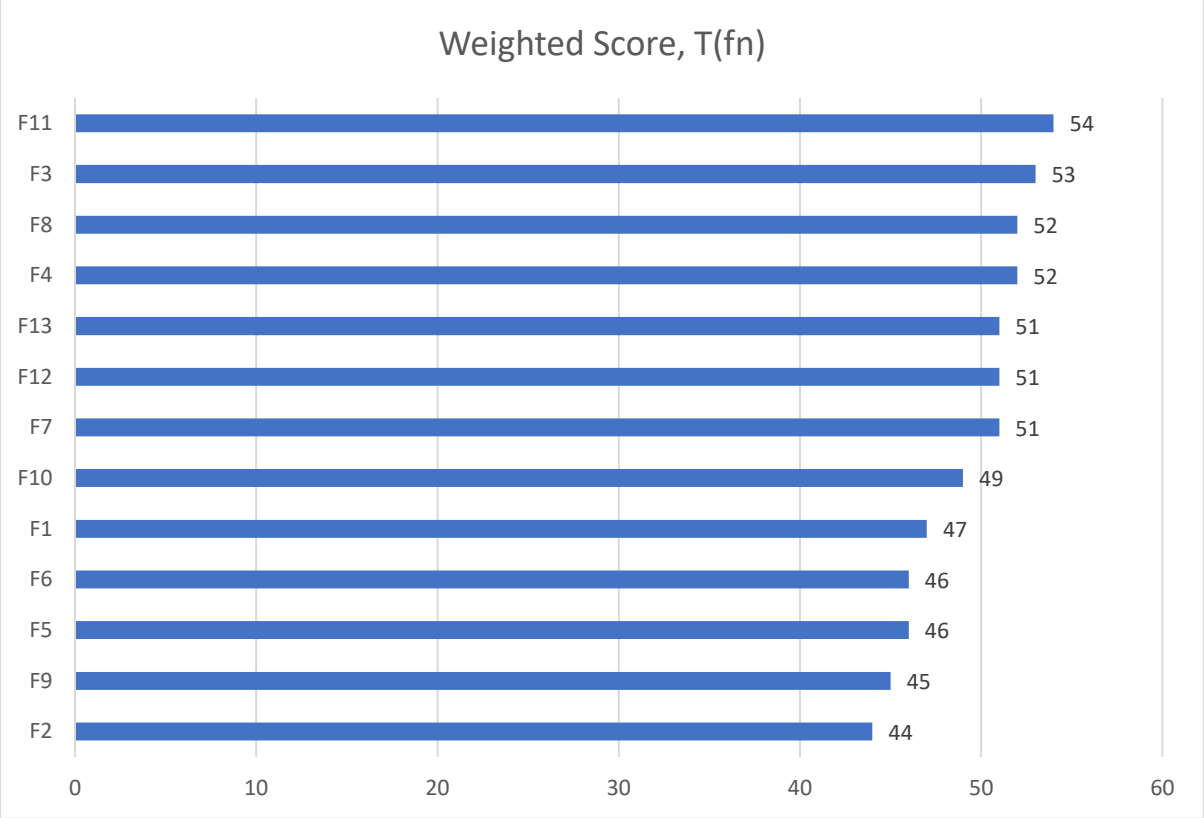


Figure 4.15: Bar chart showing rankings of 13 challenges/resistance factors from the highest to the lowest weighted score

## 4.5 Conclusion

In conclusion, the outcome of the survey conducted in Malaysia, despite the low level of respondents seems to match the findings as shared on the literature review. This is seen in the majority of the responses in the first Likert Scale pertaining to the application of agile RE, ranking mostly 4 Important and 5 very Important or the second Likert Scale relating to the challenges in agile RE being rated 4 Agree and 5 Strongly Agree. These points will be revisited in the proposed roadmap ensuring that suitable RE applications and proper processes should be included in the checklist to guide software practitioners in Malaysia intending to adopt agile RE.

# CHAPTER 5

## PROPOSED ROADMAP

### 5.1 Introduction

This chapter will discuss on the proposed roadmap pertaining to Requirements Engineering (RE) Processes in Agile projects for software practitioners in Malaysia. This roadmap will be in the form of a checklist which serves as an overview guide to the steps which a software practitioner should take to apply requirements engineering in Agile based projects. This checklist would be suitable for small or medium sized companies who do not adopt nor have standard formal protocols within their organisation in practising requirements engineering. The proposed roadmap consists of a checklist produced for the use of software practitioners looking to improve the adoption of Agile practices in requirements engineering. There are 12 points in Requirements Elicitation, 4 points in Requirements Analysis, 6 points in Requirements Specification and 8 points in Requirements Validation, amounting to a total of 30 points to guide the processes.

### 5.2 Checklist for Requirements Elicitation

In the initial process of requirement elicitation, a frequently encountered challenge as reported in an empirical study of critical requirements engineering practices (Palomares et al., 2021) is the challenges relating to stakeholders. Referring to table 5.1: Checklist for Requirements Elicitation below, the first step on the checklist is, *identify stakeholders*; they should have a good understanding of the requirements and project scope, hereby minimising costs and delays due to poor knowledge about the project requirements. *Define the project objectives*, in Schon et al. (2017), this is the product owner's responsibility to communicate a shared understanding of the product goals and sub-goals, so that everyone holds a responsibility to work towards the project objectives.

Similar to Melegati et al (2019), it is crucial to *form a project team*; this means organising a group of people to work together as a project team. The project team plays an indispensable role and is similar to the role of Product Owner in Scrum methodology or Product Manager in Extreme Programming methodology; to be responsible and to assist in the elicitation, analysis, specification and validation activities for the project (Melegati et al., 2019).

Once the project objectives have been firmly established in the conceptualisation phase, it is prudent to execute *feasibility study* to further assess the project's viability and a part of the project's risk management (Cagliano, Grimaldi and Rafele, 2015). There are various types of feasibility studies available and each is dependent on the appropriateness of the project scope, objectives, organisation and outcome of the assessment. Generally, the feasibility study aims to look into the project viability from various areas; namely technical, economic, legal, operational and scheduling before any formal commitment of resources, time, and budget are finalised. (Simplilearn, 2022). This is also in line with the survey results, with all 12 respondents rating the need of a feasibility study as 4 Important and 5 Very Important. Through feasibility stage, the organisation or stakeholders agree upon making formal commitments to the project.

The roadmap also proposes the *use of elicitation techniques* to perform the requirements elicitation process. A systematic review done by Canche and Pino (2021), shares that each elicitation technique has its own advantages and disadvantages; and that other factor such as the expertise and level of communication skills of the stakeholders, coupled with availability of time, budget and resources also needs to be analysed to select the most appropriate technique. Amongst the commonly types of technique, includes; group interaction (meetings, workshops, brainstorming), individual participation (interviews, questionnaires), user stories, scenarios, market research, reuse of requirements in similar projects of the same domain.

Communication was also a critical issue in the adaptation of requirements engineering in Agile projects. In the survey that was conducted, 83% of the respondents evaluated that face-to-face communication as an essential part of requirements elicitation with 67% respondents agreeing that maintaining on-going communication as a difficult task. Amongst the checklist on the roadmap which are communication related to help mitigate this challenge, are *initiating communication from the beginning of the project*, scheduling *constant and regular communication with team members*, *improving communication through multiple channels*, and *maintaining direct communication with the customer*. As suggested by Rasheed et al. (2021) and Dasanayake et al. (2019), direct communication can be initiated through surveys and interviews; minimizing information distortion, reduce the wait time and increase the urgency of taking actions. The initial engagement of the team members will also prove beneficial to ensure that they understand the project scope, changes and technical details involved (Rasheed et al., 2021). This is further corroborated in Schon et al. (2017), where more than 8 experts suggested that stakeholders need to be regularly involved in

review and meetings to provide crucial feedback. This is one of the top 3 ranked concerns as highlighted by the second highest weighted score in the survey analysis, that lack of customer's involvement leads to serious negative impacts to the Agile project.

Next on the checklist pertains to *establishing needs and priorities* of the stakeholders. According to Palomares et al. (2021), this is a challenge which ranked rather highly at 42% from 10 interview subjects. As such, it should be prioritised that the needs and priorities should be in a clear and well-articulated manner, as this will assist in requirements ambiguity. This will aid greatly in addressing the lack of prioritisation which accounted for 32% respondents considering it to be critical requirements elicitation problem. It should also be considered to ensure that *sufficient buffer is included during the planning stage of the pre-releases* as a way of mitigating requirements volatility (Dasanayake et al., 2019). In line with the Agile Manifesto principle of accommodating changing requirements throughout the development process (Beck, et al., 2011), the roadmap also looks into anticipating the need to *revisit and updates* changing requirements throughout the project life cycle.

| **5.2 Checklist for Requirements Elicitation** | |
|---|---|
| **Proposed Roadmap** | **Sources of References** |
| *Identify stakeholders* | (Palomares, et al., 2021) |
| *Define the project objectives* | (Schon, et al., 2017) |
| *Forming a project team* | (Melegati, et al., 2019) |
| *Consider conducting feasibility study (technical, organisational, economics)* | (Cagliano, Grimaldi and Rafele, 2015) |
| *Use elicitation techniques* | (Canche and Pino, 2021) |
| *Initiate communication from the beginning of the project* | (Rasheed, et al., 2021) & (Schon, et al., 2017) |
| *Maintain constant and regular communication between team members* | (Rasheed, et al., 2021) |
| *Improve communication using multiple communication channels* | (Dasanayake, et al., 2019) |
| *Maintain direct communication with customer* | (Rasheed, et al., 2021) & (Dasanayake, et al., 2019) |
| *Establish needs and priorities* | (Palomares, et al., 2021) |
| *Include sufficient buffer for planned releases during the planning stage* | (Dasanayake, et al., 2019) |
| *Revisit and update* | (Beck, et al., 2011) |

Table 5.1: Checklist for Requirements Elicitation

## 5.3 Checklist for Requirements Analysis

With over 83% of the 12 respondents rating the need for requirements analysis as an important or very importance, this process is also an essential part of requirements analysis. To support this process, the roadmap proposes (in reference to Table 5.2: Checklist for Requirements Analysis) that the *modelling or storyboard of the requirements* is carried out. In Inayat et al. (2015), requirement modelling is used in helping the team refine the requirements in each iteration. The survey respondents also rated using storyboards or diagrams as a top method (at 35%) in overcoming the challenge of requirements analysis.

Among the various types of modelling methods, are enterprise modelling, data modelling, domain modelling, non-functional requirements (NFR) modelling and more. In O'Driscoll (2016), in a study using Agile Design Data Modelling (ADDAM), it was concluded that data modelling process was a very effective communication tool in aiding the stakeholders to better understand how the new system works and what it can deliver. This will prove useful in helping the team and stakeholders identify incomplete or hidden requirements which are considered top critical problems in requirements analysis (at 47%) in the survey conducted. This concern was further reaffirmed as inadequate or ambiguous requirements rated top 3 of the highest weighted score by the survey respondents.

Next on the checklist refers to *categorising and prioritisation of requirements* as seen in Naicker and Maharaj (2020). By arranging the requirements in categories and levels of priority, this can help the team to easily revisit and make decisions pertaining to the development process. Furthermore, the *commitment of the team and stakeholders to conduct iterative analysis* is required to hereby guide and ensuring that the requirements align with the project objectives. This is in line with Elghariani and Kama (2016) determining that in the course of close and frequent communication between stakeholders, this will lead to an evolvement of requirements, thus rendering it a necessity to have anticipate and commit to an iterative analysis process. This also mitigates inadequate or ambiguous requirements which are considered as serious issue in Agile based projects, as agreed by all 12 respondents of the survey.

Lastly, parallel to the last point in requirements elicitation, the team needs to be committed to *revisit and update* changing requirements as and when required, in accordance with Agile principles to accommodate changes (Beck, et al., 2011).

| **5.3 Checklist for Requirements Analysis** | |
|---|---|
| **Proposed Roadmap** | **Sources of References** |
| Provide modelling of the requirements<br>(eg., Enterprise modelling, Data modelling, Domain modelling, NFR modelling, etc) | (Inayat, et al., 2015) &<br>(O'Driscoll, 2016) |
| Categorise and prioritise requirements | (Naicker and Maharaj, 2020) |
| Commit to an iterative analysis process | (Elghariani and Kama, 2016) |
| Revisit and update | (Beck, et al., 2011) |

Table 5.2: Checklist for Requirements Analysis

## 5.4 Checklist for Requirements Specification

Within the requirements specification process, in reference to Table: 5.3: Checklist for Requirements Specification, the first recommendation on the roadmap pertains to the *education of the use of formal specification practices*. Lack of documentation within this process is a reoccurring theme, and as investigated during Rodrigues et al. (2018), these challenges were found to be related to the subject's lack of formal specification knowledge. Thus, providing training on formal specification practices such as Z notation, or B methods should aid in the process.

With the training provided, this team find it much easier to comprehend and to *adopt formal specification techniques*. Correspondingly, Rodrigues et al. (2018) and Rasheed et al. (2021) also found that when the subjects applying of formal specification techniques that they were taught, their perception regarding the difficulty of the process had changed for the better. In *streamlining the specification writing process*, this can better establish the relationships of the requirements; a good engineering requirements document should be coordinated, clear and comprehensible, feasible, complete, verifiable, traceable and necessary (Huang, 2021). These steps should help address the proper record keeping of changes in requirement which the majority of the respondents, at 83% had agreed and strongly agreed that it was challenging. 37% of respondents further responded that development of proper policies or templates helped overcome the issue, hence by streamlining the process, it could greatly

assist in standardisation of the specification writing process and perhaps lead to companies developing policies and templates for the use of software agile teams.

Rasheed et al. (2021) suggested that the stakeholders write *user stories and case scenarios* to better capture the requirements for the software development teams. Moreover, software practitioners should consider using *tools in assisting in improving documentation practices*; such as Jira, Wiki, Trello or Clickup. These tools may help in structuring recording of the requirements and aligning them into various hierarchical levels, hereby ensuring that the requirements are adequately collected and properly documented (Dasanayake et al., 2019). The last on the checklist on the specification process is similar to the previous processes, which is the *revisitation and update* of changing requirements as per the Agile manifesto (Beck, et al., 2011).

| **5.4 Checklist for Requirements Specification** | |
|---|---|
| **Proposed Roadmap** | **Sources of References** |
| Educate the use of formal specification practices | (Rodrigues, et al., 2018) |
| Adopt formal specification techniques | (Rodrigues, et al., 2018) & (Rasheed, et al., 2021) |
| Streamline the specification writing process | (Huang, L., 2021) |
| Write user stories with brief description | (Rasheed, et al., 2021) |
| Use tools to assist in improving documentation practices (eg. Jira, Wiki, Trello) | (Dasanayake, et al., 2019) |
| Revisit and update | (Beck, et al., 2011) |

Table 5.3: Checklist for Requirements Specification

## 5.5 Checklist for Requirements Validation

The roadmap for requirements validation (in referring to Table 5.4: Checklist for Requirements Validation) begins with a *pre-revision*. In reference to Maalem and Zarour (2016), this is an overview to detect missing requirements, faulty spelling, non-standard compliant and typographical errors. Moving on, the team also needs to *validate the working system*, this means checking ensuring that the product has been developed in accordance to the specification. This can be done using the 3 C's: consistency, correctness and completeness (Kamalrudin and Sidek, 2015). As the highest weighted score in the survey, inadequate validation has negative impacts to the Agile project, thus, by using the 3 C's, to perform the validation checks, this can resolve this underlying challenge within the requirements engineering process.

It is prudent to properly validate the project, this is in line with 44% of the respondents from the survey agreeing that the use of checklists to guide the requirements validation process may help in mitigating the challenges of requirements validation. Next on the list refers to using *Computer Assisted Software Engineering (CASE) tools* to assist and aid the process. CASE tools in general refers to any form of automated support related to software engineering. In Atoum et al. (2021), some examples of tools used are the Automated Inconsistency Checker (MaramaAIC) and TestMERred. With CASE tools, it is hoped that this might aid the *revision of the requirements*. This means identifying inconsistencies, conflicts and omissions, with the aim to minimize any changes (Maalem and Zarour, 2016).

Maintaining *traceability* is also said to be a challenge during the validation process, this refers to documenting the dependencies between requirements and the sources of the requirements, dependencies between the requirement themselves and between requirements in system implementation (Tukur, Umar and Hassine, 2020). Dasanayake et al. (2019) further adds that by improving traceability, this can help the team to understand any implications which may occur due to changing requirements. *Inspection of requirements* to help ensure that the product outcome is understandable is another validation point in Maalem and Zarour (2016).

Additionally, the roadmap also proposes to *use validation techniques* in helping the validation process. Prototyping is a popular validation technique, as agreed by 30% the survey respondents. Rasheed et al. (2021) suggests that the use of prototyping can mitigate unambiguous documentation and serves as a visual medium in understanding the requirements of the system However, it should be noted that there are other types of

validation techniques which can be used, namely Minimum Viable Product (MVP) and mock-ups.

Last but not least, *revisiting and updating* of changing requirements as per the Agile manifesto (Beck, et al., 2011).

| **5.5 Checklist for Requirements Validation** | |
|---|---|
| **Proposed Roadmap** | **Sources of References** |
| Pre-revision | (Maalem and Zarour, 2016) |
| Validate the working system | (Kamalrudin and Sidek, 2015) |
| Use case tools to assist in validating requirements | (Atoum, et al., 2021) |
| Revision of requirements | (Maalem and Zarour, 2016) |
| Traceability | (Tukur, Umar and Hassine, 2020) & (Dasanayake, et al., 2019) |
| Inspection of requirements | (Maalem and Zarour, 2016) |
| Use of validation techniques (eg. Prototyping, MPV, mock-up) | (Maalem and Zarour, 2016) & (Rasheed, et al., 2021) |
| Revisit and update | (Beck, et al., 2011) |

Table 5.4: Checklist for Requirements Validation

## 5.6 Conclusion

It is hoped that the proposed roadmap would aid software practitioners in Malaysia navigate the common challenges faced when working with requirements engineering in Agile based projects. These steps were derived from a combination of literature review and survey results to further ensure that it fully encompasses the both, in theory and real-life situations of how-to best practice requirements engineering in Agile projects.

# CHAPTER 6

## FEEDBACK OF PROPOSED ROADMAP

### 6.1 Introduction

This section pertains to seeking validation in form of feedback from actual software industry practitioners who understand the process and application to be able to give credible feedback in terms of applicability and feasibility in using the proposed roadmap in referring to objective 4 below:

**Objective 4:**

*To validate the proposed roadmap via semi-structured interview with software company representatives.*

Having industry experts to provide feedback to review the findings outcome and to provide valuable insights from the industry will provide a certain degree of reliability to the results of the data collects despite the low number of survey respondents. This will be done through 2 interviews with agile-based software practitioners working in the Malaysian software development industry.

### 6.2 Interviewees Selection and Background

There were two interviews conducted from representatives from the software industry, coming from different companies and different backgrounds. This is to facilitate collecting different perspectives or outcomes from the feedback session.

The first interviewee (Interviewee 1) is a PMO (Project Manager Officer) who is working in an MNC (multinational company) based in Malaysia branch. The company specialises in delivery software solutions relating to CRM (Customer Relationship Management). There is no specific industry, as the company covers across all sectors. Most current project being related to telecommunications company. Though he has 10-15 years of working experience, he started using Kanban as the preferred Agile methodology back in 2017 from previous other projects and has continued to work using Agile until today.

The second interviewee (Interviewee 2) is the APAC (Asia Pacific) Regional Head of Delivery. He also comes from a worldwide company which has branches all over the world. The company is a niche service provider specialising in compliance software license

management, optimisation of IT software assets, formulating security requirements and subsequently deploying them for the customers and has also recently branched out into cloud. The type of industry varies from the military to aerospace to non-profit organisations. His role ranges from working with customers from FMCG (Fast-Moving Consumer Goods), mining sector, energy industry and health sector. From the 15 years of working experience, he has 5 years of working experience with Agile, and about 20%-25% of his company is practising Agile, with the preferred method being Scrum, or Kanban mostly.

## 6.3 Key Take-Aways

Both Interviewee 1 and Interviewee 2 provided some favourable feedback to the initial draft of the roadmap and is also in agreement with most of the outcome of the survey results, pertaining to how RE is being practiced in Malaysia, challenges faced and mitigation steps taking to work towards overcoming those challenges.

### 6.3.1 Current level of Requirements Engineering adoption in their company

Interviewee 1 shared that agile is not entirely assimilated into his company as based upon the select adoption of RE processes by his team and overall, the organisation. Additionally, Interviewee 2 shared that his company is not fully adopting Agile, between 20%-25% of the company is actually practising Agile, and though there is no strong management push towards using Agile, the company has been working on educating teams and project managers on the benefits of using Agile, during the RE process to encourage adoption and practice of agile RE processes.

### 6.3.2 Main challenges faced by the organisation

Both interviewees agree with the common challenges faced as highlighted by the results of the survey conducted, and has shared how their team works to resolve these areas and the impact of these changes upon the entire project itself, in terms of timeline, budget, contingency adjustments. As such, Interviewee 1 is commented that the need for sufficient buffer during the planning stages as one of the checklists on the requirement elicitation roadmap will be essential to the project, as they do anticipate changes as part of the agile philosophy.

Interviewee 2 addressed the level of commitment and understanding of the RE processes from the stakeholder’s perspective, and in having multiple channels of

communication and regular meetings with the stakeholders would be a possibly mitigation to this challenge. They also worked towards educating the stakeholders on how and why these steps are important as part of the Agile projects. He further pointed out, that though the organisation did not have very detailed specification process, they do not have difficulties in requirements specifications, as they rely upon other types of documentation; such as minutes of meetings which are well documented to address the issue. This is similar to interviewee 1 who shared that the organisation has a set of project charter which will remain as their main point of reference through the many phases of the project life cycle.

### 6.3.1 Inclusion of risk management

Interviewee 1 suggested that the inclusion of risk management is very important to the requirements engineering process, as it may be the point of reference for the team or the organisation. These would be related to schedule, budget, process, quality and others; it may be specific to the project depending on the project's needs and requirements. This has been relooked into; and the checklist is now inclusive of feasibility studies, which is intended for various aspects, such as technical, economic, legal, operational and scheduling.

### 6.3.2 Providing better clarify, details and examples of the points reflected on the checklist

Interviewee 2 highlighted that the generality of the types of words or sentences as used in the checklist may not be easily comprehended by the team manager or team members who might be not familiar with the terms. This is a valid concern in the working environment to avoid any form of miscommunication or misinterpretation. Thus, certain word and sentences have been restructured or edited accordingly, together with providing better concrete examples to illustrate the statement in the checklist.

## 6.4 Conclusion

Based upon the suggestions and feedbacks of Interviewee 1 and Interviewee 2; which proved most valuable as they have industry experience pertaining to the research; the roadmap has included feasibility study as part of risk management factors within the requirements elicitation process and also redefined certain words and sentences within the checklist and notes to the checklist to provide a better clarify and comprehension for software practitioners who may be new to agile requirements engineering.

# CHAPTER 7

## CONCLUSION AND RECOMMENDATION

### 7.1 Introduction

This chapter oversees the discussion and outcome of the research which were done in line with the research objectives initially defined in the beginning of the research and the overall conclusion from the research study.

### 7.2 Discussion on Research Objectives

**Objective 1:**

*To examine the application of Requirements Engineering processes in Agile-based projects.*

In regards to objective 1, the application of Requirements Engineering processes was done through a combination of literature review using e-journal papers, articles and books (in Section 2.6) to comprehend the methodology of application of requirements engineering in other countries and companies, and additionally the survey was conducted to learn how locally, in Malaysia, if the method of application is similar as well (in Section 4.3).

The adoption and application of requirement engineering is dependent varying factors, some such as the size of the project, project scope, organisational culture, company size. It is also significant to understand if the organisation is indeed fully practicing Agile as mentioned or only adopting certain components of Agile in the requirements engineering process. In Malaysia, the initial survey outcome that was about 26 respondents drastically reduced to 12 during the participation screening questions, which aimed to verify that the respondents have the necessary background or work experience which is relevant to the research study. Though, the size of the participation is small, and may not represent the entire group of software practitioners in Malaysia, this still provided some insight that there seems to be a lack of awareness or adoption of agile requirements engineering in the Malaysia context.

**Objective 2:**

*To synthesize the challenges, limitations and impacts of Requirements Engineering processes in Agile-based projects.*

For Objective 2, to gather the limitations, challenges and potential negative or positive impacts faced during the application of requirements engineering in particular elicitation, analysis, specification and validation; this information was concluded through thorough literature research (in Section 2.7) this was again revisited through a survey conducted by Malaysian software practitioners (in Section 4.4) to corroborate the findings through the initial literature study.

The literature review suggests that though some companies widely practice agile methodology in requirements engineering, there are some limitations and challenges which they face in trying to implement the processes. In the survey conduct by software practitioners in Malaysia, they seem to be in agreement some common challenges faced by other software practitioners from other parts of the world. This suggests that there is commonality faced pertaining to these challenges regardless of which organisation or country the software practitioners are from.

**Objective 3:**

*To conceptualise a roadmap to mitigate the challenges in Agile-based projects*

In Objective 3, the proposed roadmap was formed through the various studies using, articles, e-journals, books, and the combination of the actual survey outcome to be used as an exploratory guide for software practitioners in Malaysia, who have some concerns in implementing requirements engineering process in agile based projects. The proposed roadmap serves as a checklist (in Section 5) this will also be further elaborated by Appendix E: Notes to the Checklist.

From understanding how requirements engineering is properly applied in agile based projects and how the type of application aids the process, there is an understanding that with the appropriate measures taken and proper steps adopted, it can be a way of mitigation to negate the limitations which are faced by software practitioners as they work to implement the right processes. This gave structure to the proposed roadmap to serve as a foundation checklist in providing the types of processes that can guide the team in properly implementing requirements engineering within the agile context.

**Objective 4:**

*To validate the proposed roadmap via semi-structured interview with software company representatives.*

With Objective 4, understanding that there might be concerns in proposing the roadmap and how in theory it might be applicable but in the real working environment, this may not be appropriated or suitable, the research also required some feedback in form of experts with valuable work experiences within the Agile area to evaluate the roadmap and to provide suggestions for improvements on the roadmap (Section 6).

This was done though semi-structured interview with 2 representatives from the software companies located in Malaysia (and also different parts of the world), who work in with agile and with requirements engineering. They were mostly in agreement with the survey outcome and that it aligned with their work experiences as well. Furthermore, they gave favourable feedback on the proposed roadmap and expressed optimism that it would prove useful to guide the team manager and team looking to implement agile and requirements engineering, as the steps are comprehensive and also in-tune with their own practices.

## 7.3 Limitation and Recommendation for Future Work

With the low number of respondents turnout for the survey conduct, there is limitation using this research to generalise how Malaysian software practitioners adopt requirements engineering in Agile based projects, as such the results may not fully represent the actual software industry in Malaysia. There are also limitations in investigating how adequately is agile adopted by the respondents, as there are might be concerns that the organisation that they worked for is not fully accommodating the agile requirements engineering concepts, this was not fully explored in this research scope due to time and budgetary constraints. Additionally, there are other areas of requirements engineering which may not be fully dived deeper into to better understand the processes.

It is recommended that the roadmap be tested in a real environment to fully validate and comprehend how to better improve the checklist and processes in making it more industry relevant in the actual application of the roadmap in Agile based projects for software practitioners in Malaysia. There are possible gaps which may not be identified through the

survey or the feedback interview, and these are areas which can be further studied in subsequent researches pertaining to the roadmap.

## 7.4 Conclusion

In conclusion, though agile requirements engineering is an emerging topic within the software development industry around many parts of the world, this field is still relatively new and exploratory for software practitioners in Malaysia, due the limited research that is currently available in the Malaysia context and from the insight of the initial survey respondents before and after the participating screening question was provided.

However, it can be seen that the challenges faced by the Malaysia software practitioners are quite similar to the ones faced by software practitioners from varying parts of the world. As such, some of the suggestions or mitigations which was adopted by other organisations can also be adapted to the context of Malaysia software practitioners in the form of a proposed roadmap, as a checklist guide to aid the software practitioners in Malaysia.

The proposed roadmap presents main steps or best practice processes which are critical to the main requirements engineering processes, namely, requirements elicitation, requirements analysis, requirements specifications and requirements validation, and fully encompasses how this can assist the software practitioners to mitigate the challenges and limitations encountered using the appropriate processes involved.

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# APPENDICES

## APPENDIX A: Ethical Clearance Approval letter

## A) Demographics

13. Name *

14. Company Name *

15. Position *

- ◯ Software Engineer
- ◯ Software Tester
- ◯ Project Manager
- ◯ Software Architect
- ◯ Technical Lead / Team Lead
- ◯ Staff Engineer
- ◯ Other

16. Type of Industry or Main Business Focus *

- ◯ Information Technology
- ◯ E-Commerce
- ◯ Financial Services
- ◯ Consumer Products or Services
- ◯ Education
- ◯ Medical
- ◯ [ ]
  Other

17. Highest Level of Qualification *

- ◯ Diploma
- ◯ Bachelor's Degree
- ◯ Master
- ◯ PhD
- ◯ Professional certification
- ◯ [ ]
  Other

18. Years of working experience *

- ◯ Less than 5 years
- ◯ 5 to 10 years
- ◯ 10-15 years
- ◯ More than 20 years

19. Which Agile method does your team/organisation adopts? *

- ◯ Scrum
- ◯ Kanban
- ◯ Extreme Programming
- ◯ [ ] Other

20. Are there any established Requirements Engineering standards/protocols within your organisation? *

- ◯ Yes
- ◯ No

## B) Likert Scale (Q17-Q20)

Q17-Q20 intends to gather your opinion on the level of importance of the Requirements Engineering processes using a likert scale.
Kindly select the most applicable scale (only 1 answer per question)

21. Requirements Elicitation *

| | 1 Very Unimportant | 2 Unimportant | 3 Neutral | 4 Important | 5 Very Important |
|---|---|---|---|---|---|
| Do you refer to business concerns in driving requirements elicitation in your Agile projects? | ○ | ○ | ○ | ○ | ○ |
| How would you rate the importance of requirements elicitation in your Agile projects? | ○ | ○ | ○ | ○ | ○ |
| How would you rate the need for a feasibility study before starting a new Agile project? | ○ | ○ | ○ | ○ | ○ |
| How important is face to face communication during the requirements elicitation process in your Agile projects? (in view of covid-19 pandemic, this can also refer to phone calls, web camera meetings) | ○ | ○ | ○ | ○ | ○ |
| How important would you rate using requirements elicitation techniques in capturing the requirements in your Agile projects? | ○ | ○ | ○ | ○ | ○ |

22. Requirements Analysis *

| | 1 Very Unimportant | 2 Unimportant | 3 Neutral | 4 Important | 5 Very Important |
|---|---|---|---|---|---|
| How would you rate the importance of requirements analysis? | ○ | ○ | ○ | ○ | ○ |
| Do you use checklists for requirements analysis? | ○ | ○ | ○ | ○ | ○ |
| Do you priorise requirements? | ○ | ○ | ○ | ○ | ○ |
| Do you use criteria to guide the prioritisation process? | ○ | ○ | ○ | ○ | ○ |
| Is the commitment of the stakeholders crucial during the requirements analysis process? | ○ | ○ | ○ | ○ | ○ |
| How would you rate the importance of using storyboards or diagrams in analyzing requirements? | ○ | ○ | ○ | ○ | ○ |

23. Requirements Specification *

| | 1 Very Unimportant | 2 Unimportant | 3 Neutral | 4 Important | 5 Very Important |
|---|---|---|---|---|---|
| Do you practice proper documentation of systems requirement? | ◯ | ◯ | ◯ | ◯ | ◯ |
| Is the documentations done with the consultation of the involved stakeholders? | ◯ | ◯ | ◯ | ◯ | ◯ |
| Is there a need to define policies for requirements specification? | ◯ | ◯ | ◯ | ◯ | ◯ |
| How would you consider the need for a requirements specification template such as the IEEE SRS template? | ◯ | ◯ | ◯ | ◯ | ◯ |
| How would you consider the need for a requirements specification document that can be used as part of the contract/agreement with stakeholders? | ◯ | ◯ | ◯ | ◯ | ◯ |

24. Requirements Validation *

| | 1 Very Unimportant | 2 Unimportant | 3 Neutral | 4 Important | 5 Very Important |
|---|---|---|---|---|---|
| Do you consider requirements validation as an important part of the Agile process? | ○ | ○ | ○ | ○ | ○ |
| Do you review that the documented requirements meets your expectations? | ○ | ○ | ○ | ○ | ○ |
| How would you consider the importance of formal requirements inspections? | ○ | ○ | ○ | ○ | ○ |
| How would you consider the need for external reviewers in the validation process? | ○ | ○ | ○ | ○ | ○ |
| Do you have checklists for requirements validation? | ○ | ○ | ○ | ○ | ○ |
| How would you consider the importance of performing verification and then follow by validation in Agile projects? | ○ | ○ | ○ | ○ | ○ |
| How would you rate the importance of prototyping as the main technique to validate requirements? | ○ | ○ | ○ | ○ | ○ |

## C) Likert Scale (Q21-Q24)

Q21-Q24 intends to gather your opinion on the challenges and their impacts on Requirements Engineering Processes using a likert scale.
Kindly select the most applicable scale (only 1 answer per question)

### 25. Requirements Elicitation

| | 1 Strongly Disagree | 2 Disagree | 3 Neutral | 4 Agree | 5 Strongly Agree |
|---|---|---|---|---|---|
| On-going communication of requirements are a problem in the Agile projects | ○ | ○ | ○ | ○ | ○ |
| I find it challenging to gather requirements during the requirements elicitation process. | ○ | ○ | ○ | ○ | ○ |
| Lack of customer / end users' involvment have negative impacts to the Agile project process. | ○ | ○ | ○ | ○ | ○ |

26. Requirements Analysis

| | 1 Strongly Disagree | 2 Disagree | 3 Neutral | 4 Agree | 5 Strongly Agree |
|---|---|---|---|---|---|
| Inadequate or ambiguous requirements are considered as serious problems in the Agile projects. | ○ | ○ | ○ | ○ | ○ |
| I face conflicting and frequent changing requirements problem in Agile projects. | ○ | ○ | ○ | ○ | ○ |
| I face changing requirements problem in Agile projects. | ○ | ○ | ○ | ○ | ○ |
| Underscoping or overscoping of requirements leads to negative impacts in Agile projects. | ○ | ○ | ○ | ○ | ○ |

27. Requirements Specification

| | 1 Strongly Disagree | 2 Disagree | 3 Neutral | 4 Agree | 5 Strongly Agree |
|---|---|---|---|---|---|
| Lack of documentation leads to a negative impact in Agile projects. | ○ | ○ | ○ | ○ | ○ |
| Traceability of requirements are a problem in Agile projects. | ○ | ○ | ○ | ○ | ○ |
| Proper record keeping of changes in requirements are a challenge in Agile projects. | ○ | ○ | ○ | ○ | ○ |

28. Requirements Validation

| | 1 Strongly Disagree | 2 Disagree | 3 Neutral | 4 Agree | 5 Strongly Agree |
|---|---|---|---|---|---|
| Inadequate validation have negative impacts in Agile projects. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Requirements validations leads to a consistent product quality in the outcome of Agile projects | ◯ | ◯ | ◯ | ◯ | ◯ |
| Participation of stakeholders have a positive impact in Agile projects. | ◯ | ◯ | ◯ | ◯ | ◯ |

## D) Open Questions (kindly select 1 or more if applicable)

29. Most frequently used requirement elicitation techniques? *

Requirements Elicitation

- [ ] Interviews
- [ ] User stories
- [ ] Facilitated meetings
- [ ] Scenarios
- [ ] 
Other

30. What would you consider to be the most critical problem in requirements elicitation? *

Requirements Elicitation

- [ ] Communication flaws between project team and customer
- [ ] Insufficient support by customer
- [ ] Lack of prioritisation techniques
- [ ] 
Other

31. How do you overcome the challenges in requirements elicitation? *

Requirements Elicitation

- [ ] Conducting direct communication with customer
- [ ] Involvement of all team members from the beginning
- [ ] Training and involving customers in decision making process
- [ ] 
Other

32. How do you deal with changing requirements after the initial release *

Requirements Analysis

- [ ] Update the product backlog
- [ ] Only work with change requests
- [ ] Regularly changing requirements specification
- [ ] 

Other

33. What would you consider to be the most critical problem in requirements analysis? *

Requirements Analysis

- [ ] Incomplete and /or hidden requirements
- [ ] Overscoping of requirements
- [ ] Incorrect analysis models due to inappropriate modeling techniques used
- [ ] 

Other

34. How do you overcome the challenges in requirements analysis? *

Requirements Analysis

- [ ] Specifying requirements in a formal manner
- [ ] Using checklist to guide the prioritisation process
- [ ] Using storyboards or diagrams in analyzing the requirements
- [ ] 

Other

35. What would you consider to be the most critical problem in requirements specification? *

Requirements Specification

- [ ] Missing traceability
- [ ] Lack of documentation of requirements
- [ ] Lack of requirements specification templates
- [ ] 

Other

36. How do you overcome the challenges in requirements specification? *

Requirements Specification

- [ ] Prioritising focus on documentation
- [ ] Development of proper policies / templates
- [ ] Consultation with involved stakeholders
- [ ] 

Other

37. What would you consider to be the most critical problem in requirements validation? *

Requirements Validation

- [ ] Lack of expert analysts / the lack of validation methods or techniques
- [ ] Lack of stakeholders' participation
- [ ] Incomplete documentation of requirements
- [ ] 

Other

38. How do you overcome the challenges in requirements validation? *

Requirements Validation

- [ ] Using checklists to guide requirements validation process
- [ ] Implementing prototyping during the requirements validation process
- [ ] Involvement of external reviewers in the requirements validation process
- [ ] 

Other

## Appreciation and Gratitude

39. Dear Participant,

Thank you very much for your time and cooperation.
Your participation will contribute towards conceptualising a roadmap in mitigating the challenges faced in Agile based projects.

If you have any inquiries or questions, please feel free to contact me at siewling.fan@1utar.my (mailto:siewling.fan@1utar.my) or whatsapp or call me at 012-6881249 or my supervisor, Ms Michelle Bah at bahhc@utar.edu.my.

Sincerely,
Fan Siew Ling
Postgraduate student of Master of Information Systems

- ◯ Select here to complete the questionnaire and click on the submit button below.

# APPENDIX D: Checklist to Guide the Requirements Engineering Process for Software Practitioners in Malaysia

**Checklist to Guide the Requirements Engineering Process for Software Practitioners in Malaysia**

**Elicitation Process**

- [ ] Identify stakeholders
- [ ] Define the project objectives
- [ ] Forming a project team
- [ ] Consider conducting feasibility study (technical, organisational, economics)
- [ ] Use elicitation techniques
- [ ] Initiate communication from the beginning of the project
- [ ] Maintain constant and regular communication between team members
- [ ] Improve communication using multiple communication channels
- [ ] Maintain direct communication with customer
- [ ] Establish needs and priorities
- [ ] Include sufficient buffer for planned releases during the planning stage
- [ ] Revisit and update

**Analysis Process**

- [ ] Provide modelling of the requirements (eg, Enterprise modelling, Data modelling, Domain modelling, NFR modelling, etc)
- [ ] Categorise and prioritise requirements
- [ ] Commit to an iterative analysis process
- [ ] Revisit and update

**Specification Process**

- [ ] Educate the use of formal specification practices
- [ ] Adopt formal specification techniques
- [ ] Streamline the specification writing process
- [ ] Write user stories with brief description
- [ ] Use tools to assist in improving documentation practices (eg. Jira)
- [ ] Revisit and update

**Validation Process**

- [ ] Pre-revision
- [ ] Validate the working system
- [ ] Use CASE tools to assist in validating requirements
- [ ] Revision of requirements
- [ ] Traceability of Requirements
- [ ] Inspection of requirements
- [ ] Prototyping techniques
- [ ] Revisit and update

# APPENDIX E: Notes to Checklist to Guide the Requirements Engineering Process for Software Practitioners in Malaysia

**Elicitation Process**

- Identify the stakeholders
  - Stakeholders should have good understanding of requirements and project scope.
- Define the project objectives
  - Align project objective to help guide decision making.
- Forming a project team
  - Similar to the role of Product Owner (Scrum) or Product Manager (XP), for the purpose for, responsible for elicitation, analysis, specification and validation activities.
- Use elicitation techniques
  - Examples such as group interaction (meetings, workshops), individual participation (interviews, questionnaires), market research, reuse of requirements in similar projects of the same domain.
- Consider conducting feasibility study
  - Evaluate the viability of the proposed project (technical, economic, legal, operational, scheduling)
- Initiate communication from the beginning of the project
  - Frequent face to face communication from the beginning to identify requirements and to keep project cost and schedule on track.
- Maintain constant and regular communication between team members
  - Schedule regular meetings to share updates and gather feedback.
- Improve communication using multiple communication channels
  - Use various communication channels (face to face, phone, email, mobile applications)
- Maintain direct communication with customer
  - Direct communication channel to reduce miscommunication or ambiguity.
- Establish needs and priorities
  - Addressing needs and priorities in a clear and well-articulated manner.
- Include sufficient buffer for planned releases during the planning stage
  - Anticipate a change in requirements by including buffer into the schedule planning stage.

- Revisit and update
  - Anticipate the need to revisit and update changing requirements throughout the project life cycle.

**Analysis Process**

- Provide modelling or storyboards of the requirements
  - Use modelling to help aid the requirements analysis process (Enterprise modelling, Data modelling, Doman modelling, NFR modelling).
- Categorise and prioritise requirements
  - Arrange the requirements into categories and levels of priority.
- Commit to an iterative analysis process
  - Conduct iteratively to ensure that the requirements are aligned with the project objectives.
- Revisit and update
  - Anticipate the need to revisit and update changing requirements throughout the project life cycle.

**Specification Process**

- Educate the use of formal specification practices
  - Providing training on formal specification practices such as Z notation, B methods.
- Adopt formal specification techniques
  - Apply formal specification techniques as trained.
- Streamline the specification writing process
  - Ensure that it is clear, comprehensible and complete.
- Write user stories and case scenarios with brief description
  - Use both user stories and case scenarios to capture requirements.
- Use tools to assist in improving documentation practices
  - Use tools such as Jira, Trello, Clickup to assist in documentation
- Revisit and update
  - Anticipate the need to revisit and update changing requirements throughout the project life cycle.

**Validation Process**

- Pre-revision
  - Overview to detect missing requirements, faulty spelling, non-standard compliance and typographical errors.
- Validate the working system
  - Ensure that the product has been developed in accordance to the specifications.
- Use CASE tools to assist in validating requirements
  - Use Computer Aided Software Engineering (CASE) tools.
- Revision of requirements
  - Identifying inconsistencies, conflicts and omissions for refinement of the requirements.
- Traceability of Requirements
  - Trace and track the requirement forwards and backwards throughout the project lifecycle.
- Inspection of requirements
  - Reviewing every requirement and eliminating defects
- Validation techniques
  - Developing prototypes to serve as a visual medium to understand the requirements of the system, using MVP (Minimum Viable Product) or mock-up to validate the requirements.
- Revisit and update
  - Anticipate the need to revisit and update changing requirements throughout the project life cycle.

# APPENDIX F: Interview Transcript – Interviewee 1

| | |
|---|---|
| Interviewer | : Fan Siew Ling (SL) |
| Interviewee | : Eleyaraj Ramani (E) |
| Position | : Project Management Officer (PMO) |
| Company | : Amdocs Software Sdn. Bhd. |
| Date | : 28th March 2022 (Monday) |
| Time and Duration | : 11.30am (about 45 minutes) |

**Clean Verbatim Transcript**

**SL : Could you share more about what is your current company, what do they do and the industry which you belong to?**

E : I am working for Amdocs in Malaysia and my company works in the CRM (Customer Relationship Management) System. We deliver software solutions for the customer; our most current project is with the telecommunications industry.

**SL : May I know the size of your company?**

E : This is an MNC (multinational corporation) company and we have branches in all other parts of the world. The company in Malaysia has about 125 employees.

**SL : Can you share about your current job title and what does your job scope entails?**

E : I am on the project management department, working as PMO (Project Manager Officer) and is in charge of the governance lead in one of my projects.

**SL : Who many years of work experience do you have, in particular in Agile and requirements engineering?**

E : We start using Agile back in 2017 in a previous project, then progress to other projects in 2018-2019 and even in the current project.

**SL : So, within your current company, is there some sort of requirements engineering practices of standard which is adopted?**

E : We generally use the standard process, and in terms of requirements engineering, this phase usually involves the presales team and the initial project team. From there, we adopt to the requirements as set out and how the process is being managed before it reaches my team, or the execution mode.

**SL : Do you practice some sort of standard industrial processes, perhaps like**

E : **IEEE?**

From what I understand, the company does have a set of process which is followed by the pre-sales team and the initial project team before the project officially begins.

**SL : So, this part of the requirements engineering, elicitation, is mainly under the pre-sales team?**

E : Yes, during the requirements gathering. Our team will be involved when the requirements are being developed or executed; the requirements gathering mainly happens at the initial state of the project.

**SL : Are these requirements then revisited in the execution stage?**

E : Yeah. For every PI (Program Increment), we will go through the requirements again before the adoption and select those which will be involved in the particular cycle. Depending on the number of Agile Sprints, we will refer to the requirements again at every time.

**SL : Can I ask what particular Agile framework are you using?**

E : For our development team, we usually use Kanban.

**SL : Like looking at the requirements engineering in the initial stage, where the elicitation, analysis, specification and validation happens. Can I ask what do you think, in your opinion, are the biggest challenges to implementing requirements engineering in an agile project?**

E : Based on experience, which is mainly during the project execution, I can share

some of my feedback, as we are not as heavily involved in that particular stage; it normally falls within obtaining the requirements or process from the previous team.

**SL : I have drafted a roadmap based on the feedback that was gathered from the survey conducted and also a combination of the literature journals. Can I share it with you for your feedback?**

E : Sure. Okay, so from your list, in elicitation process, I don't see anything pertaining to risk management. It depends on the project, right, in every project, there should be a risk assessment, like a most recent analysis before we initiate to begin the project. It would be schedule, budget, process, quality and those things. These could be specific to the particular project depending on the project needs and requirements.

**SL : Thank you for your insight, I'll be sure to look in to including risk management.**

E : In requirements validation, those points pre-revision, what is the reference point used? So, for us, before we start on any of the projects, we have a reference point, we call it our project charter, or the PMP (Project Management Plan). All the requirement set out are the deliverables, and there is where we can refer to confirm if all the requirements are there and perform some analysis and validation for the project's entire scope.

**SL : The pre-revision is an overview of the requirements, so it is dependent on how the company is practising the documentation process in the beginning. In your case, your reference point, would be the project charter or PMP, some sort of listing of requirements that you are able to quickly refer to it.**
**So your standard document would be the project charter?**

E : Yes, the project charter is the high-level project scope and requirements, as part of the project management process. Based on that, we derive the project management plan, project documents, project deliverables, stakeholder management plan, change request, performance information. Which is all part of the different project management documents. Every time or at every phase of the

project, we will refer back to these documents, especially during the validation process. We will compare all these inputs (we refer to these documents as inputs), as our reference points and validate if the requirements have been completed.

**SL : The template for that project charter, is it something standardised to your company or slightly different from each project?**

E : It depends. Depends on the companies and the projects. I'm not sure if the template meets the standard across the industry, but for my company, we consider it as the standard project charter. This project charter is provided by the pre-sales team upon their meeting with the client.

**SL : How about the validation process, are they any tools or ways you use in validating the requirements, using the project charter as a guide?**

E : We use traceability matrix. Using my project as an example, in the requirement traceability matrix, it will have all the requirements, the relevant processes involved and the relevant solutions which we are providing. Every time, we validate the requirements or at any stage where we perform the validation, we will refer back to the requirement traceability matrix. This will tell us if we are following the requirements; are we on track and within the guidelines.

**SL : Do you also use software to assist you, or do you develop prototypes?**

E : Mainly, we use the project management plan, it is another tool, that we use to validate the entire end to end project flows. Also, we use MPP project plan. It is a Microsoft Project Plan for project management.

**SL : Do you have any feedback on the analysis process and specification process as well?**

E : Most of the analysis and specification listed here is covered. It is relevant, as we do use these as part of our process.

**SL : How about the specification process? Can you kindly share some thoughts on it?**

E : This is dependent on the client. In every sprint, there is a certain number of user

stories, to help create the minimum viable product (MVP). It is the core of the nature of the products, so they need to provide very reliable, reasonable and valuable inputs. When we start developing, we then use a technique where we segregate the storyline of the user stories, we call it as the sizing of each sprint. At this part, we won't include 100% of the scope in this sprint, instead, we will split it into like a 70:30 or 70:20:10, meaning 70% of the user stories the scope is a must-have, 20% good-to-have and 10% for extra fancy requirements, otherwise, we will also use it as our buffer. If things do not go according to plan, we will assess during the risk management to consider removing it, like prioritising the requirements. So like you said, in reference back to revisit the requirements, right? In each and every sprint, we will go back to the requirements and check what has been delivered and what things are still in the backlogs. Looking at things you can add on or remove, so this is part of the sprint practice.

**SL : And in this stage, what sort of challenges that you face? Like if the requirements are inadequate, ambiguous or frequently changing? How does your team address these challenges?**

E : Mainly, most challenges are what we refer to as 'Gray areas' where those are ambiguous, which we will only find out during the development phase. Then we will know what things were not laid out at the beginning of the project or there would be new requirements coming into the picture. For these new requirements, we will follow the change process to determine of the particular add on is really needed, how are we going to take it, because, whenever we do a project planning, we obviously also have a contingency plan. So, we will decide if we will use the particular contingency to address the add on, depending on the budget or project timeline and how will we adjust it, in case there are regulatory limitations from government or any kinds of other things we can't avoid. If this has to go into delivery, then we will add in and adopt these changes, and see how will this impact the project, perhaps from financial or commercial impact, or if it's the sort of requirement that we can deliver as part of the initial projects, with addition onto the scope and we are able to deliver it. There will also be timeline delivery impact, because everything now needs to be adjusted. These kinds of things will follow the change control process. Where we will validate the new requirements

and the Gray areas will be, we call it a scoping phase, where it will be detailed out. During a particular phase, we will revalidate and go deeper into each and every requirement to ensure that are no Gray areas within the scope. These are main, very common things, which will happen in any kind of projects.

**SL : I think in the elicitation process, I have included ensure sufficient buffer in the planning stage. So, this would be the extra time that you will use if required to make any changes?**

E : Yep. So this is one of the mitigations we have.

**SL : Is there anything else you would like to point out or give feedback on their guidelines?**

E : Mostly, the things you have already added. These are relevant things, it covered in general, because it's not specific to industries or project. There could be things, which a particular project is not necessary to have, but the general template is applicable across industries.

**SL : Is there anything else to share your feedback upon? In your opinion, is the roadmap enough to mitigate those challenges that you face?**

E : Some things you pointed out like direct communication and using multiple communication channels, I think those can help detail out the specific requirements to ensure that we have not missed out clients or customer's expectations. So mostly, it's good.

**SL : Thank you very much for your time, and your feedback and sharing of your projects and experience. I hope you have a good day.**

E : Sure, welcome. You too.

# APPENDIX G: Interview Transcript – Interviewee 2

| | |
|---|---|
| Interviewer | : Fan Siew Ling (SL) |
| Interviewee | : Navin Sellappan (N) |
| Position | : APAC Head of Regional Delivery |
| Company | : SoftwareONE Experts Sdn. Bhd |
| Date | : 1st April 2022 (Friday) |
| Time and Duration | : 2.00 pm (about 35 minutes) |

**Clean Verbatim Transcript**

**SL : May I ask more about your background experience, like what is your current company, the industry you are in, and perhaps your job scope and size of your company?**

N : Sure, SoftwareONE is a niche services provider in the IT industry specialising in compliance software license management, optimization of IT software assets, we have also recently branched out into cloud scape where we do road mapping for customers, we do migration of data centres, we do security where we formulate security requirements and we also deploy them for our customers. In terms of industry, we cover all sorts of industry, so we have customers from US military, aviation, aerospace industry all the way to non-profit organisations, so we are very diverse and across all industries.

**SL : So, your customer base, is not just in Malaysia, as it also covers across different countries**.

N : Correct. For examples, I personally oversee customers in FMCG (fast-moving consumer goods), mining sector, energy sector as well as healthcare.

**SL : Can I know roughly what is the size of your company?**

N : We are currently at about 8500 to 9000 headcounts of direct staffs. We have also acquired 6 companies during the pandemic, so that has significantly increased the numbers.

**SL : Can you share a bit about your job position and perhaps, the number of years of work experiences you have in Agile itself?**

N : In terms of my scope, I oversee the delivery of services, for many services and professional services across the region, with some spillovers to other regions. I am the Head of Regional Delivery for APAC. So, in Agile itself, I would say the last 5 years of so, prior to that, where I was working, we don't really use agile methodology.

**SL : Within your current company, do you have a sort of current practice or standards, like certain protocols which are specific to your company, like an set of internal standards?**

N : Yes, we have own standards, but not really related, more in terms of certain chargeability, profitability, level of competency. Different standards or not agile specifically.

**SL : In terms, of agile practices and standards, you don't have that in the company?**

N : It's been something we have been trying to adopt throughout the company but we find that unless there is a push from the top management, or else you will not be able to standardize this. We have one or two countries in APAC who try to use agile as much as possible but again, there are always exceptions. Singapore does try to use it, and Malaysia, but the rest of the countries in this region don't really follow it.

**SL : Do you consider the methodology you use within your company as practising Agile?**

N : We use bits and pieces, so for example we use Scrum, Lean, but mostly Kanban and Scrum.

**SL : Is this dependent on the team and project?**

N : Yes, so it depends on the suitability, how we are doing it, is it in-house or using third party vendors, it really depends on a lot of things.

**SL : In your opinion, what are the biggest challenges in implementing requirements engineering in agile project? You mentioned the push from the top management earlier, are there any other challenges you would like to share?**

N : Yes, push from the management. Another thing, is that people are not giving accurate requirements, even though interviews, so sometimes you don't get the right information or inaccurate requirements.

**SL : Is it possible that they don't quite understand what they are supposed to give?**

N : They may not understand or they just couldn't be bothered, just give whatever you want to give.

**SL : So they are not very committed stakeholders, is that correct?**

N : Correct.

**SL : Seems like one of the key challenges is also deeper commitment from the stakeholder.**

N : Yes, unfortunately, you really need the push from the top for this, that is one of the big challenges we have.

**SL : Do you also have communication challenges as well?**

N : We do sometimes, yes. You know, people don't respond to emails or keep postponing things, or you ask for A, they give B, so there's a mismatch of information, or even expectations, we have that sometimes.

**SL : Can I ask about the ways you work to mitigate these challenges, because they are existing challenges within your work environment, right, what are the things or steps you take?**

N : Awareness, we work to get our project managers who run these projects to be aware of the benefits, and you know, if they can see the benefits, hopefully, they

can apply it, while running the projects, so the initial engagement. We haven't used the stick approach, it's more of awareness and the carrot approach.

**SL : Like trying to educate them and encourage them towards the direction**?

N : Correct, it is better than forcing people, because if people understand and they believe in it, you know, that is more effective.

**SL : How many percent do you think of your company who is actually really practising agile?**

N : Probably 20-25%

**SL : That is interesting, because in the recent studies, with a lot of studies on agile and requirements engineering, it would seen that is not the actual case that is actually being practised in the industry, at least not for the moment, or among the respondents of the survey also.**

N : Not in Malaysia, or even in APAC across region. I would say you probably get better results in Australia. People are more willing to follow standards and different methodologies. Even in Europe, so I worked a lot with the Netherlands, and they are also more willing to follow. Somehow in APAC, people don't follow standards or embrace methodologies, like people do the certification but after that nothing happens.

**SL : It is not really put into practice?**

N : More for the sake of certifications, but they don't actually practice it. However, I noticed in the western culture, it is very different, they do the certification and they actually try to embrace it. More like a cultural thing.

**SL : Have you had a look at the checklist? This is to help to be a guide for software practitioners in Malaysia, it's a bit general because it doesn't cover a specific industry, so something that can be applied across other areas.**

N : In terms of your survey findings, as far as elicitation face to face communication, I agree. Ongoing communication, yes, it's very important actually. Yes, use checklists and priories requirements. I am in agreement with your findings with

other respondents as well. Yes, ambiguous requirements are a serious problem in projects. Stakeholders are ickle minded, don't know what they want. They want to see something, but they don't know what they want. So you give them something, and they go, oh no no, I want it this way. Changing requirements, yea it is a common problem. I agree with underscoping and overscoping requirements lead to negative impacts to. Specification, I would say not really, but yes for the rest of the points. For specification, we usually just need to define the policies. Record keeping is not so much a concern to us.

**SL : Will this lead to any traceability problems?**

N : No not really, this is one of our strong points, we keep good records, even the meetings are minuted, so we can easily trace back.

**SL : So you like, have documentations, but in different form?**

N : Yeah, in different forms

N : So, I think in terms of your requirements gathering, I pretty much is in agreement with what your respondents have replied, so my opinion doesn't differ too much.

**SL : How about the checklist which I've developed, in proposing a roadmap for guidance, do you think it is sufficient to address all the concerns that the respondents have?**

N : Looking at elicitation, the first one, I think it is pretty comprehensive. Analysis is ok, specification also yep. Yes, this is also quite comprehensive validation process.

N : I am quite curious on the type of CASE tools used.

**SL : This was not part of the survey, but the basis of this came from the literature reviews conducted, that they do recommend using a computer assisted software to help in validating those requirements. Is this also something practiced in your company?**

N : Not at the moment, but if you can fully using Agile, which we are not, then yes, you should or must have a CASE tool.

**SL : Do you have any feedback or recommendations pertaining to this road map? Perhaps anything to add in or change?**

N : It's very comprehensive, I must say. But perhaps, you need to break down to simplify the terms for a project manager who is probably going to have to drive this.

**SL : Yes, that is a good point, I do have an accompanying note to the checklist but will make sure to make it something easier to understand.**

**SL : Do you think it can help mitigate certain challenges that you are facing?**

N : Yes, it would actually be sufficient, you know to run a reasonable, reasonably good agile process, because it covers all the basics, like getting requirements, identifying who your stakeholders are, forming project teams, understanding requirements, prioritising, modelling prototypes. So I think it covers it, checks all the boxes.

**SL : Thank you so much for your time and feedback. It is really valuable and I will see how much I can further improve the roadmap.**

N : Sure, happy to hear from you, take care.