



**BARRIERS OF AGILE REQUIREMENTS ENGINEERING  
IN THE PUBLIC SECTOR:  
A SYSTEMATIC LITERATURE REVIEW**

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**ABSTRACT**

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Aim/Purpose	The objective of this study is to summarize the challenges of Agile Requirements Engineering (Agile RE) in the public sector in republican and constitutional monarchy nations. Additionally, it offers recommendations to address these challenges.
Background	Failure of IT projects in the public sector results in financial losses for the state and loss of public trust, often attributed to issues in requirements engineering such as prioritization of user needs and excessive scope of requirements. IT projects can have a higher success rate with Agile RE, but there are also drawbacks. Therefore, this study holds significance by presenting a thorough framework designed to pinpoint and overcome the challenges associated with Agile RE to increase the success rate of IT projects.
Methodology	This study employs a Systematic Literature Review (SLR) protocol in the field of software engineering or related domains, which consists of three main phases: planning the review, conducting the review with a snowballing ap-

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	<p>proach, and reporting the review. Furthermore, the authors perform open coding to categorize challenges based on the Agile methodologies adoption factor model and axial coding to map potential solutions.</p>
Contribution	<p>The authors assert that this research enriches the existing literature on Agile RE, specifically within the public sector context, by mapping out challenges and possible solutions that contribute to creating a foundation for future studies to conduct a more in-depth analysis of Agile adoption in the public sector. Furthermore, it compares the barriers of Agile RE in the public sector with the general context, leading to the discovery of new theories specifically for this field.</p>
Findings	<p>Most challenges related to Agile RE in the public sector are found in the people and process aspects. Project and organizational-related are subsequent aspects. Therefore, handling people and processes proficiently is imperative within Agile RE to prevent project failure.</p>
Recommendations for Practitioners	<p>Our findings offer a comprehensive view of Agile RE in the public sector in republican and constitutional monarchy nations. This study maps the challenges encountered by the public sector and provides potential solutions. The authors encourage practitioners to consider our findings as a foundation for adopting Agile methodology in the public sector. Furthermore, this study can assist practitioners in identifying existing barriers related to Agile RE, pinpointing elements that contribute to overcoming those challenges, and developing strategies based on the specific needs of the organizations.</p>
Recommendations for Researchers	<p>Researchers have the potential to expand the scope of this study by conducting research in other countries, especially African countries, as this study has not yet encompassed this geographic region. Additionally, they can strengthen the evidence linking Agile RE challenges to the risk of Agile project failure by performing empirical validation in a specific country.</p>
Impact on Society	<p>This research conducts a comprehensive exploration of Agile RE within the public sector, serving as a foundation for the successful adoption of Agile methodology by overcoming obstacles related to Agile RE. This study highlights the importance of managing people, processes, projects, and organizational elements to increase the success of Agile adoption in the public sector.</p>
Future Research	<p>In the future, researchers should work towards resolving the limitations identified in this study. This study has not provided a clear prioritization of challenges and solutions according to their significance. Therefore, future researchers can perform a Fuzzy Analytical Hierarchical Process (F-AHP) to prioritize the proposed solutions.</p>
Keywords	<p>Agile requirements engineering, public sector, Agile challenges, systematic literature review</p>

## INTRODUCTION

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Over the past few years, the Agile approach has been adopted more widely in the private sector (Cico et al., 2021) and the public sector (Fontana & Marczak, 2020). This trend can be attributed to the numerous advantages associated with an Agile approach, such as increasing productivity and efficiency (Lagerberg et al., 2013; Rasheed et al., 2021), adaptability, and short time-to-market (Mishra et al., 2021), significant accelerating the speed of change, and forces the organization to respond swiftly to

various unexpected challenges and opportunities with limited information and in conditions of considerable uncertainty (Vaia et al., 2022). Nevertheless, transitioning to the Agile methodology within the public sector, particularly within complex hierarchical structures such as government organizations, posed greater challenges compared to less bureaucratic entities (Dwi Harfianto et al., 2022). The public sector tends to be passive and shows reluctance to promptly adopt innovations from other sectors (Hale & Woronkiewicz, 2021; Windrum & Koch, 2008). The public sector refers to the part of the economy under government control, encompassing government institutions, government agencies, state-owned companies, educational institutions, and businesses that offer various services to the public. Countries have special characteristics regarding their public sectors. Governance plays a crucial role in a nation's public sector, serving as a key facilitator for economic and administrative success (Alqooti, 2020). Republic and constitutional monarchy nations typically have more stable governance than provisional nations.

The failure of public sector projects resulted in financial losses for the state. Requirement issues were cited as the cause of failure for certain projects (Rizkiyah et al., 2020). In software development, Requirements Engineering (RE) holds significant importance (Ochodek & Kopczyńska, 2018). Several cases show project failure due to issues with engineering requirements. The user requirement prioritization and over-scope requirement emerged as the most notable challenges as they have the potential to cause project delays (Marnada et al., 2021). On the other hand, successful requirement engineering leads to higher-quality software and reduces project failure (Daun et al., 2023). Therefore, Agile Requirement Engineering (Agile RE) is crucial to success in an Agile project.

The objective of this study is to summarize the challenges of Agile RE in republican and constitutional monarchy public sectors. This study also provides recommendations to address these challenges. Therefore, this study aims to answer these research questions:

**RQ1:** What are the challenges of Agile RE in republican and constitutional monarchy public sectors?

**RQ2:** What are the possible solutions to overcome Agile RE issues in the public sector?

Previous studies conducted systematic literature reviews on Agile RE issues (Coutinho et al., 2019; Curcio et al., 2018; Inayat et al., 2015). However, no studies have specifically done a systematic literature review within the public sector. Therefore, this study employs a snowballing approach to conduct a systematic literature review. In addition, the identified challenges are classified based on Shahane et al.'s (2014) proposed factors model of Agile methodologies adoption: process, people, project, and organization. Hence, this state-of-the-art study focuses on the public sector, uses a snowballing approach, and adopts an Agile method framework to categorize the challenges. The main contribution of this paper is to map the challenges and possible solutions of Agile RE in the public sector. This study contributes to creating a foundation for future research to conduct a more in-depth analysis of Agile adoption in the public sector.

The following sections are structured as follows. The next section reviews related work in the literature, specifically focusing on challenges and issues related to Agile RE in the public sector. The subsequent section outlines the research methodology in the study, followed by a presentation of the research findings related to defined research questions and an analysis of the results. Finally, the last section presents the conclusion of this study.

## LITERATURE REVIEW

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### *AGILE REQUIREMENTS ENGINEERING*

RE is one of the crucial processes in software development. RE focuses on the identification, modeling, communication, and documentation of system requirements, as well as the surrounding context in which the system will be utilized. The process of RE encompasses a strict sequence of activities to

derive, validate, and upload a comprehensive document of system requirements (Curcio et al., 2018; Ochodek & Kopczyńska, 2018). RE substantially affects the effectiveness of software development projects (Khan et al., 2021). The initial RE was founded in the 1970s and was called “traditional requirement engineering.” The process is referred to as the waterfall life cycle model (Curcio et al., 2018). However, globalization and rapidly changing markets need to enforce the process to adapt effectively.

Agile has emerged as a highly adopted methodology for software development projects. Implementing Agile requires distinctive practices compared to traditional RE (Nisyak et al., 2020; Ochodek & Kopczyńska, 2018). Practices, namely collaboratively planning short iterations or conducting daily team meetings that were traditionally not seen as integral to RE, now serve as catalysts for embracing lightweight requirements-related approaches such as crafting user stories (Ochodek et al., 2020). In Agile methodologies, the emphasis lies on the operational software rather than the generated artifacts, posing a significant challenge for professionals in the field of RE. Generating and maintaining requirement documentation is often viewed as a bureaucratic practice within Agile approaches, hindering the agility of the process (Coutinho et al., 2019).

The term “Agile Requirements Engineering” has been coined to describe the Agile approach to planning, executing, and testing requirements within an Agile framework (Coutinho et al., 2019). Requirement changes are welcome in Agile; hence, the RE activities occur throughout the lifetime of software development. The high-level customer needs are defined in the initial stage and transformed as epic. Then, it is broken down into smaller and more detailed requirements to be discussed and re-prioritized for the next iteration (Curcio et al., 2018). Traditional RE is confronted with numerous obstacles, encompassing communication gaps, scope creep, requirements validation, documentation, and limited customer involvement. Agile RE emerges to address these challenges through some practices, covering face-to-face communication to diminish the need for extensive documentation and bridge communication gaps, progressively elaborating on requirements to mitigate over-scoping, prioritizing requirements based on their business value as determined by the customer to enhance requirements validation, and fostering close collaboration between the team and the customer to circumvent insufficient customer participation. In addition, Agile RE proposed some practices, such as creating user stories to record the requirement, iterative requirements by gradually detailing the requirement, and executing requirement prioritization prior to initiating a new iteration (Inayat et al., 2015).

Ochodek and Kopczyńska (2018) conducted a study to analyze and rank the Agile RE practices considering the perceived importance by practitioners. The list of practices was collected through a survey of 136 Agile software development practitioners, which were then graded using the PROMETHEE family method to form a seven-tier ranking of the practices. Tier 1 practices encompass creating a testable requirement, establishing project shared vision, available onsite customers, conducting review meetings, placing the requirement to be easily accessed, and requirement prioritization based on customer needs (Ochodek & Kopczyńska, 2018).

### ***AGILE ADOPTION IN THE PUBLIC SECTOR***

While Agile methodologies have emerged as the industry standard for software development, the public sector is gradually embracing them, but at a slower pace (Mohagheghi & Lassenius, 2021). The public sector is closely related to bureaucracy, which can be defined as highly systematic, formal, and impersonal. It has a hierarchical structure established through regulations and policies (Dwi Harfianto et al., 2022). Public sector organizations encounter both common challenges faced by private sector entities and unique hurdles inherent to their specific context. These obstacles encompass an organizational culture that is often incompatible with Agile principles due to the presence of hierarchical and bureaucratic structures, limited familiarity with Agile methodologies, and a reliance on rigid and prescriptive approaches (Fontana & Marczak, 2020; Mohagheghi & Lassenius, 2021).

Rizkiyah et al. (2020) conducted a study on the issue of practical requirements within an unsuccessful Agile project on a government agency in order to prevent similar setbacks in the future. The initial factors were obtained through a systematic literature review, analyzed official project documents, direct observation, and interviews with correspondence, resulting in 25 factors which were classified into seven categories. The findings highlight that requirement changes, scope creep, and communication emerged as the dominant challenges in the case study. The study proposed Agile best practices as solutions for each factor and challenge, providing a comparative analysis between the service provider and government organization. While these findings cannot be universally generalized, they offer valuable insights into requirement-related issues and their mitigation in Agile-based government outsourcing projects (Rizkiyah et al., 2020).

Fontana and Marczak (2020) studied the adoption of Agile Software Development (ASD) by the Brazilian government by analyzing its characteristics and challenges. The data was gathered through a survey targeting civil servants in Brazil, and 167 responses were obtained. ASD projects demonstrate a high rate of success, often implemented in conjunction with other software development approaches. The primary drivers for adopting Agile practices within Brazilian government IT organizations are the desire to expedite product delivery and enhance productivity. However, significant challenges persist, including the need for cultural transformation and overcoming resistance to change (Fontana & Marczak, 2020).

## RESEARCH METHODOLOGY

To achieve the research objective and answer the research questions, a Systematic Literature Review (SLR) protocol is conducted. This research follows the SLR protocol proposed by Kitchenham and Brereton (2013). SLR is a commonly employed review method that seeks to comprehensively examine and integrate existing literature (Abusaed et al., 2023). SLR incorporates three main phases: planning the review, conducting the review, and reporting the review.

The objective of this study is to summarize the obstacles faced in Agile RE within the public sector and offer possible solutions to address them. Therefore, in the planning phase, we include the “public sector” keyword in the search string and specify questions related to the public sector for quality assessment purposes. Figure 1 illustrates the proposed research design.

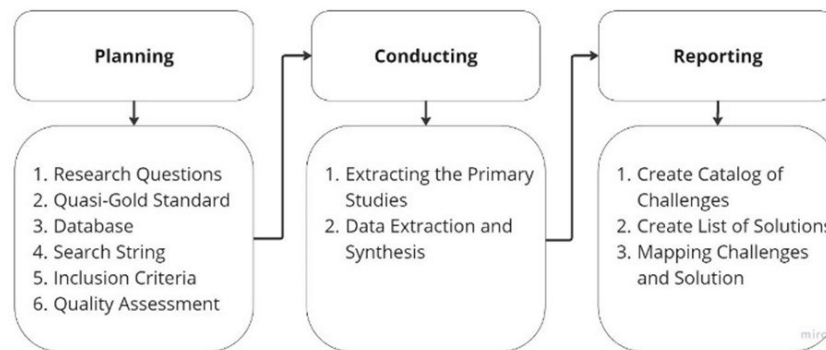


Figure 1. Research design

### PLANNING THE REVIEW

The initial phase of conducting SLR involves devising a comprehensive strategy to commence the review process. This strategy encompasses a range of variables, including formulating research questions, identifying Quasi-Gold Standard papers, selecting relevant databases, constructing effective search strings, establishing inclusion criteria, and designing quality check criteria. The subsequent section will extensively detail these steps, providing a thorough understanding of their execution.

### Research questions

The research questions are crafted by considering the specific research objectives of the current study.

RQ1: What are the challenges of Agile RE in the public sector?

RQ2: What are the possible solutions to overcome Agile RE issues in the public sector?

### Quasi-Gold Standard

The Quasi-Gold Standard (QGS) methodology serves as a valuable approach to combine both manual and automated search methods with the objective of assessing the effectiveness of search procedures. QGS provides guidance on formulating the essential keywords and their corresponding alternatives (Akbar et al., 2020; Kitchenham & Brereton, 2013). In the present study, two specific articles (Fontana & Marczak, 2020; Khan et al., 2021) have been selected as QGS references, serving as a foundation for constructing the search string.

### Databases

In order to access a wide range of scholarly publications, we made use of seven prominent subscription-based digital databases: “IEEE Xplore,” “ACM Digital Library,” “Springer Link,” “Emerald Insight,” “Scopus,” “Sage Journal,” and “Science Direct.” These databases were selected for their established reputation as reliable and comprehensive repositories of academic literature (Kamal et al., 2020).

### Search strings

To develop an effective search strategy, we adhere to the guidelines outlined by Kitchenham et al. (2007) and Kitchenham and Brereton (2013). First, we compile a comprehensive list of primary keywords. Then, we identify alternative words, synonyms, and related terms associated with these main keywords. The search is conducted by employing the Boolean operator ‘OR’ to incorporate synonyms and related terms, while the ‘AND’ operator is used to connect the main terms, thereby refining the search results. By integrating various categories of key terms, as presented in Table 1, we construct the search string by integrating all the key terms from each category.

**Table 1. Category and key terms**

Category	Key terms
Requirements Engineering	Requirements Engineering, Requirements Specification, Quality Requirements
Challenge	Challenge, Issue, Problem
Public Sector	Public Sector, Government
Agile	Agile, Scrum, Kanban

### Inclusion and exclusion criteria

In order to ascertain the eligibility of studies for inclusion, a set of predefined criteria was employed to determine their suitability, these criteria served as guidelines to determine whether a study should be included or excluded from the analysis, ensuring a systematic and consistent selection process (Inayat et al., 2015).

- *Inclusion criteria:* Paper published between 2014-2023 (IN1), it is an empirical research article or case study (IN2), it is classified as computer science, engineering, and related subject areas (IN3), and the paper should answer the following research questions (IN4).
- *Exclusion criteria:* Duplicated publication (EX1), published using other than English (EX2), full-text paper not being downloaded (EX3), and irrelevant theory (EX4).

## Quality assessment

To assess the quality of the articles, we utilized a quality checklist (QC) developed by Kitchenham and Brereton (2013). The purpose of this process was to ascertain the relevance and significance of the selected studies to the objectives of our own study.

A series of questions, outlined in Table 2, were employed to validate the quality of each article. Based on these checklist questions, the selected studies were evaluated and assigned one of three options: Yes (Y), Partial (P), or No (N). Each option was then assigned a corresponding score. When an article provided a definitive answer to a checklist question, it was marked as Y=1. If an article failed to address the quality checklist questions, it was marked with an N, resulting in a score of 0. In cases where the selected study partially addressed the checklist questions, a P mark was assigned, along with a score of 0.5. For this assessment process, our study set the passing grade at 2.5 (see Appendix A).

**Table 2. Quality checklist questions**

Code	Quality checklist question
QC1	Does the finding or analysis of the selected study purely relate to research questions?
QC2	Does the study explore the challenges of Agile RE?
QC3	Does the study state how to overcome the challenges or state the best practice of Agile RE?
QC4	Does the literature fully or partially discuss Agile RE in the public sector?

## *CONDUCTING THE REVIEW*

### Primary study selection

The selection of primary studies was carried out in three distinct phases. In the initial phase, two articles were chosen as QGS papers to construct the search string. The second phase involved conducting the final search string across selected electronic databases, resulting in a pool of 3,579 articles. These papers were processed by filtering based on the predefined inclusion criteria, resulting in 570 articles. Subsequently, the titles and abstracts of the remaining articles were reviewed, followed by a quality assessment. As a result, 18 prior studies successfully passed the assessment phase. In the third phase, a snowballing method, encompassing both forward and backward snowballing, was employed to expand the primary study. Three additional papers were selected and successfully passed the assessment steps. The entire process and the various steps undertaken are illustrated in Figure 2, ultimately culminating in the identification of 21 final papers that were considered as the primary study (see Appendix B).

### Data extraction and synthesis

The initial step involved capturing and compiling the various themes, statements, concepts, and ideas presented in the selected papers. The extracted data focused on identifying the challenges and barriers associated with performing Agile RE in the public sector. To categorize and analyze the data for constructing the mapping, both open and axial coding techniques were employed in NVIVO 12, facilitating a comprehensive understanding of the underlying patterns and relationships within the data.

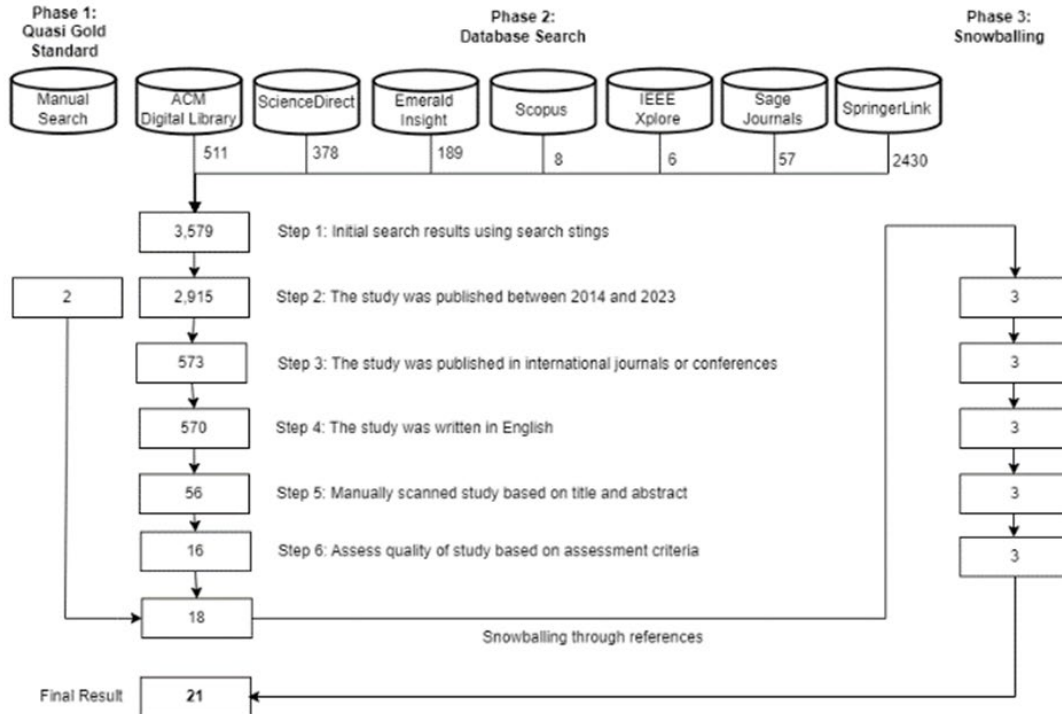


Figure 2. Systematic literature review process

## REPORTING THE REVIEW

In the concluding phase, the outcomes of the review are reported by generating a comprehensive catalog that encompasses the identified challenges. Additionally, a mapping of these variables is created as a foundational framework for compiling recommendations and drawing conclusions. This step ensures a systematic and structured presentation of the findings, facilitating a clear understanding of the implications and insights derived from the review process.

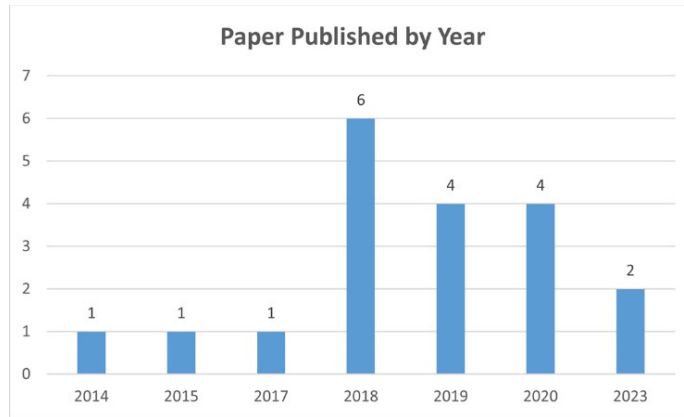
## RESULTS

In this section, the research questions that have been explained earlier will be addressed and answered. First, the identified challenges that are categorized in Shahane et al.'s (2014) framework focus on the public sector. Second, each identified challenge is mapped to a possible solution. Lastly, a profound discussion is provided, which focuses on Agile RE in a bureaucratic environment compared to a general context.

### OVERVIEW OF STUDIES

We have identified and analyzed 21 studies which were narrowed down from 3,579 papers (see Appendix B). Figure 3 illustrates the year-wise distribution of the studies. The research on Agile RE in the public sector was relatively stable from 2014 to 2017. However, it peaked in 2018. It shows that researchers' interest in Agile RE is growing. Hence, it can be stated that it commenced gaining popularity in 2018.





**Figure 3. Distribution of selected studies by year**

The identified studies on Agile RE were published in journals and conferences. Most studies were published at conferences, approximately 57,14%, while publications on journal articles are about 42.86%. We conducted a review of the Q1, Q2 and Q3 journals. Most articles were published in Q1 journals, indicating their higher rank or impact within the academic community. Five papers were published in Q1 journals and four in Q2 journals. The remaining paper was published in a Q3 journal. Details of research based on the name of publications are shown in Table 3.

**Table 3. Distribution by publication**

Publication name	Publication type	Rank	Quantity
ACM Transactions on Software Engineering and Methodology	Journal	Q2	1
Information and Software Technology	Journal	Q1	1
Journal of Systems and Software	Journal	Q1	4
Journal of Technology Management & Innovation	Journal	Q3	1
Requirements Engineering	Journal	Q2	3
2017 ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM)	Conference	-	1
2020 3rd International Conference on Computer and Informatics Engineering (IC2IE)	Conference	-	1
2020 7th International Conference on Electrical Engineering, Computer Sciences and Informatics (EECSI)	Conference	-	1
Proceedings of the 40th International Conference on Software Engineering: Software Engineering in Society (ICSE-SEIS 18)	Conference	-	1
Proceedings of the 2018 International Conference on Software and System Process (ICSSP 18)	Conference	-	1
IEEE International Conference on Requirements Engineering	Conference	-	1
Lecture Notes in Business Information Processing	Conferences	-	1
Procedia Computer Science	Conferences	-	1
Proceedings of the European Conference on e-Government (ECEG)	Conferences	-	1
Proceedings of the 34th ACM/SIGAPP Symposium on Applied Computing (SAC 19)	Conferences	-	1

Publication name	Publication type	Rank	Quantity
Proceedings of the 19th International Conference on Agile Software Development: Companion (XP 18)	Conferences	-	1
2017 ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM)	Conferences	-	1

According to research methods, we found that 57.14% of the studies were conducted as case studies. This category can be further divided into single-case studies and multi-case studies. Rizkiyah et al. (2020), Nisyak et al. (2020), Alsaqaf et al. (2017), Lindsjörn and Moustafa (2018), Russo et al. (2018), and Noor et al. (2014) are single case studies. In contrast, Alexandrova and Rapanotti (2020), Chen et al. (2019), Kasauli et al. (2021), Schön et al. (2017), and Wohlrab et al. (2018) are multi-case studies. Additionally, 23.81% of the studies employed surveys to gather data, while the remaining portion utilized interviews. Table 4 shows the percentage of studies based on research methods.

**Table 4. Distribution of studies by research method**

Research method	Studies	Percentage
Case study	Wohlrab et al. (2018), Rizkiyah et al. (2020), Nisyak et al. (2020), Alsaqaf et al. (2017), Lindsjörn and Moustafa (2018), Russo et al. (2018), Noor et al. (2014), Alsaqaf et al. (2018), Schön et al. (2017), Alexandrova and Rapanotti (2020), Kasauli et al. (2021), Chen et al. (2019)	57.14%
Interview	Alsanoosy et al. (2020b), Alsaqaf et al. (2019), Palomares et al. (2021), Franch et al. (2023)	19.05%
Survey	Ochodek and Kopczyńska (2018), Fontana and Marczak (2020), Garousi et al. (2015), Tripathi et al. (2018), Wagner et al. (2019)	23.81%

### *AGILE REQUIREMENTS ENGINEERING CHALLENGES*

Table 5 describes the 22 challenges, which are classified into four categories. These challenges are derived from a summary of 21 relevant papers. There are two challenges in organizational aspects. Within the categories of people and processes, eight challenges are identified for each category. In the last category, the project, we discovered four challenges.

**Table 5. Agile requirements engineering challenges**

Aspect	Id	Challenge	N	References
Organizational	C1	Lack of capacity to modify the organizational culture	3	Fontana and Marczak (2020), Lindsjörn and Moustafa (2018), Noor et al. (2014)
	C2	Lack of top management support	2	Chen et al. (2019), Fontana and Marczak (2020)
People	C3	Increased stress and workload	1	Nisyak et al. (2020)
	C4	Lack of communication with stakeholders	8	Rizkiyah et al. (2020), Nisyak et al. (2020), Fontana and Marczak (2020), Russo et al. (2018), Wohlrab et al. (2018), Schön et al. (2017), Franch et al. (2023), Noor et al. (2014)

Aspect	Id	Challenge	N	References
	C5	Lack of individual commitment	1	Nisyak et al. (2020)
	C6	Lack of stakeholders' availability	4	Rizkiyah et al. (2020), Nisyak et al. (2020), Chen et al. (2019), Schön et al. (2017)
	C7	Lack of trust between stakeholders and IT provider	3	Lindsjörn and Moustafa (2018), Schön et al. (2017), Noor et al. (2014)
	C8	Lack of understanding of Agile values	4	Wohlrab et al. (2018), Nisyak et al. (2020), Garousi et al. (2015), Alsaqaf et al. (2018)
	C9	Team's capability	7	Nisyak et al. (2020), Fontana and Marczak (2020), Alsaqaf et al. (2017), Wohlrab et al. (2018), Chen et al. (2019), Alsaqaf et al. (2019), Franch et al. (2023)
	C10	Team's interactions	4	Alsaqaf et al. (2017), Schön et al. (2017), Franch et al. (2023), Alsaqaf et al. (2019)
Process	C11	Difficulty prioritizing requirements	5	Wohlrab et al. (2018), Rizkiyah et al. (2020), Chen et al. (2019), Palomares et al. (2021), Alsaqaf et al. (2018)
	C12	Frequent architectural modification	4	Chen et al. (2019), Alsaqaf et al. (2017), Alsaqaf et al. (2018), Alsaqaf et al. (2019)
	C13	Lack of requirements traceability	3	Rizkiyah et al. (2020), Kasauli et al. (2021), Franch et al. (2023)
	C14	Lack of requirements understanding	7	Nisyak et al. (2020), Fontana and Marczak (2020), Alsaqaf et al. (2017), Wohlrab et al. (2018), Chen et al. (2019), Alsaqaf et al. (2019), Franch et al. (2023)
	C15	Long feedback cycles	1	Kasauli et al. (2021)
	C16	Quality requirements infeasibility	3	Alsaqaf et al. (2017), Franch et al. (2023), Alsaqaf et al. (2018)
	C17	Requirements are not well-documented	4	Rizkiyah et al. (2020), Garousi et al. (2015), Alsaqaf et al. (2018), Kasauli et al. (2021)
	C18	Unclear acceptance criteria	4	Chen et al. (2019), Alsaqaf et al. (2017), Alsaqaf et al. (2018), Alsaqaf et al. (2019)
Project	C19	Divergent interests of contract	1	Russo et al. (2018)
	C20	Inaccurate estimation of cost and schedule	4	Rizkiyah et al. (2020), Noor et al. (2014), Palomares et al. (2021), Chen et al. (2019)
	C21	Lose sight of the vision	1	Schön et al. (2017)
	C22	Requirements enforcement while the cost and schedule have been settled	1	Rizkiyah et al. (2020)

**Lack of capacity to modify the organizational culture (C1)**

Cultural factors play a major role in the resistance to change within the public sector, with the obstacles posed by bureaucracy (Fontana & Marczak, 2020). Public servants in the public sector typically

display a reluctance to embrace changes in the new business process unless they can clearly see personal advantages and tangible benefits (Fakhruzzaman, 2019). In some cases, the public servant, as a customer, attempts to exceed the agreed-upon scope without being willing to compensate for the additional requirements, which causes conflict with the service providers (Lindsjörn & Moustafa, 2018).

### **Lack of top management support (C2)**

A significant obstacle to employee participation in the requirements process stems from the inadequate support provided by management, including insufficient time allocation for engagement in the requirements phase (Chen et al., 2019). The notable significance of securing top management support emphasizes its greater importance compared to other challenges (Fontana & Marczak, 2020). Agile emphasizes customer involvement. Hence, the presence of top management is essential throughout the process.

### **Increased stress and workload (C3)**

The failure in Agile RE leads to the escalation of stress and workload, which arises from employees having to juggle their daily tasks alongside the project (Rizkiyah et al., 2020). This lack of dedicated resources to manage the Agile RE task has adverse consequences and negative effects. The Agile requirement engineering process will not be fully monitored and covered.

### **Lack of communication with stakeholders (C4)**

Failure to acknowledge stakeholders representing various system viewpoints can result in missing requirements and amplified project costs (Alsaqaf et al., 2019). The absence of a stable relationship between shareholders and teams in reaching an agreement on user requirements and quality of use, particularly when collaborating with end users, presents notable challenges (Fontana & Marczak, 2020; Rizkiyah et al., 2020; Schön et al., 2017). Moreover, communication difficulties between business stakeholders and engineers compound the complexities of aligning customer and vendor expectations (Nisyak et al., 2020; Noor et al., 2014; Palomares et al., 2021; Wohrab et al., 2018).

### **Lack of individual commitment (C5)**

The failure of software development can be attributed to issues concerning the roles, responsibilities, and commitment of the individuals involved (Nisyak et al., 2020). Agile methodologies emphasize the significance of self-driven teams with a strong sense of commitment. However, in the context of Agile requirement engineering in the public sector, the lack of individual commitment of public servants has a detrimental impact on the overall process.

### **Lack of stakeholder availability (C6)**

Engaging stakeholders consistently throughout the development process is a general challenge in Agile requirement engineering, with the goal of attaining successful product development (Chen et al., 2019; Schön et al., 2017). The active participation and accessibility of clients/customers significantly enhance the likelihood of project success (Rizkiyah et al., 2020). However, neglecting the inclusion of customer representatives in crucial activities like the Sprint Review can result in detrimental effects, including ineffective feedback processes and a lack of clarity regarding project progress (Nisyak et al., 2020).

### **Lack of trust between stakeholders and IT provider (C7)**

The challenge in Agile software development is gaining stakeholders' understanding and acceptance of the development team's autonomy in making detailed independent decisions (Schön et al., 2017). On the other hand, government organizations and officials heavily rely on approved contracts and documents, coupled with limited IT knowledge and past negative experiences, and tend to distrust vendors' abilities and intentions (Noor et al., 2014). Additionally, government officials view the provider as dishonest when deadlines are missed and not all agreed-upon requirements are delivered (Lindsjörn & Moustafa, 2018).

**Lack of understanding of Agile values (C8)**

Practitioners are required to adopt Agile practices within their teams and with external departments (Wohlrab et al., 2018). However, several developers still maintain a waterfall mentality. They follow the PO's instructions to implement user stories, but they do not invest time in determining the necessary Quality Requirements (QRs) unless the system starts showing inflexibility (Alsaqaf et al., 2018). Lack of awareness of Agile values can lead to the failure of Agile Software Development (ASD) in the organization (Garousi et al., 2015; Nisyak et al., 2020).

**Team's capability (C9)**

Each team member has a unique set of abilities and expertise (Chen et al., 2019; Nisyak et al., 2020). Nevertheless, the effectiveness of an Agile project relies on the team's capability (Alsaqaf et al., 2017; Wohlrab et al., 2018). So, sharing information within the team is crucial to enhancing the quality of RE (Alsaqaf et al., 2019; Fontana & Marczak, 2020; Palomares et al., 2021).

**Team's interactions (C10)**

In ASD, team coordination is important (Alsaqaf et al., 2019; Schön et al., 2017). Problems in communication and insufficient coordination can lead to infeasibility of requirements (Franch et al., 2023). Therefore, effective communication between teams and their members should be prioritized to ensure the accurate and successful implementation of RE (Alsaqaf et al., 2017).

**Difficulty prioritizing requirements (C11)**

It is difficult to determine priority when customers claim all features are equally important (Chen et al., 2019; Rizkiyah et al., 2020). As a customer representative, the PO has limited knowledge in all domains, and it can cause bias in requirements a priority. In order to meet the deadline, the PO can push the team to eliminate any requirement that they did not specifically request (Alsaqaf et al., 2018; Palomares et al., 2021). However, there is a possibility that the requirement holds significant importance and has a higher value. Hence, the team must carefully consider which requirements are more of a priority (Wohlrab et al., 2018).

**Frequent architectural modification (C12)**

Requirements changes can result in architectural modification. This occurs as a consequence of the previous architecture being no longer suitable for new requirements (Alsaqaf et al., 2019; Chen et al., 2019). In addition, inadequate documentation of architectural modification can lead to difficulties in understanding and maintaining the software (Alsaqaf et al., 2017). As projects become more complex, some requirements cannot be met due to architectural limitations (Alsaqaf et al., 2018).

**Lack of requirements traceability (C13)**

Lack of requirements traceability can lead to team confusion, difficulties in tracking back the changes in requirements and missing some requirements (Kasauli et al., 2021; Rizkiyah et al., 2020). Moreover, it may cause development inefficiencies and maintenance difficulties (Franch et al., 2023; Kasauli et al., 2021).

**Lack of requirements understanding (C14)**

In RE, ambiguity is a major issue that is often raised (Franch et al., 2023). During sprint planning, the team frequently encounters difficulty due to a lack of clarity in specifying requirements (Nisyak et al., 2020; Rizkiyah et al., 2020). It is difficult to understand customers' viewpoints and not effectively communicate how they provide value to them (Kasauli et al., 2021; Nisyak et al., 2020; Noor et al., 2014). A lack of understanding of the requirements makes it difficult for stakeholders to reach agreement on requirements across the organization (Chen et al., 2019). Furthermore, the developer team understood these requirements more (Alexandrova & Rapanotti, 2020; Nisyak et al., 2020).

### **Long feedback cycles (C15)**

Long feedback cycles are one of the Agile RE challenges. Long feedback cycles can be caused by several reasons (Kasauli et al., 2021). First, customers need a certain amount of time to test and approve new features. Second, there are too many stakeholders involved. So, the team needs to communicate requirements with various stakeholders, which causes delays in obtaining feedback.

### **Quality requirements infeasibility (C16)**

Some requirements can not be implemented due to various limitations (Palomares et al., 2021). For example, a project has an objective to be available 24/7 (Alsaqaf et al., 2018). For security purposes, access to the system was restricted to a limited number of hours per day (Alsaqaf et al., 2017, 2018). This is one of the challenges when eliciting requirements.

### **Requirements are not well documented (C17)**

It is very challenging to understand user stories and test cases with poor requirements documentation (Kasauli et al., 2021). Poor documentation on user stories and their specifications leads to different interpretations among team members (Alsaqaf et al., 2018; Rizkiyah et al., 2020). In contrast, as requirements are documented more clearly, team members do not need to memorize the requirements (Garousi et al., 2015).

### **Unclear acceptance criteria (C18)**

To determine whether requirements are properly implemented, the tester needs to verify them (Alsaqaf et al., 2017). However, testers face difficulties in testing the requirements due to unclear acceptance criteria and unclear business requirements (Alsaqaf et al., 2019; Chen et al., 2019). To make testing process easier, the acceptance criteria must be clearly defined and unambiguous (Alsaqaf et al., 2018).

### **Divergent interests of contract (C19)**

Some public sector projects are carried out through contracts between IT providers/contractors and organizations. But, they have different interests, such as deadline, cost, requirements interpretation, quality, and security (Russo et al., 2018). It is very challenging when both parties engage in a software contract.

### **Inaccurate estimation of cost and schedule (C20)**

Government organizations often set unreasonable deadlines for IT projects (Noor et al., 2014). This is due to a lack of understanding regarding project scope, limited experience in IT project development, and administrative delays in the public sector (Noor et al., 2014; Palomares et al., 2021). These factors lead to unrealistic scheduling and inappropriate cost estimates (Chen et al., 2019; Rizkiyah et al., 2020).

### **Lose sight of the vision (C21)**

In ASD, it is a challenge to maintain a focus on the vision when implementing complex requirements. Teams need to share understanding and remind each other not to lose sight of the bigger picture (Schön et al., 2017).

### **Requirements enforcement while the cost and schedule have been settled (C22)**

Some customers tend to add more requirements during the development (Rizkiyah et al., 2020). In Agile, new requirements are encouraged as long as the schedule and cost can be modified. Even after the schedule and costs have been established, the customer persists in requesting additional requirements. Team members will face a new challenge to meet the requirements.

***MAPPING POTENTIAL SOLUTIONS TO CHALLENGES***

We mapped potential solutions to the identified challenges reported in Table 5. The potential solutions are derived from previous studies and books. Table 6 presents a comprehensive mapping between the identified challenges and the corresponding solutions.

**Table 6. Mapping potential solutions to challenges**

Aspect	Challenge ID	Practice ID	Best practice solutions
Organizational	C1	P1	Implementing Agile principles gradually to modify organizational culture (Alexandrova & Rapanotti, 2020; Noor et al., 2014).
	C2	P2	Seek top management support (Noor et al., 2014).
People	C3	P3	Pick a Person In Charge (PIC) from the organization (Nisyak et al., 2020).
	C4	P4	Maintain regular communication with stakeholders (Chen et al., 2019; Nisyak et al., 2020; Rizkiyah et al., 2020; Schön et al., 2017).
		P5	Establish stakeholder representatives' groups (Schön et al., 2017; Wohlrab et al., 2018).
	C5	P6	Establish working agreements with stakeholders (Rizkiyah et al., 2020).
		P7	One person focuses on one project (Nisyak et al., 2020).
	C6	P4	Maintain regular communication with stakeholders (Chen et al., 2019; Nisyak et al., 2020; Rizkiyah et al., 2020; Schön et al., 2017).
		P5	Establish stakeholder representatives' groups (Schön et al., 2017; Wohlrab et al., 2018).
		P6	Establish working agreements with stakeholders (Rizkiyah et al., 2020).
	C7	P4	Maintain regular communication with stakeholders (Chen et al., 2019; Nisyak et al., 2020; Rizkiyah et al., 2020; Schön et al., 2017).
		P8	Deliver value frequently (Lindsjörn & Moustafa, 2018; Noor et al., 2014).
		P9	Conduct user acceptance tests (Lindsjörn & Moustafa, 2018).
	C8	P10	Arrange training for team members on Agile values (Nisyak et al., 2020).
	C9	P10	Arrange training for team members on Agile values (Nisyak et al., 2020).
	C10	P11	Organize regular team meetings (Schön et al., 2017).
Process	C11	P12	Regular reviews of requirements (Kasauli et al., 2021; Ochodek & Kopczyńska, 2018; Schön et al., 2017; Tripathi et al., 2018; Wagner et al., 2019; Wohlrab et al., 2018).
		P13	Implement Dynamic Systems Development Method (DSDM) Model (Rizkiyah et al., 2020).

Aspect	Challenge ID	Practice ID	Best practice solutions
	C12	P14	Establish a preparation team (Alsaqaf et al., 2018).
	C13	P15	Ensure requirements are traceable (Garousi et al., 2015; Kasauli et al., 2021; Ochodek & Kopczyńska, 2018; Rizkiyah et al., 2020; Wagner et al., 2019).
	C14	P12	Regular reviews of requirements (Kasauli et al., 2021; Ochodek & Kopczyńska, 2018; Schön et al., 2017; Tripathi et al., 2018; Wagner et al., 2019; Wohlrab et al., 2018).
		P16	Customer availability on site (Ochodek & Kopczyńska, 2018).
		P17	Splitting big stories into smaller user stories (Nisyak et al., 2020).
	C15	P18	Prioritize requirements based on value (Kasauli et al., 2021; Tripathi et al., 2018).
	C16	P19	Maintaining an assumption wiki page (Alsaqaf et al., 2018).
	C17	P20	Write documentation of requirements clearly (Garousi et al., 2015; Kasauli et al., 2021; Rizkiyah et al., 2020; Tripathi et al., 2018; Wagner et al., 2019).
	C18	P21	Implement Independent, Negotiable, Valuable, Estimable, Small, and Testable (INVEST) criteria to evaluate stories (Ochodek & Kopczyńska, 2018; Rizkiyah et al., 2020; Wagner et al., 2019).
Project	C19	P22	Using Sprint-based contracts (Russo et al., 2018).
	C20	P23	Create feature and schedule buffers (Noor et al., 2014; Rizkiyah et al., 2020).
	C21	P24	Establish the project's shared vision (Ochodek & Kopczyńska, 2018; Schön et al., 2017).
	C22	P23	Create feature and schedule buffers (Alsaqaf et al., 2018; Rizkiyah et al., 2020).
		P25	Establish RE company standards (Wagner et al., 2019).

### Implementing the Agile principle gradually to modify organizational culture (P1)

Gradually implementing Agile could be a way rather than a dramatic change in a bureaucratic organization. To achieve this, it is important to create an environment where organizational hierarchies do not hinder open discussions and where ideas are presented in a competitive context with immediate feedback and rewards (Alexandrova & Rapanotti, 2020). Additionally, adopting Agile methods and ensuring proximity between the development team and the client, either by bringing a representative client to the development site or having the team work closely with the client, can greatly enhance collaboration and fulfill the promises made by higher management (Noor et al., 2014).

### Seek management support (P2)

The active support of top management plays a critical role in overcoming obstacles encountered during the process. When the vendor successfully earns the trust of the client, particularly the official management, it significantly enhances the project's prospects for success. In certain cases, the intervention and involvement of management have resulted in smoother progress of Agile RE (Noor et al., 2014).



**Pick a PIC from the organization (P3)**

In order to tackle the barrier of increased stress and workload within the public sector, it is essential to designate a Person in Charge (PIC) who assumes the pivotal role of being the ultimate decision-maker and primary communicator with the vendor or vice versa. A mutually agreed-upon estimate or schedule that ensures active participation from all parties involved in the project should be established (Nisyak et al., 2020). The selected PIC should fully keep their eyes on the ball, ensuring project success.

**Maintain regular communication with stakeholders (P4)**

In order to overcome the challenge of infrequent communication with stakeholders, it is essential for the project team to establish a strong and regular collaboration with stakeholders for both the Product Owner (PO) (Rizkiyah et al., 2020) and Technical Leads for the development side stakeholders (Chen et al., 2019). By maintaining consistent touchpoints with stakeholders, the team can effectively navigate the complexities while also facilitating crucial processes that require active organizational involvement (Nisyak et al., 2020). This collaborative approach should include the presentation of potential solutions, transparent communication of decision-making rationales, and educating stakeholders about the consequences of interfering with detailed decisions (Schön et al., 2017).

**Establish stakeholder representative groups (P5)**

Another practice could be performed to eliminate the less frequent communication with stakeholders by creating stakeholder representative groups to engage in discussions and disseminate valuable information (Wohlrab et al., 2018). When managing stakeholders, it is crucial to clearly identify their roles and involvement during regular iterations, emphasize goal-setting rather than imposing specific solutions, engage all relevant stakeholders from the project's outset, and gradually streamline the number of participants over time (Schön et al., 2017).

**Establish a working agreement with stakeholders (P6)**

A low level of development team commitment can be mitigated by establishing ground rules or a working agreement about the development (Rizkiyah et al., 2020). The organization should set the working agreement, which covers working hours, communication protocol, a detailed list of communication channels, and its expected frequency. All stakeholders, including the development teams, must acknowledge the ground rules to be agreed upon. Penalty could be discussed in any case of failure to follow the agreements.

**One person focuses on one project (P7)**

Individual commitment can be enhanced by assigning employees to dedicated projects, enabling them to focus on their work within the project and reinforcing mutual commitments based on sprint goals established by the team and the Product Owner (Nisyak et al., 2020). This approach not only facilitates performance measurement and assessment but also fosters a sense of accountability among team members. By aligning individual efforts with project objectives, organizations can effectively gauge employee performance and level of commitment.

**Deliver value frequently (P8)**

Establishing trust is vital in Agile projects, and it is achieved through regular interaction and the iterative delivery of valuable increments to the customer (Lindsjörn & Moustafa, 2018). In the relationship between the vendor and client, trust is a cornerstone that allows the vendor's assessments to be valued and the client to understand the vendor's concerns. By consistently delivering high-quality work in incremental stages and meeting deadlines, trust is effectively built-in software development projects (Noor et al., 2014). Trust can also be built by the value perceived by the public sector through sprint execution.

### **Conduct user acceptance test (P9)**

Following the review meetings, the customer can perform an acceptance test, evaluating the system's compliance with predetermined criteria that define its expected behavior. When the system successfully meets the customer's requirements, it fosters a sense of trust in the vendor and guarantees acceptance of the system. This process ensures that the customer's needs are met and solidifies the relationship between the customer and the provider (Lindsjörn & Moustafa, 2018).

### **Arrange training for team members on Agile value (P10)**

A lack of understanding of Agile values can result in the ineffectiveness of the implementation of ASD (C8). To overcome this challenge, the organization needs to provide dedicated training for team members on Agile values. It is also an effective solution to improve team capability (C9). By investing in training, the team can prevent the same failures in prior projects. It is necessary to conduct an assessment of the team member's competencies by utilizing a skill requirements matrix (Nisyak et al., 2020).

### **Organize regular team meetings (P11)**

Organizing coordination meetings on a regular basis is essential. The purpose of conducting regular team meetings is to establish an understanding, enhance collaboration, and promote continuous communication (Schön et al., 2017). This practice can address challenges related to team interaction (C10).

### **Regular reviews of requirements (P12)**

To address challenges related to the difficulty of prioritizing requirements (C11) and lack of understanding of requirements (C14), we recommend implementing regular reviews of requirements. This practice is required to identify the importance level of each requirement so the team can see which requirements are less essential (Kasauli et al., 2021; Wohlrab et al., 2018). This will make it easier to prioritize the requirements. By conducting regular reviews and keeping documents up to date, the team will also be able to understand requirements clearly (Schön et al., 2017; Tripathi et al., 2018). Therefore, public sector organizations can continually improve their RE (Ochodek & Kopczyńska, 2018; Wagner et al., 2019).

### **Implement DSDM (P13)**

The Dynamic System Development Method (DSDM) model stands as an Agile project framework, offering methodologies and deliverables to encompass the entirety of the software development life cycle. The primary principle of DSDM in ensuring product quality remains at an optimal level involves permitting flexibility in scope and features while maintaining a constant project cost and budget (Özcan-Top & McCaffery, 2019). DSDM encompasses five main stages (Al-Saqqa et al., 2020):

- *Feasibility study stage.* The technical requirements and risks are analyzed, which produces a feasibility report and the outline plan.
- *Business study stage.* The discussion concerns the user's requirements and functionality, which are documented in ER diagrams and the summary of the prototyping plan.
- *Functional model iteration stage.* During this phase, analysis, coding, and prototyping are carried out iteratively and incrementally. The prototypes are then analyzed to improve the analysis model.
- *Design and build stage.* Following identification, requirements are translated into code, subsequently disseminated, and subjected to user testing. User feedback then fuels an iterative process of system refinement, resulting in tested software.
- *Implementation stage.* In this phase, the software is published in the production environment.

In this framework, the requirements are prioritized based on four groups: Must Have, Should Have, Could Have, and Won't Have (Rizkiyah et al., 2020). Implementing this framework will be useful in

solving the problem of prioritizing requirements (C11). The project must ensure that no more than 70% of the allocated resources are dedicated to fulfilling the Must Have requirements (Rizkiyah et al., 2020).

#### **Establish preparation team (P14)**

The preparation team is a group of senior software architects, senior information analysts, and business representatives (Alsaqaf et al., 2018). The preparation team starts “sprint zero” to define the overall architecture and elicit critical requirements (Alsanoosy et al., 2020b). This team ensures its readiness for the upcoming sprint (Alsanoosy et al., 2020b; Alsaqaf et al., 2018). By establishing a preparation team, the organization can mitigate the problems of frequent architectural changes (C12).

#### **Ensure requirements are traceable (P15)**

The lack of traceability of requirements can lead to other problems (C13), so it is important to ensure that requirements are traceable (Garousi et al., 2015; Kasauli et al., 2021). There are several ways to make requirements easier to trace. First, regularly write documents that relate to important meetings (Rizkiyah et al., 2020). Second, store requirements documentation in easy-access locations (Ochodek & Kopczyńska, 2018). Third, update the backlog periodically and keep it up to date (Wagner et al., 2019).

#### **Customer availability on site (P16)**

In order to overcome the lack of understanding of requirements (C14), the availability of customers is critical. Customers’ ability to answer requirements-related questions can help the team to understand the requirements clearly, thereby improving the effectiveness of development (Ochodek & Kopczyńska, 2018).

#### **Splitting the big story into smaller user stories (P17)**

Splitting the big story into smaller user stories can help the developer team understand requirements clearly (Nisyak et al., 2020). Smaller user stories can help the team to focus on specific features or functionality at a time. This enhances clarity and minimizes ambiguity, as the team can understand the outcome of the story. Therefore, this practice can prevent the C14 issue.

#### **Prioritize requirements based on value (P18)**

Problems related to long feedback cycles (C15) can be mitigated by prioritizing the requirements based on their value (Tripathi et al., 2018). It is a crucial aspect of the development process. The primary objective is to focus on customer value in each sprint and provide value for the product (Kasauli et al., 2021).

#### **Maintaining an assumption Wiki page (P19)**

When the Product Owner is unable to provide clarity on the requirements, the teams start to make their own assumptions (Garousi et al., 2015). They can use an assumption Wiki page to record their assumption. An assumption Wiki page is a collaborative online platform where a team’s assumptions are documented and shared. It allows team members to share the same understanding of a project. So, the challenges that team members face can be identified, and they can discuss how to solve the infeasibility of requirements (C16).

#### **Write documentation of requirements clearly (P20)**

It is crucial to have documentation in an appropriate format (Garousi et al., 2015; Tripathi et al., 2018). Some companies write their own additional custom requirements documents to complement tests and user stories (Kasauli et al., 2020). Clear and well-documented requirements simplify the validation process (Rizkiyah et al., 2020), (Kasauli et al., 2021). This practice can mitigate the problem caused by the C17 challenge.

### **Implement INVEST criteria to evaluate stories (P21)**

There is a guideline to evaluate the user stories called INVEST (Rizkiyah et al., 2020). INVEST stands for Independent, Negotiable, Valuable, Estimable, Small, and Testable. This guideline can help to ensure that user stories are manageable and well-defined. The unclear acceptance criteria issue (C18) is caused by the absence of INVEST implementation. Consequently, the testers face difficulties testing user stories (Ochodek & Kopczyńska, 2018; Wagner et al., 2019). By implementing INVEST, the organization can more easily create acceptance criteria.

### **Using Sprint-based contract (P22)**

In contract-based projects, especially in the public sector, there are different interests between organizations and IT providers (C19). To address the concerns of both parties involved, the organizations can adopt a Sprint-based contract approach. Instead of specifying all the requirements and deliverables upfront in detail, a sprint-based contract is organized around a series of time-limited iterations or sprints. Hence, The organization and IT providers agree on the scope and deliverables for each upcoming sprint. The Sprint-based contracts are considered a suitable approach in the public sector (Russo et al., 2018).

### **Create feature and schedule buffers (P23)**

This practice can be used to solve the C20 and C22 issues. The feature buffer is extra time allocated to handle unexpected requirements changes or additional features that may arise during the project (Alsaqaf et al., 2018). It is advised that 30% of the project's effort be considered optional to create a feature buffer for the project (Rizkiyah et al., 2020). The schedule can still be fulfilled by removing items from the feature buffer if the time is limited. Meanwhile, a schedule buffer is an additional time to accommodate uncertainty and potential risks that may cause delays (Rizkiyah et al., 2020).

### **Establish the project's shared vision (P24)**

It is recommended that organizations create a project's shared vision to ensure the team understands the big picture (Schön et al., 2017). This practice can assist in maintaining the team's focus and ensure the right direction (Ochodek & Kopczyńska, 2018). So, the project vision must be shared within the team in order to solve the vision loss issue (C21).

### **Establish RE company standard (P25)**

Many organizations have a RE company standard. This standard can be customized by an experienced project lead at the beginning of the project (Wagner et al., 2019). This standard comprises guidelines/best practices for eliciting, managing, documenting, and validating requirements. By following this practice, it is expected to prevent requirements enforcement issues (C22).

## ***COMPARISON OF RESEARCH FINDINGS WITH PRIOR STUDIES***

Previous research has delved into the difficulties presented by the collaboration-focused Agile approach to handling requirements engineering tasks. In this section, identified challenges in this study are compared with prior studies (Hoy & Xu, 2023; Inayat et al., 2015). Table 7 demonstrates the comparison of our research findings with current literature. It is noticeable that the challenges discussed in the two studies are fully identified in this paper in more detail and context. The primary novelty of this study lies in its concentration on Agile requirement engineering challenges within the public sector domain, whereas previous studies addressed these issues in more general contexts. Lack of capacity to modify the organizational culture (C1), lack of top management support (C2), and long feedback cycle (C15) are unique to the public sector domain due to the bureaucracy in the public sector. It represents a highly structured and formal system within a specific organization, characterized by a hierarchical structure governed by established regulations and policies. There is often an adherence to rigid hierarchical protocols, with clear distinctions between superiors and subordinates (Dwi Harfianto et al., 2022).

Adopting the Agile methodology necessitates a comprehensive understanding of Agile values by all stakeholders, including customers and the developer team. In software development specifically, customers must possess a thorough understanding of the desired value to be translated into software products. However, in many cases, as identified by Hoy and Xu (2023) and Inayat et al. (2015), qualifications did not exist on the customer side. Our discoveries delved deeply into this area of the public sector domain where the public sector's representatives do not possess sufficient understanding of the requirements (C14) or Agile values (C15).

**Table 7. Comparison of challenges with prior studies**

Prior study 1 (Inayat et al., 2015)	Prior study 2 (Hoy & Xu, 2023)	Research finding
Minimal documentation	Minimal documentation	Lack of requirement traceability (C13)
		Requirements are not well documented (C17)
	Poorly written requirements	Unclear acceptance criteria (C18)
Customer availability	Customer unavailability or low availability	Lack of individual commitment (C5)
		Lack of stakeholders' availability (C6)
Inappropriate architecture	Inappropriate architecture	Frequent architectural modification (C12)
Budget and time estimation	Inaccurate effort estimation	Inaccurate estimation of cost and schedule (C20)
Neglecting non-functional requirements	Quality requirements are neglected	Quality requirements infeasibility (C16)
Customer inability and agreement	Customer knowledge	Lack of requirement understanding (C14)
		Lack of understanding of Agile values (C8)
		Team's capability (C9)
	Inappropriate prioritization method	Difficulty prioritizing requirements (C11)
Contractual limitations	-	Divergent interests of contract (C19)
Requirements change and its evaluation	Managing change	Requirements enforcement while the cost and schedule have been settled (C22)
	Maintaining a software requirement	Increased stress and workload (C3)
-	Communication methods	Lack of communication with stakeholders (C4)
		Team's interaction (C10)
-	-	Lack of capacity to modify the organizational culture (C1)
		Lack of top management support (C2)
		Lack of trust between stakeholders and IT provider (C7)
		Long feedback cycles (C15)
		Lose sight of the vision (C21)

Previous studies by Inayat et al. (2015) and Hoy and Xu (2023) discussed the practices of Agile requirement engineering to overcome the identified challenges in a general context, while this research focused on the public sector environment. Table 8 explains the comparison of our research findings

with prior studies. Practices discussed by Inayat et al. (2015) encompassed various practices in more detail compared to the research findings of Hoy and Xu (2023). In contrast, our findings present comprehensive practical action that suits the public sector atmosphere. For instance, Hoy and Xu (2023) mentioned sharing knowledge about requirements that can be translated as face-to-face communication and customer involvement based on Inayat et al. (2015). This study proposed more detailed and concrete practices, such as appointing an organization representative (P3) and ensuring that they are available on site (P16), maintaining regular communication with the stakeholders (P4), and creating a commitment to working agreements with the stakeholders (P6) to ensure seamless communication between all parties.

Testing before coding is a practice that was proposed by Inayat et al. (2015), but it has not appeared in our primary studies. The practice is well-known as the Test-Driven Development (TDD) approach, where small, automated tests are iteratively created to guide the writing of code that demonstrably fulfills those test cases. While TDD offers clear advantages, its exclusive reliance on test cases for development can result in subpar documentation, hindering understanding during future maintenance. Additionally, the potentially blurred lines between roles, where developers are solely responsible for test script creation, which may traditionally fall under the testing domain, could lead to confusion and inefficiencies (Al-Saqqa et al., 2020). Hence, the practice does not suit the rigid and hierarchical environment of the public sector.

**Table 8. Comparison of practices with prior studies**

Prior study 1 (Inayat et al., 2015)	Prior study 2 (Hoy & Xu, 2023)	Research finding
Face-to-face communication	Share knowledge about the requirement	Maintain regular communication with stakeholders (P4)
		Customer availability on site (P16)
		Organize regular team meetings (P11)
Customer involvement		Pick a PIC from the organization (P3)
		Establish stakeholder representatives' group (P5)
		Establish working agreement with stakeholders (P6)
User stories	Provide the requirement information needed	Splitting big story into smaller user stories (P17)
		Implement INVEST criteria to evaluate stories (P21)
Iterative requirements	-	Delivery value frequently (P8)
		Regular reviews of requirements (P12)
Requirement prioritization	Improve the method for requirements prioritization	Prioritize requirement based on value (P18)
		Implement DSDM (P13)
Change requirement	-	Regular review requirements (P12)
		Establish working agreement with stakeholder (P6)
Cross-functional teams	-	One person focuses on one project (P7)
		Establish stakeholder representatives' group (P5)
Prototyping	-	Implement DSDM (P13)

Prior study 1 (Inayat et al., 2015)	Prior study 2 (Hoy & Xu, 2023)	Research finding
Testing before coding	-	-
Requirement modeling	-	Implement DSDM (P13)
Requirement management	Manage a product backlog	Implement INVEST criteria to evaluate stories (P21)
	Identify minimal documentation needed	Write documentation of requirements clearly (P20)
	Maintain requirement traceability	Ensure requirements are traceable (P15)
Review meetings and acceptance test	-	Conduct user acceptance test (P9)
Code refactoring	-	Implement DSDM (P13)
Shared conceptualizations	Share the product vision	Arrange training on Agile value for team members (P10)
		Establish the project's shared vision (P24)
Pairing for requirement analysis	-	Establish preparation team (P14)
Retrospectives	-	Organize regular team meetings (P11)
Continuous planning	-	Using Sprint-based contract (P22)
-	Improve estimation process	Create feature and schedule buffers (P23)
-	Manage requirement quality	Maintaining an assumption wiki page (P19)
-	-	Implementing the Agile principle gradually to modify organizational culture (P1)
		Seek management support (P2)
		Establish RE company standard (P25)

Testing before coding is a practice that was proposed by Inayat et al. (2015), but it has not appeared in our primary studies. The practice is well-known as the Test-Driven Development (TDD) approach, where small, automated tests are iteratively created to guide the writing of code that demonstrably fulfills those test cases. While TDD offers clear advantages, its exclusive reliance on test cases for development can result in subpar documentation, hindering understanding during future maintenance. Additionally, the potentially blurred lines between roles, where developers are solely responsible for test script creation, which may traditionally fall under the testing domain, could lead to confusion and inefficiencies (Al-Saqqa et al., 2020). Hence, the practice does not suit the rigid and hierarchical environment of the public sector.

### ***DOMAIN-SPECIFIC QUALITY ISSUES WITH AGILE RE***

To improve comprehension, we clarify the insights gathered collectively from prior studies and categorize them according to their domain. We provide a mapping of each domain concerning challenges, quality issues, and associated solutions of Agile RE in Table 9.

**Table 9. Domain-specific quality issues**

Domain	Challenge	Quality issue	Solution
Organizational	The culture within the public sector tends to foster resistance to change and inadequate top management support to ensure the involvement of all stakeholders during the requirements phase.	Value delivery delays and mismatched expectations.	Implement the Agile principle gradually and seek management support.
People	Communication, interaction, and availability issues.	Increase in rework, increase in cost, and project delays.	Maintain regular communication, organize regular team meetings, and establish stakeholder representatives' groups.
Process	Insufficient project documentation and inadequate understanding and knowledge of requirements by the public sector organization representative.	Unachieved value delivery and knowledge gaps.	Well-documented requirements based on value-driven and initiated highly prepared Agile team.
Project	An unrealistic timeline was exacerbated by frequent changes and additional requirements.	Excessive workload and compromise the quality of the delivered value.	Uniform RE procedure and a built-in margin for adjustments within the project timeline.

### Organizational domain

Agile RE challenges in the organizational domain are related to the organizational culture of resistance to change and insufficient top management support to ensure the involvement of all stakeholders. These challenges affect how well the Agile methodologies perform. Resistance to change within the public sector may hinder the delivery of value, thereby degrading the quality of Agile methodology (Fontana & Marczak, 2020). In addition, inadequate support from top management may lead to a decrease in the quality of the delivered value. In the requirement phase, the involvement of all stakeholders is critical to ensure the value delivered meets expectations. In the public sector, the challenges arise from the complexity of arranging collaborative meetings, particularly involving diverse units with distinct tasks and schedules. Hence, the support of top management is essential to allow the involved stakeholders sufficient time to engage in the requirements phase (Chen et al., 2019). To deal with these challenges and prevent quality issues, potential solutions include gradually implementing the Agile principle and seeking support from the management.

### People domain

In this domain, challenges in Agile RE primarily pertain to communication, interaction, and availability issues. Communication challenges encompass issues in interacting with stakeholders and teams. Stakeholders' perspectives and expectations hold significant importance as they directly impact the value that will be delivered. These insights are typically gathered during the requirements phase. The unavailability of stakeholders is one of the elements that lead to communication issues. The team required clear guidance and perspective on requirements from stakeholders. If relevant stakeholders are



not present, this will lead to uncertainty within the team (Nisyak et al., 2020). If communication with stakeholders encounters difficulties, it may lead to unsuitable delivered value.

Similarly, effective communication and interaction among team members are essential to ensure accurate Agile RE implementation. Insufficient team coordination may result in the impractical fulfillment of requirements (Franch et al., 2023). These may lead to increased rework in the subsequent sprint. These reworks contribute to higher costs and delays in the project timeline. Hence, it is important to mitigate communication, interaction, and availability issues to avoid cost overruns and project delays. To mitigate the potential quality issues, preventive strategies include maintaining regular communication, organizing regular team meetings, and establishing stakeholder representatives' groups.

### **Process domain**

In accordance with the Agile Manifesto, the Agile process places a higher priority on functional software rather than comprehensive documentation. It underscores direct face-to-face communication among team members (Inayat et al., 2015). Nevertheless, in the public sector, where stakeholder engagement is minimal, organization representatives have limited knowledge of requirements (Nisyak et al., 2020), and there is a lack of adequate project documentation (Kasauli et al., 2021), a cascade of consequences ensues. Such fragmentation engenders inefficiencies in development and maintenance (Franch et al., 2023; Kasauli et al., 2021), heightens susceptibility to errors and defects, and fosters divergent interpretations within the team and stakeholders (Rizkiyah et al., 2020), ultimately resulting in unrealized value. Preventive actions are proposed to hinder the issues, such as establishing well-documented requirements (Rizkiyah et al., 2020), prioritizing requirements based on value-driven (Tripathi et al., 2018), and staffing equipped organization representatives in Agile teams (Alsanoosy et al., 2020b). Having organization representatives with a solid understanding of business requirements is crucial to elaborate the requirements comprehensively and make decisions to prioritize the requirements accountable to achieve desired outcomes. A role must be accountable for building comprehensive documentation within an Agile team.

### **Project domain**

Public sector projects are often subject to unrealistic timelines (Noor et al., 2014) and frequent requirement changes (Rizkiyah et al., 2020) due to political pressures and evolving policy landscapes. This confluence of factors creates excessive workloads, compresses development cycles, and ultimately results in deliverables with compromised quality and hinders the optimum value. To facilitate this, it is paramount to establish a standardized requirement engineering process (Wagner et al., 2019) and implement a timeline buffer with calculated flexibility (Alsaqaf et al., 2018). Seamless processes are fundamental to unlocking both superior quality and targeted value realization.

## **DISCUSSION**

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### ***GENERAL FINDINGS***

In our analysis of the 21 relevant studies, one important element is geographical location. A geographical classification system was implemented for the articles, employing the case study's location as the defining factor, with the ultimate objective of elucidating regional research trends and topical preferences. The most significant contribution came from European countries, specifically half of all contributions. This contribution came from the Netherlands, Sweden, Germany, Switzerland, Norway, Italy, and Ireland. This aligns with the fact that Sweden and the Netherlands rank as innovative countries in Europe. Moreover, it shows that the Agile RE topic was popular in European countries between 2014 and 2023 since this study conducted papers published in that period. Asian countries, including Turkey, Pakistan, and Indonesia, held the second contribution spot, with American countries following closely after. Research concerning Agile RE in American countries was less extensive

during that period because the Agile Manifesto had been established and well-known many years earlier. It was created by a software development professional from North America in 2001. Based on SLR results, no research related to Agile RE has been conducted in Africa. The possible reason is that many African companies are still in the early stages of adopting Agile methodologies or that there are no researchers examining Agile RE in Africa.

There are three research methods in 21 relevant papers: case study, interview, and survey. The limited number of selected primary studies is caused by the limited empirical research on adopting Agile requirements engineering in public sector environments. Previous SLR articles had a limited number of selected articles. Alsanoosy et al. (2020a) investigated the impact of national culture on implementing requirement engineering based on 16 primary studies. Aldave et al. (2019) explored the cutting-edge methods that harness creativity in gathering requirements in Agile software development, referring to 17 primary studies. Inayat et al. (2015) provided a research mapping based on 21 papers regarding the practices employed in requirements engineering and the challenges encountered by Agile teams to comprehend the resolution of traditional RE issues through the application of Agile RE. Hence, our number of selected studies is comparable to prior review articles in this field.

We found that 12 papers used a case study method, consisting of six papers of multiple case studies and six papers of single case studies. This confirms that researchers recognize Agile methods as a social process and consequently examine them in the real world through case studies. Besides that, there are five papers that used surveys, and the rest used interview methods. The survey method explores social problems in a certain geographic area to gather scientific information. In contrast, the interview method collects information through conversations to better understand people's perspectives and experiences. Moreover, the heterogeneity of research methods implies that Agile RE aligns closely with work practices in public sector companies.

### ***FINDINGS RELATED TO RQ1***

The analysis of the selected studies illustrates that a variety of different barriers are identified when implementing Agile RE in the public sector. Three challenges that are frequently cited in the previous research are lack of communication with stakeholders (C4), lack of requirement understanding (C14), and team capability (C9). We would emphasize the influential connection of minimum communication activity between the stakeholders and the team, which greatly affects how the team comprehends the requirement. Public sector organization has a unique culture and communication approaches. The public sector has to operate under multiple constraints, including political and national regulations. It has a bureaucratic culture of administration and accountable to multiple stakeholders, affecting the pace of the decision-making process cautiously compared to private organizations (Luoma-aho & Canel, 2020). Several stakeholders' viewpoints are required to determine the requirement and ensure that each constraint is followed since each stakeholder's presence is essential in multiple requirement meetings. This ideal scenario rarely occurs due to minimum stakeholder availability (C6), which is influenced by the low level of commitment towards the projects. The public sector's organizational culture of slow pace in the decision-making process is reflected in the long time it takes for stakeholders to provide feedback (C15). This non-Agile organizational culture is hardly transformed due to their reluctance to change (C1). In our view, a large number of empirical studies are required to understand some practices in order to overcome some unbeneficial culture.

Some antecedent studies have discovered the challenges of Agile RE in general (Hoy & Xu, 2023; Inayat et al., 2015). Some of the identified challenges are also found in the public sector, such as minimal documentation (C17), inappropriate prioritization method (C11), customer unavailable or low availability (C4 & C6), inappropriate architecture (C9), and inaccurate effort estimation (C20). It illustrates that some challenging factors occur generally. According to our findings, challenges in implementing Agile RE are dominantly related to the rigid culture of the public sector. A long historical hierarchy model in the public sector requires an extended period to understand Agile values

(C8) and transform its culture (C1). It often occurs that the top management in a public sector organization is swapped to another organization rapidly, which leads to the discontinuation of new top management support (C2) and loss of sight of the vision (C21). Therefore, some empirical research is required to unveil an effective approach to transforming the organizational culture of the public sector.

### ***FINDINGS RELATED TO RQ2***

In order to solve Agile RE challenges in the public sector, there are three solutions that are frequently referenced in prior research papers. These solutions involve regular reviews of requirements (P12), ensuring requirements are traceable (P15), and writing documentation of requirements clearly (P20). The public sector is notorious for its bureaucratic processes. Ensuring that Agile RE processes run well in the public sector requires a clear understanding of how Agile can coexist with the nation's regulations. To conduct regular reviews of requirements in the public sector (P12), it is necessary to make formal invitations to particular participants, prepare meeting rooms, and do documentation as a report. To ensure requirements are traceable (P15) and clear requirements documentation is written (P20), the team must be dedicated to consistently generating documents related to important meetings, storing the documentation of requirements in an easy-to-access location, and regularly updating them.

We found the similarity between possible solutions for Agile RE offered in the public sector and in general (Hoy & Xu, 2023), including regular reviews of requirements (P12), ensuring requirements are traceable (P15), prioritizing requirements based on value (P18), and establishing the project's shared vision (P24). On the other hand, we discovered some unique characteristics in bureaucratic environments. First, employees often do multiple tasks simultaneously, which reduces their concentration levels. To overcome this challenge, management needs to create a policy or environment so that one employee can focus on one project (P7). Second, customers often travel on business trips. In the context of the public sector, the customer might be an employee from another department who is making a request for the application. Ensuring the customer's availability on site (P16) is an important factor in the public sector. They need to schedule regular meetings in advance. Hence, we need more empirical research to evaluate the effectiveness of these recommended solutions.

## **CONCLUSION, IMPLICATIONS, AND FUTURE WORK**

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### ***CONCLUSION***

This study has presented a concise summary of Agile RE within the public sector, encompassing challenges, quality issues, and proposed solutions. In recent years, the Agile methodology has gained increasing popularity in both the public and private sectors. This trend is due to many benefits gained from adopting an Agile approach, including increased productivity, flexibility, and significantly accelerating the pace of change. However, the public sector faces several challenges with Agile RE, such as communication issues, cultural barriers, knowledge gaps, and unrealistic timelines. These obstacles need to be mitigated to successfully implement Agile RE in the public sector and prevent financial losses for the state.

The findings of a systematic literature review regarding challenges in Agile RE are discussed in this paper. The review follows established guidelines for conducting a systematic literature review (Kitchenham et al., 2009). This research reviewed and analyzed 21 relevant studies between 2014 and June 2023. In this research, 22 identified challenges are grouped into four categories: people, process, project, and organization. Most challenges related to Agile RE in the public sector are found in the people and process aspects. Project and organizational-related are subsequent aspects. Therefore, proficiently handling both people and process aspects is imperative within Agile RE to prevent project failure. Within the organizational context, challenges arise from cultural resistance to change and issues regarding inadequate top management support, thus hindering value delivery and mismatched

expectations. From the people domain, the primary challenges arise from communication, interaction, and availability issues, leading to project delays, increase in rework, and increase in cost. Within the process domain, inadequate project documentation and a lack of understanding of requirements generate serious problems that result in unachieved value delivery and knowledge gaps. Furthermore, in the project domain, unrealistic timelines are worsened by frequent changes and additional requirements. This causes excessive workload and diminishes the quality of the delivered value.

To address these challenges, we propose a set of 25 practices that serve as potential solutions. The 25 solutions were aligned with their respective challenges and categorized into four domains. It is necessary to seek management support and adopt the Agile principle incrementally to overcome the obstacles posed by Agile RE in the organizational domain. Gradually reducing resistance to change and top management support to ensure stakeholder involvement is crucial. Overcoming obstacles within the people domain, actions such as maintaining regular communication, organizing regular team meetings, and establishing groups representing stakeholders are required. Addressing the process domain challenges involves creating well-documented requirements based on value-driven and initiating a highly prepared Agile team. Lastly, to overcome issues in the project domain, the public sector needs to determine uniform RE procedures and a built-in margin for adjustments within the project timeline.

### ***IMPLICATIONS***

There are two primary implications in this study: theoretical and practical. From a theoretical perspective, the authors suggest that this study enriches the current literature on Agile RE, particularly in the context of the public sector. It offers a thorough framework that enhances comprehension of the challenges and related solutions in the public sector. This research's theoretical significance lies in its potential to generate novel theories and models for future exploration, which encourage more in-depth studies of Agile implementation in the public sector. This research broadens the theoretical foundation, facilitating more extensive investigations and deepening understanding of Agile RE within the public sector. For instance, research related to Agile RE in public service projects requires incorporating input from civil society and research on implementing flexible requirements analysis procedures to effectively respond to frequent changes in national policy.

From a practical perspective, this study extensively explores Agile RE in the public sector, offering in-depth explanations and valuable insights. The findings hold significant relevance for decision-makers and policymakers who employ Agile methodology in the public sector. Through barrier identification and proposed resolution, this study establishes a solid basis for the effective implementation of Agile methodology within the public sector. Moreover, this study can also help practitioner recognize current obstacles related to Agile RE in their organizations and develop strategies tailored to the specific requirements of organizations.

### ***FUTURE WORK***

This research has several limitations. First, this study does not cover all countries. So, these results cannot be generalized, and not all countries have similar challenges. This study is limited to discussing Agile RE within republic and constitutional monarchy nations. It does not include a discussion of provisional nations. Republican countries may align well with the collaborative and democratic characteristics of Agile values, whereas constitutional monarchies may need a hierarchical structure to fully adopt Agile values. Moreover, future studies can explore Agile RE in provisional countries such as Libya, Guinea, Niger, and Sudan.

Second, the identified challenges and proposed solutions are not clearly ranked in order of importance. Further research can perform a Fuzzy Analytical Hierarchical Process (F-AHP) to prioritize the proposed solutions, which will assist public sector organizations in revising their management approaches and strategies while implementing Agile methodology.

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## APPENDIX A. QUALITY ASSESSMENT

ID	QC1	QC2	QC3	QC4	TOTAL
S1	0.5	1	0	1	2.5
S2	0.5	0.5	0.5	1	2.5
S3	1	1	0	0.5	2.5
S4	1	1	0.5	0.5	3
S5	1	1	0	1	3
S6	1	0.5	0.5	0.5	2.5
S7	1	1	0	1	3
S8	1	1	0.5	0	2.5
S9	1	1	0	0.5	2.5
S10	1	1	0.5	1	3.5
S11	0.5	0.5	0.5	1	2.5
S12	1	1	0	1	3
S13	0.5	0.5	1	0.5	2.5
S14	1	1	0.5	0.5	3
S15	1	1	1	0	3



ID	QC1	QC2	QC3	QC4	TOTAL
S16	0.5	0.5	0.5	1	2.5
S17	1	0.5	1	0	2.5
S18	1	1	0	0.5	2.5
S19	1	1	1	0.5	3.5
S20	1	1	0.5	0.5	3
S21	1	1	0.5	0	2.5

## APPENDIX B. SELECTED STUDIES

Id	Authors	Title	Publication name	Year
S1	Alexandrova and Rapanotti (2020)	Requirements analysis gamification in legacy system replacement projects	Requirements Engineering	2020
S2	Alsanoosy et al. (2020b)	Exploratory analysis of cultural influences on requirements engineering activities based on stakeholders' profile	24th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems	2020
S3	Alsaqaf et al. (2017)	Agile quality requirements engineering challenges: First results from a case study	2017 ACM/IEEE International Symposium on Empirical Software Engineering and Measurement	2017
S4	Alsaqaf et al. (2019)	Quality requirements challenges in the context of large-scale distributed Agile: An empirical study	Information and Software Technology	2019
S5	Nisyak et al. (2020)	Human related challenges in Agile software development of government outsourcing project	International Conference on Electrical Engineering, Computer Science and Informatics (EECSI)	2020
S6	Chen et al. (2019)	Contemporary requirements challenges and issues: An empirical study in 11 organizations	SAC '19: Proceedings of the 34th ACM/SIGAPP Symposium on Applied Computing	2019
S7	Fontana and Marczak (2020)	Characteristics and challenges of Agile software development adoption in Brazilian government	Journal of Technology Management & Innovation	2020
S8	Franch et al. (2023)	The state-of-practice in requirements specification: An extended interview study at 12 companies	Requirements Engineering	2023
S9	Garousi et al. (2015)	A survey of software engineering practices in Turkey	The Journal of Systems and Software	2015
S10	Rizkiyah et al. (2020)	Agile-based requirement challenges of government outsourcing project: A case study	2020 3rd International Conference on Computer and Informatics Engineering (IC2IE)	2020

## Barriers of Agile Requirements Engineering in the Public Sector

<b>Id</b>	<b>Authors</b>	<b>Title</b>	<b>Publication name</b>	<b>Year</b>
S11	Lindsjörn et al. (2018)	Challenges with lack of trust in Agile projects with autonomous teams and fixed-priced contracts	XP '18: Proceedings of the 19th International Conference on Agile Software Development: Companion	2018
S12	Noor et al. (2014)	Vendors' challenges in e-government projects in Pakistan: Experience report of prisons automation	Proceedings of the European Conference on e-Government, ECEG	2014
S13	Ochodek and Kopczyńska (2018)	Perceived importance of Agile requirements engineering practices – A survey	The Journal of Systems & Software	2018
S14	Palomares et al. (2021)	The state-of-practice in requirements elicitation: An extended interview study at 12 companies	Requirements Engineering	2021
S15	Kasauli et al. (2021)	Requirements engineering challenges and practices in large-scale Agile system development	The Journal of Systems & Software	2021
S16	Russo et al. (2018)	Contracting Agile developments for mission critical systems in the public sector	2018 ACM/IEEE 40th International Conference on Software Engineering: Software Engineering in Society Contracting	2018
S17	Schön, Eva-Maria et al. (2017)	Key challenges in Agile requirements engineering	Lecture Notes in Business Information Processing	2017
S18	Tripathi et al. (2018)	An anatomy of requirements engineering in software startups using multi-vocal literature and case survey	Journal of Systems and Software	2018
S19	Noor et al. (2014)	Understanding challenging situations in Agile quality requirements engineering and their solution strategies: Insights from a case study	2018 IEEE 26th International Requirements Engineering Conference (RE)	2018
S20	Wagner et al. (2019)	Status Quo in Requirements Engineering: A Theory and a Global Family of Surveys	ACM Transactions on Software Engineering and Methodology	2019
S21	Wohlrab et al. (2018)	Boundary objects in Agile practices: Continuous management of systems engineering artifacts in the automotive domain	ICSSP '18: Proceedings of the 2018 International Conference on Software and System Process	2018

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