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Challenges of Agile Software Development in the Banking Sector: A Systematic Literature Review

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***Abstract*—The banking industry is expected to thrive, generate profits, and contribute to national development and societal welfare. However, this sector is susceptible to volatility caused by global and domestic economic fluctuations. This research aims to identify and address challenges related explicitly to implementing agile methodologies within the banking sector. The study utilized a Systematic Literature Review (SLR) approach based on the guidelines provided by Kitchenham. A substantial number of academic journals (1,933) were analyzed during this review. Among the vast pool of literature, 28 relevant studies were extracted. These studies were chosen because they provided insights into the challenges of implementing agile practices in the banking domain. The analysis and categorization of these studies were structured according to the Project Management Body of Knowledge (PMBOK) 6th edition framework. This framework was employed to organize and understand the identified challenges systematically. The study's primary finding is that the most prevalent challenge encountered in the context of agile development within the banking sector is "Project Resource Management." In essence, effectively managing and allocating resources is a significant hurdle banks face when adopting agile methodologies. The challenges related to resource management are not confined to a single aspect. Instead, they encompass various dimensions, including human resources, technological resources, and organizational factors. This suggests that challenges in agile banking are multifaceted, involving issues related to people, technology, and the structure and processes within banking organizations.**

***Keywords*—Agile development; Agile; banking, bank challenges; systematic literature review.**

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I. INTRODUCTION

Global and national economic conditions and technological developments are unpredictable and increasingly complex. Business and digital technology are interconnected [1]–[3]. Excessive acceptance of digital technology as a tool to achieve business goals that can respond to changing market dynamics [4], [5]. Over time, business changes have led to the software market with collaboration between IT operations and software. However, the mismatch between the development and testing phases and the environment hinders organizational change, including in banks. [6]–[8]. Very uncertain changes require the banking industry to adapt quickly to survive in line with changes that often occur [9]. Banks that adapt well can focus more on consumers and changes in their surroundings because they are more open and flexible in dealing with uncertainty in the VUCA (volatility, uncertainty, complexity, ambiguity) era [9]–[11].

Rapid change requires agile leaders to bring about change. For this reason, leadership capabilities need to be possessed to support changes, such as being able to transform mindsets or habits, how to work in a team, and bringing a work culture into agility as a whole [12], [13]. Technological changes also make it necessary to adapt system development and frequent changes to adapt to trends, balance business needs, and improve customer service. Agile development will significantly impact the bank's business processes in the future.

Many previous studies have discussed the case study-based challenges faced by companies or financial organizations [14], [15]. Other challenges in agile development are change resistance, lack of investment, coordination team, organization, requirements engineering, quality, and assurance [16], [17]. Another challenge is finding a team committed to adapting to changes during development [18]–[20]. In practice, project managers with high skills can compete and succeed in systems development projects as

much as 18%, with 20% failure and still struggling or having challenges in agile development at 62% in 2020 [21], [22]. A high percentage of challenges in agile development will be obstacles to business development and customer service.

Although previous research has discussed challenges in agile development, it has not explicitly conducted research in the banking sector. Agile Development in the banking or financial environment has not been widely discussed [23], [24]. It still adheres to the development of the waterfall system because it collides with systems and rules. In addition, the existing legacy system makes the core business follow the previous path, so there is no tolerance, and it follows the trend of technological developments [25], [26]. As a result, not many banks adopt an agile system because of the legacy system and do not dare to take the challenge of change because of the high risk [27]–[29]. This study aims to identify the challenges of agile development in the banking sector and provide solutions for overcoming these challenges.

In this era, banks should adapt to increasingly modern technology and systems [30], [31]. Banks need to know the latest technology to update existing systems to adjust customer performance and quality [27], [32]. The biggest challenge is increasing competitiveness to transform the banking industry's digital era. To support this, the quality of human resources in the technology area is very much needed, as a digital mindset to adapt to technological changes [33], [34]. Expanding technical insight certainly provides convenience in serving consumer needs [9], [35], [36].

To answer the challenges in agile development, the researcher formulated the following Research Question:

- RQ 1: "What are the challenges in developing Agile in the banking environment?"
- RQ 2: "What are the solutions to address the challenges of Agile development in the banking environment?"

By answering the research questions above, the researcher hopes to provide space for other researchers to conduct and develop this research and become the essential foundation for banking in developing agile systems. This study consists of 6 sections. Section 1, the background, discusses the reason this research was conducted. Section II, research method, which examines the techniques used in the study. Section III presents the results of this research and discussion, answers research questions, and supports the idea of the research results. Section IV, conclusions related to the summary of the study, includes limitations of the research, future research, and suggestions for future research.

II. Materials and Method

The systematic Literature Review (SLR) method is used in this research. SLR is used to evaluate and identify research that already exists or is relevant to a particular topic, area, or question [37],[38]. SLR is used as a form of research question by searching for publications and assessing quality as well as conducting qualitative and quantitative synthesis [39]–[41]. Based on Kitchenham's theory, the SLR process has three main steps: planning, implementation, and reporting. The first planning stage consists of conducting an initial search for the SLR process, such as objectives, and reviewing the standard rules of the journal search process. The second stage is implementation, in the form of standard protocol development activities and conducting a literature search, assessing the quality of journals, and extracting data. The last stage is a report documenting the results of the review [39], [42]. The following are the SLR stages used in the research.

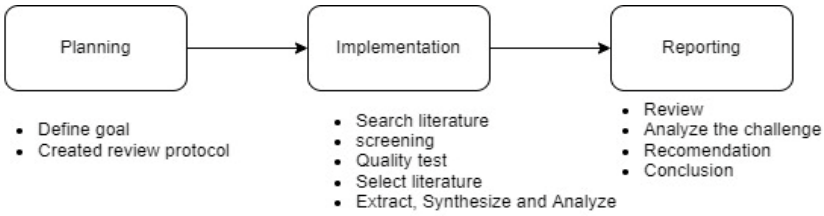

Fig. 1 SLR Methodology Stages

The method used in this study consists of three parts, starting from planning and collecting fundamental information in research. The initial process of identifying research objectives starts with determining the next step. At this stage, clear rules are also made when deciding which journal to use, which will later become the primary basis for screening journals at the next stage. The next stage is the implementation process, which consists of a literature search process. Screening is taken by selecting the appropriate literature and conducting quality tests from related journals. This quality test is the primary basis for choosing journals directly related to the topic and research questions. Eight quality test questions were used in this study to get a good journal quality. After the quality test was carried out, the selected journals were following the research. The last process is extraction, synthesis, and analysis. At this stage, an analysis of the paper chosen is running, from the abstract to the conclusion, to get the essence of the journal. The result is the identification of challenges and solutions that will be used as a reference. The last stage of the SLR method is a report consisting of the results of a review of selected journals and an analysis of journals related to challenges that align with the research questions. Recommendations are given, and the study ends with conclusions.

A. Planning

The planning phase begins by determining the purpose of the SLR used. After that, the literature search process used a review consisting of research questions and keywords. This study used five databases: Scopus, IEEE, ACM, Emerald Insight, and SAGE. The literature search process in 5 databases uses keywords described in the research questions: ("Agile Development" OR agile) AND bank*. So that the literature search is based on the latest and greatest research, the criteria are compiled. The researchers used standard criteria for a journal search to get the appropriate journal. In this study, the researchers chose journals that matched the keywords; the year of publication was 2017–2022 or the last

5 years; the language used was English, and the types of journal articles and proceedings were similar. Meanwhile, what is not included in the search is outside the predetermined standard.

B. Implementation

After the planning stage, the next stage is the implementation process, which begins by searching for literature that has determined keywords and inclusion criteria. After obtaining the literature, the screening process is continued according to the requirements in Table I.

TABLE I
CRITERIA FOR THE SCREENING PROCESS

Stage	Inclusion Criteria	Exclusion Criteria
Stage 1: (Selection of Title and abstract)	Related to the topic: Agile Development Agile Financial	Paper that is not related to the topic Inaccessible paper Paper whose title is related to Systematic Literature Review or the like
Stage 2: (Full-Text Selection)	Able to answer the RQ in this study	Papers that can't be accessed completely

In the previous planning stage, it was discussed that researchers set standards in conducting journal searches to make the scope more specific for this research. In this implementation phase, the standards that have been determined are divided into two parts. The first part defines keywords by reducing agile, financial, and agile development scope. The exclusion criteria do not match those keywords, journals that are not accessible, and journals that are not related to the literature review. After doing the first part, the researcher continued to the second part by reading the entire journal and matching the questions or previous research objectives that aligned with this research. A literature quality test based on predetermined weights and ratings will determine the screening results.

C. Reporting

The last stage is a report based on the process that has been carried out. This report contains all the information contained in the literature that has been analyzed. The results of the analysis were reviewed to be readjusted with the research. The analysis results carried out in the quality test phase are used as the primary reference in discussing the challenges of agile software development. The report will review the challenges the organization or company faces and provide an overview of possible solutions to overcome them. So, researchers can conclude several references to be used as a guide in facing the challenges of agile software development in the banking sector.

III. RESULTS AND DISCUSSION

A. Literature Selection

From the 1,933-literature identified, a literature selection process was carried out based on the steps of the SLR methodology. As a result, 28 pieces of literature were selected for extraction, synthesis, and analysis. Database sources are selected based on existing research databases related to the research goal. Selection is done based on the steps described in Kitchenham. Several final papers are selected based on the following criteria:

- Does the paper clearly explain the research goal?
- Does the article write a literature review, as well as a background and context of the research?
- Does the article display related work from previous research to show the main contribution of the research?
- Does the article describe the proposed architecture or methodology used?
- Does the article have research results?
- Does the article present relevant conclusions to the research objective/problem?
- Does the article recommend future work or improvements for the future?
- Is the article Scopus Indexed (Q1/Q2/Q3/Q4/unindexed)

TABLE II
LITERATURE QUALITY TEST RESULTS

Source	Initial	Number of Final Papers
Scopus	151	100
Emerald Insight	1.043	10
IEEE Xplore	100	50
Sage Journals	519	2
ACM Digital Library	212	4
Total	2.025	~~166~~

Based on the five source databases selected by the researchers, Scopus, Emerald Insight, IEEE Xplore, Sage Journals, and ACM Digital Library, journal selection was started using predetermined keywords. The results show the total literature that has the exact keywords is 2.025. The next stage is the selection process based on titles and abstracts that have similarities and discussions with this research. A total of 106 journals from 5 databases were obtained, and in the next stage, by selecting all the texts in the journals, 48 selected journals were obtained. Finally, a quality test was undertaken with the eight questions above to classify journals with a discussion level based on the research. As many as 166 selected journals were obtained.

B. Data Extraction

The raw data from these 166 works of literature were extracted and analyzed to determine the essence of the literature according to this study. Based on the results that have been investigated, the researchers classify the findings based on the Project Management Body of Knowledge (PMBOK) area 6th edition to facilitate understanding of the concept of challenges in agile development, especially in the banking area. There are seven research-related knowledge areas in 10 areas of PMBOK 6th edition. There is project integration. scope, quality, resources, communication, risk, and stakeholders. In comparison, the three knowledge areas do not intersect directly. Table III shows classifications from the PMBOK area. After identification, it is known that project resource management is the biggest challenge in agile development, with 14 related studies. And 12 studies in the area of scope management.

TABLE III
CLASSIFICATION OF KNOWLEDGE AREA IN RESEARCH

PMBOK Area	References	Count
Project Integration Management	[43][44][27][45][18][46][47] [48][49][50]	10
Project Scope Management	[51][27][52][53][54][18][55] [56][57][58][59][60]	12
Project Quality Management	[43][44][53][57][61]	5
Project Resource Management	[62][63][27][64][65][52][43] [4][18][6][66][55][57][59]	14
Project Communications Management	[51][67][27][68][6][69][46] [59][70][71][72]	11
Project Risk Management	[64][54][67][18][57][73]	6
Project Stakeholder Management	[51][68][52][27][45][46][66]	7

Meanwhile, knowledge areas that are not significant have problems; there are project quality management 4, related studies, and risk management with 5 related studies. The distribution map of the knowledge area that is in direct contact can be seen in Figure II.

Fig. 2 Distribution of related studies based on PMBOK

Based on PMBOK 6th edition, the results of extracting journal data that have been obtained show that as many as 14 journals have challenges in agile development in project resource management and 24% experience challenges in the resource field. The next challenge is scope management, which is 21%. And 14% have the same obstacles in communication and integration management in agile development. Meanwhile, from the stakeholder session, 12% of organizations or companies experienced challenges in software development. It does not impact agile development much or become an obstacle in risk management at 8% and quality management at 7%. A few knowledge areas related to research will be discussed in this discussion regarding the challenges and solutions that can be provided based on the PMBOK 6th edition.

C. Project Integration Management

The challenge in agile development in this knowledge area is a collaboration between application and service teams [27],[43]. Weaknesses in managing the organization and a lack of cross-functionality make the integration between teams hampered [18]. Blocked integration creates different concepts and thinking in agile development [8], [46]. Because they will affect each other [47], [74], [75]. Response and low correspondence between response time from team A and response time from team B [48], [30].

The instability of integration between management and developer expectations hampered the development and implementation process [44]. An unstable work environment can also affect developmental delays [52]. Combining the results of reviews from managers regarding software requirements and the effects of reviews from other teams regarding risks, problems, and changes in agile development becomes a challenge, especially for project managers [45].

For this reason, members are involved in the system development process to support development goals and ensure that agile development can run in a timely, secure, reliable service and mainframe and can be adapted for all teams. Not only between teams but organizations also need support so that collaboration can run well [46],[27]. All teams need to share a sense of responsibility by increasing self-organization in projects [18], [76]. The use of technology can be a solution for collaboration between teams; building a culture of self-regulation and staying connected with others will provide good focus and cooperation between groups [27]. Achieving success in a systems development project must incorporate some thoughts or ideas and eliminate egocentricity. Communication between teams and stakeholders is needed to produce joint decisions for project success [45]. The right direction is the existence of a manual so that it can make the right decisions [52].

D. Project Scope Management

Problems that often occur in this knowledge area from the inner side are unclear high-level requirements in early development, and it is not easy to create user stories and estimates in agile development [7], [51]. Unclear scope, goals, technology used, and changing system requirements make the company's maturity level low [18], [13], [19], [30], [55], [57], [59]. The implementation's effect is unclear at the beginning, making the understanding of the project's needs non-existent. Many changes occur, such as management and decision-making processes [55],[56].

Therefore, the development goals must be clear and ensured to determine the next step in the development process [27],[60]. Meanwhile, from the outside, swift changes make the team less flexible in accepting them and still use the traditional approach [53], [58], thus reducing the sense of competitiveness against outside developments [54]. Building an organizational culture in the face of change by collaborating with fellow teams will form a solid team so we can adapt to change and analyze needs earlier so that it can be carefully planned [18], [51]. Support from organizations, such as the implementation of the latest technology, allows the team to continue to update the system, collaborate, innovate, and make certain that all requirements and documentation are met [18], [27], [55]. Organizational support can change to agile to ensure the readiness of resources by facilitating so that the preparation and the required goals can be matched [56]. With good collaboration and communication within the organization, it will create equality in achieving goals so that

the requirements needed become clearer and more focused [58],[59],[60].

E. Project Quality Management

The development of banking products has a predetermined standard time and cost [53]. The ability to develop products in software development is a challenge for banks in improving quality [43],[57], such as skills and understanding of developing agile methods [44]. Innovation creates awareness of how quality practices enhance the effectiveness of team performance by adjusting quality software functions while creating communication and shared knowledge [43], [53],[57]. Sharing experiences also contributes to helping technical skills in collective agile development [7], [43].

F. Project Resource Management

The biggest challenge in agile development in this research is the knowledge area resource. Management resources in terms of increased capacity and orientation in agile learning, as well as the ability to increase consumer value, are still minimal in agile development [18],[15],[20],[31],[55][57]. Balance sheet management, risk management, changing technological developments, and resource management are challenges for banks. The effect can be seen in asset quality, capital adequacy, and low profitability [4],[59]. Lack of visibility and control for management, coordination between teams, consistent coding standards among teams, and each independent team's understanding of broader development are obstacles in determining the next steps [59]. In addition, motivation to work is still needed to improve team and individual performance [43].

In terms of resources, building skills is a valuable basis for reading the characteristics of information and making the right decisions [27], [62], [63]. The competence and expertise of the project team and IT executive, as well as each individual, will be seen in how to respond to changes so that they can provide value or decisions quickly [15],[17],[25]. Changes that occur will always go hand in hand with technology. Understanding this technology is a challenge for banks in agile development because rapid changes make teams have to try to adapt by recognizing IT development trends, using technology as a platform, and sharing information to move forward together for the success of the project [8],[20],[25],[66].

The challenges faced in the resource management area can be overcome by IT Executives who can communicate effectively with bank managers, and proper understanding by the IT team regarding organizational plans and policies in understanding business functions. So that the direction and goals are clear, coupled with the IT team, it is necessary to have technology management expertise in managing technology trends in banking and assessing the estimated return on significant IT investments [62],[66]. The nature of agility, competence, flexibility, and speed coupled with psychological empowerment can improve the post-implementation of products that depend on the user [63], [77]. Organizational managers can adapt to agile development by innovating resources and employee routines. Organizational rigidity and unfavorable workplace culture in the business environment can hinder the implementation of agility in the organization [6],[65].

Clan culture in the organization is considered suitable for agile development. Organizational culture can be developed as the project progresses [78]. Project effectiveness can still be improved by selecting the right corporate culture. The way to determine this is by conducting a survey or interview among the project team so that later, the project manager can make decisions on the transformation of organizational culture and provide the right motivation [10],[17]. In addition, organizations need to ensure that all tasks are completed efficiently [57],[66] by adopting agile and dev ops to create more effective communication and shared knowledge [6],[57]. Techno-fusion integration in business and digital can result in good performance by increasing adaptability and resilience in the face of competition [4], [79], [80].

G. Project Communication Management

Understanding the importance of team collaboration causes an imbalance between product and software development teams [8],[26]. Communication can make interaction difficult between groups, and ineffective communication can cause problems in a project team [6],[45],[46],[59]. The project team and the lack of communication, cooperation, efficiency, quality planning, and commitment between clients is also a challenge in the project [45], [51],[69]. Another challenge is the misunderstanding of agile concepts and the lack of the necessary skills that make them weak in the face of change [51].

Organizations can facilitate training, coaching, and monitoring to improve employee knowledge and skills, such as introducing thinking about agile by aligning products with agile concepts. By defining the rules and responsibilities of each team, a culture will be formed in every organizational unit involved in software development so that collaboration between groups can be established [8],[13],[14],[26],[46]. Organizations that implement human IT infrastructure can be seen with differences in performance as being more attentive, responsive, and adaptive to changes so that they can achieve sustainable profitability and excellence [69], [81].

H. Project Risk Management

Banks have the autonomy that government regulations have regulated [82], [83]. Risks in project development in banking are legal requirements, addressing regulatory needs in the surrounding environment, security, and more specifically related to documentation of project requirements that are used together [17],[18][24],[57]. Business processes and systems passed down from generation to generation become a challenge for banks in applying agile because they will change the existing order [84]. Rationally, legacy systems are based on sustainability and benefit to the organization. However, rigid characteristics can hinder organizational growth and development. Another thing is that a poor test plan can increase the risk of stalling agile development [46], [85].

Organizations must think creatively and logically in managing systems passed down from generation to generation by considering current changing trends [27]. Management is also carried out in the development process by ensuring all documentation requirements have been met and following the rules [18]. Make a risk management plan so that control can be done if there is a significant change in the project [86].

I. Project Stakeholder Management

Organization is one of the success factors in project management, in addition to technology and resources. On a top-level management scale, poor communication and expectations of IT can lead to a lack of commitment between stakeholders[13],[14],[66],[42]. In addition, issues related to organizational culture and unclear rules and responsibilities have hampered projects being carried out [13],[14]. Management support is essential from initiation to release. In a project, biweekly review planning will take time if not optimized [27], [52], [68].

The organizational structure must be changed to support self-employed teams responsible for product development. Agile practices will be better if the required architecture and technology support them. A coherent approach can be used to maximize the benefits and outcomes of agile development because it considers culture, organizational structure, software development processes, and technology [68],[46].

IV. Conclusion

This study uses the SLR method to identify challenges and provide solutions for agile development in banking. Answering research questions from the results of the related literature review, 28 studies were obtained that were mapped in the PMBOK. Most of the challenges of resource management. Three factors influence the development of agility in banking. The first is the human factor, which is the lack of knowledge or skills in agile thinking. Second, the element of understanding technology trends and their use as a platform is still minimal. Third, the organizational culture is still rigid, which hinders agile application in the banking environment.

In responding to these challenges, training, coaching, and monitoring are needed so that they can align with an agile mindset. In addition, organizational restructuring needs to be carried out to keep up with the changes that occur so that the decentralization decisions used are by the autonomous team in creating quality products from the business and development perspective. With these changes, the technological support needed to implement the changes will be more realized.

In conducting this research, there are still limitations. The references obtained are still relatively few and need to be added with references from other databases. Agile software development was not as broad a scope as the current regulations. There is a risk that the data extraction and reference selection process does not cover all the challenges in agile development.

Future research is expected to analyze and explore further related to finance and development systems, namely scrum, Kanban, or XP. Research themes can be combined with other themes such as finance and digital banking to be mapped in the PMBOK area and further discussed. Further research can add references from different databases to obtain more results.

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