JURNAL TEKNOLOGI DAN OPEN SOURCE
Vol. 9, No. 1, June 2026, pp. 271~279
e-ISSN: 2622-1659, accredited Four Grade by Kemenristekdikti, Decree No: 152/E/KPT/2023
DOI: https://doi.org/10.36378/jtos.v9i1.5627

The Impact of Agile Methodology Implementation on Software Quality in Information System Development: A Case Study of Industry X

Muhammad Galih Ramaputra [1], Hendri Purnomo [2], Seli Puri Andini [3]
[1]Department of Computer Science, Faculty of Mathematics and Natural Sciences, Universitas Lampung, Indonesia
[2]Department of Computer Systems, Institute Informatics and Business Darmajaya, Indonesia,
[3]Department of Informatics, Universitas Muhammadiyah Lampung, Indonesia

Article Info

Article history:

Received 05 18, 2026
Revised 06 03, 2026
Accepted 06 20, 2026

Keywords:

Agile Methodology, Software Quality, Information Systems, Software Development, Linear Regression

ABSTRACT

The rapid demand for high-quality software requires organizations to adopt adaptive and efficient development methodologies. This study examines the impact of Agile methodology adoption on software quality within information system development in Industry X. Utilizing a quantitative explanatory design, data were collected via questionnaires from 100 software development team members and analyzed using simple linear regression. Descriptive analysis indicates that both Agile implementation (mean = 4.14) and software quality (mean = 4.09) fall into the high category. Hypothesis testing confirms that Agile methodology has a positive and significant effect on software quality ($\beta = 0.68$, t-count = 11.33, $p < 0.001$), contributing 52% to its variance ($R^2 = 0.52$). While team collaboration and functional suitability emerged as the strongest contributors, customer engagement and performance efficiency received the lowest scores. These findings imply that robust Agile practices substantially elevate system quality. To maximize outcomes, organizations must strategically intensify user participation throughout the development cycles and reinforce rigorous performance testing.

Corresponding Author:

Muhammad Galih Ramaputra
Department of Computer Science
Universitas Lampung
Lampung, Indonesia
Email: galih.ramaputra@fmipa.unila.ac.id

1. Introduction

The rapidly growing digital transformation in various sectors requires organizations to produce adaptive, responsive, and high-quality information systems. Information systems not only function as operational tools, but also as strategic instruments in improving efficiency, decision-making accuracy, and organizational competitiveness. In this context, software quality is a fundamental aspect that determines the success of information system implementation[1] Software quality includes the dimensions of functionality, reliability, efficiency, ease of maintenance, and user satisfaction level[2][3]

Success in producing quality software is inseparable from the development methodology applied. Traditional models such as Waterfall offer a systematic and structured approach, but they have limitations in accommodating dynamic changing user needs. The linear nature of development often leads to delays in project completion as well as high revision costs when changes occur in the final stages of development[4][5]

In response to these limitations, the Agile methodology evolved as a more flexible and adaptive approach based on the four core values articulated in the Agile Manifesto [6]. Agile emphasizes iterative and incremental processes, intensive collaboration between team members, and active stakeholder engagement in each development cycle. With a relatively short development cycle, Agile allows for continuous evaluation and improvement so that it is expected to be able to progressively improve the quality of the software [7], [8][9][10].

A number of previous studies have examined the impact of implementing Agile on the success of software projects. Research by shows that Agile practices have a positive influence on project success through improved communication and team collaboration[11][12], which indirectly contributes to the quality of the software. Another study by affirming that Agile improves stakeholder engagement and adaptability to changing needs[13], which has an impact on the quality of the products produced. Meanwhile, in its empirical study, it was found that Agile practices are significantly related to increased developer productivity and user satisfaction[14].

However, there are still some research gaps. First, most previous studies have focused on the success of the project in general, rather than specifically measuring software quality based on standardized indicators [15]. Second, research examining the influence of Agile applications on software quality in the context of information systems development in a given organizational environment is still relatively limited [16]. Third, the variation of quality indicators used in previous studies led to results that were difficult to generalize comprehensively [17], [18].[17].

Based on these identified gaps, further research is required to systematically and empirically examine the influence of Agile methodology implementation on software quality within information system development projects. Although Agile has been widely adopted across various industries and is often associated with greater flexibility, faster delivery cycles, and improved collaboration among stakeholders, existing studies have produced inconsistent findings regarding its actual impact on software quality. Some research highlights significant improvements in system reliability, maintainability, and user satisfaction, while other studies suggest that the benefits of Agile may vary depending on project complexity, organizational culture, team expertise, and implementation practices. These inconsistencies indicate the need for more comprehensive and evidence-based investigations.

This research is important because it seeks to provide measurable scientific evidence regarding the effectiveness of Agile methodologies in enhancing software quality. By employing a systematic and empirical approach, the study can identify the specific Agile practices that contribute most significantly to quality improvement and evaluate the conditions under which these practices are most effective. Furthermore, the findings can serve as valuable references for organizations, project managers, and software development teams when selecting development approaches that align with project characteristics, business objectives, and user requirements.

In addition to its practical relevance, this research is expected to contribute to the advancement of software engineering knowledge by enriching the body of literature related to software development methodologies and quality management. The results may help bridge existing knowledge gaps and provide a stronger theoretical foundation for future studies. Practically, the study can support organizations in improving the quality, reliability, and usability of information systems through the adoption of Agile methodologies supported by measurable outcomes and empirical evidence, ultimately leading to more successful software development projects and higher stakeholder satisfaction.

2. Research Method

2.1 Research Design

This study uses a quantitative approach with explanatory research. This approach aims to test the causal relationship between the application of Agile methodology and the quality of software in information systems development. The explanatory design was chosen because the study not only describes the phenomenon, but also empirically tests the influence of intervariables through inferential statistical analysis [14][19]. The Agile framework used in this study refers to the Scrum guide [20] as a representation of the most widely applied Agile approach [21][14][19].

The research was conducted in a cross-sectional manner, namely data collection was carried out in a certain period of time on respondents involved in the Agile-based information system development project[13][5].

2.2 Research Conceptual Model

This study aims to analyze the influence of the application of the Agile methodology on the quality of software in information system development. Conceptually, this study examines the relationship between the Application of Agile Methodology (Independent Variables) and Software Quality (Dependent Variables).

2.3 Independent Variable (X): Application of Agile Methodology

The application of Agile methodology is a process that involves the use of Agile principles and practices in software development. In more detail, these variables are measured based on several key indicators that reflect the implementation of Agile in software projects. Here are the indicators used to measure the adoption of Agile[10]:

1. Iterative Development Software development is done in small cycles (iterations) that allow for quick feedback and continuous improvement.
2. Customer Involvement Users are actively involved in every stage of development, from planning, testing, to product assessment.
3. Team Collaboration between development team members, both internally within the team and with external stakeholders, such as users and project managers.
4. Adaptive Planning The ability to plan and adjust projects based on the feedback obtained on each iteration. Decisions are made with flexibility to deal with changing needs.
5. Continuous Improvement A continuous improvement process in software development that prioritizes improving quality and efficiency through regular reviews and updates.

These indicators were measured through a questionnaire using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree), which indicates the level of respondents' suitability towards the application of the Agile methodology in their projects[4].

2.4 Dependent Variable (Y): Software Quality

Software quality is the expected outcome of the implementation of the Agile methodology. The quality of the software in this study was measured based on five key indicators that are in accordance with international standards in software engineering, such as ISO/IEC 25010 [22]. The software quality indicators used in this study are:

1. Functional Suitability: The extent to which the software meets the needs and functionality desired by users or stakeholders.
2. Reliability: The ability of the software to operate without errors or failures during a specified period of use.
3. Performance Efficiency: How well the software manages resources, such as execution time and memory usage, and how the software responds under high workload conditions.
4. Maintainability: The software be maintained and updated easily without disrupting the overall stability of the system.
5. User Satisfaction: The level of user satisfaction with the software developed, which includes ease of use, reliability, and performance of the product.

Software quality indicators are measured using a 5-point Likert scale that shows user satisfaction and perception of each dimension of software quality[9].

2.5 Relationships Between Variables

Conceptually, this study tests that the higher implementation of Agile methodologies (with faster iteration rates, more intense user engagement, better team collaboration, and more effective adaptive planning and continuous improvement) will contribute to improved software quality. In more detail, the model of the relationship between variables is as follows[23]:

1. A better implementation of Agile will affect Software Quality in terms of:
    a. Improved functionality due to active user engagement more often allows the software to better suit their needs.
    b. Improve reliability through a continuous testing process and improvements that occur in each iteration.
    c. Improve performance efficiency due to faster adjustments to feedback and more adaptive planning.
    d. Improves the ease of maintenance due to the flexible and adaptive development structure.
    e. Increase user satisfaction as they feel engaged and the product is more in line with expectations.

2.6 Conceptual Models (Diagrams)

The conceptual model that describes the relationship between the Application of Agile Methodology and Software Quality is as follows[3]:

Figure 1 Conceptual model

2.7 Variable Operationalization

1. **Implementation of Agile Methodology (X)**
   Measured through indicators:
   1. Iterative development
   2. Customer involvement
   3. Team collaboration
   4. Adaptive planning
   5. Continuous improvement

   Measurements were taken using a Likert scale of 1–5 (1 = strongly disagree, 5 = strongly agree)[12].
2. **Software Quality (Y)**
   Refers to the characteristics of software quality, with indicators:
   1. Functional suitability
   2. Reliability
   3. Performance efficiency
   4. Maintainability
   5. User satisfaction

   The research instrument was developed in the form of a closed questionnaire[24].

2.8 Population and Sample

The population of this study is all members of the information systems development team in organizations that have applied Agile methodology in the software development process[14].

Sample criteria:

1. Directly involved in Agile-based projects
2. Have at least one sprint cycle experience
3. Role as a developer, system analyst, tester, or project manager

The number of samples is determined based on the needs of statistical analysis and the number of research indicators. For SEM, the minimum sample size is 5–10 times the number of indicators.

2.9 Data Collection Techniques

Data is collected through:

1. **Questionnaire** as the main instrument
2. **Project documentation** for supporting data
3. **Limited observation** of Agile practices applied

Before use, the instrument is piloted to ensure validity and reliability.

2.10 Test Research Instruments

1. Validity Test
    1. Pearson correlation (for regression)
    2. Outer loading (SEM-PLS)An item is declared valid if the correlation value is > 0.30 or the loading factor > 0.70.
2. Reliability Test
    1. Cronbach's Alpha > 0,70
    2. Composite Reliability > 0,70

2.11 Data Analysis Techniques

1. Descriptive Analysis: To describe the characteristics of respondents and the distribution of answers.
2. Classic Assumption Test
    1. Normality Test
    2. Multicollinearity Test
    3. Heteroscedasticity Test
3. Inferential Analysis
    1. Simple Linear Regression if only one independent variable
    2. Structural Equation Modeling (SEM-PLS) for the analysis of relationships between constructs
4. Hypothesis test: Performed using a t-test with a significance level of 0.05. The hypothesis is accepted if the p value < 0.05.

2.12 Research Flow

The stages of the research flow carried out:

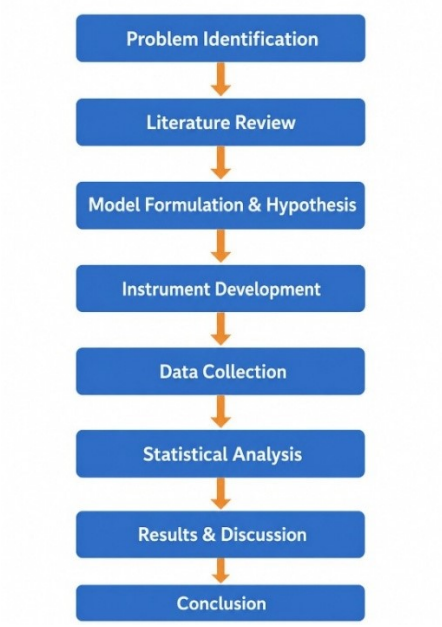

Figure 2 Research Flow

3. Results and Discussion

3.1 Respondent Characteristics

This study involved 100 respondents who were a team of information system developers in Industry X. Respondents were dominated by developers as many as 48% with experience in implementing Agile between 1-3 years (52%). This shows that respondents have a good understanding of Agile practices.

3.2 Descriptive Analysis

Table 1. Descriptive Statistics of Research Variables

Variable	Red	Category
Agile Implementation	**4,14**	**High**
- Development iterations	4,28	Very High
- User Engagement	3,88	High
- Team Collaboration	4,32	Very High
- Adaptive Planning	4,05	High
- Continuous Improvement	4,15	High
Software Quality	**4,09**	**High**
- Functionality	4,22	Very High
- Reliability	4,02	High
- Performance Efficiency	3,94	High
- Ease of Maintenance	4,08	High
- User Satisfaction	4,18	High

The results of the descriptive analysis showed that the application of the Agile methodology in Industry X was in the high category (mean=4.14). The team collaboration indicator scored the highest (4.32), while user engagement scored the lowest (3.88). Software quality is also in the high category (mean=4.09), with indicators of functionality (4.22) and user satisfaction (4.18) as the main contributors.

3.3 Validity and Reliability Tests

Table 2. Validity and Reliability Test Results

Indicator	Validity*	Reliability**	Remarks
X1 (Iteration)	0,85		Valid
X2 (User Engagement)	0,79		Valid
X3 (Team Collaboration)	0,89		Valid
X4 (Adaptive Planning)	0,82		Valid
X5 (Continuous Improvement)	0,84		Valid
Agile (α)		**0,89**	**Reliable**
Y1 (Functionality)	0,88		Valid
Y2 (Reliability)	0,84		Valid
Y3 (Performance Efficiency)	0,79		Valid
Y4 (Ease of Maintenance)	0,86		Valid
Y5 (User Satisfaction)	0,88		Valid

Quality (α)	**0,90**	**Reliable**

*Description: * = Indicator-total correlation; ** = Cronbach's Alpha*

Based on Table 2, all indicators have a validity value of > 0.70 and a Cronbach's Alpha value of > 0.70, so that the instrument is declared valid and reliable.

3.4 Hypothesis Testing

Table 3. Regression Analysis Results

Path	Coefficient	t-count	T-Table	P-value	Verdict
Agile → Quality	0,68	11,33	1,98	0,000	**Significant**
R Square	**0,52**				

The results of the regression analysis showed that the application of the Agile methodology had a positive and significant effect on the quality of the software (β = 0.68; t-count = 11.33 > t-table 1.98; p < 0.05). A positive coefficient value indicates that the higher the adoption of Agile, the higher the quality of the software produced. Agile's contribution to software quality was 52% (R^2 = 0.52), while the remaining 48% was influenced by factors outside the model.

3.5 Discussion

The findings of this study prove that the application of the Agile methodology contributes significantly to improving the quality of software. These results are in line with research by Nguyen (2021) [7] which states that Agile practices such as development iteration, team collaboration, and user engagement have a positive impact on product quality. In addition, these findings are also consistent with the empirical studies of Dybå and Dingsøyr [8] which concluded that the Agile approach consistently improves productivity and software quality compared to conventional methods. The support of Agile-based project management tools also contributes to the effectiveness of implementation [25].

The mechanism of Agile's influence on software quality can be explained as follows. *First*, iterative development enables early detection and continuous repair of defects, thereby improving software reliability. *Second*, active user engagement ensures that the products developed are in accordance with the needs, which has an impact on improved functionality and user satisfaction. *Third*, intensive team collaboration creates an environment of knowledge sharing and best practices, which contributes to the ease of software maintenance.

Nonetheless, the indicators of user engagement (mean=3.88) and performance efficiency (mean=3.94) obtained the lowest scores. This indicates the need to increase the intensity of user participation in the development process as well as strengthen performance testing in each Agile cycle.

4. Conclusion

This study concludes that the application of Agile methodology has a positive and significant effect on software quality in the development of information systems in Industry X. Agile's contribution to software quality reaches 52%. These findings provide practical implications for organizations to continue to optimize the implementation of Agile, especially in terms of user engagement and performance efficiency, in order to produce better quality software according to the ISO/IEC 25010 standard [22]. Further research is suggested to explore the application of Agile at the enterprise scale by considering organizational contextual factors [15] as well as involving diverse Agile frameworks such as Scrum [20] and Kanban [26].

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