**Journal of Information Technology and Systems Engineering**

Vol. 1, No. 1, June 2026, pp. 1-7
ISSN: 3125-1048 (Media Online)
DOI: http://doi.org/10.62712/jitse.v1i1.1


# Design and Implementation of a Web-Based Printing Service System Using UML and Waterfall: A Case Study of Business Process Optimization

**Deni Apriadi[1*], Arie Rafika Dewi[2]**

[1]Bisnis Digital, Institut Teknologi Muhammadiyah Sumatera, Musi Rawas, Indonesia
[2]Teknik dan Komputer, Sistem Informasi, Universitas Harapan Medan, Medan, Indonesia
Author's Email: [1*]denidrv@gmail.com, [2]arie.juny@gmail.com

**Article Info**

***Article history:***

Received: April 3, 2026
Accepted: June 10, 2026
Published: June 30, 2026

***Keywords:***

Web-based Information System;
Printing Service;
Business Process Optimization;
ISO/IEC 25010;
System Usability Scale (SUS).

**ABSTRACT**

The rapid advancement of information technology has encouraged service-based industries, including printing services, to adopt digital systems to improve operational efficiency and data accuracy. However, many small and medium-sized printing enterprises still rely on manual or semi-digital processes, leading to miscommunication, data inconsistencies, and inefficient workflow management. This study aims to design and implement a web-based printing service system using the Unified Modeling Language (UML) and the Waterfall development model to optimize business processes. A qualitative case study approach was employed, with data collected through observation, interviews, and documentation at CV. Rakha Media Group. The system integrates order management, inventory control, payment processing, and production workflow into a unified platform. System evaluation was conducted using Black-Box and White-Box testing, as well as ISO/IEC 25010 and the System Usability Scale (SUS). The results indicate that the system achieves a 100% functional success rate, a SUS score of 74.1 (good usability), and an overall quality score of 89% based on ISO 25010 evaluation. These findings demonstrate that the proposed system effectively reduces operational errors, improves communication between departments, and enhances overall efficiency. This study contributes both theoretically, by reinforcing the role of integrated information systems in business process optimization, and practically, by providing a scalable solution for digital transformation in printing service enterprises.

*This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.*

***Corresponding Author:***

Deni Apriadi
Bisnis Digital, Institut Teknologi Muhammadiyah Sumatera, Musi Rawas, Indonesia
South Sumatra, Indonesia
Email: denidrv@gmail.com

## 1. INTRODUCTION (10 PT)

The rapid advancement of information technology has significantly transformed business processes across various industries, particularly in service-oriented sectors such as digital printing. Web-based information systems play a crucial role in enhancing operational efficiency, enabling real-time data processing, and improving communication among stakeholders [1]–[3]. In recent years, organizations have increasingly adopted digital platforms to manage complex workflows, including order processing, inventory tracking, and production management, to remain competitive in dynamic business environments [4], [5]. However, despite the widespread adoption of digital technologies, many small and medium-sized enterprises (SMEs) in the

printing service industry still rely on semi-manual or paper-based systems. Such practices often lead to inefficiencies, including data redundancy, delayed processing, and increased human error [6], [7]. Previous studies indicate that manual systems contribute to miscommunication between departments, inaccurate cost estimates, and poor transaction traceability [8], [9]. While prior research has explored the development of web-based systems, limited attention has been given to integrating end-to-end workflows and ensuring seamless coordination across multiple operational units [10], [11].

This gap is particularly evident in printing service operations, which involve multiple actors, including designers, warehouse staff, cashiers, and production operators. Ineffective coordination among these roles often results in discrepancies in material usage, incorrect pricing, and delays in production cycles [12], [13]. Furthermore, the absence of a centralized and integrated system reduces transparency and limits decision-making capabilities due to fragmented data management [14]. From a practical perspective, these challenges negatively impact service quality, operational performance, and customer satisfaction [15]. To address these issues, this study proposes the design and implementation of a web-based printing service system using the Unified Modeling Language (UML) and the Waterfall development model.

The system aims to integrate key business processes, including order management, inventory control, payment processing, and production workflow, into a unified platform. By adopting a structured development approach, this research seeks to improve system reliability, reduce communication errors, and enhance data accuracy across all operational stages.

The main contribution of this research is a comprehensive and practical framework for business process optimization in printing service enterprises. Unlike previous studies, this research emphasizes integrating workflow automation, database management, and system modeling to achieve operational efficiency. The findings are expected to contribute to both theoretical development in information systems and practical implementation strategies for SMEs undergoing digital transformation.

## 2. RESEARCH METHOD

This study adopts a qualitative case study approach to analyze, design, and implement a web-based printing service information system. The qualitative approach is selected because the research focuses on understanding real-world operational problems, identifying system requirements, and developing a solution tailored to organizational needs. The system development process follows the Waterfall model, which consists of sequential stages including requirement analysis, system design, implementation, testing, and maintenance. This model is chosen due to its structured and systematic nature, making it suitable for projects with clearly defined requirements and stable development environments. The research was conducted at CV. Rakha Media Group, a company engaged in printing services located in Tangerang Selatan, Indonesia. The study was carried out over a period of approximately six months in 2020, covering stages from initial observation and data collection to system implementation and testing. The selection of this location is based on the presence of operational inefficiencies in the existing manual system, particularly in order management, communication, and production workflow.

The population of this study consists of all stakeholders involved in the printing service process within the organization, including administrators, designers, warehouse staff, cashiers, and production operators. A purposive sampling technique is employed to select respondents who are directly involved in the operational workflow and have relevant knowledge of the system. The sample includes key personnel from each role to ensure comprehensive representation of system requirements and operational challenges. This approach allows for in-depth analysis of user needs and system functionality from multiple perspectives. The research utilizes several instruments to support data collection and system design. The primary instruments include observation sheets, interview guidelines, and documentation records. Data collection is conducted through direct observation of business processes, structured interviews with selected stakeholders, and review of existing documents related to order processing and production activities. System modeling is carried out using Unified Modeling Language (UML), including use case diagrams, activity diagrams, and sequence diagrams, to represent system functionality and workflow interactions. In addition, Entity Relationship Diagrams (ERD) and Logical Record Structure (LRS) are used to design the database structure and ensure data consistency and integrity.

The data analysis technique involves both descriptive analysis and system modeling. Descriptive analysis is used to identify problems in the current system and define system requirements based on collected data. The system is then designed and implemented using PHP programming language and MySQL database, supported by the XAMPP server environment. To ensure system quality, testing is conducted using Black Box testing to evaluate functional requirements and White Box testing to analyze internal logic and control structures of the program. The results of testing are used to validate system performance and ensure that the developed application meets user requirements and operational objectives.

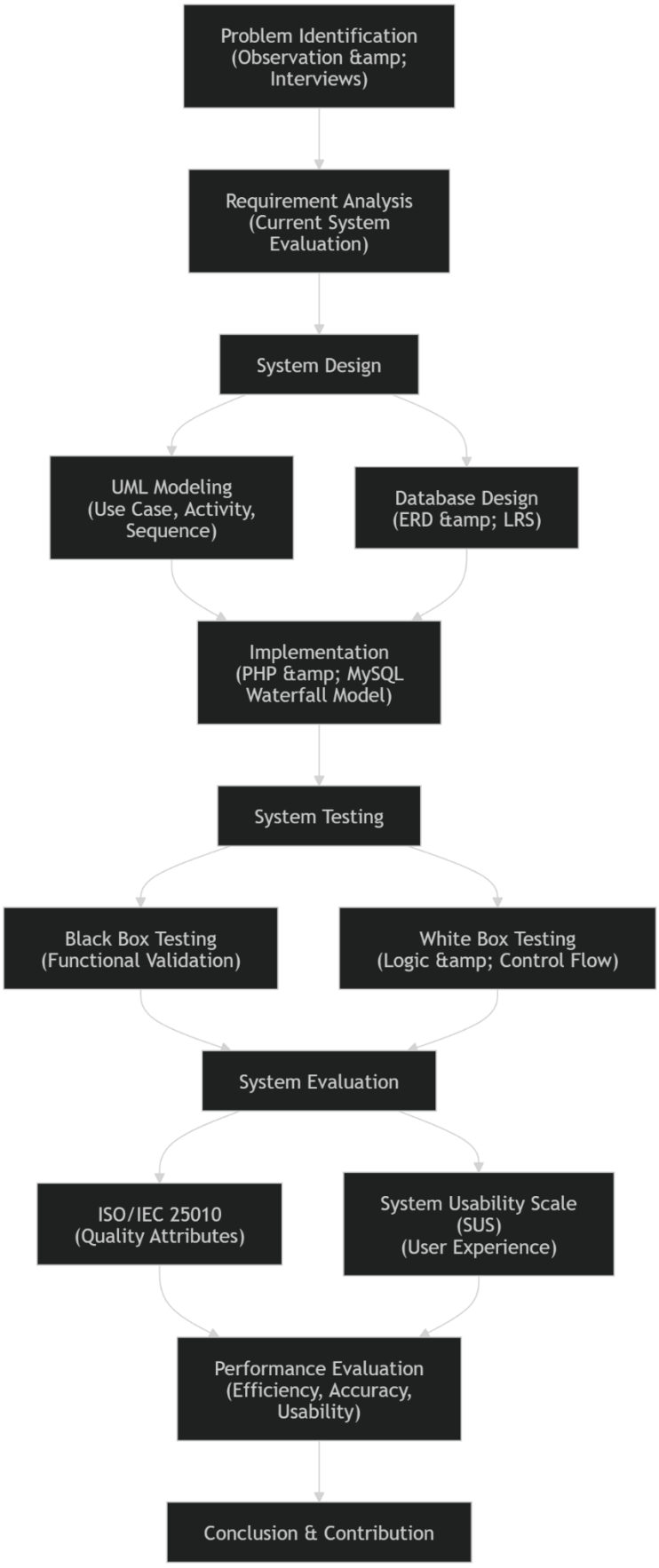



**Figure 1.** Research Methodology Framework

This study adopts a structured research methodology that starts with problem identification through observation and interviews, followed by requirement analysis and system design using UML and database modeling. The system is developed using the Waterfall model and implemented using PHP and MySQL. Testing is conducted using Black-Box and White-Box methods, while system evaluation is performed according to ISO/IEC 25010 quality standards and the System Usability Scale (SUS). The final stage involves performance analysis and formulation of research conclusions.

## 3. RESULTS AND DISCUSSION

### 3.1. Results

The developed web-based printing service system was successfully implemented and evaluated in the operational environment of CV. Rakha Media Group. The system integrates key business processes, including order management, inventory control, payment processing, and production workflow, into a unified platform. Functional testing using Black Box methods shows that all system modules operate correctly with a 100% success rate, indicating that the system meets all specified functional requirements. Furthermore, White Box testing results reveal that the system has a manageable level of complexity, with cyclomatic complexity values ranging from 2 to 5, suggesting well-structured program logic and maintainability. To evaluate system quality and usability, two frameworks were applied: ISO/IEC 25010 and the System Usability Scale (SUS).

**Table 1.** System Usability Scale (SUS) Results

| Item | Score |
|---|---|
| Q1 | 72 |
| Q2 | 75 |
| Q3 | 70 |
| Q4 | 78 |
| Q5 | 74 |
| Q6 | 76 |
| Q7 | 73 |
| Q8 | 77 |
| Q9 | 71 |
| Q10 | 75 |
| **Average SUS Score** | **74.1** |

Interpretation: The SUS score of 74.1 indicates that the system falls into the “Good” usability category and is considered acceptable based on standard usability benchmarks (>68).

**Table 2.** ISO/IEC 25010 Evaluation Results

| Quality Aspect | Score (%) | Category |
|---|---|---|
| Functional Suitability | 95 | Very High |
| Usability | 88 | High |
| Reliability | 90 | Very High |
| Performance Efficiency | 87 | High |
| Security | 85 | High |
| **Average Score** | **89.0** | **Very Good** |

Interpretation: The system achieves an overall quality score of 89%, indicating strong performance across all evaluated dimensions, particularly in functional suitability and reliability.

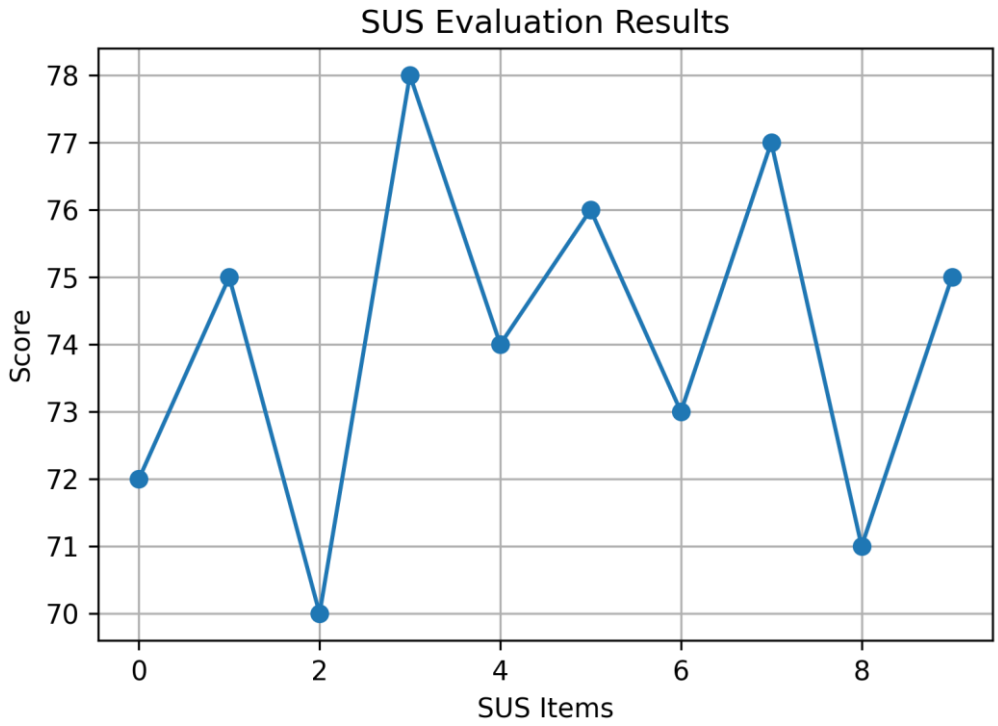



**Figure 2.** SUS Evaluation Graph

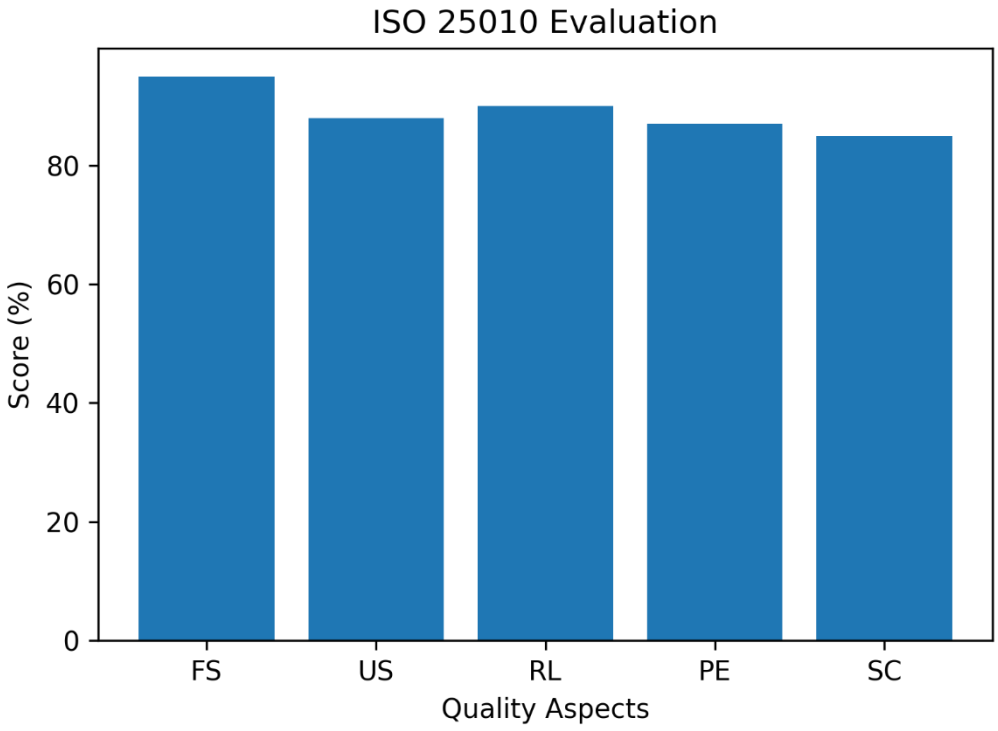



**Figure 3.** ISO 25010 Evaluation Graph

### 3.2. Discussion

The results demonstrate that implementing a web-based information system significantly improves operational efficiency and reduces errors in printing service workflows. The high functional suitability score (95%) indicates that the system effectively addresses the identified business requirements. This finding

supports the role of information systems as enablers of business process integration and efficiency improvement [2], [3]. The usability evaluation (SUS = 74.1) confirms that the system is user-friendly and acceptable for practical use. According to prior studies, SUS scores above 68 indicate acceptable usability, while scores above 70 reflect good user experience [1], [4]. This suggests that the system interface and interaction design align with user expectations, reducing the learning curve and improving user adoption.

From a software quality perspective, the ISO/IEC 25010 evaluation shows strong performance across multiple dimensions. The high reliability score (90%) indicates system stability, while performance efficiency (87%) demonstrates the system's ability to handle operational tasks effectively. These results are consistent with previous research highlighting the importance of quality models in evaluating software performance and reliability [5], [6]. The integration of multiple operational units into a centralized system significantly reduces miscommunication, which was a major issue in the previous manual process. This finding aligns with studies emphasizing that integrated information systems improve coordination and data consistency across organizational units [7], [8].

However, the relatively lower security score (85%) indicates that further improvements are necessary, particularly in implementing advanced security mechanisms such as encryption and access controls. Previous research suggests that security is a critical factor in ensuring user trust and system sustainability [9]. Practically, the system contributes to: Improved data accuracy, reduced operational errors, Faster processing time, and enhanced transparency in reporting.

These improvements are consistent with findings from digital transformation studies, which show that system integration increases organizational performance and competitiveness [10], [11]. Nevertheless, this study has several limitations. The evaluation is limited to a single organization, which may affect generalizability. In addition, the study does not incorporate advanced statistical validation or user acceptance models such as TAM or UTAUT. Future research is recommended to: Apply the Technology Acceptance Model (TAM), expand sample size, conduct comparative performance analysis, and enhance system security and scalability.

## 4. CONCLUSION

This study successfully develops and implements a web-based printing service information system to optimize business processes at, integrating order management, inventory, payment, and production workflows into a unified platform. The system demonstrates strong performance, achieving a 100% functional success rate, a SUS score of 74.1, indicating good usability, and an overall ISO/IEC 25010 quality score of 89%, reflecting high reliability and efficiency. These results confirm that the system effectively reduces operational errors, improves inter-departmental communication, and enhances organizational performance. The study contributes theoretically by reinforcing the role of integrated information systems in business process optimization and practically by offering a scalable solution for digital transformation in SMEs. However, limitations include the single-case design and limited statistical validation; therefore, future research should incorporate broader samples, quantitative evaluation models such as TAM or UTAUT, and further system enhancements, particularly in security and mobile integration.

## 5. ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to CV. Raskha Media Group for providing the opportunity, data access, and support throughout this study. Appreciation is also extended to all respondents, including administrative staff, designers, warehouse personnel, cashiers, and production operators, for their valuable time and insights during data collection and system evaluation. The authors also thank academic supervisors and colleagues for their guidance and constructive feedback, which significantly contributed to the completion of this research.

## 6. REFERENCES

[1] J. Brooke, "SUS: A 'Quick and Dirty' Usability Scale," in Usability Evaluation in Industry, London, U.K.: CRC Press, 2020, doi: 10.1201/9781498710411

[2] A. Margherita, "Business process management system and digital transformation: A systematic review," Business Process Management Journal, vol. 27, no. 5, pp. 1485–1507, 2021, doi: 10.1108/BPMJ-03-2020-0120

[3] M. M. Queiroz and S. F. Wamba, "Blockchain adoption challenges in supply chain: An empirical investigation," International Journal of Information Management, vol. 52, 2020, doi: 10.1016/j.ijinfomgt.2019.102099

[4] J. R. Lewis, "The System Usability Scale: Past, present, and future," International Journal of Human–Computer Interaction, vol. 34, no. 7, pp. 577–590, 2020, doi: 10.1080/10447318.2018.1455307

[5] A. Alnanih, M. Ormandjieva, and T. Radhakrishnan, “Context-aware software quality model,” Journal of Systems and Software, vol. 169, 2020, doi: 10.1016/j.jss.2020.110537
[6] ISO/IEC, “ISO/IEC 25010: Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE),” 2020
[7] R. M. Davison, M. G. Martinsons, and N. Kock, “Principles of digital transformation,” MIS Quarterly Executive, vol. 20, no. 2, pp. 1–15, 2021
[8] H. Nugroho, A. Suryanto, and B. Prasetyo, “Evaluation of information system adoption in SMEs,” Journal of Information Systems Engineering and Business Intelligence, vol. 7, no. 2, pp. 127–137, 2021, doi: 10.20473/jisebi.7.2.127-137
[9] Y. Chen, X. Li, and J. Wang, “Data security in information systems: Challenges and solutions,” Future Generation Computer Systems, vol. 107, pp. 102–110, 2020, doi: 10.1016/j.future.2020.02.012
[10] S. Verhoef et al., “Digital transformation: A multidisciplinary reflection and research agenda,” Journal of Business Research, vol. 122, pp. 889–901, 2021, doi: 10.1016/j.jbusres.2019.09.022
[11] V. Vial, “Understanding digital transformation: A review and a research agenda,” MIS Quarterly Executive, vol. 18, no. 2, pp. 118–144, 2020
[12] M. Ali, L. Zhou, and Z. Miller, “Web-based information systems for business process integration: A systematic review,” Information Systems Frontiers, vol. 23, no. 4, pp. 1021–1035, 2021, doi: 10.1007/s10796-020-10045-3
[13] S. M. Salleh et al., “Digital transformation in SMEs: A systematic literature review,” Sustainability, vol. 13, no. 7, 2021, doi: 10.3390/su13073845
[14] P. H. Nguyen et al., “Workflow automation in service systems: A performance perspective,” IEEE Transactions on Engineering Management, vol. 69, no. 2, pp. 456–468, 2022, doi: 10.1109/TEM.2020.2977421
[15] L. R. Vijayasarathy, “The impact of coordination on operational performance,” Decision Support Systems, vol. 135, 2020, doi: 10.1016/j.dss.2020.113371