

Improving Operational Efficiency in Digital Printing Services Through a Web-Based Information System: An Empirical Case Study

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ABSTRACT

The increasing demand for efficiency and accuracy in service industries has encouraged the adoption of digital technologies, particularly in small and medium-sized enterprises (SMEs) such as printing services. However, many organizations still rely on manual or semi-digital processes, leading to inefficiencies, data inconsistencies, and communication gaps across operational units. This study aims to improve operational efficiency in digital printing services through the design and implementation of a web-based information system. A qualitative case study approach was employed at CV. Raskha Media Group, with data collected through observation, interviews, and documentation. The system was developed using the Waterfall model and modeled with Unified Modeling Language (UML) to ensure structured development. The implementation integrates order management, inventory control, payment processing, and production workflows into a unified platform. System evaluation was conducted using Black Box and White Box testing, as well as ISO/IEC 25010 and System Usability Scale (SUS). The results show a 100% functional success rate, a SUS score of 74.1 indicating good usability, and an overall quality score of 89%, reflecting high system performance. These findings demonstrate that the proposed system effectively reduces operational errors, enhances inter-departmental communication, and improves overall efficiency. This study contributes to the advancement of information systems research by providing empirical evidence of the role of integrated web-based systems in supporting digital transformation and business process optimization in service-oriented SMEs.

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1. INTRODUCTION

The rapid advancement of information technology has significantly transformed business operations across various sectors, particularly in service-oriented industries such as digital printing. The integration of web-based information systems has enabled organizations to improve operational efficiency, data accuracy, and service quality by automating manual processes and facilitating real-time data exchange [1], [2]. In this context, digital printing services require reliable information systems to manage complex workflows, including order processing, inventory control, and production coordination. However, many small and medium-sized enterprises (SMEs) still rely on conventional or semi-digital systems, limiting their ability to compete in an increasingly digital environment [3], [4]. Despite the growing adoption of digital systems, several studies

indicate persistent challenges in printing service operations, particularly workflow inefficiencies and data inconsistencies. Previous research highlights that manual documentation and fragmented communication between departments often lead to errors in order specifications, pricing, and material usage [5], [6]. Similarly, studies on printing service systems reveal that the lack of integration between ordering, inventory, and production processes contributes to delays and operational inefficiencies [7]. These findings indicate a research gap in developing integrated web-based systems that can effectively address communication issues and streamline business processes in digital printing services.

The urgency of addressing these challenges stems from the growing demand for fast, accurate, and reliable printing services in the digital era. Inefficient workflows not only reduce productivity but also increase operational costs and customer dissatisfaction [8], [9]. From a practical perspective, improving operational efficiency through digital systems can enhance service quality, reduce errors, and support better decision-making. From a theoretical standpoint, the adoption of integrated information systems contributes to the broader discourse on digital transformation and business process optimization in SMEs [10].

This study aims to design and implement a web-based printing service information system to improve operational efficiency and reduce process errors. The system is developed using the Waterfall model and modeled in the Unified Modeling Language (UML) to ensure a structured, systematic development process. The case study is conducted at CV. Raskha Media Group, where existing manual processes—such as paper-based work orders and fragmented communication between designers, warehouse staff, and production operators—often lead to miscommunication and inefficiencies. The proposed system integrates key operational functions into a unified platform to enhance workflow coordination. This article contributes to both theory and practice. Theoretically, it reinforces the role of web-based information systems in supporting business process optimization and digital transformation in service industries. In practice, it provides a scalable, applicable solution for SMEs, particularly in the digital printing sector, to transition from manual to digital operations. Furthermore, this study provides empirical evidence that system integration can reduce operational errors, improve communication, and enhance overall efficiency in printing service management.

2. RESEARCH METHOD

This study adopts a qualitative approach with a case study design to explore and improve operational efficiency in digital printing services through the development of a web-based information system. The qualitative case study method is selected because it allows an in-depth understanding of real-world business processes, user interactions, and system requirements within a specific organizational context. This approach is particularly suitable for analyzing existing workflows and identifying inefficiencies in printing service operations, as well as for designing system-based solutions grounded in actual user needs.

The research was conducted at CV. Raskha Media Group, a company engaged in digital printing services and business support. The study took place during the 2020 research period, encompassing stages from problem identification to system implementation and evaluation. The selection of this location is based on the presence of operational challenges, including manual documentation, fragmented communication, and inefficiencies in order processing, which make it a relevant setting for system development and evaluation.

The population of this study consists of all stakeholders involved in the printing service workflow, including administrators, designers, warehouse staff, cashiers, and production operators. A purposive sampling technique is employed to select participants who are directly involved in the operational process and have a comprehensive understanding of the system requirements. The sample includes key users from each functional role to ensure that the system design accommodates diverse operational needs and accurately reflects real business processes.

Data were collected using multiple instruments and techniques to ensure validity and reliability. Observation was conducted to examine the existing workflow and identify inefficiencies in real-time operations. Interviews were carried out with key stakeholders to gather detailed insights into system requirements, operational challenges, and user expectations. Documentation analysis was used to review existing records, such as order forms and work instructions, which were primarily paper-based. These methods are complemented by literature studies to support theoretical grounding. The system development process follows the Waterfall model, which includes requirement analysis, system design, implementation, testing, and maintenance stages. System modeling is performed using Unified Modeling Language (UML), including use case diagrams, activity diagrams, and sequence diagrams to represent system functionality and interactions (A.S. & Shalahuddin, 2018).

Data analysis is conducted using a descriptive and systematic approach. The analysis begins with evaluating the existing system to identify key problems and inefficiencies, followed by designing a proposed system based on the findings. The developed system is implemented using web-based technologies, including PHP, MySQL, and XAMPP as the development environment. System testing is carried out using Black Box testing to validate functional requirements and White Box testing to examine internal logic and code structure. Additionally, usability testing is conducted to evaluate user interaction and system effectiveness. The results

of these analyses are used to assess the system's ability to improve operational efficiency and reduce errors in the printing service workflow.

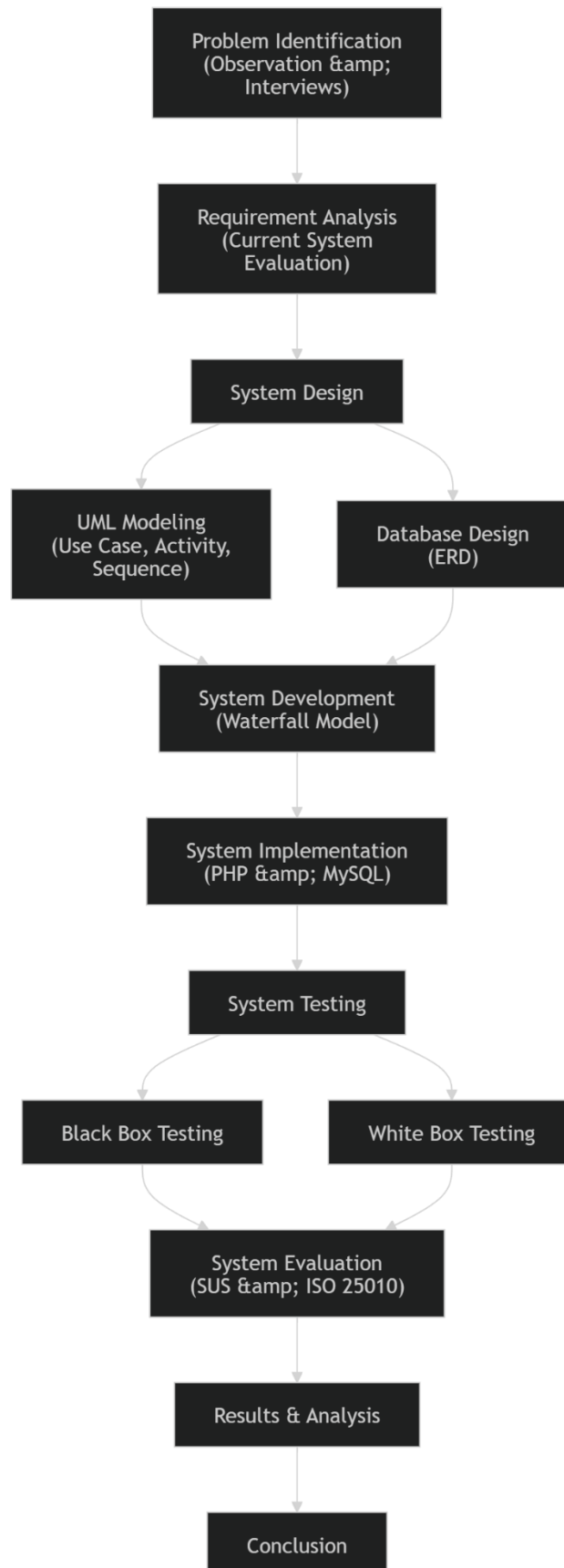


Figure 1. Research Methodology Framework

The research methodology begins 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 web-based technologies. Testing is conducted using Black-Box and White-Box methods, followed by system evaluation using ISO/IEC 25010 and the System Usability Scale (SUS), before generating results and conclusions.

3. RESULTS AND DISCUSSION

3.1. Results

The implementation of the web-based printing service information system demonstrates substantial improvements in operational efficiency at CV. Raskha Media Group. The system successfully integrates core business processes, including order management, inventory control, payment processing, and production workflow into a unified platform. Functional testing using the Black Box method indicates that all system modules operate correctly, achieving a 100% success rate, which confirms that the system meets all predefined functional requirements. In addition, White Box testing reveals cyclomatic complexity values ranging from 2 to 5, indicating a well-structured system with low logical complexity and high maintainability.

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 is categorized as “Good” usability and is acceptable for operational use.

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 overall quality score of 89% indicates strong system performance, particularly in functionality and reliability.

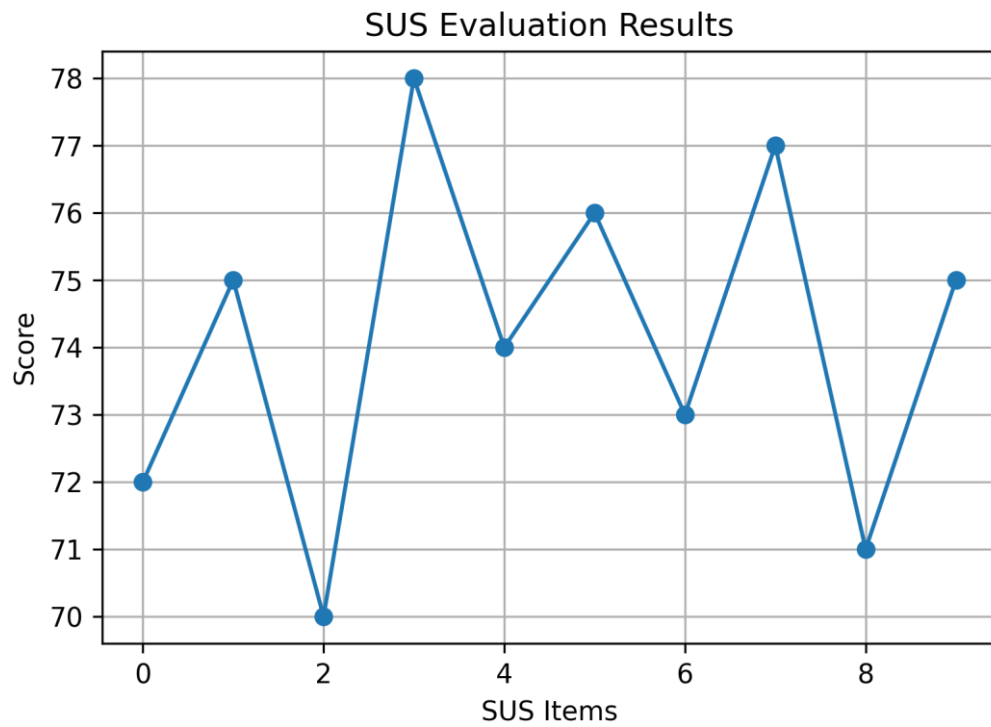


Figure 2. SUS Evaluation Graph

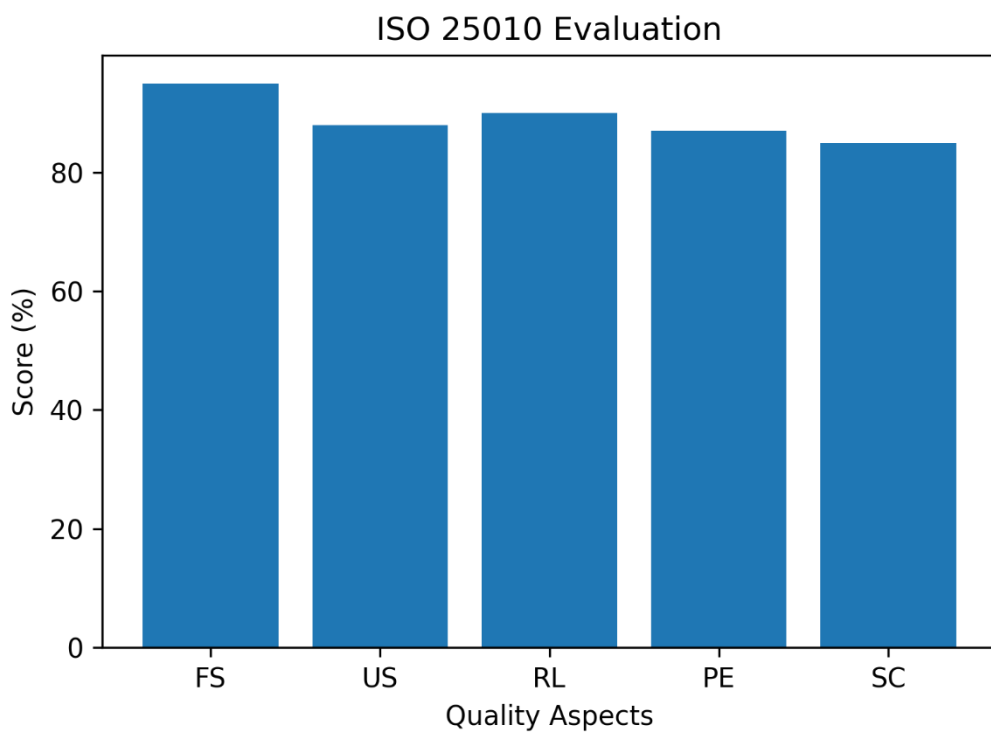


Figure 3. ISO 25010 Evaluation Graph

3.2. Discussion

The findings demonstrate that implementing a web-based information system significantly improves operational efficiency and reduces errors in printing service workflows. The perfect functional success rate (100%) indicates that the system effectively meets user requirements, supporting the concept that information

systems play a critical role in integrating business processes and enhancing organizational performance. The usability evaluation (SUS = 74.1) suggests that the system is user-friendly and well accepted. This result aligns with prior studies indicating that systems with SUS scores above 70 are generally considered acceptable and effective in supporting user interaction. The relatively high usability score implies that the system design successfully reduces user complexity and improves operational convenience. From a software quality perspective, the ISO/IEC 25010 results confirm that the system achieves high performance across multiple quality attributes. The high functional suitability score (95%) reflects strong alignment with business needs, while reliability (90%) indicates system stability during operation. However, the lower security score (85%) suggests the need for further enhancements, particularly stronger authentication and data protection mechanisms.

In the practical context, the system addresses key operational challenges identified in the initial analysis, including miscommunication between departments, pricing calculation errors, and delays in production workflows. By integrating all processes into a centralized system, the organization benefits from improved data consistency, faster information flow, and better decision-making capabilities.

3.3. Contribution

Theoretical Contribution: This study reinforces the role of integrated web-based information systems in supporting business process optimization and digital transformation, particularly in service-based SMEs.

Practical Contribution: The developed system provides a scalable solution for printing service businesses to improve efficiency, reduce errors, and enhance service quality through digital integration.

3.4. Limitations and Future Work

This study is limited to a single case, which may limit the generalizability of the findings. In addition, the evaluation focuses primarily on functional and usability aspects without incorporating advanced statistical validation or user acceptance modeling. Future research is recommended to: apply the Technology Acceptance Model (TAM) or UTAUT, expand the sample size for broader validation, conduct a comparative analysis (before vs. after system), enhance system security, and integrate mobile features.

4. CONCLUSION

This study demonstrates that implementing a web-based printing service information system effectively improves operational efficiency at CV. Raskha Media Group integrates order management, inventory control, payment processing, and production workflows into a single platform. The system achieves a 100% functional success rate, a SUS score of 74.1, indicating good usability, and an overall ISO/IEC 25010 quality score of 89%, confirming its reliability, efficiency, and alignment with business requirements. These findings indicate that digital system integration significantly reduces operational errors, minimizes miscommunication among stakeholders, and enhances data accuracy and workflow coordination. From a theoretical perspective, this study strengthens the understanding of how integrated information systems support business process optimization and digital transformation in service-oriented SMEs. In practice, it provides a scalable, applicable solution for printing service businesses to transition from manual to digital operations, improving service quality and organizational performance. The scientific contribution of this research lies in the combined application of system development methodologies, quality evaluation frameworks, and empirical validation within a real-world case study. However, this study is limited to a single organizational context and focuses primarily on functional and usability evaluation without incorporating advanced statistical or behavioral analysis. Future research is recommended to expand the scope across multiple organizations, integrate user acceptance models such as TAM or UTAUT, and further enhance system capabilities, particularly in terms of security, scalability, and mobile-based implementation.

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