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Design of Information Systems and Layout Equipment Loan Area in the Workshop Division at PT XYZ

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ABSTRAK

Dalam era transformasi digital industri, peningkatan efisiensi operasional menjadi faktor penting dalam menjaga daya saing perusahaan. Divisi workshop PT XYZ sebagai pusat pemeliharaan, perbaikan, dan penyimpanan peralatan kerja masih menghadapi permasalahan berupa pencatatan peminjaman alat yang dilakukan secara manual serta tata letak penyimpanan yang belum optimal. Kondisi tersebut menimbulkan risiko kesalahan data, keterlambatan administrasi, dan kesulitan dalam memantau ketersediaan peralatan secara real-time. Oleh karena itu, proyek ini bertujuan merancang sistem informasi berbasis web untuk mendigitalisasi proses keluar-masuk peralatan serta melakukan penataan ulang tata letak penyimpanan agar lebih sistematis dan efisien. Data penelitian dikumpulkan melalui wawancara, observasi langsung, dan divalidasi menggunakan Focus Group Discussion (FGD) guna memastikan kesesuaian kebutuhan pengguna terhadap rancangan sistem. Pengembangan proyek ini mengintegrasikan beberapa bidang dalam Body of Knowledge Teknik Industri, yaitu System Design and Engineering, Information Engineering, Facilities Engineering and Energy Management, serta Engineering Economic Analysis. Pendekatan System Design and Engineering digunakan untuk analisis kebutuhan dan perancangan proses menggunakan BPMN, Use Case Diagram, dan Sequence Diagram. Information Engineering diterapkan dalam perancangan aliran informasi untuk mendukung pengambilan keputusan berbasis data, sedangkan Facilities Engineering and Energy Management digunakan untuk penataan fasilitas yang efisien dari sisi ruang dan energi. Selain itu, kelayakan finansial sistem dianalisis menggunakan metode Net Present Value (NPV), Internal Rate of Return (IRR), dan Payback Period. Secara keseluruhan, proyek ini diharapkan mampu meningkatkan efisiensi operasional, akurasi pencatatan, serta efektivitas pemanfaatan fasilitas di PT XYZ.
Kata Kunci: *Sistem informasi berbasis web, Efisiensi operasional,Manajemen peralatan,Tata Letak*

ABSTRACT

In the era of industrial digital transformation, improving operational efficiency has become a crucial factor in maintaining corporate competitiveness. The workshop division of PT XYZ, which serves as a center for equipment maintenance, repair, and storage, currently faces challenges related to manual equipment borrowing records and a suboptimal storage layout. These conditions lead to risks of data errors, administrative delays, and difficulties in tracking equipment availability in real time. Therefore, this project aims to design a web-based information system to digitalize the inbound and outbound equipment management process and to redesign the storage layout to be more systematic and efficient. Data was collected through interviews and direct observations in the workshop division and validated using Focus Group Discussions (FGD) to ensure alignment between user needs and system design.
The project integrates several fields within the Industrial Engineering Body of Knowledge, including System Design and Engineering, Information Engineering, Facilities Engineering, and Energy Management, as well as Engineering Economic Analysis. System Design and Engineering is applied to analyze user requirements and design process flows using BPMN, Use Case Diagrams, and Sequence Diagrams. Information Engineering supports effective information-flow design for data-driven decision-making, while Facilities Engineering and Energy Management optimize facility layout for space and energy efficiency. Furthermore, the system's financial feasibility is evaluated using Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period methods. Overall, the proposed system is expected to enhance operational efficiency, improve data accuracy, and increase the effectiveness of facility utilization within PT XYZ.

Keywords: *Web-based information system; operational efficiency; equipment management; facility layout*

1. Introduction

The rapid development of digital technologies has significantly reshaped operational processes across industries, driving organizations to adopt digital information systems to enhance operational efficiency, accuracy, and decision-making capabilities[1]. Web-based information systems have been shown to reduce error rates and administrative lead times in inventory and equipment management, demonstrating measurable improvements in operational efficiency in logistics and warehousing contexts. For example, the implementation of a web-based inventory information system at PT Bintang Delapan Terminal reduced response and transaction times while increasing data accuracy, illustrating the practical benefits of digital transformation for real-time operational control[2].

Despite the acknowledged advantages of digital information systems, many operational units still rely on manual or semi-manual processes. The workshop division of PT XYZ, which serves as a core facility for maintenance, repair, and storage of equipment, continues to record equipment loan and return transactions manually. This practice is prone to inaccuracies, data processing delays, and challenges in tracking real-time asset availability, reflecting a research gap in digital equipment management systems within operational support functions. While studies have explored information systems to improve operational efficiency generally, there is limited empirical evidence on integrated web-based solutions tailored to workshop environments, with a focus on both digital record-keeping and physical facility layout optimization[1]

The inefficiencies in manual equipment management have practical implications. Manual processes increase the risk of data errors and inconsistencies, impede efficient workflow, and constrain the ability to monitor and allocate resources effectively in real time. This aligns with broader findings that ineffective management information systems can lead to suboptimal performance unless optimized for specific operational[3]. Enhancing equipment management through digital means is, therefore, not only a technological priority but also an operational imperative in contemporary industrial settings[3]

In response to these challenges, this study aims to design a web-based information system that digitizes equipment check-out and check-in in the workshop division of PT XYZ, complemented by a systematic redesign of the storage layout to improve spatial efficiency and workflow. The system development process uses validated requirements from interviews, direct observation, and focus group discussions (FGD) to ensure alignment with user needs. The integration of information and facilities engineering principles provides a comprehensive approach to addressing both informational and physical bottlenecks in equipment handling processes.

This article contributes to the body of industrial engineering knowledge by demonstrating how a web-based information system combined with structured facility layout planning can enhance operational performance in workshop environments. Through empirical application and evaluation, the study offers insights into practical design considerations for digital systems in operational contexts, thus advancing both theoretical and applied research on the intersection of digital transformation, equipment management, and facility optimization.

2. Literature Review

The conceptual foundation of digital transformation in industrial settings is rooted in socio-technical systems theory, which views organizational performance improvement as the result of deliberate alignment among human actors, technological tools, and operational processes. At the meso-theoretical level, Information Systems Theory posits

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that well-designed information systems strengthen operational decision-making by increasing the reliability, availability, and timeliness of data [4]. Complementarily, Facility Layout Theory maintains that rational and structured spatial arrangements within operational environments can reduce material movement time and enhance workflow effectiveness, commonly through systematic design and optimization approaches such as Systematic Layout Planning and simulation-based analysis[4]. In parallel, Engineering Economic Analysis offers a normative framework for assessing the feasibility of system investments using cost-benefit indicators, including Net Present Value (NPV), Internal Rate of Return (IRR), and coverage or payback analyses, to ensure that technological initiatives generate quantifiable economic value over their lifecycle [5].

Empirical investigations consistently highlight the operational benefits associated with web-based systems for inventory and equipment management[6]. Demonstrate that implementing a real-time, web-based inventory platform substantially shortened data input duration, reduced human error, and accelerated access to information relative to manual practices, thereby increasing operational efficiency. In warehouse operations, [7]Show that web-enabled inventory applications improve stock accuracy, minimize discrepancies, and enhance service quality through real-time transaction processing and automated reporting. Further evidence from [8] Indicates that embedding structured inventory control principles, such as FIFO, within web-based systems improves alignment between inventory records and financial reporting, reducing inconsistencies in consumable logistics. Additional studies suggest that the use of formal software development methodologies, including RAD and waterfall models, contributes to higher system accuracy, usability, and operational reliability in web-based inventory applications [9].

Complementing the information systems literature, research on warehouse and facility layout underscores the influence of spatial configuration on material handling efficiency and overall operational performance. Empirical studies applying SLP-oriented and simulation-supported layout designs report significant gains, including reduced travel distances, shorter order-picking times, and lower operational costs [10]. These outcomes are consistent with broader operations management research, which identifies facility layout design as a fundamental driver of efficiency in storage, production, and workshop environments.

Although substantial empirical support exists for both web-based inventory systems and facility layout optimization, prior studies frequently examine these domains in isolation. Integrated analyses that simultaneously address information flow, spatial arrangement, and economic justification, particularly within workshop-based operational contexts, remain scarce. Moreover, limited attention has been given to linking system design principles, such as iterative and participatory development, with performance evaluation that explicitly connects operational improvements to financial outcomes.

To address these limitations, this study introduces an integrated empirical framework that combines web-based information system development, systematic facility layout planning, and engineering economic evaluation within a single analytical setting. By adopting this holistic approach, the research advances theory while offering practical guidance for organizations seeking to enhance accuracy, responsiveness, and economic performance in equipment management and facility operations.

Table1. Literature Review

Author(s)	Year	Method	Main Findings	Relevance to This Study
Kukharev a et al.	2022	Framework development	Life-cycle evaluation improves IT effectiveness	Supports continuous system evaluation
Wahyudin	2024	Case study (SLP)	Layout redesign reduces handling distance and improves efficiency	Basis for facility layout planning
Abdelalim et al.	2025	Empirical & conceptual	Digital integration improves facility management efficiency	Supports integration of IS and facilities
Faisal et al.	2024	Case study	Web-based inventory system improves accuracy and speed	Empirical support for a web-based system
Elmardi Suleiman & Muki Nafea	2021	Literature review	NPV, IRR, PP are standard for feasibility analysis	Basis for economic evaluation

The summary table.1 of previous research indicates that this study is grounded in a strong, complementary theoretical and empirical foundation. In terms of system evaluation, [11] Show that technology lifecycle-based evaluation contributes to the continuous improvement of information system effectiveness. In terms of facilities [12] Proves that the application of Systematic Layout Planning can improve operational efficiency by reducing material handling distances, while [13] assert that the integration of information systems and facility management results in more efficient facility management. Empirically, [14] provide evidence that web-based inventory systems improve the accuracy and speed of administrative processes, and from a financial feasibility perspective, [15] emphasize that NPV, IRR, and Payback Period are standard methods for assessing the feasibility of engineering projects. thus, overall, the table indicates the need for an integrated approach that combines system design, facility layout, and economic analysis as done in this study.

3. Method

This research employed a qualitative case study approach with a design-oriented research perspective to analyze and improve equipment management practices in an industrial workshop environment. The case study approach was selected to enable an in-depth understanding of real operational conditions, while the design-oriented perspective facilitated the development of a web-based information system and facility layout redesign as integrated solutions to identified operational inefficiencies.

The study was conducted at the workshop division of PT XYZ, an industrial estate management company responsible for equipment maintenance, repair, and storage activities. The research was carried out during 2024, covering stages of problem identification, requirement analysis, system and layout design, as well as validation of the proposed solutions.

The research subjects were workshop personnel directly involved in equipment management, including administrators, technicians, and supervisors. A purposive

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sampling technique was applied to select respondents with relevant experience and knowledge of equipment borrowing, returning, and storage activities, ensuring that all critical operational roles were represented.
Data collection was conducted through direct observation, semi-structured interviews, document review, and Focus Group Discussions (FGD). Observations and interviews were used to capture existing workflows, equipment movement patterns, and storage conditions, while FGDs were conducted to validate system requirements and design results. Supporting instruments included interview guidelines, observation checklists, and system modeling tools such as Business Process Model and Notation (BPMN), Use Case Diagrams, and Sequence Diagrams.
Data analysis followed a qualitative descriptive approach involving data reduction and thematic interpretation to identify key operational issues and user requirements. Process analysis results were translated into system models, while facility layout analysis applied Systematic Layout Planning (SLP) principles to improve space utilization and workflow efficiency. In addition, an engineering economic analysis using Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period were conducted to evaluate the financial feasibility of implementing the proposed system.

4. Results and Discussion

4.1 Results

The results of this study are derived from the synthesis of system design analysis, facility layout planning, and economic feasibility evaluation based on established theoretical frameworks and findings from previous studies. The proposed web-based information system successfully addresses key operational issues identified in the literature, particularly those related to manual equipment recording, limited traceability, and delayed access to inventory information. Conceptually, the system enables real-time monitoring of equipment availability, standardized borrowing and return procedures, and improved data accuracy, consistent with outcomes reported in prior web-based inventory system implementations [6].

In terms of facility layout, the application of Systematic Layout Planning (SLP) principles conceptually improves spatial organization by reducing unnecessary movement and clarifying storage zones. This aligns with previous case-based studies showing that systematic layout redesign contributes to improved workflow efficiency and reduced material handling distance[16]. From an economic perspective, the application of engineering economic analysis methods—Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period—indicates that investments in integrated digital systems and facility optimization are theoretically feasible and justified, as supported by prior feasibility studies in engineering system implementations [17].

4.2 Discussion

The findings of this study indicate that integrating a web-based information system with a structured redesign of the equipment borrowing area layout constitutes a comprehensive approach to addressing operational inefficiencies in the workshop division of PT XYZ. From a system design perspective, the proposed information system conceptually resolves key issues associated with manual recording practices, such as data inconsistency, limited traceability, and delays in identifying equipment availability. These findings are consistent with recent studies demonstrating that web-based inventory and equipment management systems significantly improve data accuracy, transparency, and processing speed compared to manual systems [2]. Viewed through the lens of information engineering theory, the proposed system strengthens the role of data as a strategic

operational resource. Real-time recording and centralized data management enable more effective monitoring and control of equipment usage, which is essential in workshop environments where equipment availability directly affects operational continuity. This aligns with empirical evidence showing that real-time web-based inventory systems enhance responsiveness and support data-driven decision-making in operational units [6]. In the context of PT XYZ, such improvements are particularly relevant given the high dependency of field operations on timely access to workshop equipment.

The reconfiguration of the equipment borrowing area serves as a physical counterpart to the improvement of the information system by mitigating inefficiencies in activity flow. From the perspective of facilities engineering, inadequately structured layouts tend to generate excessive non-value-adding movement and extend task execution durations. The application of Systematic Layout Planning (SLP) principles in the proposed design enhances spatial coherence and clarifies workflow patterns across borrowing and storage zones. This outcome aligns with contemporary empirical evidence indicating that systematic layout optimization can significantly shorten material handling distances and raise operational efficiency in industrial environments[10]. Furthermore, aligning digital system implementation with facility layout planning reinforces the view that successful digital transformation in facility management depends on the synchronized design of both physical infrastructures and information flows [18].

Viewed through managerial and economic lenses, the incorporation of engineering economic evaluation strengthens the applied significance of the proposed solution. Recent studies underline that rigorous financial feasibility assessments must accompany investments in digital information systems to support long-term and sustainable organizational implementation[17]. In this research, the application of Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period metrics provides a structured, rational foundation for assessing investment decisions related to both system development and facility layout reconfiguration. Such an analytical approach is consistent with current scholarly work that stresses the need to connect operational performance gains with quantifiable economic benefits directly [19].

The primary theoretical value of this research is its articulation of an integrated approach that positions information system design and facility layout planning within a unified framework for operational enhancement in workshop settings. In contrast to earlier studies that typically address digital solutions or spatial optimization in isolation, this study conceptually demonstrates the mutual dependence of these elements in advancing the effectiveness of equipment management. From an applied standpoint, the results provide a structured reference framework to guide organizations in digitizing equipment-borrowing activities while increasing the efficiency of associated physical service spaces.

Despite these contributions, several limitations must be acknowledged. The analysis is grounded in conceptual modeling and evidence from prior literature, rather than in full-scale system deployment and direct quantitative assessment of performance outcomes. As a result, subsequent research should empirically test the proposed framework through implementation-oriented studies that quantify impacts such as reductions in transaction processing time, decreases in error rates, improvements in equipment availability, and realized cost efficiencies. Additional investigations could also address user acceptance, system scalability, and integration with organization-wide information systems to strengthen generalizability and support sustained operational impact.

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5. Conclusion

This study demonstrates that integrating web-based information system design with systematic facility layout planning provides a coherent, practical approach to improving equipment-borrowing operations in workshop environments. The conceptual framework indicates that aligning digital information flows with optimized physical layouts can reduce process inefficiencies, enhance workflow clarity, and support more accurate and responsive equipment management.

From a theoretical perspective, the findings reinforce the interdependence among socio-technical systems theory, information systems theory, and facility layout theory by showing that operational performance is maximized when digital and physical systems are designed in a coordinated manner. Practically, the study offers a structured reference model that can guide organizations in simultaneously digitalizing service processes and reorganizing physical service areas to achieve operational and managerial efficiency.

In terms of scientific contribution, this research advances the field by proposing an integrated operational improvement framework that bridges information systems design, facilities engineering, and engineering economic analysis within a single conceptual structure. By synthesizing these domains, the study extends the existing literature, which has traditionally treated them as separate analytical strands, particularly in the context of workshop and equipment management operations.

Despite its contributions, this research remains limited by its conceptual and case-based orientation. Future studies should empirically validate the proposed framework through full-scale implementation and quantitative evaluation using indicators such as reductions in transaction time, changes in error rates, equipment availability, and cost savings. Further research is also encouraged to examine system scalability, user acceptance, and integration with enterprise-wide information systems to strengthen generalizability and long-term applicability.

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