

Aligning IT Strategy with Operational Performance: A Case Study of the Semarang-Demak Toll Road Project

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Abstrak

Penelitian ini bertujuan untuk memberikan pemahaman mendalam mengenai penyelarasan strategi Teknologi Informasi (TI) dengan kinerja operasional di PT PP Semarang Demak (PPSD), khususnya terkait implementasi sistem Lajur Otomatis (LOS) berbasis RFID. Dilatarbelakangi oleh kebutuhan untuk mengelola fluktuasi lalu lintas dan meningkatkan efisiensi layanan, penelitian ini menggunakan pendekatan studi kasus kualitatif. Data dikumpulkan melalui wawancara mendalam dengan pemangku kepentingan utama dari divisi Teknik, Operasi, dan Keuangan, serta didukung oleh observasi lapangan langsung yang dilakukan antara Februari hingga Juni 2024. Temuan penelitian menunjukkan bahwa meskipun strategi TI memiliki tingkat kesesuaian yang tinggi dengan kebutuhan operasional terbukti dengan berkurangnya kemacetan dan peningkatan kecepatan transaksi proses integrasi masih menghadapi hambatan teknis dan organisasional. Tantangan utama yang teridentifikasi meliputi keterbatasan kompetensi sumber daya manusia, gangguan faktor lingkungan, dan risiko finansial akibat ketidakcocokan teknologi (technology mismatch). Penelitian ini menyimpulkan bahwa penyelarasan yang berkelanjutan memerlukan lebih dari sekadar adopsi teknis; hal ini menuntut adanya mekanisme validasi yang ketat, seperti penerapan Proof of Concept (PoC), serta investasi berkelanjutan dalam pengembangan modal manusia. Wawasan ini memberikan implikasi strategis bagi sektor konstruksi dan infrastruktur dalam mengelola transformasi digital secara efektif.

Kata Kunci: Strategi Teknologi Informasi; Kinerja Operasional; RFID; Manajemen Infrastruktur; Studi Kasus Kualitatif.

Abstract

This study aims to provide an in-depth understanding of how Information Technology (IT) strategies are aligned with operational performance at PT PP Semarang Demak (PPSD), specifically regarding the implementation of the RFID-based Lajur Otomatis (LOS) system. Motivated by the need to manage traffic fluctuations and enhance service efficiency, the research employs a qualitative case study approach. Data were collected through in-depth interviews with key stakeholders from the Engineering, Operations, and Finance divisions, supplemented by direct field observations conducted between February and June 2024. The findings indicate that while the IT strategy is highly congruent with operational needs significantly reducing congestion and accelerating transaction speeds the integration process is hindered by technical and organizational barriers. Key challenges identified include limited human resource competency, environmental disruptions, and the financial risk of technology mismatch. The study concludes that sustainable alignment requires more than technical adoption; it demands rigorous validation mechanisms, such as Proof of Concept (PoC), and continuous investment in human capital. These insights offer valuable strategic implications for the construction and infrastructure sector regarding the effective management of digital transformation.

Keyword: Information Technology Strategy; Operational Performance; RFID; Infrastructure Management; Qualitative Case Study.

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1. Introduction

In the current era of globalization, business is growing rapidly with increasingly fierce competition (Huang, 2023; Sutrisno *et al.*, 2024). Consequently, companies must be proactive regarding dynamic environmental changes by developing innovation strategies to survive (Aragón-Correa & Rubio-López, 2007). Technological change serves as a critical factor because it can improve operational performance (Fosso Wamba & Mishra, 2017). Technology is defined as human efforts to produce products or services by utilizing tools, processes, and resources (Agar, 2020; Nightingale, 2014). Companies across various sectors, including services, trade, and manufacturing, must align themselves with the development of information technology (Zabukovšek *et al.*, 2023), which plays an important role in processing data into information. Information and Communication Technology (ICT) emerged because of the fusion of computer and communication technologies in the mid-20th century (Lee *et al.*, 2018). Although the rapid development of ICT is outpacing other technologies, the mere adoption of technology is insufficient to create a long-term competitive advantage (Bughin *et al.*, 2018; Manjunath *et al.*, 2024). Instead, IT capabilities are needed to effectively manage, understand, and utilize information, resulting in a unique advantage that is difficult for other business entities to replicate (Koo & Le, 2024; Makhloufi *et al.*, 2021). Organizational readiness and technological competence are internal factors, while competitive business pressures are external factors that influence e-business adoption decisions.

Furthermore, IT investment requires a learning process and strategic integration in order to create sustainable competitiveness. The importance of operational efficiency in economic management is necessary to improve competitiveness and have a positive impact on the welfare of society (Handoyo *et al.*, 2023). Technological innovations, both in the form of hardware and software, have brought about major changes in the way operations are conducted. With the right technology adoption, economic management can gain significant advantages in terms of efficiency, productivity, and resource management (Hwang & Kim, 2022). This study focuses on the implementation of such strategies at PT PP Semarang Demak (PPSD), a subsidiary of a state-owned enterprise engaged in the management, construction, and operation of toll road infrastructure. PPSD manages the Semarang-Demak Toll Road, a project with unique characteristics that integrates a toll road with a flood control embankment to address tidal flooding in coastal areas. Base on Table 1, Operational data from January 2024 to April 2024 indicates that the number of vehicles entering the toll road has fluctuated significantly. To address these fluctuations and improve service speed, the company introduced the Automatic Lane or Lajur Otomatis (LOS) program, an innovation utilizing Radio Frequency Identification (RFID) technology to facilitate smoother transactions for road users.

Table 1. Number of Vehicles Entering the Semarang-Demak Toll Road from January to April 2024

Month	Total Vehicle
January 2024	248.199
February 2024	255.492
March 2024	195.508
April 2024	341.338

Therefore, this research aims to analyze the perceptions and practices of aligning information technology strategy with operational performance at PT PP Semarang Demak. Specifically, this study assesses whether the technology used is appropriate for work needs, identifies obstacles in integration, and evaluates the impact of technology on the smoothness and results of operational work. This effort is expected to generate a sustainable competitive advantage due to the accumulation of experience and the speed of adaptation to changes in the business environment. The findings of this study are expected to provide a basis for decision-making regarding future technology development and offer insights for the construction industry on the effective application of IT in project operations. The remainder of this paper is organized as follows: Section 2 reviews the relevant literature and theoretical framework; Section 3 details

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the qualitative research methodology; Section 4 presents the findings and discussion; and Section 5 provides the conclusion and managerial implications.

2. Literature Review

2.1 Innovation Strategy and Information Technology

Innovation is the process of creation and development that results in new products, production processes, organizational structures, or technologies (Kochetkov, 2023; Vărzaru & Bocean, 2024). This definition encompasses the utilization of ideas, knowledge, and technology to generate significant improvements in company performance. In the current era of globalization, business grows rapidly with fierce competition (Efrat *et al.*, 2017). Consequently, organizations must be proactive regarding dynamic environmental changes by developing innovation strategies to survive. Innovation management involves developing, implementing, and managing innovative technologies and business models, all of which impact a company's competitiveness (Baden-Fuller & Haefliger, 2013; Karstegl *et al.*, 2025). Information and Communication Technology (ICT) plays a central role in this process. However, the mere adoption of technology is insufficient to create a long-term competitive advantage. IT capabilities are required to effectively manage, understand, and utilize information (Koo & Le, 2024). Therefore, IT investment requires a learning process and strategic integration to create sustainable competitiveness.

2.2 Operational Performance

Operational performance is defined as the strategic dimensions of competing firms and consists of operational level indicators, such as flexibility and delivery (Chavez *et al.*, 2015). It is broadly aimed at achieving delivery reliability, process flexibility, cost reduction, product or process innovation, and product quality. Operational performance is also defined as the ability of a manufacturer or service provider to meet the standards of expectations established for customers (Trattner *et al.*, 2019). A business entity demonstrates quality competence if it can satisfy customer demand and differentiate its products from those of its competitors (Farida & Setiawan, 2022). The importance of operational efficiency is necessary to improve competitiveness (Handoyo *et al.*, 2023). With the right technology adoption, management can gain significant advantages in terms of efficiency, productivity, and resource management (Boothby *et al.*, 2010).

3. Research Methodology

3.1 Research Design

This study employs a qualitative case study approach to examine the perceptions and practices of aligning information technology strategy with operational performance at PT PP Semarang–Demak. The methodology synthesizes principles proposed by Creswell (2023) and Eisenhardt (2007) to achieve a comprehensive understanding of strategic alignment across organizational units. The qualitative approach is rooted in an interpretive framework and constructivism theory, which posits that knowledge is subjective and shaped by individual perspectives and experiences (Creswell & Creswell, 2022). This method allows for a holistic assessment of data collection methods while noting their advantages and disadvantages.

3.2 Data Collection Techniques

Data collection focused on obtaining a comprehensive overview of the implementation and challenges of IT at PPSD. Case selection employed theoretical sampling involving three main units: Project Management, the Information Systems and Digital Engineering Division, and Field Operations. Semi-structured interviews were conducted with three key informants holding strategic positions. This method is flexible, allowing questions to evolve during the process based on the interviewee's responses.

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Table 2. Respondent Profile

Name of Respondent	Division	Interview Duration
RBP	Engineering Division	78 Minute
HR	Operation Division	75 Minute
FE	Finance Division	50 inurte

3.3 Data Analysis

Data analysis followed Eisenhardt’s theory-building approach. Internal case analysis facilitated an in-depth examination of each unit to identify distinctive patterns related to perceptions and digital literacy. Subsequently, cross-case analysis integrated findings across units to uncover convergent and divergent themes. This iterative process continued until the pattern of findings stabilized and yielded no new information.

4. Results and Discussion

4.1 Results

This study employed a qualitative case study approach to evaluate the alignment of Information Technology (IT) strategies with operational performance at PT PP Semarang Demak (PPSD). Data was gathered through in-depth interviews with three key informants: HR (Operations Division), FE (Finance Division), and RBP (Engineering Division), supplemented by field observations of the Lajur Otomatis (LOS) system and internal documentation from January to April 2024. The data analysis followed an inductive approach, aggregating specific observations into first-order concepts, which were then synthesized into three aggregate second-order dimensions: (1) Strategic Fit and Operational Efficiency, (2) Barriers to Technological Integration, and (3) Determinants of Sustainable IT Performance.

4.1.1 Strategic Fit and Operational Efficiency

The triangulation of data from the Operations, Finance, and Engineering divisions confirms that the implementation of the RFID-based LOS system is highly congruent with PPSD’s operational necessities. The Operations Division emphasized the tangible impact on service speed. HR noted that the technology directly addressed the issue of congestion caused by traditional tapping methods. In the interviews, HR explained:

"Previously, the queue at the gate was a major bottleneck. Since implementing the LOS system, the alignment with our work needs is clear—it significantly supports smooth performance and time efficiency. The system automates what used to be a manual delay."

This operational perspective was corroborated by the Engineering Division. RBP highlighted the technical suitability of the RFID implementation for the Sayung-Demak section:

"The technology isn't just a gimmick; it fits the specific traffic characteristics of Section 2. By allowing users to pass without tapping, we are utilizing IT to solve a physical engineering problem—traffic flow."

From a financial and strategic perspective, FE validated these operational claims but added a layer regarding data visibility. She argued that the "fit" is not just about speed, but about the accuracy of information flows:

"The technology reflects relevant innovation because it integrates real-time data. It's not just about moving cars faster; it's about giving us the visibility to make financial decisions based on accurate traffic counts."

Thus, the convergence of these views suggests that IT alignment at PPSD is not merely incidental but is a deliberate response to specific operational pressures.

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4.1.2 Barriers to Technological Integration

Despite the strategic fit, the data revealed a complex set of obstacles. The analysis identified a distinction between technical/environmental barriers (Engineering/Operations) and strategic barriers (Finance). Both the Operations and Engineering divisions reported that external factors frequently disrupt the theoretical efficiency of the system. Rahmad (Engineering) provided a detailed account of these disruptions:

"We face significant hurdles from the user side—many drivers don't understand the ideal sensor reading distance or run out of balance. Furthermore, extreme weather is a technical enemy; heavy rain often interferes with the RFID sensors, causing read failures."

Operations) Division highlighted a critical internal gap: the disparity between advanced technology and human capability:

"The hardware is ready, but our human resources are catching up. We encounter limited competency in troubleshooting these advanced systems. We need more personnel who possess a deep understanding of this specific technology, not just general operators."

In contrast, FE (Finance) framed the barrier as a risk of "Technology Mismatch." She warned that without rigorous validation, IT adoption could become a liability:

"The biggest obstacle isn't the rain; it's the potential for budget waste through incompatibility. If we select technology without a comprehensive needs analysis, we risk a 'mismatch' where the investment cost outweighs the operational efficiency gained.."

4.1.3 Determinants of Sustainable IT Performance

The findings indicate that PPSD mitigates these barriers through a combination of educational, technical, and procedural solutions. The participants agreed that technology is only as effective as the ecosystem supporting it. To address the "Technology Mismatch" risk, the Finance division enforces a strict validation protocol. FE explained:

"We don't just buy technology; we test it. Implementing a Proof of Concept (PoC) and establishing measurable KPIs before full-scale investment is our primary defense against incompatibility."

Simultaneously, to address the human and technical gaps, the Operations and Engineering divisions focus on continuous improvement. Rahmad emphasized the external solution:

"We are ramping up user education campaigns. Drivers need to know how to interact with the LOS. It's a two-way street; the sensor works only if the driver behaves correctly."

4.2 Discussion

The findings indicate that PPSD's implementation of the RFID-based LOS system is not merely a technical upgrade but a strategic response to dynamic environmental changes. This aligns with the definition of innovation by Kochetkov, (2023) and Vărzaru & Bocean, (2024), who describes it as a process of utilizing technology to result in significant improvements in company performance. The empirical data from the Operations Division confirms that the technology successfully reduced congestion and accelerated transaction times. This outcome directly supports the theoretical perspective of Fahreza *et al.* (2025), who define operational performance as the ability to meet customer expectation standards in this case, the reliability and speed of toll services. By integrating the LOS system, PPSD has demonstrated what Agazu and Kero (2024) describe as the "innovation management" process, providing added value in the operational process to enhance competitiveness. A critical insight from this study is the distinction between possessing technology and possessing the capability to use it. While the Engineering Division confirmed the technical suitability of the RFID sensors, the Operations Division reported significant hurdles regarding human resource competency. This finding corroborates the theory posited by Manjunath (2024), which argues that the mere adoption of technology is insufficient to create a long-term competitive advantage. Instead, "IT capabilities" are required to effectively manage and utilize information.

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The challenges faced by PPSD specifically the need for specialized personnel to maintain complex systems validate Koentjoro and Gunawan (2020) assertion that IT investment requires a "learning process" and strategic integration to create sustainable competitiveness. The gap identified suggests that without parallel investment in human capital, the theoretical efficiency of the innovation cannot be fully realized in practice.

5. Conclusion

This study aimed to analyze the perceptions and practices of aligning Information Technology (IT) strategy with operational performance at PT PP Semarang Demak (PPSD). The findings confirm that the alignment of IT strategy plays a crucial role in improving operational performance. Specifically, the implementation of the RFID-based Lajur Otomatis (LOS) system has proven to be strategically aligned with the company's objective to reduce congestion and accelerate service delivery. However, the research reveals that technical adoption alone is insufficient. The effectiveness of this technology is heavily moderated by internal factors, such as human resource competency, and external factors, including environmental conditions and user behavior. Consequently, while the "Strategic Fit" at PPSD is high, the "Operational Readiness" requires continuous adjustment to fully realize the potential of digital innovation. The findings of this study offer several practical implications for infrastructure operators and decision-makers in the construction industry. First, to mitigate the risk of "Technology Mismatch," companies must institutionalize a validation protocol. The implementation of a Proof of Concept (PoC) and the establishment of measurable Key Performance Indicators (KPIs) should be mandatory prerequisites before full-scale investment. This ensures that capital expenditure yields tangible operational efficiency. Second, investment in technology must be matched by investment in human capital. The study suggests that specialized training programs are essential to bridge the gap between advanced hardware and operator competency. Finally, for public-facing technologies like toll systems, user education is a critical operational variable. Digital campaigns and clear information dissemination are necessary to ensure that end-users interact correctly with the system, thereby preventing technical bottlenecks. This study has limitations that present opportunities for future research. First, the scope is limited to a single case study at PT PP Semarang Demak, utilizing data from a specific internship period (February to June 2024). Consequently, the findings may not be fully generalizable to other toll road operators with different traffic characteristics or organizational cultures. Future research could employ a comparative analysis across multiple toll operators to validate these findings. Second, the data is primarily qualitative, relying on perceptions and observations. Future studies could benefit from a quantitative approach, using statistical analysis to measure the precise correlation between IT investment and operational speed or revenue growth.

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