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Product Innovation Transformation and Process Efficiency through the Strategic Role of Business Information Systems in Technology Startups in the Digital Era

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ABSTRACT

The digital era has driven technology startups to adopt business information systems to enhance product innovation and operational process efficiency. This study aims to analyze the strategic role of business information systems in driving innovation transformation and optimizing business processes in technology startups. Using a literature review method with a qualitative approach and descriptive analysis, this study examines 17 articles obtained from Google Scholar from the 2019–2025 period. The findings indicate that the implementation of data analytics, artificial intelligence, and cloud computing-based business information systems enables startups to develop more innovative products and improve supply chain efficiency as well as internal management. Case studies of Gojek, Tokopedia, Ruangguru, and Qasir confirm that business information systems assist startups in data-driven decision-making, enhancing customer experience, and optimizing resources. However, challenges such as limited resources and organizational readiness remain obstacles to the optimal implementation of business information systems. This study provides implications for startups, investors, and policymakers in designing more effective technology adoption strategies to support the growth of the startup industry.

ABSTRAK

Era digital telah mendorong startup teknologi untuk mengadopsi sistem informasi bisnis guna meningkatkan inovasi produk dan efisiensi proses operasional. Penelitian ini bertujuan untuk menganalisis peran strategis sistem informasi bisnis dalam mendorong transformasi inovasi dan optimalisasi proses bisnis di startup teknologi. Menggunakan metode tinjauan pustaka dengan pendekatan kualitatif dan analisis deskriptif, penelitian ini mengkaji 17 artikel yang diperoleh dari Google Scholar periode 2019–2025. Hasil penelitian menunjukkan bahwa penerapan sistem informasi berbasis data analytics, artificial intelligence, dan cloud computing memungkinkan startup untuk mengembangkan produk yang lebih inovatif dan meningkatkan efisiensi rantai pasok serta manajemen internal. Studi kasus Gojek, Tokopedia, Ruangguru, dan Qasir mengonfirmasi bahwa sistem informasi bisnis membantu startup dalam pengambilan keputusan berbasis data, peningkatan pengalaman pelanggan, serta optimalisasi sumber daya. Namun, tantangan seperti keterbatasan sumber daya dan kesiapan organisasi masih menjadi hambatan dalam implementasi sistem informasi secara optimal. Penelitian ini memberikan implikasi bagi startup, investor, dan pemerintah dalam merancang strategi adopsi teknologi yang lebih efektif untuk mendukung pertumbuhan industri startup.

1. INTRODUCTION

The advancement of digital technology has pushed technology startups to adopt business information systems as a key strategy for enhancing competitiveness in a dynamic market. Technology startups operate in a rapidly evolving ecosystem where product innovation and process efficiency are crucial factors in sustaining business continuity. Business information systems enable companies to manage data effectively, improve

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decision-making processes, and create innovation opportunities through more accurate market analysis (Mustafa et al., 2024). In the context of technology startups, the utilization of business information systems supports operational activities and acts as a catalyst in developing adaptive and technology-driven business models.

Product innovation transformation is a critical aspect of technology startups' sustainability, given the highly competitive nature of the industry and the rapidly changing consumer preferences. Business information systems play a strategic role in accelerating the product innovation cycle by providing relevant data on market needs, industry trends, and customer feedback (Yoshikuni & Dwivedi, 2023). With the integration of technologies such as big data analytics, cloud computing, and artificial intelligence, startups can develop products that better meet user needs while also speeding up market validation processes. The use of business information systems in product innovation also allows startups to personalize services, enhance user experience, and create more competitive added value.

Beyond product innovation, process efficiency is a fundamental factor in strengthening the competitiveness of technology startups. Business information systems contribute to business process automation, reducing operational costs and increasing productivity (Seun et al., 2023). Startups can optimize resource management, minimize inefficiencies, and improve decision-making accuracy by implementing enterprise resource planning (ERP), customer relationship management (CRM), and supply chain management (SCM) systems. Cloud-based technology also allows startups to access real-time data, enhance team collaboration, and respond more quickly to market changes.

In the digital era, technology startups face increasingly complex challenges, including regulatory changes, emerging technologies, and rising customer expectations. To address these challenges, business information systems serve as a strategic instrument that provides a competitive advantage through optimized information management. The adoption of data-driven decision-making enables startups to become more adaptive to market changes, minimize business risks, and identify growth opportunities more efficiently. The success of digital transformation in technology startups depends largely on how well they integrate business information systems with their innovation strategies and operational efficiency (Asrul, 2025).

The competitive advantage of technology startups that optimize business information systems is evident in companies like Gojek, Tokopedia, and Traveloka, which have successfully transformed their services through digital technology. Gojek, for instance, leverages AI-based information systems and big data to optimize driver allocation, reduce customer wait times, and enhance efficiency in logistics and digital payment services. Tokopedia utilizes cloud technology and machine learning to personalize the online shopping experience, while Traveloka relies on business information systems to optimize ticket pricing and data-driven customer service. These cases demonstrate that innovation-driven product transformation and process efficiency based on business information systems can be key success factors for technology startups in the digital era (Shang et al., 2024).

However, while business information systems offer numerous benefits, there are challenges in their implementation, especially for startups in the early growth stages. Limited financial resources, a shortage of experts in data analytics, and resistance to change pose major obstacles to adopting integrated information systems. Additionally, startups must ensure that their use of business information systems aligns with their specific needs to avoid inefficiencies in technology investments. Therefore, a well-thought-out strategy is essential for adopting and managing business information systems to maximize the benefits of this technology.

This literature review will explore the strategic role of business information systems in driving product innovation transformation and process efficiency in technology startups in the digital era. The analysis will focus on the benefits of business information systems in optimizing product innovation strategies, improving operational efficiency, and addressing the challenges startups face in adopting digital technology. This research aims to provide insights for entrepreneurs, academics, and industry practitioners in designing more adaptive strategies for digital transformation by understanding how technology startups can effectively leverage business information systems.

2. THEORETICAL FRAMEWORK AND HYPOTHESES

Innovation Transformation

Innovation transformation refers to fundamental changes in how a company creates, develops, and imple-

ments new ideas to produce better products or services (Vărzaru & Bocean, 2024). In the context of technology startups, innovation transformation involves developing new features and improving business models, marketing strategies, and user experiences through the use of advanced technology. This process is often driven by the integration of artificial intelligence, big data, and digital market analytics to identify opportunities and respond quickly to changing consumer needs. For example, Gojek has revolutionized the transportation and logistics industry by introducing an app-based service that connects drivers and customers within an extensive digital ecosystem.

Process Efficiency

Process efficiency is the effort to improve business operational performance by minimizing resource waste, optimizing time, and increasing productivity without compromising quality (Handoyo et al., 2023). In technology startups, process efficiency can be achieved through workflow automation, cloud computing implementation, and the integration of information systems that enable more effective business management. For instance, Tokopedia uses machine learning to streamline seller verification processes, shorten product delivery times, and optimize customer experience through data-driven personalization. Startups can allocate their resources more optimally by improving process efficiency, enhance competitiveness, and accelerate business growth in a dynamic and competitive environment.

Business Information Systems

Business information systems are a combination of technology, processes, and people used to collect, manage, and analyze data to support decision-making and improve business efficiency (Aydiner et al., 2019). In the digital era, technology startups heavily rely on business information systems to automate operations, enhance interdepartmental coordination, and provide strategic insights based on real-time data analysis. A concrete example of business information system implementation can be seen in Ruangguru, which utilizes a cloud-based platform to manage student data, provide personalized educational content, and enhance interactions between teachers and students through AI-driven features. With integrated business information systems, startups can improve work effectiveness and create better customer experiences.

Technology Startups

Technology startups are early-stage companies focused on developing and utilizing technology to create innovative solutions across various industry sectors such as e-commerce, fintech, edtech, and healthtech (Chakraborty et al., 2021). Unlike conventional companies, technology startups typically have flexible business models, high scalability, and rely on digital innovation as their main competitive advantage. For example, Qasir, a startup providing digital point-of-sale solutions, helps SMEs manage transactions and inventory efficiently through an easily accessible cloud-based system. The strength of technology startups lies in their ability to rapidly adopt and develop new technologies to meet the ever-evolving market demands.

Digital Era

The digital era refers to a period where information and communication technology is rapidly advancing, transforming how individuals, businesses, and society interact and conduct daily activities (Hasin et al., 2022). The growth of the internet, cloud computing, artificial intelligence, and big data has created both opportunities and challenges for businesses, including technology startups. In this era, companies must be more adaptive in responding to market changes and enhancing their digital capabilities to remain competitive. For instance, the adoption of e-commerce and digital payments in Indonesia has surged significantly with the increasing use of platforms such as Shopee, Tokopedia, and Gojek, which offer faster, safer, and more efficient transaction experiences. Businesses can expand market reach, improve services, and develop more innovative and sustainable business models by optimizing technology.

3. RESEARCH METHOD

This study is a literature review employing a qualitative approach aimed at analyzing the strategic role of business information systems in driving product innovation transformation and process efficiency in technology startups in the digital era. A qualitative approach is utilized because this research focuses on an in-depth understanding of concepts, theories, and empirical findings related to business information systems, product innovation, and process efficiency in the context of technology startups. The analytical method used

in this study is descriptive analysis, which aims to interpret and describe observed phenomena based on secondary data from various scientific sources. Descriptive analysis enables this research to identify trends, patterns, and relationships between business information systems, product innovation transformation, and process efficiency in technology startups. By using this method, the study provides a comprehensive understanding of how business information systems are implemented in startups and their impact on business sustainability in the digital era. The data sources for this study were obtained through Google Scholar, covering publications from 2019 to 2025. This time frame was selected to ensure that the data used is relevant to the latest developments in the application of business information systems in technology startups. Initially, the literature search yielded 38 scientific articles related to the research topic. However, after a rigorous selection process based on relevance, source credibility, and alignment with the research objectives, only 17 articles were used as the primary basis for analysis. The selection of articles was carried out by considering several criteria, including journals indexed in reputable databases, relevance to the research topic, and alignment with the research objectives. The selected articles were analyzed to explore various perspectives on the role of business information systems in enhancing product innovation and process efficiency in technology startups. The findings from this analysis were then used to formulate conclusions that contribute to understanding how startups can leverage business information systems as an effective strategy in the digital era.

4. DATA ANALYSIS AND DISCUSSION

The transformation of product innovation and process efficiency through the strategic role of business information systems has become a determining factor for technology startups in facing competitive pressure in the dynamic digital era, where the ability to quickly adapt to market changes and customer needs is the key to business sustainability. Business information systems function as a support tool for data-driven decision-making and act as a catalyst for accelerating innovation cycles through deeper data analysis, process automation, and more efficient resource management. Startups can integrate various information sources to identify market opportunities, predict consumer behavior, and develop more personalized and adaptive marketing strategies by leveraging technologies such as artificial intelligence, big data, and cloud computing. Additionally, business information systems enable startups to enhance operational effectiveness by reducing inefficiencies in the supply chain, accelerating product development processes, and improving team collaboration through integrated digital platforms (Amira S, 2024). The competitive advantage resulting from the optimization of these information systems helps startups survive intense competition and create sustainable growth.

The utilization of business information systems in product innovation, as implemented by Gojek, illustrates how big data analytics and artificial intelligence can serve as a strategic foundation for developing a digitally driven service ecosystem that dynamically and precisely caters to customer needs (Republic Indonesia, 2020). Gojek has been able to design service expansion strategies that enhance user retention and create synergy across products by collecting and analyzing transaction data, user preferences, and customer behavior patterns in real time, such as the integration of GoFood with GoPay to improve transaction convenience or the use of GoSend within the local e-commerce ecosystem. Through automated and machine-learning-based business information systems, Gojek can personalize service recommendations, dynamically adjust pricing based on demand and market conditions, and optimize resource allocation, including a more efficient driver-partner allocation system. The effectiveness of this strategy is evident in increased customer engagement and broader market penetration, allowing Gojek to transform from a mere ride-hailing service into a comprehensive digital ecosystem encompassing digital payments, logistics, and microfinance services. Gojek enhances its operational efficiency and establishes a sustainable competitive advantage in the platform-based technology industry with continuously updated and analyzed data-driven approaches.

Process efficiency in technology startups like Tokopedia focuses on operational optimization and the creation of a digital ecosystem capable of handling large transaction volumes in real time with high accuracy and speed. Tokopedia can manage millions of daily transactions without system disruptions by utilizing cloud computing-based business information systems, while machine learning technology is applied to enhance efficiency in product matching, personalized recommendations, and fraud detection to improve transaction security (Tokopedia, 2023). Data-driven algorithms in supply chain management enable Tokopedia to optimize product distribution with logistics partners, forecast market demand, and reduce bottlenecks in deliveries, thereby speeding up order fulfillment times and enhancing customer satisfaction. Furthermore, business information systems allow for automation in payment processing through integration with various

digital payment methods, including OVO and other e-wallets, accelerating transaction verification and settlement processes. With this approach, Tokopedia has successfully reduced operational errors, increased data processing efficiency, and built a more seamless and responsive user experience, ultimately driving customer loyalty and strengthening its position as one of Indonesia's largest marketplaces.

Process efficiency in human resource management and internal coordination is a crucial aspect for Ruangguru in maintaining scalability and service quality amidst the increasingly competitive edtech ecosystem. Ruangguru efficiently manages thousands of educators by implementing a cloud-based business information system, including class scheduling, content distribution, and integrated performance-based payment systems, ensuring smooth operations without complex administrative burdens (Febrianti Safitri Anggraini, 2021). The application of machine learning and data analytics in the learning system allows for curriculum personalization based on students' learning patterns, ensuring a more adaptive and effective educational experience tailored to individual academic needs. Additionally, a data-driven dashboard enables real-time monitoring of student engagement, teaching effectiveness, and continuous program evaluation, allowing Ruangguru to optimize its pedagogical approach. From a customer service perspective, AI-powered chatbot automation enhances efficiency in handling user inquiries, reducing the workload of support teams, and accelerating responses to technical or academic issues. Ruangguru has successfully improved its operational quality and efficiency while continuously innovating in delivering more relevant, interactive, and impactful digital education products for millions of students across Indonesia, with a robust business information system.

For technology startups still in the development stage, the implementation of business information systems serves as both an operational support tool and a key driver of product innovation and process efficiency, as demonstrated by Qasir in providing digital point-of-sale (POS) solutions for MSMEs. Qasir enables business owners to access transaction data in real-time from various devices by adopting a cloud-based system, allowing them to make faster and more accurate decisions regarding inventory management, pricing strategies, and supply needs (Rizqullah & Hasim, 2023). The integration of data analytics into its platform provides MSMEs with deep insights into sales patterns, customer trends, and the effectiveness of marketing strategies, which were previously difficult to achieve with manual record-keeping. Additionally, automation in transaction recording and inventory management helps reduce administrative errors, accelerate accounting processes, and enhance financial transparency, ultimately facilitating MSMEs' access to financing from financial institutions. Qasir enhances operational efficiency for MSMEs with continuously developed features tailored to user needs, creates a more inclusive digital business ecosystem, empowers small business owners to compete in larger markets, and accelerates digital transformation in Indonesia's microeconomic sector.

Although business information systems offer significant benefits for startups, their implementation presents challenges, especially for those facing budget constraints, infrastructure limitations, and technical expertise shortages. High costs in internal system development, from hardware investment and server procurement to maintenance and software updates, often pose major obstacles, particularly for startups in the bootstrap phase or relying on initial funding. Moreover, the lack of experts in data analysis, cybersecurity, and information system management can lead to suboptimal technology utilization, where generated data is not fully leveraged for strategic decision-making. Another common challenge is internal resistance to adopting new systems, especially in organizations without a strong digital culture (Scholkmann, 2021). Therefore, startups need to develop more realistic and sustainable business information system adoption strategies, such as implementing cost-effective SaaS (Software as a Service) solutions that do not require significant infrastructure investments and offer scalability according to business growth. Additionally, collaborating with technology providers, startup incubators, or other strategic partners can help gain access to technical expertise, employee training, and more efficient technology integration. With the right approach, startups can maximize the benefits of business information systems without being burdened by excessive financial and technical constraints, allowing them to remain competitive in an increasingly dynamic digital business landscape.

The successful implementation of business information systems in technology startups depends on technological sophistication and organizational readiness to manage change, where work culture, leadership, and employees' digital skills play a crucial role in ensuring the effectiveness of system adoption. Digital transformation requires an open mindset toward innovation and flexibility in navigating technological disruptions, making it essential for startups to build a work ecosystem that fosters cross-team collaboration,

data-driven experimentation, and more agile decision-making. One of the primary challenges in business process digitization is internal resistance to change, especially when employees lack sufficient understanding of technology benefits or feel threatened by automation replacing their manual tasks (Almatrodi et al., 2023). Hence, training programs and digital competency development are indispensable, requiring startups to invest in enhancing employees' data analysis skills, understanding of information management systems, and overall digital literacy to optimize technology use in their work. Furthermore, a holistic approach to digital transformation involves aligning technology strategies with business objectives, ensuring that business information systems function not only as operational tools but also as a foundation for product innovation, process efficiency optimization, and customer experience enhancement. Startups can integrate technology more effectively with strong organizational readiness and support from all company elements, accelerate market adaptation, and build sustainable competitive advantages in an increasingly dynamic digital era.

Based on various case studies discussed, it can be concluded that business information systems serve as both an operational support tool and a strategic element in creating competitive advantages for technology startups through product innovation optimization and process efficiency. Startups that effectively utilize business information systems can identify market trends more quickly, respond to changing customer needs in real-time, and automate various business aspects that previously required manual intervention, resulting in higher efficiency and reduced operational costs. Additionally, integrating business information systems with big data, AI, and cloud computing enables startups to develop more personalized services, enhance user experience, and build stronger customer loyalty, ultimately contributing to sustainable business growth. However, the success of business information system implementation is not solely dependent on technology but also on organizational readiness, human resource capabilities, and digitalization strategies aligned with long-term business goals. Therefore, a deeper understanding of the role of business information systems is essential for startup industry players to enhance competitiveness and ensure their survival and growth in an increasingly competitive and disruptive digital business landscape.

5. CONCLUSION, IMPLICATION, SUGGESTION, AND LIMITATIONS

This study confirms that business information systems play a strategic role in driving product innovation transformation and process efficiency in technology startups in the digital era. Startups can optimize operations and enhance their competitiveness in an increasingly competitive market by leveraging data analytics, artificial intelligence, cloud computing, and other digital solutions. Case studies from Gojek, Tokopedia, Ruangguru, and Qasir illustrate that business information system implementation accelerates product innovation, improves supply chain efficiency, and enhances internal resource management. However, implementation challenges, such as resource limitations and organizational readiness, remain obstacles that must be addressed for startups to fully utilize business information systems for long-term growth.

The theoretical implications of this study enrich the understanding of how business information systems contribute to product innovation and process efficiency in technology startups, particularly within the rapidly evolving digital industry. From a practical perspective, the study's findings provide insights for startup entrepreneurs in designing more effective technology-driven strategies, including data-driven decision-making, efficient resource management, and market-responsive product development. Additionally, the study offers valuable perspectives for investors and policymakers in shaping policies and funding initiatives to accelerate business information system adoption in the technology startup sector.

Technology startups should be more proactive in adopting business information systems by prioritizing investments in technology that align with their business needs. Collaborating with technology service providers, such as SaaS and cloud computing solutions, can be a viable option for startups with limited resources to develop in-house information systems. Moreover, startup entrepreneurs must enhance digital literacy and human resource competencies in data management and information system utilization to ensure effective implementation. Government and educational institutions are also expected to provide support through regulations and training programs that help startups improve their digital readiness.

This study has several limitations that should be considered. First, as a literature review with a qualitative approach, it does not present primary empirical data obtained directly from technology startups, making its findings conceptual and requiring further validation through empirical studies. Second, the study focuses solely on technology startups in Indonesia and does not explore comparisons with other countries, which may have different industry dynamics. Third, the study is limited to analyzing 17 articles from Google Scholar, which may affect the scope and depth of the findings. Therefore, future research is recommended to

adopt a mixed-method approach with empirical data and expand the study scope to gain a more comprehensive understanding.

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