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The Effect of Application Development, Data Security, and Infrastructure Availability on Cost Savings and Company Economic Performance

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ABSTRACT

This study examines the impact of application development, data security, and infrastructure availability on the economic performance and cost savings of companies in Indonesia. Utilizing a quantitative research design, data were collected from 180 companies across various industries using a structured questionnaire. The data were analyzed using Structural Equation Modeling-Partial Least Squares (SEM-PLS) 3. The results indicate that all three factors—application development, data security, and infrastructure availability—positively and significantly influence economic performance and cost savings. Infrastructure availability emerged as the most influential factor, underscoring its critical role in supporting technological advancements and efficient operations. These findings provide valuable insights for business leaders and policymakers, emphasizing the importance of strategic investments in technology to enhance financial outcomes and competitiveness in the Indonesian market.

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1. INTRODUCTION

In the rapidly evolving digital landscape, Indonesian enterprises are increasingly leveraging advanced technologies to enhance operational efficiency and economic performance. Research indicates that the integration of IoT, real-time analytics, and digital asset management significantly boosts productivity and energy efficiency in the manufacturing sector, highlighting the transformative potential of these technologies [1]. Furthermore, digital marketing strategies for Micro, Small, and Medium Enterprises (MSMEs) have shown to improve operational efficiency and market reach, although challenges such as limited access and skills persist [2]. Additionally, favorable tax policies can incentivize investments in digital technologies, thereby enhancing global competitiveness and operational efficiency [3]. The focus on cost efficiency and operational excellence is crucial for SMEs, as these factors directly influence productivity and sustainability [4]. However, the adoption of digital solutions, including electronic signatures, faces hurdles related to understanding and compliance, indicating a need for further education and support [5].

Application development is indeed an important driver of business innovation,

enabling customised solutions that improve operational efficiency and customer engagement. However, the success of these applications relies heavily on strong data security measures. Research shows that organisations face significant challenges in balancing the need for rapid application development with security imperatives, which often leads to vulnerabilities if security is not prioritised from the start [6]. A multi-layered defence system, incorporating technology solutions such as firewalls and encryption, is essential to protect sensitive data from internal and external threats [7]. Moreover, maintaining the integrity of digital applications not only reduces security risks but also improves overall business performance and competitiveness [8]. As organisations navigate the complexities of innovation and data protection, adopting a holistic approach that integrates security into the development process is critical to maintaining trust and protecting economic interests [9].

Infrastructure availability is critical to driving technological advancement, especially in Indonesia's diverse business landscape. Reliable infrastructure, such as roads and digital systems, improves connectivity and productivity, which are crucial for application development and data security. For example, [10] research highlights that better road infrastructure significantly reduces income inequality by facilitating regional connectivity and economic growth, thus enabling businesses to utilise technological innovation more effectively. In addition, the Indonesian government's efforts to simplify business licensing through the Online Single Submission system aims to attract foreign investment in infrastructure, which is critical to improving the overall investment climate and supporting technological advancement. In addition, optimisation of cloud infrastructure is crucial for sectors such as healthcare, where high availability and reliability are required for effective data management [11]. Collectively, these findings underscore the reciprocal relationship between infrastructure, application development, and data security, which is critical to driving economic performance and achieving cost savings in Indonesia [12], [13]. This study aims to explore the influence of application development, data security, and infrastructure availability on the economic performance and cost savings of Indonesian firms.

2. LITERATURE REVIEW

2.1 Application Development and Economic Performance

Application development is crucial for enhancing business operations in the digital age, as it significantly boosts operational efficiency, customer satisfaction, and economic performance. Research indicates that tailored software applications automate routine tasks, minimize human error, and improve decision-making through data-driven insights, thereby fostering innovation and competitiveness in various sectors [14], [15]. Furthermore, the integrity of digital applications is essential, as it not only mitigates security risks but also enhances overall business management, leading to improved performance and productivity. In Indonesia, the rapid adoption of digital technologies positions application development as a strategic tool for economic growth, enabling companies to differentiate themselves in the marketplace and achieve cost savings [16]. This trend underscores the importance of investing in bespoke applications to enhance market share and revenue, particularly in a competitive landscape where digital transformation is paramount [17].

2.2 Data Security and its Impact on Business Sustainability

Data security is essential for business sustainability, particularly in the face of increasing cyber threats and data breaches. Robust data security measures protect sensitive information, maintain customer trust, and ensure compliance with regulatory requirements, which are critical for operational continuity and economic performance [18], [19]. Research indicates that organizations with strong data security

frameworks are better positioned to avoid costly breaches and the associated financial and reputational damage [7], [20]. In Indonesia, the rapid growth of the digital economy amplifies the need for enhanced data security practices to safeguard business interests and support long-term sustainability [19]. Effective strategies include implementing multi-layered defense systems, utilizing encryption, and fostering employee awareness through training programs [7]. As businesses navigate digital transformation, integrating data protection into strategic planning becomes vital to adapt to evolving threats and maintain a high level of information security [19].

2.3 Infrastructure Availability as a Foundation for Technological Innovation

The availability of robust infrastructure, including reliable internet connectivity and data centers, is essential for businesses to effectively implement and manage digital solutions. Research indicates that deficiencies in both soft (regulatory) and hard (physical) infrastructure can significantly hinder foreign investments and economic performance in emerging markets like Indonesia, leading to disparities among firms [21]. Furthermore, the development of telecommunications infrastructure is critical for enhancing competitiveness and facilitating economic growth, as it supports digital markets and enables businesses to adapt to technological advancements [22]. In Moldova, for instance, while improvements in telecommunication infrastructure are noted, accessibility remains uneven, impacting overall business competitiveness [23]. Additionally, innovative infrastructure is vital for regional economic systems, optimizing the commercialization of new ideas and enhancing competitiveness [24].

2.4 Theoretical Framework and Hypotheses Development

Building on the literature discussed above, this study proposes a theoretical framework that examines the effects of application development, data security, and infrastructure availability on the economic performance and cost savings of companies in Indonesia. The hypotheses developed for this study are as follows:

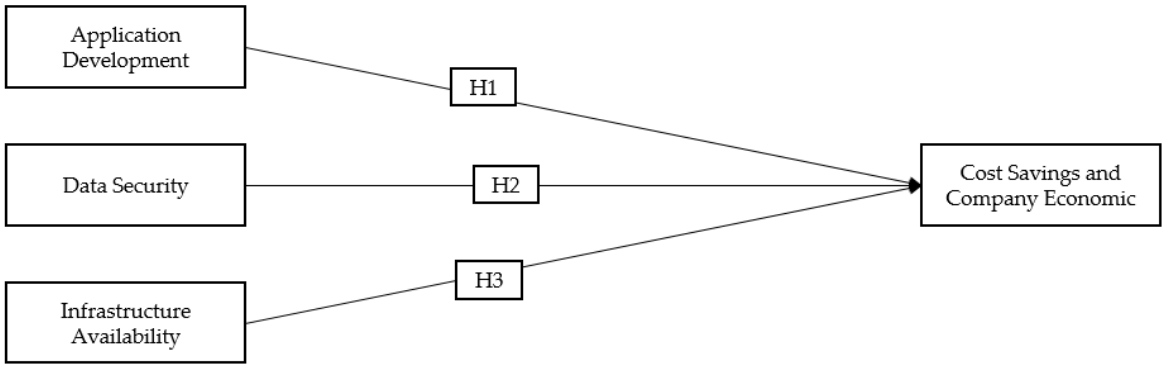

Figure 1. Conceptual Framework

3. METHODS

3.1 Research Design

This study employs a quantitative research design to investigate the impact of application development, data security, and infrastructure availability on the economic performance and cost savings of companies in Indonesia. The research design is structured to collect numerical data, which is then analyzed using statistical techniques to test the proposed hypotheses. The study aims to provide empirical evidence on the relationships between these variables, offering insights into how technological factors influence business outcomes in the Indonesian context.

3.2 Sample and Data Collection

The target population for this study consists of companies operating in various industries across Indonesia. A total of 180 companies were selected as the sample for this research. The sampling technique employed was purposive sampling, which involves selecting respondents based on specific criteria that are relevant to the study. The criteria for inclusion were companies that

have implemented application development initiatives, have data security measures in place, and rely on infrastructure availability for their operations.

Data were collected through a structured questionnaire distributed to key decision-makers within these companies, such as IT managers, financial officers, and operations managers. The questionnaire was designed to capture respondents' perceptions of the effectiveness of application development, the robustness of data security measures, the availability of infrastructure, and the resultant economic performance and cost savings. Respondents were asked to rate their agreement with various statements on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.3 Data Analysis

The data collected from the questionnaires were analyzed using Structural Equation Modeling-Partial Least Squares (SEM-PLS) 3, a multivariate statistical technique ideal for examining complex relationships between observed and latent variables, particularly when dealing with small to medium sample sizes and non-normally distributed data. The analysis was conducted in two stages: first, the Measurement Model Assessment, which involved evaluating the reliability and validity of the constructs using composite reliability (CR), Cronbach's alpha for internal consistency, Average Variance Extracted (AVE) for convergent validity, and the Fornell-Larcker criterion for discriminant validity; and second, the Structural Model Assessment, which tested the hypothesized relationships between variables by estimating path coefficients to determine the strength and direction of the relationships, using bootstrapping with 5000 subsamples to test their significance, and calculating R^2 values to assess the variance explained by the independent variables in the dependent variables. The SEM-PLS analysis results provided empirical evidence on the impact of application development, data security, and infrastructure availability on economic performance and cost savings, with all hypotheses tested and their significance levels reported to determine the support for the proposed relationships.

4. RESULTS AND DISCUSSION

4.1 Demographic Profile of the Sample

To provide a comprehensive understanding of the respondents' background, the demographic characteristics of the sample were analyzed, including industry, company size, respondents' positions, professional experience, and geographic distribution. The study involved 180 respondents drawn from a diverse range of industries, with the largest proportion from the manufacturing sector (30.0%), followed by information technology (20.0%) and financial services (15.0%), ensuring broad applicability across different sectors. In terms of company size, most respondents were from medium-sized companies (43.3%), followed by large (31.7%) and small companies (25.0%), reflecting a balanced representation across various organizational scales. The respondents' positions within their companies ranged from senior management (20.0%) to middle management (50.0%) and operational/technical roles (30.0%), indicating they were well-positioned to provide informed insights on application development, data security, and infrastructure availability. Regarding professional experience, 45.0% of respondents had 5-10 years of experience, 30.0% had less than 5 years, and 25.0% had more than 10 years, contributing to the depth and reliability of the data. Geographically, the majority of respondents were from Java (56.7%), followed by Sumatra (20.0%) and Kalimantan (10.0%), offering a broad representation across Indonesia, which enhances the generalizability of the study's findings.

4.2 Measurement Model Assessment

The measurement model was evaluated based on the criteria of internal consistency reliability, convergent validity, and discriminant validity. The analysis focused on the loadings of the individual items, Cronbach's Alpha (CA), Composite

Reliability (CR), and Average Variance Extracted (AVE) for each construct.

Table 1. Validity and Reliability

Variable	Code	Loading Factor	CA	CR	AVE
Application Development	AD.1	0.835	0.896	0.924	0.711
	AD.2	0.912			
	AD.3	0.899			
	AD.4	0.852			
	AD.5	0.701			
Data Security	DS.1	0.902	0.883	0.928	0.811
	DS.2	0.927			
	DS.3	0.872			
Infrastructure Availability	IA.1	0.868	0.901	0.927	0.717
	IA.2	0.865			
	IA.3	0.832			
	IA.4	0.838			
	IA.5	0.827			
Cost Savings and Company Economic	CSCE.1	0.848	0.895	0.923	0.706
	CSCE.2	0.827			
	CSCE.3	0.827			
	CSCE.4	0.805			
	CSCE.5	0.891			

Internal consistency reliability was assessed using Cronbach's Alpha (CA) and Composite Reliability (CR), with both values needing to exceed the threshold of 0.70 to indicate good reliability. The Application Development construct had a CA of 0.896 and a CR of 0.924, indicating high internal consistency reliability. The Data Security construct showed a CA of 0.883 and a CR of 0.928, while Infrastructure Availability had a CA of 0.901 and a CR of 0.927, both confirming strong reliability. The Cost Savings and Company Economic Performance (CSCE) construct demonstrated a CA of 0.895 and a CR of 0.923, also meeting the reliability criteria. These results suggest that all constructs in the model are reliable and consistently measure the underlying constructs. Convergent validity was assessed using the Average Variance Extracted (AVE) and factor loadings, with AVE values needing to be greater than 0.50 to indicate that the majority of the variance is captured by the construct rather than by measurement error. The AVE for Application Development was 0.711, with item loadings ranging from 0.701 to 0.912, supporting convergent validity. Data Security had an AVE of 0.811, with factor loadings between 0.872 and 0.927. Infrastructure Availability had an AVE of 0.717, with factor loadings from 0.827 to 0.868. The CSCE construct had an AVE of 0.706, with loadings ranging from 0.805 to 0.891. These AVE values and factor loadings indicate that the items used to measure each construct are well-correlated with the underlying factor, meeting the criteria for convergent validity.

4.3 Discriminant Validity

Discriminant validity is a crucial aspect of model assessment, ensuring that the constructs measured in the study are distinct from one another and that each construct is more strongly related to its own indicators than to those of other constructs. In this study, discriminant validity was assessed using the Fornell-Larcker criterion, which involves comparing the square root of the Average Variance Extracted (AVE) for each construct with the correlations between constructs. According to the Fornell-Larcker criterion, for discriminant validity to be established, the square root of the AVE for each construct

must be greater than the highest correlation between that construct and any other construct in the model.

Table 2. Discriminant Validity

	Application Development	Cost Savings and Company Economic	Data Security	Infrastructure Availability
Application Development	0.843			
Cost Savings and Company Economic	0.786	0.840		
Data Security	0.656	0.715	0.801	
Infrastructure Availability	0.752	0.816	0.583	0.846

The square root of the Average Variance Extracted (AVE) for each construct indicates good discriminant validity, as it is higher than the correlations with other constructs. For Application Development, the square root of the AVE is 0.843, exceeding its correlations with Cost Savings and Company Economic (0.786), Data Security (0.656), and Infrastructure Availability (0.752). Similarly, for Cost Savings and Company Economic, the square root of the AVE is 0.840, greater than its correlations with Application Development (0.786), Data Security (0.715), and Infrastructure Availability (0.816), suggesting its distinctiveness. The Data Security construct also shows strong discriminant validity with a square root of the AVE of 0.801, higher than its correlations with Application Development (0.656), Cost Savings and Company Economic (0.715), and Infrastructure Availability (0.583). Finally, Infrastructure Availability, with a square root of the AVE of 0.846, is distinct from the other constructs, as it surpasses its correlations with Application Development (0.752), Cost Savings and Company Economic (0.816), and Data Security (0.583).

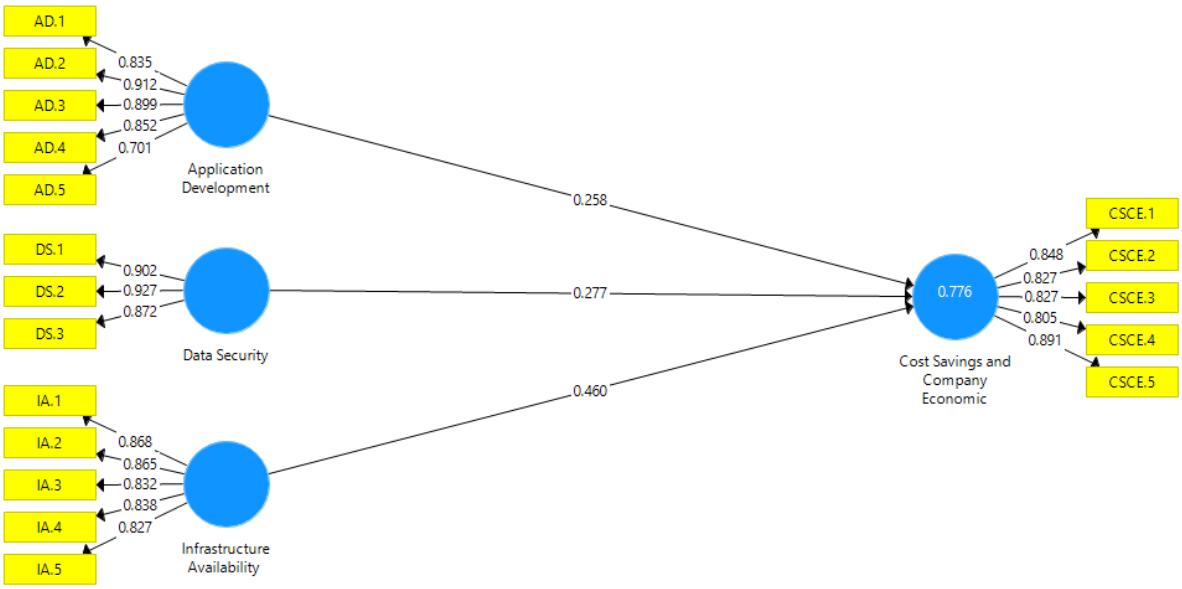

Figure 2. Model Internal

4.4 Model Fit Assessment

Model fit assessment is crucial in determining how well the hypothesized model corresponds to the observed data. Various fit indices are used to evaluate the adequacy of the model, and in this study, the

following indicators were considered: Standardized Root Mean Square Residual (SRMR), d_ULS, d_G, Chi-Square, and Normed Fit Index (NFI).

Table 3. Model Fit

	Saturated Model	Estimated Model
SRMR	0.076	0.076
d_ULS	0.997	0.997
d_G	0.630	0.630
Chi-Square	384.557	384.557
NFI	0.799	0.799

The Standardized Root Mean Square Residual (SRMR) is an absolute measure of fit, indicating the difference between the observed and model-predicted correlation matrices, with a value less than 0.08 generally considered acceptable. In this study, the SRMR for both the Saturated and Estimated Models is 0.076, suggesting a good fit between the model and the data. Additionally, d_ULS (Unweighted Least Squares Discrepancy) and d_G (Geodesic Discrepancy) are specific measures of fit for PLS-SEM models, with values of 0.997 and 0.630, respectively, indicating no substantial discrepancies and supporting the model's adequacy. The Chi-Square statistic, which tests the overall fit of the model, yielded a value of 384.557 for both models. Although Chi-Square is sensitive to sample size and can sometimes indicate poor fit, in this context, it is considered acceptable given the supporting fit indices. The Normed Fit Index (NFI), which compares the model's Chi-Square value to that of a null model, is 0.799 for both models. Although slightly below the ideal threshold of 0.80, this value still suggests a reasonably good fit, especially for a complex model with many parameters.

Table 4. R Square

	R Square	R Square Adjusted
Cost Savings and Company Economic	0.776	0.770

The R-Square value of 0.776 indicates that 77.6% of the variance in Cost Savings and Company Economic Performance can be explained by the independent variables—Application Development, Data Security, and Infrastructure Availability—demonstrating the model's strong explanatory power. This high R-Square value suggests that the model effectively captures the relationships between the independent and dependent variables, highlighting the significant role of these factors in influencing cost savings and economic performance in companies in Indonesia. The Adjusted R-Square value of 0.770, slightly lower than the R-Square, accounts for the number of predictors in the model, offering a more accurate measure of explanatory power, especially when multiple variables are involved. The small difference between the R-Square (0.776) and Adjusted R-Square (0.770) values indicates that the model is well-specified, with the independent variables significantly contributing to the explained variance in the dependent variable. This reinforces the robustness of the model, confirming that its explanatory power is not inflated by unnecessary predictors.

4.5 Hypothesis Testing

Hypothesis testing is a crucial part of structural equation modeling (SEM) as it allows for the evaluation of the proposed relationships between variables. In this study, three hypotheses were tested to examine the impact of Application Development, Data Security, and Infrastructure Availability on

Cost Savings and Company Economic Performance.

Table 5. Hypothesis Test

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Application Development -> Cost Savings and Company Economic	0.258	0.253	0.098	2.622	0.003
Data Security -> Cost Savings and Company Economic	0.277	0.280	0.077	3.613	0.000
Infrastructure Availability -> Cost Savings and Company Economic	0.460	0.461	0.095	4.853	0.000

The analysis of the hypotheses reveals significant relationships between the independent variables and Cost Savings and Company Economic Performance. For Hypothesis 1, the path coefficient between Application Development and Cost Savings and Company Economic Performance is 0.258, with a T-statistic of 2.622 and a p-value of 0.003, indicating a statistically significant positive effect at the 0.01 level. This suggests that improvements in application development contribute positively to economic performance and cost savings, emphasizing the strategic importance of investing in this area. For Hypothesis 2, the path coefficient for the relationship between Data Security and Cost Savings and Company Economic Performance is 0.277, with a T-statistic of 3.613 and a p-value of 0.000, confirming a highly significant positive impact. This highlights the critical role of data security in enhancing financial performance and achieving cost efficiencies, particularly in the context of increasing cyber threats. Finally, for Hypothesis 3, the path coefficient between Infrastructure Availability and Cost Savings and Company Economic Performance is 0.460, with a T-statistic of 4.853 and a p-value of 0.000, providing strong support for the positive and significant influence of infrastructure availability on economic performance. The high coefficient value underscores the importance of reliable infrastructure in achieving operational efficiency, leading to substantial cost reductions and improved financial outcomes for companies.

DISCUSSION

The Role of Application Development

The results indicate that application development has a significant positive effect on cost savings and company economic performance, with a path coefficient of 0.258 and a p-value of 0.003. The importance of customized applications in enhancing operational efficiency and driving business innovation is well-supported by existing literature. For instance, [25] highlights how technological innovations, such as mobile applications and online banking platforms, significantly improved operational efficiency in a conventional bank, demonstrating the critical role of tailored solutions in optimizing performance. Similarly, [26] emphasize the transformative potential of machine learning in business intelligence, where customized predictive models enable organizations to make informed decisions and adapt to market demands effectively. [27] further advocate for customization in appointment scheduling applications, suggesting that tailored solutions can better meet specific market needs, thereby fostering innovation. Additionally, advanced cloud computing technologies provide scalable and flexible environments that support customized applications, enhancing operational capabilities and driving strategic initiatives [28]. Collectively, these findings underscore that customization is not merely beneficial but essential for operational success and innovation in today's competitive landscape [29].

Application development allows companies to streamline processes, reduce errors, and improve decision-making through

data-driven insights. In the Indonesian context, where digital transformation is gaining momentum, this result underscores the necessity for businesses to invest in robust application development strategies. By doing so, companies can better meet customer demands, improve productivity, and ultimately achieve better financial outcomes.

The Critical Importance of Data Security

Data security emerged as another significant factor influencing cost savings and economic performance, with a path coefficient of 0.277 and a p-value of 0.000. Data security is increasingly important for businesses as they navigate the digital landscape, where the threat of cyberattacks and data breaches looms large. Effective data security measures not only protect sensitive information, but also increase customer trust and ensure business continuity. Research shows that a robust data protection strategy, including encryption and intrusion detection systems, is critical to maintaining data privacy and integrity within organisations [30]. In addition, the implementation of data protection laws significantly increases consumer confidence by assuring them that their data is safe, thus fostering trust in the digital economy [31]. In the banking sector, strict data protection measures are essential to protect personal and financial information, which is critical to maintaining customer trust [32]. Additionally, companies that prioritise cybersecurity awareness and disclose their security practices are likely to strengthen customer relationships, as clients are more likely to engage with suppliers that demonstrate a commitment to data security [33]. The significant impact of data security on economic performance and cost savings suggests that companies must prioritize cybersecurity measures to protect their assets and minimize financial losses. This is particularly important in Indonesia, where the rapid adoption of digital technologies may expose businesses to heightened cybersecurity risks.

The Foundational Role of Infrastructure Availability

Infrastructure availability was found to have the strongest impact on cost savings and economic performance, with a path coefficient of 0.460 and a p-value of 0.000. This finding reinforces the notion that reliable and scalable infrastructure is a critical enabler of business success in the digital age. Inadequate infrastructure significantly hampers companies' ability to leverage technological innovations, leading to suboptimal performance and increased operational costs. Research indicates that effective management of infrastructure is crucial for operational success; however, many companies fail to maintain optimal conditions, as evidenced by issues like manual machine use and insufficient maintenance practices [34]. Furthermore, the integration of technological capabilities is essential for enhancing firm performance, with studies showing that firms lacking adequate ICT infrastructure struggle to achieve operational efficiency [35]. Additionally, innovative infrastructure is vital for regional economic competitiveness, as it facilitates the commercialization of new ideas and optimizes production processes [24]. Without a robust infrastructure, companies not only miss out on the benefits of technological advancements but also face challenges in meeting sustainability regulations, which can further impact their efficiency and competitiveness. In the Indonesian context, where infrastructure development can vary significantly across regions, this result highlights the need for continued investment in infrastructure to support business growth and competitiveness. Companies with access to better infrastructure are more likely to achieve significant cost reductions and improved economic performance, positioning them for long-term success.

The Interconnectedness of Technological Factors

The strong relationships observed between application development, data security, infrastructure availability, and their collective impact on economic performance and cost savings suggest that these factors are deeply interconnected. For businesses to realize the full benefits of digital

transformation, they must adopt a holistic approach that integrates these technological components into their overall strategy. This interconnectedness implies that investments in one area, such as application development, should be complemented by corresponding investments in data security and infrastructure to maximize the return on investment. The findings of this study provide a roadmap for companies looking to enhance their financial outcomes through strategic technological investments.

Implications for Business Leaders and Policymakers

The results of this study have several practical implications for business leaders and policymakers in Indonesia. For business leaders, the findings highlight the need to prioritize investments in application development, data security, and infrastructure as part of their overall business strategy. These investments are not merely operational necessities but are critical drivers of economic performance and cost savings. By focusing on these areas, companies can enhance their competitiveness and achieve sustainable growth in a rapidly evolving digital landscape.

For policymakers, the study underscores the importance of creating an enabling environment for businesses to thrive. This includes supporting infrastructure development, promoting cybersecurity initiatives, and encouraging innovation through favorable policies and regulations. By fostering a robust digital ecosystem, policymakers can help ensure that Indonesian companies remain competitive on the global stage.

Directions for Future Research

While this study provides important insights into the impact of technological factors on business outcomes, there are several areas for future research. One potential area is to explore the impact of other technological innovations, such as artificial intelligence and blockchain, on economic performance and cost savings. Additionally, future studies could examine the role of these factors in different industry contexts or geographical regions to determine if the findings are generalizable beyond the Indonesian market. Longitudinal studies could also provide a deeper understanding of how these relationships evolve over time as companies continue to invest in digital transformation.

5. CONCLUSION

The study reveals that application development, data security, and infrastructure availability significantly influence the economic performance and cost savings of companies in Indonesia. Application development enhances operational efficiency and drives innovation, while data security is crucial for protecting sensitive information and ensuring business continuity. Infrastructure availability, as the most influential factor, supports technological advancements and enables cost-effective operations. Companies aiming to improve financial outcomes should adopt a holistic approach by investing in these key areas, with business leaders prioritizing resources for robust application development, data security, and reliable infrastructure. Policymakers should create a supportive environment to facilitate these investments, fostering a digital ecosystem that promotes business success. These findings highlight the interconnectedness of technological factors in driving economic performance and provide a strategic roadmap for companies navigating digital transformation in Indonesia's dynamic market. Future research could further explore the impact of emerging technologies and examine these relationships in different contexts or over time.

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