Sustainable Digital Economy Development for E-Commerce Users in Indonesia

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Abstract

Despite rapid digital growth, Indonesia faces challenges such as the digital divide. This study investigates key factors affecting sustainable digital economy development among e-commerce users, including ICT infrastructure, perceived security, perceived risk, and digital literacy. A quantitative survey of 135 urban young adults is conducted online using Likert scale questionnaires. Probability sampling facilitates data collection and analysis with SPSS. Findings reveal that ICT infrastructure, perceived security, and digital literacy significantly influence business sustainability in Indonesia, while perceived risk has no impact. This research offers valuable insights into digital economy advancement and provides a framework for future studies.

Keywords: Electric Commerce; Digital Economy; Sustainable Digital Economy; Information Communication Technology (ICT) Infrastructure

DOI: https://doi.org/10.21834/jabs.v9i29.455

1.0 Introduction

Economic sustainability ensures long-term stability, and the Sustainable Digital Economy focuses on tech-driven activities supported by digital infrastructure that enhance productivity and drive growth. It connects economic, social, and cultural aspects, contributing to economic and technological development. In Indonesia, the rapid growth of digital commerce has reshaped the economy, with e-commerce platforms like Tokopedia and Shopee boosting MSMEs (Yuda, 2021). However, the digital divide, cybersecurity risks, low digital literacy, and inconsistent policies threaten long-term sustainability. Thus, many e-commerce users remain vulnerable to phishing scams, identity theft, and fraudulent transactions, raising concerns about the effectiveness of cybersecurity regulations and enforcement mechanisms.

Additionally, low levels of digital literacy pose a significant barrier to digital economy sustainability. While internet penetration is high, many individuals and MSMEs lack the skills to navigate online platforms securely, manage digital financial transactions, and optimise e-commerce tools effectively. Digital literacy gaps have led to inefficiencies in business operations, reduced consumer trust in online shopping, and increased susceptibility to misinformation and fraud. Addressing these gaps is crucial for ensuring that digital transformation efforts benefit all segments of society. Moreover, regulatory and policy inconsistencies continue to impact Indonesia's digital business environment. The government has introduced various initiatives, such as the Indonesia Digital Roadmap 2021–2024, to support e-commerce and ICT infrastructure development (Yuda, 2021). However, regulatory challenges, including inconsistent enforcement of digital business laws, complex tax regulations, and evolving data protection policies, have created uncertainties for businesses and investors. These policy gaps make it difficult for businesses—especially MSMEs—to scale their digital operations sustainably. Given these challenges, this study examines the key factors influencing the development of a sustainable digital economy in Indonesia and proposes a solution-oriented model for improving digital business operations. Specifically, the study aims to achieve four main objectives:

1. To analyse the relationship between ICT infrastructure development and the sustainability of the digital economy. Understanding how technological advancements and internet accessibility contribute to long-term digital economic growth is essential for identifying infrastructure investment priorities.
2. To evaluate the impact of perceived security on digital economy growth, particularly among e-commerce users. This will help assess consumer trust in digital transactions and explore strategies to enhance cybersecurity measures.
3. To assess the effect of perceived risk on the sustainability of the digital economy. Investigating concerns related to online fraud, financial risks, and data breaches can provide insights into how risk perception influences e-commerce participation.
4. To examine the role of digital literacy in promoting a sustainable digital economy among e-commerce users in Indonesia. Improving digital literacy is crucial for empowering

consumers and businesses to maximise the benefits of e-commerce while minimising risks.

By addressing these objectives, this study aims to provide valuable insights into the drivers and barriers of Indonesia's digital economy, offering strategic recommendations for policymakers, businesses, and stakeholders to build a resilient, inclusive, and sustainable digital economy. Using a regression model analysis, the research assessed the interplay between ICT infrastructure, security perceptions, risk assessment, and digital literacy in shaping Indonesia's digital future.

1.1 Problem Statement

The inability to implement effective digital economy strategies has significantly contributed to the closure of many businesses in Indonesia, particularly among Micro, Small, and Medium Enterprises (MSMEs) (Yuda, 2021). Despite the increasing importance of digital transformation, many MSMEs struggle to adapt to the rapidly evolving digital landscape, leading to operational inefficiencies, declining sales, and business shutdowns (Ma, 2023). Although the COVID-19 pandemic accelerated the urgency for digital engagement, many MSMEs lacked the knowledge, skills, and resources to transition effectively, particularly in adopting digital tools such as e-commerce platforms, digital marketing strategies, and online payment systems (Yuda, 2021). This lack of preparedness and a limited understanding of the key factors driving a sustainable digital economy have exacerbated the challenges small businesses face in Indonesia. Despite numerous government-led digital initiatives, including training programs and financial incentives to foster digital literacy, many MSMEs remain ill-equipped to fully leverage the digital economy's potential (Aminullah et al., 2021). Several structural and systemic challenges hinder widespread adoption, particularly in rural and remote areas where internet connectivity remains a significant obstacle. Indonesia's digital infrastructure lags behind global standards, ranking 120th globally in internet speed. These connectivity issues disproportionately impact MSMEs outside major urban centres, preventing them from fully integrating digital solutions into their business models.

Furthermore, the rapid expansion of e-commerce has introduced new risks and vulnerabilities that discourage MSMEs from fully embracing digital transformation. The surge in cyber-attacks, data breaches, and fraudulent activities has raised serious concerns about digital security. These security concerns and low cybersecurity awareness among business owners further deter MSMEs from expanding their online presence. Many small business owners lack the technical expertise to safeguard their digital assets, protect customer data, and implement cybersecurity best practices, leaving them vulnerable to financial losses and reputational damage (Ma,2023). Another significant challenge is Indonesia's persistently low digital literacy levels, directly affecting MSMEs' ability to operate successfully in the digital economy. Many business owners lack basic digital skills, such as managing e-commerce storefronts, utilising analytics tools, and engaging in digital marketing campaigns, limiting their ability to scale their businesses online. Without adequate digital literacy training, MSMEs struggle to navigate competitive online markets,

optimise pricing strategies, and adopt new business models, putting them at a disadvantage against more technologically adept competitors.

Additionally, regulatory and bureaucratic hurdles continue to pose significant challenges for digital business adoption. While Indonesia has made strides in developing a digital economy roadmap, inconsistent policy enforcement, complex tax regulations, and unclear e-commerce guidelines create an uncertain business environment. Many MSMEs face difficulties complying with online transaction tax policies, data protection regulations, and licensing requirements, leading to reluctance to fully formalise their digital operations (Mulya et al., 2021). Furthermore, the rise of foreign e-commerce giants has increased market competition, making it harder for local businesses to gain visibility and sustain profitability in the highly saturated digital marketplace.

These issues highlight the urgent need for a more comprehensive and inclusive digital strategy to ensure the sustainability and long-term growth of MSMEs in Indonesia. The current challenges go beyond merely adopting digital technologies; they underscore the broader issue of digital readiness, resilience, and equitable access to resources (Ramdhani et al. (2023.) Without significant improvements in digital literacy, infrastructure development, and cybersecurity measures, many small businesses will continue to face insurmountable challenges, leading to more closures and widening economic disparities across the country (Intarat, 2022). By bridging the digital divide and fostering a secure, inclusive, and innovation-driven digital ecosystem, Indonesia can empower MSMEs to thrive in an increasingly digital economy while ensuring that the country remains competitive in the global marketplace.

2.0 Literature Review

Economic sustainability is centred on achieving long-term stability, resilience, and equitable growth in various industries (Mahmoud & Youssef, 2023). In the digital era, a sustainable digital economy is a system where economic activities rely heavily on information technology, digital innovation, and knowledge-driven processes to ensure consistent growth and adaptation. As digital transformation accelerates globally, ICT (Information and Communication Technology) infrastructure has emerged as a foundational pillar for supporting, expanding, and sustaining e-commerce ecosystems.

This study aims to explore the relationship between ICT infrastructure and the sustainability of e-commerce businesses, identifying key factors that influence digital economic growth in Indonesia. ICT infrastructure includes broadband connectivity, mobile network coverage, cloud computing, and digital payment systems, all critical enablers of e-commerce success. Research by Farhad et al. (2023) highlights that technological advancements and digital innovations have played a transformative role in shaping the e-commerce industry. Improved ICT infrastructure enhances digital accessibility, optimises supply chain efficiency, facilitates secure online transactions, and expands market reach, all of which contribute to the long-term viability of digital businesses.

Moreover, robust ICT infrastructure is essential for fostering an inclusive digital economy, bridging the gap between urban and rural digital markets, and ensuring that businesses of all sizes—especially Micro, Small, and Medium Enterprises (MSMEs)—can compete in the e-commerce sector. Countries with well-developed digital infrastructure experience higher levels of e-commerce penetration, increased consumer trust in online transactions, and accelerated business growth. Conversely, regions with inadequate ICT infrastructure often struggle with slow internet speeds, connectivity issues, cybersecurity vulnerabilities, and limited adoption of digital financial services, hindering their ability to sustain digital economic activities. Given the critical role of ICT infrastructure in driving e-commerce sustainability, this study proposes the following hypothesis:

H1: The sustainability of Indonesia's digital economy is directly linked to the quality of ICT infrastructure available to e-commerce users in the region.

This hypothesis underscores the importance of continuous investment in digital infrastructure, developing high-speed broadband networks, and implementing supportive government policies to create Indonesia's resilient, competitive, and sustainable digital economy.

Perceived security refers to a customer's confidence that their personal and financial information remains safeguarded during online transactions, ensuring that unauthorised entities cannot access or misuse their data. It also encompasses the degree of control customers feel over their sensitive information when interacting with an online system and their assessment of the platform's overall security measures (Kalinin et al., 2024). Additionally, perceived security reflects a user's trust in protecting their credentials during transmission over digital networks. Given the critical role of security in fostering trust and participation in digital commerce, the following hypothesis is proposed:

H2: The sustainability of the digital economy is significantly influenced by the quality of security measures implemented to protect e-commerce users within the region.

Perceived risk refers to the potential for dissatisfaction that arises from an online purchase, particularly when the product or service does not meet the buyer's expectations (Deb et al., 2024). This dissatisfaction can stem from various factors, including product quality, delivery issues, or misalignment with the consumer's needs. In addition to these concerns, numerous studies emphasise that one of the primary anxieties for consumers in the digital marketplace is the financial risk associated with online transactions, which is closely tied to their overall perception of risk (Garba et al., 2024). This concern about potential financial loss contributes to the hesitation and uncertainty surrounding e-commerce activities. Given the significant impact of perceived risk on consumer behaviour, the following hypothesis is proposed:

H3: The sustainability of the digital economy is directly influenced by the level of perceived risk as indicated by e-commerce users in the region.

Digital literacy involves comprehension and proficiency in computer hardware and software, understanding online safety measures, analysing data, and mastering the technological skills required to effectively use digital tools and platforms (Intaratat, 2022). It comprises four essential components: technological skills, information processing,

communication, and content creation. Research has shown that internet literacy significantly promotes economic growth and improves educational and healthcare outcomes. This highlights the crucial role of digital literacy in advancing societal well-being and development. Therefore, the following hypothesis is proposed:

H4: The sustainability of Indonesia's digital economy is strongly linked to the quality of digital literacy among e-commerce users in the region.

Fig 1 illustrates the research framework for the study, with four main hypotheses being proposed.

Fig 1: Research Framework

The Technology-Organization-Environment (TOE) Framework and Diffusion of Innovation (DOI) Theory offer essential theoretical foundations for examining the relationships within the research framework, including ICT infrastructure, perceived security, perceived risk, digital literacy, and a sustainable digital economy. The TOE framework (Farliana, 2024) provides insights into how technological, organisational, and environmental factors, such as ICT infrastructure, perceived security, and digital literacy, influence e-commerce sustainability. Perceived risk, in this context, is viewed as an environmental factor. On the other hand, DOI theory focuses on how innovations like ICT infrastructure and digital security are adopted and spread throughout society. It emphasises factors such as relative advantage, compatibility, and user skills, which are crucial for driving adoption. Together, these theories highlight the significance of infrastructure, security, and digital literacy in developing a sustainable digital economy.

3.0 Methodology

This study employed simple random sampling, allowing researchers to conclude a larger population by randomly selecting participants. This method ensures that everyone has an equal chance of being chosen. A similar approach was used in a study by Kang (2021), who also utilised G-Power software to calculate the sample size, providing flexibility for various research methods. The sample size recommended by the G-Power platform was 135 participants, all residing in urban areas of Indonesia with prior experience in e-

commerce purchases (Aminullah et al., 2024). Rural residents of Indonesia were excluded from the sample.

A set of questionnaires was created using a five-point Likert scale to collect data. The research followed a cross-sectional design, with data gathered over three weeks using an online survey method (Alexandrova, 2022). The survey link was shared within Indonesia's residential communities via several online platforms. The four leading platforms for distributing the survey were Facebook, Instagram, Telegram, and WhatsApp. A total of 170 responses were collected, but after filtering for valid responses, only 135 were deemed usable, resulting in a validity rate of 79%. To ensure the relevance and validity of the responses, a filtering question was included to confirm participants' eligibility based on criteria such as their residential area and e-commerce experience. The collected data were then analysed using SPSS software (Alexandrova, 2022).

4.0 Results

4.1 Descriptive Analysis

The study begins with a detailed examination of the demographic characteristics of the respondents, as summarised in Table 1. The findings indicate that male participants engage in e-commerce transactions more frequently than their female counterparts. Additionally, the most active demographic group falls within the age range of 21 to 23 years, highlighting the prevalence of young adults in online shopping behaviours. The study employed two key screening criteria to ensure a relevant and focused sample. First, only respondents residing in urban areas were included, while individuals from rural locations were excluded. This criterion was established to reflect the higher accessibility and adoption rates of e-commerce in urban settings. Second, only individuals with prior experience in online shopping were considered eligible participants. Those without any history of e-commerce transactions were excluded to maintain the study's relevance to consumer behaviour in digital marketplaces. These filtering measures ensured that the dataset accurately represents an active e-commerce user base, allowing for a more precise and meaningful analysis of online shopping behaviours.

Table 1: Demographic Analysis

Demographic Info	Types	Frequency	Per cent
Gender	Male	95	24
	Female	40	59
Age	18-20 Years Old	24	17.8
	21-23 Years Old	59	43.7
	24-27 Years Old	29	21.5
	28-30 Years Old	23	17.0
Residential Area	Urban	135	100

	Rural	0	0
E-Commerce Experience	Yes	135	100
	No	0	0

Cronbach's Alpha was used to test the questionnaire's validity. Table 2 indicates the score for each construct. In this case, every variable has a perfect reliability score above 0.8 for all independent and dependent variables tested in the study.

Table 2: Cronbach's Alpha Value

Variables	Cronbach's Alpha Score
ICT Infrastructure – IV	0.899
Perceived Security – IV	0.895
Perceived Risk – IV	0.862
Digital Literacy – IV	0.893
Sustainable Digital Economy – DV	0.879

4.1 Regression Analysis

Regression analysis was conducted to test the relationship between the independent and dependent variables using a coefficient in regression analysis. Table 3 indicates the result. It shows that the independent variable affected only 59% of the dependent variable. The R Square value further indicates that the predictors in the model explain approximately 35.1% of the variation in the dependent variable.

Table 3: Model Summary of Regression Analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.592[a]	0.351	0.331	0.52270

a. Predictors: (Constant), AVG_DL, AVG_PS, AVG_II, AVG_PR

Table 4: Coefficients in Regression Analysis

		Unstandardised Coefficients		Standardised Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.209	0.291		4.158	<0.001
	ICT Infra	0.185	0.083	0.213	2.230	0.027
	P.Security	0.207	0.084	0.234	2.469	0.015
	P.Risk	0.069	0.098	0.074	0.709	0.480
	Digital. L	0.174	0.086	0.195	2.035	0.044

a. Dependent Variable: Sustainable Digital Economy

The multiple regression analysis reveals that ICT Infra, Perceived Security, and Digital Literacy are statistically significant predictors of the "Sustainable Digital Economy," with p-

values less than 0.05, indicating that increases in these variables are associated with improvements in the dependent variable. Precisely, ICT Infra (β = 0.213), Perceived Security (β = 0.234), and Digital. L (β = 0.195) all have positive relationships with the outcome, with Perceived Security showing the most substantial impact. However, Perceived Risk (β = 0.074) is not a significant predictor (p = 0.480), suggesting it does not meaningfully contribute to the model. The intercept is also statistically significant (p < 0.001), indicating the baseline value of the Sustainable Digital Economy when all predictors are zero. Overall, the results highlight the importance of ICT infrastructure, privacy/security, and digital literacy in fostering a sustainable digital economy.

Table 5:ANOVA Analysis

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19.197	4	4.799	17.566	<0.001[b]
	Residual	35.518	130	0.273		
	Total	54.715	134			

a. Dependent Variable: SDE
b. Predictors: (Constant), DL, PS, ICT, PR

The results of the ANOVA test for the regression model show a significant overall fit. The model's regression sum of squares is 19.197, with 4 degrees of freedom, and the mean square for regression is 4.799. The F-statistic is 17.566, with a p-value less than 0.001, indicating that the regression model as a whole is statistically significant in predicting the dependent variable (AVG_SDE). The residual sum of squares is 35.518 with 130 degrees of freedom, resulting in a mean square for the residuals of 0.273. The total sum of squares is 54.715 with 134 degrees of freedom. This suggests that the predictors (DL, PS, ICT, PR) significantly explain the variation in the dependent variable (Sustainable Digital Economy).

The multiple regression equation for predicting the "Sustainable Digital Economy" (γ) is as follows:

$$\gamma = \alpha + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + \varepsilon \qquad (1)$$

γ=1.209+0.185×(ICT Infrastructure)+0.207×(Perceived Security)+0.069×(Perceived Risk)+0.174×(Digital Literacy)+0.291

The equation's constant (α=1.209) represents the baseline Sustainable Digital Economy value. Positive coefficients for ICT Infrastructure (B_1=0.185), Perceived Security (B_2=0.207), and Digital Literacy (B_4=0.174) indicate their strong influence, while Perceived Risk (B_3=0.069) shows a weak, non-significant effect. The error term (ε) captures unexplained variation. This model can assess the variance in the relationship between the dependent variable and the independent variable by using a simulation score ranging from 1 (very dissatisfied) to 5 (very satisfied) to report on the sustainability of the digital economy model.

The hypothesis testing revealed that three out of four hypotheses were supported. H_1 significantly linked Indonesia's digital economy sustainability to ICT infrastructure quality ($p=0.027$). H_2, connecting sustainability to e-commerce security quality, was also significant ($p=0.015$). H_4, associating sustainability with digital literacy among users, showed significance ($p=0.044$). However, H_3, proposing a link between sustainability and perceived risk, was rejected ($p=0.480$). This suggests that perceived risk may not be a priority for Indonesian e-commerce users, who likely value ICT infrastructure, security, and literacy more. Additionally, the sample size or growing user familiarity with online transactions may have influenced the result.

5.0 Discussion

The study confirmed that ICT infrastructure positively impacts a sustainable digital economy (correlation = 0.492, p = 0.027), supporting findings from Mahmoud et al. (2021) and Yuda (2021). A well-developed ICT infrastructure is essential for increasing digital platform access, enabling businesses and consumers to engage in e-commerce and fostering long-term digital economic growth in Indonesia. The second hypothesis, which suggested that perceived security enhances the sustainability of the digital economy, was also validated (correlation = 0.498, p = 0.015). This aligns with Ma (2023) and Kalinin et al. (2024), emphasising the role of security in building trust within the e-commerce sector. Ongoing investments in cybersecurity are crucial for maintaining consumer confidence and ensuring digital economy stability.

Contrary to expectations, the study found no significant relationship between perceived risk and digital sustainability (correlation = 0.467, p = 0.480), challenging prior research by Garba et al. (2024) and Deb et al. (2024). This may suggest that Indonesian consumers have become more familiar with digital transactions, reducing the impact of perceived risks such as fraud, which may not be a decisive factor in shaping the digital economy. Finally, the study confirmed that digital literacy positively contributes to a sustainable digital economy (correlation = 0.488, p = 0.044), supporting research by Intaratat (2022). Improving digital literacy is vital for enhancing consumer confidence and broadening participation in e-commerce, making the digital economy more inclusive and sustainable. The study's theoretical framework, incorporating the TOE and DOI theories, illustrates how ICT infrastructure, security, digital literacy, and perceived risk shape e-commerce sustainability. These findings reinforce the importance of strengthening ICT infrastructure, enhancing security, and improving digital literacy to build Indonesia's resilient and inclusive digital ecosystem.

6.0 Conclusion

This study highlights the critical roles of ICT infrastructure, digital security, and digital literacy in fostering a sustainable digital economy in Indonesia. The research demonstrates how these factors shape digital economic activities' adoption and long-term success by

applying the Technology-Organization-Environment (TOE) framework and Diffusion of Innovation (DOI) theory. A robust ICT infrastructure enhances internet access and connectivity, enabling more individuals and businesses to participate in the digital economy. Digital security measures help build consumer trust by safeguarding online transactions, essential for increasing e-commerce participation. Meanwhile, digital literacy empowers individuals and businesses to navigate online platforms effectively, optimising their use of e-commerce tools and minimising risks associated with digital transactions. Together, these elements form a foundation for a resilient and sustainable digital ecosystem.

One notable limitation of this study is its exclusive focus on urban respondents. Since urban areas typically have better access to ICT infrastructure and higher digital literacy rates than rural regions, the findings may not fully reflect the challenges and opportunities rural populations face. The digital divide, which affects rural areas more significantly, could lead to unequal access to digital opportunities. Therefore, future research should incorporate rural populations to provide a more comprehensive understanding of digital adoption across diverse geographical and socioeconomic contexts. The study's findings underscore the importance of government and private sector collaboration in improving digital access, security, and literacy. Governments must prioritise infrastructure development in underserved regions, where internet connectivity and digital education are often lacking. This would help bridge the digital divide and create more equal opportunities for economic participation. Meanwhile, businesses have a crucial role in investing in digital literacy programs and enhancing cybersecurity measures to protect consumers and build confidence in digital transactions.

Future studies should explore regional disparities in ICT infrastructure and digital adoption, mainly focusing on the challenges faced by rural areas. These studies should also assess the effectiveness of government initiatives, such as the Indonesia Digital Roadmap 2021–2024, in addressing the digital divide. Furthermore, investigations into specific e-commerce risks and digital literacy challenges—such as concerns over online fraud, data privacy, and payment security—will provide valuable insights into the barriers to digital economy participation. As Indonesia's digital economy continues to expand, prioritising ICT infrastructure, cybersecurity, and digital literacy will ensure a sustainable and inclusive digital future for all.

Article Contribution to Related Field of Study

This study rigorously investigates the pivotal factors driving the sustainability of Indonesia's digital economy, with a sharp focus on the critical roles of ICT infrastructure, security perceptions, digital literacy, and perceived risk among e-commerce users. The findings compellingly demonstrate that a robust ICT infrastructure, adequate security measures, and heightened digital literacy are beneficial and essential for catalysing e-commerce growth. Conversely, the minimal impact of perceived risk indicates a significant shift in user priorities that must be addressed. This research lays a strong foundation for targeted

interventions that can transform the digital landscape by highlighting the urgent need to bridge digital literacy gaps and tackle regional disparities. Furthermore, it advances both theoretical and practical domains by extending the Technology-Organization-Environment (TOE) Framework and the Diffusion of Innovation (DOI) Theory, unequivocally affirming the vital interplay between ICT infrastructure, security, and digital literacy in fostering sustainable e-commerce. These insights are crucial for policymakers and industry leaders, providing a clear roadmap for prioritising investments in these transformative areas. By doing so, they can forge a more secure and inclusive digital economy, ultimately building stronger trust and encouraging active engagement in digital transactions across all segments of society.

Acknowledgement

Thanks to the Asia Pacific University of Technology and Innovation for the resources throughout the study and to AMER for the research funding

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