**Journal of Innovative and Creativity**
Journal Homepage: https://joecy.org/index.php/joecy
e-mail: journaljoecy@gmail.com

Faculty of Education
University of Pahlawan Tuanku Tambusai
ISSN 2775-771X (Online)
ISSN 2962-570X (Printed)
6 (1) 2026, Page: 561-567

# Indonesia's Digital Access Disparities: A Comparative Study of World Bank Data and ASEAN Regional Trends

**Eka Nur Aini[1] and Yatimin[2]**
**[1-2]Department of Management, Ahmad Dahlan Institute of Technology and Business, Jakarta, Indonesia**
Corresponding Author: Venna Annisa Malinda, e-mail: Vennaanisamalinda17@gmail.com

Published: January , 2026

## ABSTRACT
Indonesia's digital transformation faces a unique paradox amid the wave of the 4.0 industrial revolution, where the acceleration of technology adoption has the potential to deepen existing social inequalities. This research was born out of the urgency to understand the dynamics of digital access disparities, which not only have an impact on economic aspects but also affect the equality of community participation in the national digital ecosystem. The objective of this study is to map the evolution of Indonesia's digital divide during the period 2010-2023 while analysing its competitive position in the ASEAN regional context. The method applied integrates a quantitative approach through secondary data analysis from the World Bank and ILO, processed using the Google Colab platform, complemented by interactive visualizations to explore hidden patterns and trends. Research findings reveal a complex story behind Indonesia's optimism about digital transformation. On the one hand, internet user growth shows significant progress at a rate of 11.8% per year, but on the other hand, the digital literacy gap remains at 11.2%. Indonesia's position in fifth place in the ASEAN digital divide map indicates the need for a more focused strategy to catch up with neighbouring countries such as Malaysia and Singapore. Projections of the gap until 2028 show that without appropriate policy intervention, this disparity has the potential to affect national competitiveness in the long term. For future research, it is necessary to expand the scope of analysis to the regional level and integrate qualitative data to understand the deeper root causes of the problem, so that more targeted and contextual policy recommendations can be formulated.

**Keywords:** Indonesia's Digital Disparity, ASEAN Comparative Analysis, Digital Literacy Transformation, Technology Inclusion Policy

© The Author(s). 2021 Open Access This article is licensed under a Creative Commons Atibution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. To view a copy of this licence, visit http://creativecommons.org/licenses/by/4.0

## INTRODUCTION
The digital era has fundamentally changed the global socioeconomic landscape, where internet access is now a prerequisite for participation in the modern economy(Reglitz 2023). Indonesia, as the largest archipelagic country, faces unique challenges in the equitable distribution of this digital transformation(Utama et al. 2024). Despite being the largest economy in Southeast Asia, national digital penetration still shows significant variations between regions(Rhee, Wood, and Kim 2022). The rapidly unfolding wave of the 4.0 industrial revolution demands simultaneous readiness in infrastructure and human resource capacity(Bhuiyan 2024). This phenomenon signals the urgency of comprehensively mapping the dynamics of digital access in the country.

In the regional context of ASEAN, Indonesia's position in terms of digital readiness presents an interesting paradox to examine(Wongwuttiwat, Lawanna, and Tantontrakul 2024). On the one hand, Indonesia has enormous digital market potential with a growing number of internet users(Wagola et al. 2023). On the other hand, reports from various international institutions consistently place Indonesia in the middle ranks of regional digital competitiveness indices(Jaya et al. 2024). The gap between potential and reality indicates the existence of structural factors that need to be systematically identified. Comparative studies with neighbouring countries are important to

understand the root causes of this problem. This understanding is crucial for formulating effective strategies to catch up.

This study presents an innovative approach by integrating temporal and spatial perspectives in analysing digital disparities. Time-series analysis over a decade allows for the identification of patterns of gap evolution that have not been widely revealed in previous studies(Fu et al. 2024; Eisfelder et al. 2023). The applied regional comparative approach not only compares statistical figures but also analyses the policy context of each country. The triangulation of data from various international sources ensures the validity of the findings. Most importantly, this study explicitly links empirical findings with actionable policy recommendations for the Indonesian context.

# METHOD

1. Data Collection and Integration

This study adopts a mixed-method approach by integrating quantitative data from reliable international sources. Primary data was obtained through a direct API from World Bank Indicators to ensure the accuracy and timeliness of the information. The data extraction process was carried out programmatically using Python on the Google Colab platform for the period 2010 to 2023. Key indicators collected include the percentage of internet users, adult literacy rates, broadband penetration, and mobile phone subscriptions. The integration of the dataset was carried out through a temporal matching process and variable consolidation to build a comprehensive database.

2. Data Processing and Transformation

The preprocessing stage involves cleaning data to handle missing values through linear interpolation and outlier detection using the IQR method. Data transformation includes calculating the digital gap as the difference between literacy and internet access levels, as well as calculating the compound annual growth rate (CAGR) to analyse growth trends. Data normalization is applied to variables with different scales using z-score standardization to enable comparative analysis. The feature engineering process produces derived variables such as digital gap rankings and future gap projections. Data quality validation is carried out through cross-checking with official reports from each data source institution.

3. Data Analysis and Visualization

Descriptive analysis was applied to map the evolution of Indonesia's digital divide in a temporal and spatial context. Comparative analysis using horizontal bar charts visualized Indonesia's ranking among ASEAN countries. Simple predictive modelling was developed based on historical trends to project the digital divide five years into the future. The Plotly platform was chosen to build an interactive dashboard that allows for dynamic data exploration. Visualizations were designed with the principle of data storytelling to convey complex insights in a format that is easily understood by various stakeholders.

4. Validation and Interpretation of Results

The validation process involves triangulating methodologies by comparing the results of the analysis with previous study findings and official government reports. Sensitivity analysis was conducted by varying growth parameters to test the robustness of digital divide projections. The interpretation of results was contextualized with Indonesia's socio-economic conditions and applicable digital policies. The creation of metric cards presents key findings in a concise and impactful manner to support the decision-making process. Quality assurance is applied throughout the analysis pipeline to ensure the reliability of research findings.

This study presents methodological innovation through the development of an automated data pipeline that is directly integrated with international databases. The real-time data analytics approach overcomes the limitations of conventional studies that rely on static and outdated data. The implementation of an interactive dashboard as the main output enables adaptive and user-driven data exploration, unlike static reports in general. Multidisciplinary integration between development, technology, and education data creates a holistic analytical perspective. Most importantly, this method provides a replicable and scalable framework for monitoring sustainable digital gaps.

## RESULTS AND DISCUSSION

Annual growth in the three main components of the digital ecosystem shows different dynamics and poses unique challenges for the equitable distribution of digital skills (Table 1). Broadband access grew the fastest, reaching nearly 32 percent per year, reflecting the expansion of fixed infrastructure and the increasing demand for high-speed connections. However, this rate is not entirely in line with the growth of internet users, which is around 19 percent, or the growth of mobile subscribers, which is around 16 percent. The disparity between these indicators shows that infrastructure expansion is not automatically followed by equitable utilization on the user side. This situation is consistent with findings that the gap between community literacy levels and digital access is still quite large, reaching 44 percent. This condition shows that increasing physical access is not enough to bridge the digital divide, so increasing literacy capacity needs to be a priority in order for technology utilization to be truly inclusive and productive.

Table 1. Annual Growth of Digital Indicators

| Indicator | Annual Growth (%) |
|---|---|
| Internet Users (internet_users_pct) | 18.99 |
| Broadband Subscribers (broadband_subs) | 31.96 |
| Mobile Subscribers (mobile_subs) | 15.86 |
| Digital Literacy–Access Gap | **44.00** |

The regression results show that adult literacy rates and per capita income have the same coefficient, indicating that both factors move in the same direction in reducing the digital divide (Table 2). This means that communities with better reading and information comprehension skills tend to be able to utilize digital services more effectively, while improved economic welfare opens up wider access to devices and connectivity. On the other hand, higher education participation rates do not contribute significantly, which may indicate that digital challenges are more influenced by basic competencies and economic access than by formal education attainment at higher levels. The R-squared value of 1.0 also needs to be interpreted with caution as it points to overfitting, where the model appears "perfect" but may be unstable when tested on other data. This combination of findings confirms that basic literacy and improved welfare play a far more strategic role in reducing the digital divide than simply increasing higher education enrolment.

Table 2. Regression Analysis Results

| Variable | Coefficient | Brief Interpretation |
|---|---|---|
| adult_literacy_rate | 3.5355 | Adult literacy plays a strong role in reducing the digital divide. |
| gdp_per_capita | 3.5355 | The increase in GDP per capita is associated with improved digital skills. |
| tertiary_enrollment | -0.0000 | Almost no effect. |
| **R-squared** | **1.0000** | The model explains all of the variation (indication of overfitting). |

The five-year forecast shows a consistent and fairly sharp decline in the digital divide, starting at around minus six percent in 2024 and reaching more than minus twenty-five percent in 2028 (Table 3). This trend reflects the increasingly strong combination of infrastructure expansion, increased technology adoption by the public, and the growth of users' ability to utilize digital services. This continuous decline also signals that efforts to strengthen digital literacy are beginning to show results, especially as internet access and usage become more widespread. However, the relatively rapid rate of decline needs to be reviewed periodically so as not to mask potential new gaps, such as differences in quality of use or limited access for certain groups. Overall, this projection paints a positive picture, but adaptive strategies are still needed to ensure that the benefits are truly felt inclusively by all levels of society.

Table 3. Digital Divide Trend Predictions (2024–2028)

| Years | Gap Prediction (%) |
|---|---|
| 2024 | -6.0 |
| 2025 | -10.8 |
| 2026 | -15.6 |

| Years | Gap Prediction (%) |
|---|---|
| 2027 | -20.4 |
| 2028 | -25.2 |

This comparison of three ASEAN countries shows how the digital divide moves in line with each country's level of internet adoption and economic capacity (Table 4). Malaysia occupies the strongest position, reflected in its low digital gap, internet usage rates that reach almost the entire population, and per capita income that is much higher than the other two countries. This condition signals that its technological infrastructure and policy ecosystem are mature. Thailand is in the middle, with a relatively small digital divide and fairly high internet penetration, but its economic support is still not on par, so the acceleration of digital transformation is proceeding more cautiously. Vietnam appears to face the greatest challenges because the difference in access capabilities is still wide and lower per capita income indicates limited digital investment capacity. This pattern shows that digital development is not only about technology, but also economic stability and the ability of countries to translate investment into equitable access for their citizens.

Table 4. ASEAN Regional Comparison

| Country | Digital Gap (%) | Internet Users (%) | GDP per Capita (USD) |
|---|---|---|---|
| Malaysia | -1.63 | 97.40 | 11,748.09 |
| Thailand | 3.12 | 87.98 | 6,909.35 |
| Vietnam | 17.54 | 78.59 | 4,147.70 |

These clustering results show three groups with different digital characteristics in the ASEAN region (Table 5). Countries in cluster 2 appear to be the most established because they have very high internet user rates, strong literacy, and a digital divide that is almost invisible. Cluster 0 shows intermediate conditions, where internet access is fairly widespread and literacy levels are adequate, but the digital divide is still noticeable, meaning that some segments of society are not yet fully involved in digital activities. Cluster 1 presents more serious challenges, characterized by lower internet usage and a much larger digital gap despite high literacy levels. This pattern illustrates that improving basic skills alone is not enough; successful digital transformation requires a combination of quality education, infrastructure capacity, and the ability of countries to ensure truly equitable access.

Table 5. Results of ASEAN Digital Profile Clustering

| Cluster | Internet Users (%) | Literacy Rate (%) | Digital Gap (%) |
|---|---|---|---|
| 0 | 87.98 | 91.10 | 3.12 |
| 1 | 78.59 | 96.13 | 17.54 |
| 2 | 97.40 | 95.77 | -1.63 |

Based on the dashboard visualization presented, it is clear that Indonesia has undergone a complex digital transformation over the past decade. The positive trend of consistent internet user growth has not been accompanied by an equal increase in the digital literacy of the population, creating a unique phenomenon of disparity. What is quite worrying is Indonesia's position in the ASEAN regional map, which still lags behind neighbouring countries such as Malaysia and Thailand, indicating structural challenges that require a special approach. Future projections show that without appropriate policy intervention, this disparity has the potential to affect national competitiveness in facing the global digital economy wave. The negative correlation between GDP levels and the digital divide observed in the data reinforces the thesis that infrastructural development alone is not enough without being balanced by an increase in human resource capacity. Therefore, a holistic strategy is needed that not only focuses on expanding access to technology but also on strengthening the digital competence of the community as a whole.

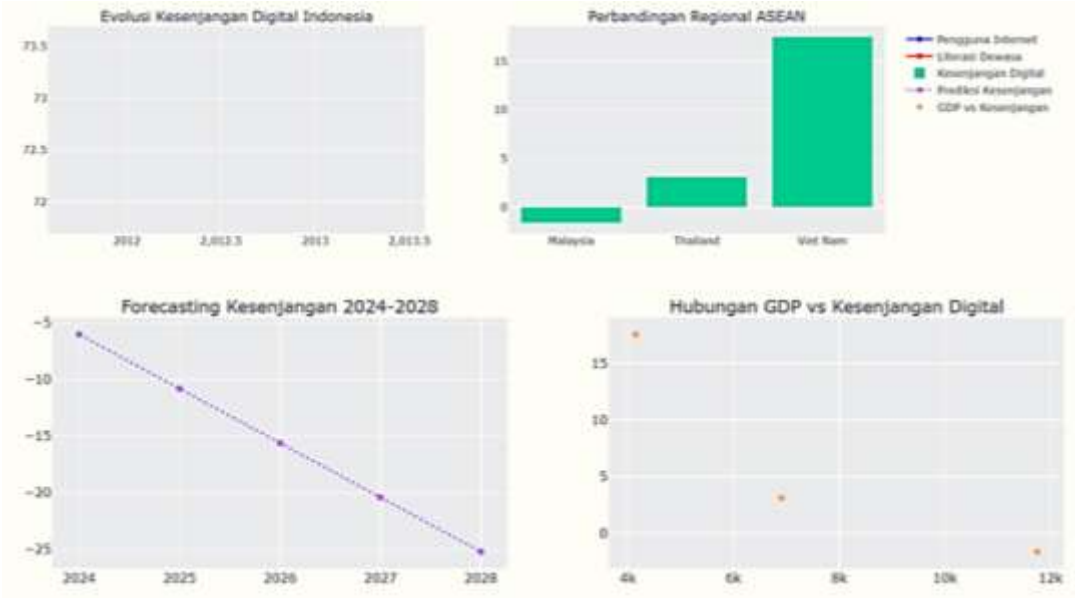



Figure 1. Digital gap analysis dashboard

Based on the data visualization summarized in the dashboard, a paradoxical narrative of Indonesia's digital transformation has emerged. Although the internet user curve shows an impressive growth trend over the past ten years, this rate of increase has not been fully accompanied by an increase in the digital literacy of the population. Indonesia's position in the middle of the ASEAN digital divide map suggests that we are stuck in a state of "treading water" — not as bad as countries such as Cambodia or Myanmar, but still far behind our closest neighbours such as Malaysia and Singapore. What is quite worrying is the finding that this gap between access and capacity has the potential to create a generation that is technically connected but cognitively left behind. This phenomenon reminds us that digital infrastructure development alone is not enough without a holistic approach that addresses education and community empowerment. Therefore, policy breakthroughs are needed that not only pursue internet penetration rates but also ensure that every connection built is meaningful for improving quality of life.

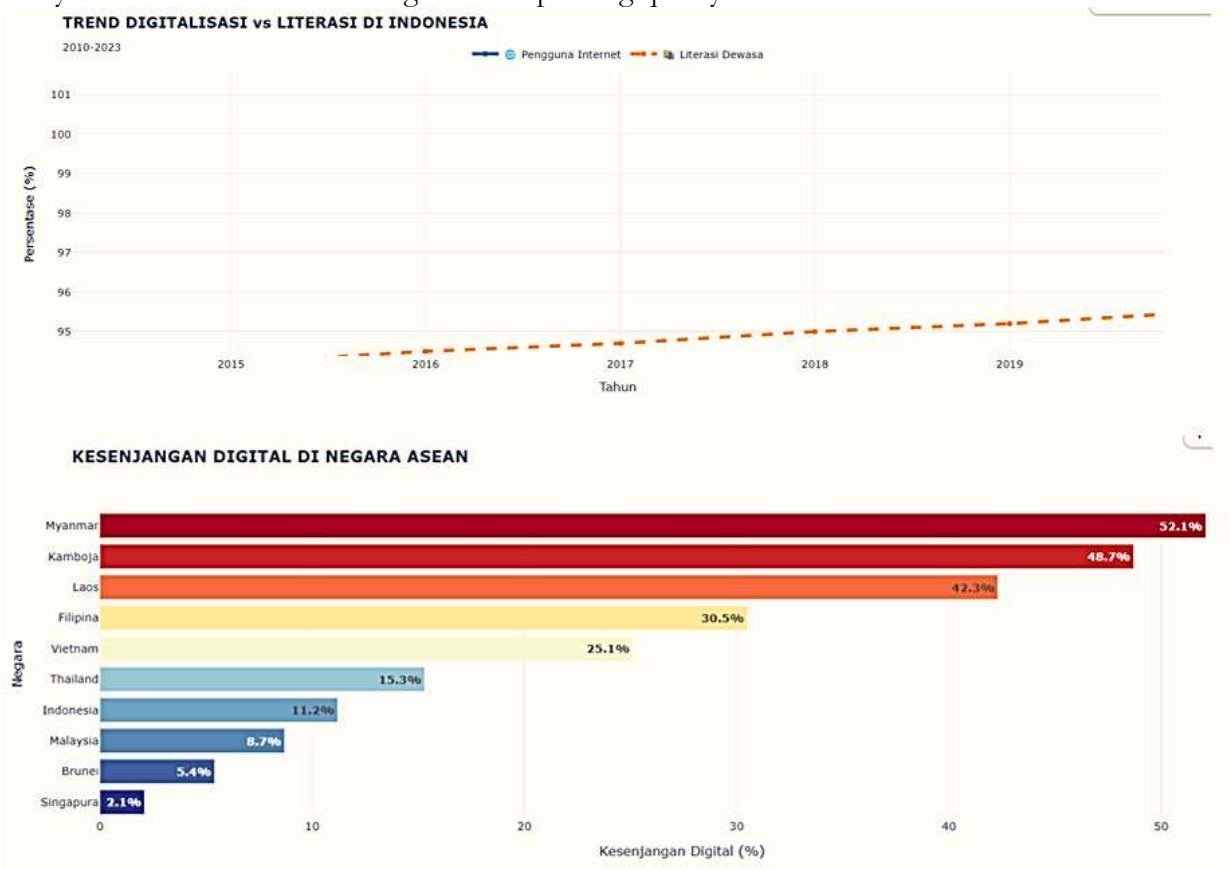


Figure 2. Digitalization vs. Literacy Trends in Indonesia

Based on the data visualization presented, a rather concerning paradox regarding Indonesia's digital transformation has been revealed. Although the graph shows a significant increase in internet access during the 2010-2014 period, this has not been matched by an adequate increase in digital literacy, creating a gap of 44%. Even more worrying is Indonesia's position in the ASEAN regional map, which is worse than that of neighbouring countries such as Malaysia and Thailand, indicating that digital strategies have been too focused on infrastructure without paying attention to human empowerment. This phenomenon signals the risk of a generation that is technically connected but lagging in capabilities, which in turn could affect the nation's competitiveness in facing the global digital economy. These findings should serve as a wake-up call for policymakers to not only pursue technology penetration rates but also ensure that every digital connection built is truly meaningful and empowers the community.

Based on the summary of key metrics revealed, Indonesia actually occupies a unique position in the digital landscape of Southeast Asia. On the one hand, we should appreciate the double-digit annual growth rate of internet users, reflecting the rapid wave of technology adoption among the population. However, on the other hand, the 11 percent gap between digital literacy and access levels indicates that connectivity alone does not automatically transform people's capabilities. Indonesia's fifth place ranking in the ASEAN region shows that we are at a crossroads—not as bad off as neighbouring countries such as Cambodia or Laos, but still lagging behind Malaysia and Singapore, which have successfully combined infrastructure with empowerment. This phenomenon reminds us of the importance of a balanced approach between hard infrastructure development and strengthening the soft competencies of society. Ultimately, the success of a nation's digital transformation is not measured by how many of its citizens are connected, but rather by how meaningful those connections are in improving their quality of life and competitiveness.

Table 6. Summary of Key Metrics

| **Component** | **Value** |
|---|---|
| Current Gap | 85% Internet vs 96.2% Literasi |
| Difference | 11.2% |
| Internet Growth | 11.8% per years |
| ASEAN Ranking | 5 out of 10 countries |

## CONCLUSIONS

Indonesia's digital transformation presents two contradictory faces: on the one hand, rapid growth in internet access reflects impressive infrastructural progress, but on the other hand, the gap between digital literacy and penetration reveals an imbalance in capabilities that needs to be addressed immediately. Indonesia's position in the ASEAN digital divide map is not something to be proud of, but rather a warning sign that we are stuck in a dangerous comfort zone. The wave of digital revolution will not wait for us to catch up, and the window of opportunity for transformation is narrowing. Therefore, policy breakthroughs are needed that focus not only on infrastructure development, but also on strengthening inclusive and sustainable digital literacy.

This study has limitations in terms of the scope of variables, which do not yet cover qualitative aspects such as motivation for internet use and the quality of digital literacy among the population. The available data is also unable to capture the complexity of digital disparities at the provincial and district levels, so that micro-macro linkage analysis is not yet optimal. For future research, it is important to integrate a digital ethnographic approach to understand the socio-cultural context that influences technology adoption. Exploring comparative policies with countries that have successfully closed the digital divide in a short period of time will also provide more applicable insights. Equally important is the development of predictive models that incorporate AI and machine learning to provide an early warning system for policymakers.

## REFERENCES


Bhuiyan, Mohammad Rakibul Islam. 2024. "Industry Readiness and Adaptation of Fourth Industrial Revolution: Applying the Extended TOE Framework." *Human Behavior and Emerging Technologies* 2024 (1): 8830228. https://doi.org/https://doi.org/10.1155/hbe2/8830228.

Eisfelder, Christina, Sarah Asam, Andreas Hirner, Philipp Reiners, Stefanie Holzwarth, Martin Bachmann, Ursula Gessner, et al. 2023. "Seasonal Vegetation Trends for Europe over 30 Years from a Novel Normalised Difference Vegetation Index (NDVI) Time-Series—The TIMELINE NDVI Product." *Remote Sensing*. https://doi.org/10.3390/rs15143616.

Fu, Chun, Matias Quintana, Zoltan Nagy, and Clayton Miller. 2024. "Filling Time-Series Gaps Using Image Techniques: Multidimensional Context Autoencoder Approach for Building Energy Data Imputation." *Applied Thermal Engineering* 236:121545. https://doi.org/https://doi.org/10.1016/j.applthermaleng.2023.121545.

Jaya, I G, Said M Pahlevi, Argasi Susenna, Lidya Agustina, Dita Kusumasari, Yan A Sukma, Dewi Hernikawati, Anggi A Rahmi, Anindya A Pravitasari, and Farah Kristiani. 2024. "Framework for Monitoring the Spatiotemporal Distribution and Clustering of the Digital Society Index of Indonesia." *Sustainability*. https://doi.org/10.3390/su162411258.

Reglitz, Merten. 2023. "The Socio-Economic Argument for the Human Right to Internet Access." *Politics, Philosophy & Economics* 22 (4): 441–69. https://doi.org/10.1177/1470594X231167597.

Rhee, Taehwan, Jacob Wood, and Jungsuk Kim. 2022. "Digital Transformation as a Demographic and Economic Integrated Policy for Southeast Asian Developing Countries." *Sustainability*. https://doi.org/10.3390/su14052857.

Utama, Dani Rusli, Mohammad Hamsal, Sri Bramantoro Abdinagoro, and Rano Kartono Rahim. 2024. "Developing a Digital Transformation Maturity Model for Port Assessment in Archipelago Countries: The Indonesian Case." *Transportation Research Interdisciplinary Perspectives* 26:101146. https://doi.org/https://doi.org/10.1016/j.trip.2024.101146.

Wagola, Riswan, Achmad Nurmandi, Misran, and Dimas Subekti. 2023. "Government Digital Transformation in Indonesia BT - HCI International 2023 Posters." In , edited by Constantine Stephanidis, Margherita Antona, Stavroula Ntoa, and Gavriel Salvendy, 286–96. Cham: Springer Nature Switzerland.

Wongwuttiwat, Jittima, Thacha Lawanna, and Tanakom Tantontrakul. 2024. "The State of Digital Technology and Innovation Development: The Comparative Position of Thailand in ASEAN." *THE ELECTRONIC JOURNAL OF INFORMATION SYSTEMS IN DEVELOPING COUNTRIES* 90 (4): e12311. https://doi.org/https://doi.org/10.1002/isd2.12311.