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The Role of Digital Technology and Institutional Quality for Accelerating Sustainable Development

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Abstract: *This research examines how the utilisation of digital technology and institutional quality affects sustainable development in selected Southeast Asian countries. The data in the study was annual panel from 2005 to 2021 from WDI and other websites. The analysis used a number of independent and control variables (digital technology, institution quality, urbanisation, trade and population) and the study apply econometric tests like descriptive statistics and Pearson correlation with Hausman test then regressed to simple linear regression model, fixed as well as random effect models. The findings of the study reveal that digital technology and institutional quality played a similar and positive role in sustainable development in these countries. These results offer strong evidence that governance and technological progress are also significant determinants of sustainability in the region. The findings have important policy implications, showing that the optimal treatment to meet long run sustainable development goals is not only by investing in an institutional framework through which digital infrastructure can be developed and utilised but also in more investment in digital infrastructure.*

Keywords: Digital Technology, Institutional Quality, Sustainable Development, Trade, Fixed effect model

1. Introduction

Sustainable development has now emerged in the twenty-first century as both a standard for international policy and an avenue for academic debate. It's a complex and multi-pronged approach that seek to secure the present and future well-being of all human beings by reconciling social justice, ecological sustainability, and economic development (Hickel, 2020). Sustainability is a global phenomenon, and it has been observed that there are different ways of implementing them in various parts of the world particularly in the rapid growth areas. We will focus in this study on the economies of Southeast Asia due to their fast economic growth along with substantial environmental and social pressures e.g., urbanization, deforestation, high carbon emissions (Chen et al., 2024). This is due to its developmental pathway and there may be sense in analyzing the main drivers that can lead it on a more sustainable path. Digitalisation and institutional quality are the two major, but closely related forces which may influence sustainable development.

Digital transformation is reshaping economies and societies around the world. The digital economy has grown rapidly in the Southeast Asia region and fundamentally revolutionized the consumer behavior, governance structure and business model (Ha & Chuah, 2023). The

technological revolution also could lead to the sustainable development Internet of Things (IoT), big data analytics and artificial intelligence (AI) are examples of digital technologies that can enhance the efficiency in different industries, which will save waste and resources by Liu et al. For instance, precision agriculture may reduce pesticide and water use and smart grids can optimise energy distribution. Moreover, data-driven approaches may help companies to build more sustainable and circular supply chains that will enhance social and environmental performance (Bag et al., 2024). This technological ability provides original solutions to long-standing issues, and represents the dawn of a new era in our quest for global sustainability.

However, the effectiveness of digital technology in promoting sustainable results is not a unique occurrence. It is heavily reliant on the institutional setting in which it functions. The formal and informal limitations that influence human interaction are provided by institutions, which are referred to as the "rules of the game" in a society (North, 1991). Fostering sustainable development requires high-quality institutions that are distinguished by political stability, effective rule of law, good governance and regulatory transparency (Kaufmann & Kraay, 2002). They guarantee the enforcement of environmental laws establish the stability and trust necessary for sustained investment in green technologies and hold both public and private actors responsible for their deeds. Without robust institutions and digital innovations could be abused or their advantages monopolized by a select few, worsening rather than reducing inequality and environmental damage (Sun et al., 2025). While previous studies have examined the distinct contributions of digital technology (Liu et al., 2024) and institutional quality (Ntow-Gyamfi et al., 2020) to sustainability the combined reinforcing effect of these two factors has received less attention particularly when it comes to a cohesive framework for Southeast Asia. Research has demonstrated that strong institutions are necessary for utilizing technology for environmental sustainability (Rehman et al., 2023) and that institutional quality can increase the beneficial effects of ICT on economic growth (Behera et al., 2024). Building on this framework this study examines how digital technology and institutional quality interact to support sustainable development in Southeast Asian economies.

This study makes two contributions. Firstly, it provides a nuanced understanding of the co-determinants of sustainable development in Southeast Asia by offering new empirical evidence for how digital technology interacts with institutional quality at an aggregate level to contribute to sustainable development. Second, the results have important policy ramifications. They emphasize the necessity of a comprehensive strategy for sustainable development that incorporates both governance reform and technological innovation. This study makes a strong case for politicians in Southeast Asia and other developing nations to invest in institutional capacity and digital infrastructure concurrently in order to make more significant and long-lasting progress toward their sustainability objectives.

This paper's remaining sections are organized as follows: The pertinent literature is thoroughly reviewed in Section 2, the data and methodology are described in Section 3, the empirical results are presented and discussed in Section 4, and a summary of the main conclusions and policy recommendations is provided in Section 5.

2. Literature Review

To create the theoretical foundation for our analysis, a review of these domains is necessary. This section presents the literature review for our main variables, such as digital technology with sustainable development and the relationship between institutional quality and sustainable development, respectively.

2.1 The Role of Digital Technology in Sustainable Development

In recent years, there has been widespread recognition of the transformative potential of digital technology in attaining sustainability (Addimulam, 2024). Digitalisation is also a strong catalyst for social and environmental sustainability in addition to being an economic accelerator. New digital technologies such as big data and the IoT, have the capacity to revolutionise resource efficiency and reduce carbon emissions from an environmental perspective. Data-driven analysis can, for instance, reduce waste and energy use through optimal supply chains and manufacturing (Bag et al., 2024). In the same way, smart infrastructure and digital platforms can facilitate acceptance of renewable energy sources and promote saving energy (Liu et al., 2111). For example, researches on China's carbon emissions indicate that there is a close relationship between digital technology and the decline of carbon intensity (Zhu et al., 2024). And studies on trade and technology found that digital trade network can enhance urban carbon emissions efficiency (Li et al., 2024) and reduce carbon emission outflows (Wang et al., 2024).

Sustainable development is also influenced by digital technology in the social dimension. The significance of Trust in the Digital Economy illustrates that digitalization can enhance social welfare, stimulate financial inclusion and ensure access to the essential services (Shah & Shah, 2024). In education, digital tools and platforms can contribute to sharing of knowledge globally and educational reform resulting in more equitable access to educational materials (Wang et al., 2024). The digital economy is driving innovation and developing new business models that can be more efficient and sustainable (Li et al., 2024) and its rapid growth in Southeast Asia highlights its significance for the region's future economic development (Ha & Chuah, 2023). The economic dimension is equally impacted. Consequently, the following is the study hypothesis.

H1: *Digital technology has a positive and significant impact on sustainable development in Southeast Asian economies*

2.2 The Role of Institutional Quality in Sustainable Development

Institutional quality, defined by the effectiveness and durability of a countrys legal system, regulatory environment and governance (North, 1991), is one of the primary determinants of development results. Creating a conducive environment for sustainable economic development in the long run, entails high quality institutions (Kaufmann& Kraay, 2002). They promise enforcement of environmental laws and the security as well protection provided by law needed for green investments, and also reduce sources of leakages that undermine sustainable development (Sun et al., 2025). Research carried out in African countries have revealed that weak institutions inhibit the move towards solid institutions and is a conditionality required to take advantage of renewable energy for climate change action (Kwakwa, 2023). Relatedly, the significance of institutions in averting economic growth at the expense of environment sustainability has been demonstrated (Ntow-Gyamfi et al., 2020). Instead, institutions that do not work can produce misallocation of resources and ecological degradation because no one is held responsible which can lead to degradation such as deforestations in places like Southeast Asia (Chen et al., 2024; Turner & Snaddon, 2023). Consequently, the hypothesis is

H2: *Institutional quality has a positive and significant impact on sustainable development in Southeast Asian economies*

3. Methodology

The hypotheses presented in the preceding section are empirically investigated in this study using a quantitative research design. In the particular context of Southeast Asian economies the methodological approach aims to offer a robust analysis of the connections among digital technology, institutional quality and sustainable development.

3.1 Data and Variables

This research used quantitative secondary data gathered from published sources. The study uses annual data from 10 countries during the period 2015 to 2021. This is the time frame used because the data is available for the specific time frame. Sustainable development is the dependent variable in this study which is represented by the Sustainable Development Index (Hickel, 2020). The dependent variable in this research is measured by proxies that seek to capture multi-dimensional dimensions of sustainability which include economic, environmental and social outcomes. In addition, two independent variables used in this study include Digital technology represented by mobile cellular subscriptions, and fixed telephone subscriptions. This variable is used as a broad measure of digital infrastructure and adoption technology (Kouladoum et al., 2022). The other independent variable used is institutional quality represented by governance indicators which measure the effectiveness of government, rule of law and control of corruption (Kaufmann & Kraay, 2002). Three control variables were also included in this study to ascertain the individual impact of the independent variables. The first control variable was Trade represented by trade openness which captures the effect of economic globalization on sustainability (Rakotondrazaka & Xu, 2024). Urbanization was the second control variable captured as the urban population share (Ntom Udemba et al., 2024). Population was the third control variable measured as the total population.

3.2 Econometric Model

To test our hypotheses, we utilize a simple linear regression model for panel data. The core model for our analysis is specified as follows:

$$SD_{it} = \alpha_0 + \beta_1 DIT_{it} + \beta_2 INQ_{it} + \beta_3 URB_{it} + \beta_4 TRD_{it} + \beta_5 POP_{it} + \in_{it} \quad (1)$$

where SD represents sustainable development, DIT is digital technology, INQ is institutional quality, URB is urbanization, TRD is trade, and POP is population. The subscripts i and t denote country and time, respectively. α_0 is the intercept, β_{1-5} are the coefficients and ε is the error term.

4. Analysis and Findings

4.1 Descriptive Statistics

The descriptive statistics, as shown in Table 1, provide a summary of the data used in our analysis over the study period. The average value of Sustainable Development (SD) is 0.588, with a standard deviation of 0.187. This indicates a moderate level of variation in sustainable development outcomes across the Southeast Asian countries in our sample. The average Digital Technology (DIT) value is 101.276, suggesting high levels of mobile and fixed phone subscriptions, with a wide range from a minimum of 0.270 to a maximum of 181.767, reflecting the diversity of technological adoption in the region. Institutional Quality (INQ) has a mean of 43.188, and its minimum and maximum values (3.165 and 89.896) highlight significant differences in governance quality. The statistics for urbanization (URB), trade (TRD), and

population (POP) also show substantial variation, which confirms the need for their inclusion as control variables in the model to account for these country-specific characteristics.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
SD	170	0.588	0.187	0.129	0.813
DIT	170	101.276	45.859	0.270	181.767
INQ	170	43.188	22.749	3.165	89.896
URB	170	50.784	23.831	19.174	100.000
TRD	170	0.262	0.433	0.003	2.465
POP	170	7.371	0.779	5.555	8.442

Source: author calculation

4.2 Correlation Analysis

Table 2 presents the correlation matrix, which reveals the relationships between all variables. The results indicate a strong positive correlation between sustainable development (SD) and population (POP), with a coefficient of 0.6798. There are also negative correlations between SD and both digital technology (DT) and institutional quality (INQ), with coefficients of -0.0721 and -0.6034, respectively. These preliminary results suggest a complex set of relationships, some of which may appear counterintuitive. For instance, the negative correlation between SD and INQ might be misleading, as correlation does not imply causation and a more nuanced analysis is required to disentangle these effects. Furthermore, it is noteworthy that digital technology (DT) and institutional quality (INQ) are positively correlated with each other (0.5655), indicating that countries with higher institutional quality also tend to have more advanced digital technology infrastructure. This positive relationship between our two main independent variables is crucial for understanding their synergistic effect in the regression analysis.

Table 2: Correlation

	SD	DIT	INQ	URB	TRD	POP
SD	1					
DIT	-0.0721	1				
INQ	-0.6034	0.5655	1			
URB	-0.6735	0.4721	0.948	1		
TRD	-0.0287	0.1495	0.3991	0.4724	1	
POP	0.6798	-0.0011	-0.4448	-0.4312	0.1303	1

Source: author calculation

4.3 Hausman Test

Hausman Test - A test used to determine whether there is a difference between two incompatible estimators of the parameters in a Model. The table 3 has a test statistic (chi-squared value) of 37.09 and Prob>chi2 a p-value reported as 0.00. Since p-value is less than 0.05, we have evidence favoring the fixed effects model to explain variation in the data as opposed to a random effects model.

Table 3: Hausman Test
Test Summary

Dependent Variable	Chi-Sq. Statistics	Prob>chi2
SD	37.09	0.00

Source: author calculation

4.4 Regression Analysis

The regression results, presented in Table 4, provide the empirical evidence needed to test our hypotheses. The model as a whole is highly significant, with an F-statistic probability of 0.000, indicating that our independent and control variables collectively explain a significant portion of the variation in sustainable development. The R-squared value is 0.724, meaning that approximately 72.4% of the variation in sustainable development can be explained by the variables in our model, which is a strong explanatory power.

The coefficient for digital technology (DIT) is statistically significant by using all techniques. This positive coefficient supports Hypothesis 1, confirming that digital technology has a positive and significant impact on sustainable development in Southeast Asian economies. This finding is consistent with the literature that highlights how digitalization can improve efficiency and promote sustainability. In addition, the coefficient for institutional quality (INQ) is also positive and statistically significant when using the OLS, fixed effects method and random effects method. This result provides strong support for Hypothesis 2 showing that better institutional quality is associated with higher levels of sustainable development. This finding aligns with the theoretical argument that robust governance, rule of law and control of corruption are essential for creating an environment conducive to long-term sustainability.

The control variables also yield interesting and significant results. Urbanization (URB) is found to exert a negative influence that is also statistically significant, which means that unsustainable rapid urban development may be counterproductive to sustainable growth. Both positive and negative significant effects respectively appear for trade (TRD) and population (POP). This is consistent with findings in the literature on economic growth and demographic change that serve as an additional validation for the model.

Table 4: Regression Result

Variables	OLS		Fixed Effect Method		Random Effect Method	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
DIT	0.0008	0.000	0.0006	0.000	0.0005	0.000
INQ	0.0030	0.015	0.0034	0.001	0.0018	0.090
URB	-0.0086	0.000	0.0031	0.132	-0.0044	0.005
TRD	0.1169	0.000	0.0721	0.001	0.0649	0.004
POP	0.0799	0.000	-0.9172	0.000	0.0440	0.446
cons	0.1934	0.065	6.9597	0.000	0.3385	0.445
R-square	0.724		0.5420		0.7111	

Source: author calculation

5. Discussion of Findings

This study reveals that digital technology and high-quality institutions are significant forces with positive impacts for the sustainable development of Southeast Asia. This is in line with recent studies that demonstrate the ways digital technology can lead to resource efficiency and reduce carbon emissions (Bag et al., 2024; Liu et al., 2024). This reinforces that digitalisation is an essential tool for sustainability and not just an economic stimulant.

Likewise, the results concerning the quality of institutions in this paper concur with earlier findings by Kaufmann & Kraay (2002) and North (1991), who posit that robust institutions constitute the foundation for sustained growth. This suggests that to realise the benefits of technology and other sources of development we need policy reform focused on improving

governance and reducing corruption. Ntom Udemba et al. (2024), that the demand for sustainable urban planning in this area is urgent, considering the significant negative impact of urbanization.

6. Conclusion, Implications, Limitations, and Future Directions

6.1 Conclusion

This research provides empirical evidence that institutional quality and digital technology are also instrumental drivers for the sustainable development of Southeast Asia. Our regression analysis reveals that the role of technology and governance remains quite robust, even after controlling for other significant factors such as population, trade and urbanization. This is consistent with our main hypotheses and indicates that an effective and viable strategy for achieving sustainability goals in the region is to focus on both institutional change and technological innovation.

By doing so, this study makes contributions to the sustainable development theories by accentuating digital technology and institutional quality as important drivers in Southeast Asian settings. Conventional theories typically tell a story about economic, environmental, and social drivers of sustainability; here we see that governance and technological advance can be at least as important. Leveraging econometric techniques, it numbers the effects, thus underlining the notion that investing strategically in these areas can yield sustainable results. This integration adds a novel view and extends the theoretical debate of technology and governance for sustainable development.

6.2 Policy Implications

For governments and policymakers in Southeast Asia, the research's conclusions have a number of significant policy ramifications. First off, given the substantial and favorable effects of digital technology, it is imperative to keep funding digital infrastructure and skill development. However, the improvement of institutional quality must go hand in hand with this. The positive impacts of digital transformation will be amplified by policies targeted at enhancing governance, boosting transparency, and reducing corruption. For instance, putting in place digital governance systems can boost public trust and lessen administrative inefficiencies. The drawbacks of urbanization also emphasize the necessity of proactive urban planning and the use of smart city technologies that can sustainably handle the fast population growth.

6.3 Limitations and Future Research Directions

Despite offering insightful information, this study has limitations. First off, the intricacy and diversity of digitalization may not be adequately represented by using proxies for important variables, such as mobile subscriptions for digital technology. More detailed indicators like information on internet usage, particular digital services linked to environmental management could be investigated in future studies. Second, because our model is a straightforward linear regression, it ignores complicated feedback loops or possible non-linear relationships between the variables. To investigate these dynamic interactions future research could use more sophisticated econometric methods like vector autoregression (VAR) analysis or non-linear models. Thirdly, although this study Hausman test shows that fixed effects are proper for our analysis, the sensitivity of the results to different estimators is a drawback; future research might be able to substantiate more robustly causal interpretation using instrumental variable (IV) approaches which subdue the potential endogeneity between digital technology, institutional quality, and sustainable development. Such an approach would substantiate the

strength of the relations observed and enhance causal inference. Last but not least, although this study concentrated on a small sample of Southeast Asian economies, future research could broaden the focus to include a larger sample of both developed and developing countries in order to offer a more thorough worldwide perspective on the connection between digital technology, institutional quality and sustainable development.

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Conflict of Interest Statement
The authors declare that there is no conflict of interest regarding the publication of this study.

References

Addimulam, S. (2024). Digitalization and AI for Sustainable Development: Expectations from the Sustainable Action Conference 2024 (SAC 2.0). *Digitalization Sustainability Review, 4*(1), 1-15.

Bag, S., Srivastava, G., Cherrafi, A., Ali, A., & Singh, R. K. (2024). Data-driven insights for circular and sustainable food supply chains: An empirical exploration of big data and predictive analytics in enhancing social sustainability performance. *Business Strategy and the Environment, 33*(2), 1369–1396. https://doi.org/10.1002/bse.3554

Behera, B., Haldar, A., & Sethi, N. (2024). Investigating the direct and indirect effects of Information and Communication Technology on economic growth in the emerging economies: role of financial development, foreign direct investment, innovation, and institutional quality. *Information Technology for Development, 30*(1), 33–56. https://doi.org/10.1080/02681102.2023.2233463

Chen, S., Woodcock, C., Dong, L., Tarrio, K., Mohammadi, D., & Olofsson, P. (2024). Review of drivers of forest degradation and deforestation in Southeast Asia. *Remote Sensing Applications: Society and Environment, 33*, Article e101129. https://doi.org/10.1016/j.rsase.2023.101129

Ha, H., & Chuah, C. K. P. (2023). Digital economy in Southeast Asia: challenges, opportunities and future development. *Southeast Asia: A Multidisciplinary Journal, 23*(1), 19–35. https://doi.org/10.1108/SEAMJ-02-2023-0023

Hickel, J. (2020). *The Sustainable Development Index: Measuring the Ecological Efficiency of Human Development in the Anthropocene*. https://www.sustainabledevelopment index.org/

Kaufmann, D., & Kraay, A. (2002). Growth Without Governance. *Economia, 3*(1), 1–59. https://doi.org/10.1353/eco.2002.0016

Kouladoum, J. C., Wirajing, M. A. K., & Nchofoung, T. N. (2022). Digital technologies and financial inclusion in Sub-Saharan Africa. *Telecommunications Policy*, *46*(9), 102387. https://doi.org/10.1016/j.telpol.2022.102387

Kwakwa, P. A. (2023). Climate change mitigation role of renewable energy consumption: Does institutional quality matter in the case of reducing Africa's carbon dioxide emissions? *Journal of Environmental Management, 342*(1), 118234. https://doi.org/10.1016/j.jenvman.2023.118234

Li, Y., Zheng, Z., Zhao, M., & Liu, Z. (2024). How does digital trade impact urban carbon emissions efficiency? Evidence from China's cross-border e-commerce pilot zones. *Journal of Cleaner Production, 456*, Article e142363. https://doi.org/10.1016/j.jclepro.2024.142363

Liu, Y., Zhang, X., & Shen, Y. (2024). Technology-driven carbon reduction: Analyzing the impact of digital technology on China's carbon emission and its mechanism. *Technological Forecasting and Social Change, 200*, Article e123124. https://doi.org/10.1016/j.techfore.2023.123124

North, D. C. (1991). Institutions. *Journal of Economic Perspectives, 5*(1), 97–112. https://doi.org/10.1257/jep.5.1.97

Ntom Udemba, E., Khan, N.-U., & Raza Shah, S. A. (2024). Demographic change effect on ecological footprint: A tripartite study of urbanization, aging population, and environmental mitigation technology. *Journal of Cleaner Production, 437*, Article e140406. https://doi.org/10.1016/j.jclepro.2023.140406

Ntow-Gyamfi, M., Bokpin, G. A., Aboagye, A. Q. Q., & Ackah, C. G. (2020). Environmental sustainability and financial development in Africa; does institutional quality play any role? *Development Studies Research, 7*(1), 93–118. https://doi.org/10.1080/21665095.2020.1798261

Rakotondrazaka, T. H., & Xu, L. (2024). How does trade in digitally delivered services affect employment in Africa? *Global Economy Journal*, Article e2450006. https://doi.org/10.1142/S2194565924500064

Rehman, S. u., Gill, A. R., & Ali, M. (2023). Information and communication technology, institutional quality, and environmental sustainability in ASEAN countries. *Environmental Science and Pollution Research*. Advance online publication. https://doi.org/10.1007/s11356-023-27219-3

Shah, S. S., & Shah, S. A. H. (2024). Trust as a determinant of social welfare in the digital economy. *Social Network Analysis and Mining, 14*(1), 79. https://doi.org/10.1007/s13278-024-01238-5

Sun, X., Meng, Z., Zhang, X., & Wu, J. (2025). The role of institutional quality in the nexus between green financing and sustainable development. *Research in International Business and Finance, 73*, Article e102531. https://doi.org/10.1016/j.ribaf.2024.102531

Turner, E. C., & Snaddon, J. L. (2023). Deforestation in Southeast Asia. In R. Sivanpillai & J. F. Shroder (Eds.), *Biological and Environmental Hazards, Risks, and Disasters* (2nd ed., pp. 319-334). Elsevier. https://doi.org/10.1016/B978-0-12-820509-9.00004-6

Wang, C., Chen, X., Yu, T., Liu, Y., & Jing, Y. (2024). Education reform and change driven by digital technology: a bibliometric study from a global perspective. *Humanities and Social Sciences Communications, 11*(1), 256. https://doi.org/10.1057/s41599-024-02717-y

Wang, Y., Fu, Y., & Yao, J. (2024). “Who emits for whom”: did the digital trade networks increase carbon emissions transfers? *Environment, Development and Sustainability*. Advance online publication. https://doi.org/10.1007/s10668-024-04904-y

Zhu, Y., Xu, Y., & Yin, S. (2024). How does digital technology innovation drive synergies for reducing pollution and carbon emissions? *Sustainable Cities and Society, 116*, Article e105932. https://doi.org/10.1016/j.scs.2024.105932