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Digitalization, Investment, and Education Level as Determinants of Digital Transformation in ASEAN

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ABSTRACT

Purpose – This research aims to further examine the social and cultural connections of communities in ASEAN countries to digital transformation. **Methodology/approach** – This research uses Positivism Methodology applied descriptively and verifiably, using data obtained from the World Bank and UNDP over a period of 10 years, from 2014 – 2023. **Findings** – It was found that the variables of high-speed internet, fixed telephone density, educational level, and the grouping of the ratio of the number of mobile phones to users showed a significant value from the research conducted. Meanwhile, the cellular phone user variable without grouping, ICT service exports, foreign direct investment both with or without grouping, and the level of education with grouping by years of schooling did not provide significant values in this study. **Novelty/value** – Communities in ASEAN countries that have social and cultural habits with high appreciation and interest in technology, thus using more than 1 mobile phone per person, can accelerate digital transformation in these countries.

INTRODUCTION

Computer-based automation has reached all human activities and various parts of the world, even remote areas, in this modern era. Although not yet optimal in some aspects, environments, and places, it is sufficient to provide information that automation has taken place in daily human life. This automation greatly assists in simplifying work in various sectors, both government and private. This is related not only to changing manual work systems into automatic ones, but also to human behavior as actors in the work.

Digitalization is a form of automation that changes manual systems into automatic or digital ones, carried out with the help of machines. Meanwhile, digital transformation is a fundamental change process that occurs in the way organizations operate and interact with their customers through the use of digital technology. This transformation is the basis for implementing digital technology to overhaul business processes, strategies, and organizational culture to face the demands of an era that is increasingly dependent on technology. The increasing digitalization in a field such as economics adds to the important role of digital transformation in making businesses remain competitive in the market (Kraus et al., 2021). In addition to digitalization, foreign investment and education levels have the

potential to also influence digital transformation, both on a small scale in a country and on a larger scale towards a group of countries that have similarities in location and culture, such as ASEAN.

The problem that arises in relation to digital transformation is whether digitalization, foreign direct investment (FDI) and Education Level (EL) can be driving factors for increasing and making digital transformation more effective in ASEAN countries, both simultaneously and partially? Digitalization taken in this study includes high-speed internet (HSI), the number of cellular phone users (CP), fixed telephone networks (FT), ICT export services (ICTSE). Previous researchers have found several gaps in research related to digital transformation, one of which is the influence of social and culture (Kraus et al., 2021). However, previous research did not mention in detail the social and culture of the community. The purpose of this study is to look further at the relationship between the social and culture of communities in ASEAN countries and digital transformation.

LITERATURE REVIEW

Digital Transformation in ASEAN

Digital transformation encompasses the adoption and integration of digital technologies across economies and societies, profoundly impacting business models, public services, and individual lifestyles (Brennen & Kreiss, 2016). In the ASEAN region, this transformation is not just a technological shift but also a strategic economic necessity to remain competitive and inclusive in the global digital economy. Despite efforts such as the ASEAN Digital Masterplan 2025, significant disparities remain between member states in terms of digital infrastructure, investment inflows, and human capital development (ASEAN Secretariat, 2021). The following sections examine six critical variables influencing digital transformation in ASEAN countries. Digital transformation is not just about implementing new technologies, but also involves changing mindsets and culture within an organization. In this context, organizations must develop new business models, redesign work processes, and ensure that employees have the skills needed to work in an increasingly technology-driven environment (Chao et al., 2024).

Digitalization Variables

High-Speed Internet

High-speed internet access—measured by broadband subscriptions or average internet speed—is widely considered a cornerstone of digital readiness. It facilitates real-time data exchange, supports e-governance, enables remote work and education, and promotes digital entrepreneurship. Studies show a positive correlation between broadband penetration and economic output, especially in service-based economies (Czernich et al., 2011). In ASEAN, broadband infrastructure varies significantly. Singapore and Malaysia have near-universal high-speed internet, while countries like Laos and Myanmar lag behind, impeding their digital economies (World Bank, 2020). The availability and affordability of broadband also influence the development of downstream technologies such as AI, IoT, and big data. Investments in broadband infrastructure can significantly improve productivity, reduce transaction costs, and foster innovation ecosystems (OECD, 2020).

High-speed internet is an important component in the development of information technology in the modern world. In recent decades, the internet has grown rapidly, both in terms of speed, reach and capacity. Higher internet speeds enable various new applications and services that were previously impossible (Zhan & Yang, 2024).

Cellular Phone Density

Cellular phone density—commonly measured as mobile cellular subscriptions per 100 people—serves as a proxy for digital access and mobility. In developing regions, mobile phones are often the primary tool for accessing the internet, especially where fixed-line infrastructure is limited. In ASEAN, mobile penetration is relatively high, with some countries exceeding 100% penetration due to multiple SIM

ownership (GSMA, 2021). High mobile density facilitates access to digital platforms such as mobile banking, e-commerce, and health apps, contributing to financial inclusion and social empowerment. Moreover, mobile networks have enabled rapid deployment of digital services during crises, such as the COVID-19 pandemic. However, disparities in digital literacy and smartphone affordability still pose barriers to equitable mobile internet use (ITU, 2022).

Meanwhile, mobile phones, or what is more popularly known as cell phones, are one of the communication technologies that have changed the way humans interact, work and live their daily lives. Since it was first introduced in the late 20th century, mobile phones have experienced rapid development, both in terms of technology, function and their impact on society (Veyra-selpa, 2024).

Fixed Telephone Density

While fixed telephone density has declined in importance in the era of mobile and wireless communication, it remains a useful indicator of a country's legacy ICT infrastructure. Fixed lines are often associated with urban, institutional, and enterprise networks, which may require stable, high-bandwidth connections for operations such as back-end IT systems, teleconferencing, or data centers.

Countries with strong fixed-line infrastructure are often more prepared to adopt next-generation technologies like fiber-optic broadband and enterprise cloud services. Fixed telephone density also reflects the level of historical investment in ICT, which can influence the trajectory of digital transformation (OECD, 2020). Nevertheless, in much of ASEAN, the expansion of mobile networks has surpassed fixed-line development, especially in rural and remote areas. Landline telephones are a form of communication that uses a cable system to transmit sound from one place to another. This landline telephone system has been used since the 19th century, and although communication technology has developed rapidly with the advent of mobile phones and the internet, landline telephones are still used in many places, especially in areas that are not yet reached by wireless technology. And currently, many landline telephones have changed their function to become a means of channeling high-speed data (Balashov et al., 2023).

Investment Variables

ICT Service Exports

ICT service exports capture a country's capacity to participate in the global digital economy by delivering software development, digital consulting, cloud services, and call center operations to foreign clients. This variable is both an outcome and a driver of digital transformation.

High levels of ICT service exports indicate a mature digital services sector and suggest strong capabilities in IT skills, infrastructure, and international collaboration. For example, Singapore and the Philippines have developed robust ICT export sectors, with the Philippines becoming a global hub for business process outsourcing (UNCTAD, 2021). ICT service exports contribute to employment, foreign exchange earnings, and technology transfer. Countries with high ICT export performance often benefit from network effects, knowledge spillovers, and improved digital competitiveness (World Bank, 2021). Information and Communication Technology (ICT) is a collection of tools and technologies used to manage, store, and transfer information through digital systems. ICT services include various forms of using this technology to support communication and information needs in daily life. In the context of ICT service theory, many concepts and models explain how these technologies are used, and how they can optimize performance in various sectors such as education, business, government and health (Saif et al., 2023).

Foreign Direct Investment (FDI)

FDI is a vital mechanism for transferring technology, expertise, and capital into host countries. In the context of digital transformation, FDI in ICT sectors can accelerate the development of digital infrastructure, innovation ecosystems, and human capital (Borensztein et al., 1998). ASEAN countries have actively sought to attract FDI by offering tax incentives, regulatory reforms, and digital economy agreements. For instance, Indonesia's digital economy has seen significant FDI inflows into its e-commerce and fintech sectors, contributing to job creation and service innovation (UNCTAD, 2020). FDI also fosters competition and enhances the absorptive capacity of domestic firms by exposing them to global best practices and technologies.

However, the benefits of FDI are contingent upon a country's institutional quality, infrastructure, and education system. Without adequate local skills and infrastructure, FDI may remain enclave-oriented with limited spillovers to the wider economy. Foreign investment plays an important role in the global economy. Through the flow of capital from developed to developing countries, foreign investment can drive economic growth, create jobs, and transfer technology and skills. Foreign investment includes two main forms: foreign direct investment (FDI) and foreign portfolio investment (Mai, 2020). Meanwhile, human development is a process that aims to improve the quality of life of individuals in physical, social, emotional, intellectual and spiritual aspects. The main focus of the theory of human development is to pay attention to the potential of each individual to grow, develop and achieve better well-being, which includes various perspectives, including education (Sviridova, 2022).

Human Capital Variable

Educational Level

Education is the backbone of a country's digital capacity. A well-educated population is more adaptable to technological change and more capable of using, developing, and innovating with digital tools. Higher education levels are associated with increased productivity, digital literacy, and entrepreneurial capability (Schwab, 2019). In ASEAN, countries with higher investment in education—particularly STEM—show stronger performance in digital innovation.

Educational level also determines the workforce's readiness to handle high-skill digital jobs. Lifelong learning systems, vocational training, and digital skills development are essential for reskilling workers and reducing the risk of digital unemployment (ILO, 2021). Moreover, digital education policies—such as integrating coding and data literacy into school curricula—can prepare younger generations for a digital future. However, the education gap remains a significant barrier across ASEAN, with rural populations, women, and disadvantaged groups often lacking equal access to quality education and digital skills training (World Bank, 2021).

5. Synthesis and Theoretical Implications

The six variables reviewed—high-speed internet, cellular phone density, fixed telephone density, ICT service exports, FDI, and education level—do not act in isolation. Their interactions create a synergistic environment that can either accelerate or hinder digital transformation. For instance, FDI into ICT sectors will be more impactful in countries with high educational levels and robust broadband infrastructure. Similarly, ICT service exports are more viable when there is a skilled labor force and international-grade digital infrastructure. In the ASEAN context, a multidimensional approach is needed—combining infrastructure development, investment attraction, and human capital strengthening—to ensure sustainable and inclusive digital transformation.

METHOD

The method used in this research is positivism methodology, which emphasizes empirical evidence based on observation and experimentation, applied descriptively and verifiably (Elahi et al., 2024). The descriptive method is used to determine the value of variables independently, whether one or more variables, without making comparisons or connecting one variable to another. Meanwhile, the verification method is used to determine the relationship (cause and effect) or influence between two or more variables.The descriptive method in this study is used to determine the partial effect of variables, namely high speed internet (HIS), cellular phone density (CP), fixed telephone density (FT), ICT service exports (ICTSE), foreign direct investment (FDI) and educational level (EL) on digital transformation. Meanwhile, the verification method is used to determine the simultaneous effect of all these variables on digital transformation.

RESULT AND DISCUSSION

This research demonstrates the influence between the X variables and the Y variable, both simultaneously and partially. The X variables consist of high-speed internet (HIS), cellular phone density (CP), fixed telephone density (FT), ICT service exports (ICTSE), foreign direct investment (FDI), and educational level (EL). Meanwhile, the Y variable is represented by digital transformation (DT).

For the variables high-speed internet (HIS), cellular phone density (CP), fixed telephone density (FT), ICT service exports (ICTSE), foreign direct investment (FDI), and digital transformation (DT), the data was obtained from the World Bank with a time range from 2014 to 2023. As for the educational level (EL), the data was obtained from the UNDP (United Nations Development Program) with the same time range of 10 years. The details of each data point have been summarized and can be seen in Table 1 below, which contains the variable, unit, notes, and data source.

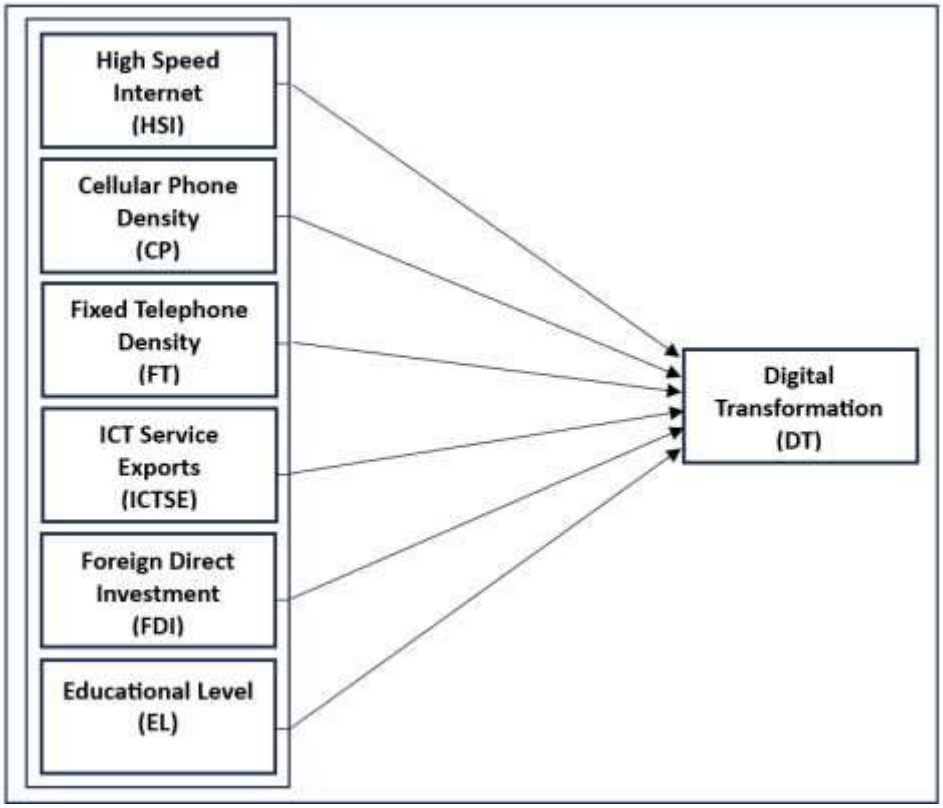
Table 1. Variables Used and Data Sources

Economies	Variable	Measurement	Note	Data Source
ASEAN Countries	High Speed Internet (HSI)	Numeric	Number of internet subscriptions per 100 people	World Bank
	Cellular Phone (CP)	Numeric	Number of mobile phones per 100 people	World Bank
	Fixed Telephon (FT)	Numeric	Number of fixed telephone subscriptions per 100 people	World Bank
	ICT Service Exports (ICTSE)	% of service exports, BOP	Includes computer and communication services and information services	World Bank
	Foreign Direct Investment (FDI)	% of GDP	Net inflows of investment	World Bank
	Educational Level (EL)	Number of years	Expected years of schooling in years	UNDP
	Digital Transformation (DT)	% of population	Individuals using the internet	World Bank

Source: Author

The table 1. above shows all the information sets from the data used in the research from ASEAN countries. BOP indicates the Balance of Payment condition, while the educational level represents expected years in schooling, and digital transformation is shown as the percentage of individuals using the internet.

As for the relationship between variables X and Y, both the simultaneous and partial influences can be seen in Figure 1 below.



Source: Author

Figure 1. Thinking Paradigm

From the Figure 1., it can be seen that there is an influence between six X variables and the Y variable, both simultaneously and partially. Then, the six X variables are added with three indicator variables with indicator or dummy data based on certain groupings, thus providing the following formulation:

$$lnDT_{i.t-1} = \delta + \gamma_1 lnHSI_{i.t-1} + \gamma_2 lnCP_{i.t-1} + \gamma_3 lnFT_{i.t-1} + \gamma_4 lnICTSE_{i.t-1} + \gamma_5 lnFDI_{i.t-1} + \gamma_6 lnEL_{i.t-1} + \gamma_7(D_{CP}\ x\ lnCP_{i.t-1}) + \gamma_8(D_{FDI}\ x\ lnFDI_{i.t-1}) + \gamma_9(D_{EL}\ x\ lnEL_{i.t-1}) + \varepsilon_{i.t-1} \quad (1)$$

D_{CP} is indicator data of CP, where groupings > 100 are valued as 1 and others as 0; D_{FDI} is indicator data of FDI, where groupings > 10% of GDP are valued as 1 and others as 0; and D_{EL} is indicator data of EL, where groupings > 12 years of schooling are valued as 1 and others as 0.

The collected data was managed using EViews 13 software based on the formulated equations. The processed results show the significance of the influence between variable X and Y, both partially and simultaneously. The Chow test results between the Common Effect Model and the Fixed Effect Model showed a significant difference, thus the Fixed Effect Model was chosen. Similarly, the Hausman test results between the Fixed Effect Model and the Random Effect Model also indicated significance,

leading to the selection of the Fixed Effect Model for examining the partial and simultaneous influences. The full results of this data processing are presented in Table 2.

Table 2. Fixed Effect Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.89563	5.950242	1.831123	0.0723
LNHSI	0.353905	0.070002	5.055639	0.0000
LNCP	-0.083837	0.428122	-0.195826	0.8454
LNFT	-0.416516	0.104627	-3.980945	0.0002
LNICTSE	-0.038451	0.040516	-0.949017	0.3466
LNFDI	0.150420	0.078192	1.923710	0.0594
LNEL	-5.769421	2.684353	-2.149278	0.0359
LNCP_DCP	0.192903	0.075298	2.561853	0.0131
LNFDI_DFDI	0.965287	0.513951	1.878168	0.0655
LNEL_DEL	3.651306	3.667943	0.995464	0.3237
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.866504	Mean dependent var		3.844352
Adjusted R-squared	0.824347	S.D. dependent var		0.625195
S.E. of regression	0.262025	Akaike info criterion		0.371566
Sum squared resid	3.913463	Schwarz criterion		0.954250
Log likelihood	4.880474	Hannan-Quinn criter.		0.604435
F-statistic	20.55435	Durbin-Watson stat		1.945184
Prob(F-statistic)	0.000000			

From Table 2, we can distinguish between the partial and simultaneous effects or influences, located in the top and bottom positions respectively. For partial influence, there are four significant variables: lnHSI, lnFT, lnEL, and (D_{CP} x lnCP). Simultaneous influence is indicated by the significance of the Prob (F-statistic) and the adjusted R-squared values. High Speed Internet (HSI) has a significant value, showing that this variable is key to the interconnectedness between entities through the internet via various media, such as smartphones, tablets, digital TVs, computers, and other IP-based communication devices.

Speed is a crucial factor in this connectivity, given that many applications today require large computer memory and high RAM (Random Access Memory) for processing large amounts of data (big data). Fixed Telephone density still plays an important role, as indicated by its significance as a partial influencing factor. While still used by individuals, commercial and non-commercial organizations, many of these networks are now being repurposed to distribute fiber optic networks, which in turn support high-speed internet. Education Level (EL) is also significant across all levels, influencing digital transformation in ASEAN. However, the grouping for education lasting > 12 years does not show significance.

Mobile phone users overall do not provide a significant value to digital transformation in this region. However, grouping mobile phone usage with > 100 users per 100 people does show significant value. This indicates that cultures with more than one mobile phone per person will have an important

influence on improving digital transformation in ASEAN. This finding is novel from the research conducted. Meanwhile, Foreign Direct Investment does not show a significant value from ASEAN countries. This is likely because foreign direct investment is not targeted towards digital transformation in a significant amount. Grouping foreign direct investment > 10% of GDP also does not show a significant impact in this research. Similarly, ICT Service Exports also do not show a significant value in relation to the development of digital transformation in ASEAN countries in this study. This is possibly because countries in this region do not yet have significant ICTSE figures important for the development of business in each country.

Meanwhile, Table 2 shows the influence of independent variables on the dependent variable, as well as the quality of the equation created. The adjusted R^2 value is good, as seen by its value being > 0.8. This indicates that each independent variable included in the equation is fairly important and consistent with the output of the dependent variable value. The Prob (F-Statistic) value, or p-value, also has a significant value, indicating that the independent variables have a significant simultaneous impact on the dependent variable. Further, other parameters from the EViews processing show that the model is good, as well as the relationship between the model. Overall, the influence of the independent variables on the dependent variables is good, both partially and simultaneously, and based on the processed data.

CONCLUSION

This research employs a positivist methodology, applied descriptively and verificatively, using several digital variables: investment and education, comprising high-speed internet (HIS), cellular phone users (CP), fixed telephone density (FT), ICT service exports (ICTSE), foreign direct investment (FDI), and educational level (EL). This is supplemented by three indicator variables derived from the groupings of cellular phone users, foreign direct investment, and educational level, all influencing digital transformation in ASEAN countries. Partially, each variable X, namely HIS, FT, EL, and the CP indicator variable, with a group of > 100 cellular phone users per 100 people, has an effect on digital transformation as the variable Y. Novelty is derived from these indicator variables, which demonstrate a high social and cultural interest in technology; the ownership of more than one mobile phone per person has a significant influence on the acceleration of digital transformation. There is also a significant influence of the variables X simultaneously on digital transformation as variable Y.

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