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THE ROLE OF DIGITAL INFRASTRUCTURE, ICT SKILLS AND ICT ACCESS IN ENHANCING LABOR PRODUCTIVITY IN INDONESIA

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Abstract
This study aims to analyze the influence of information and communication technology skills, access to information and communication technology (ICT access), and investment in BTS tower construction infrastructure on labor productivity in Indonesia during the period 2017 to 2023. The data used in the form of data panels from 34 provinces in Indonesia were analyzed using the panel data regression method. The results of the study show that ICT access and investment in BTS tower construction have a positive and significant effect on labor productivity. However, ICT skills do not show a statistically significant influence. The independent variables together are able to explain 99% of the changes in labor productivity in Indonesia. These findings affirm the importance of developing infrastructure and equitable access to ICT as the key to increasing productivity, as well as the need to improve the quality of education and training to strengthen the digital skills of the workforce. This research provides policy recommendations to accelerate the development of digital infrastructure and ICT capability improvement programs to support national productivity growth.

Keywords: Labor Productivity, ICT Skills, ICT Access, BTS Investment

1. Introduction

In the era of global digital transformation, information and communication technology (ICT) has become a major pillar in supporting modern economic development. Technological advances are not only changing the way humans work and interact, but also contribute directly to labor productivity through increased efficiency and access to information. In Indonesia, although the rate of internet penetration and the use of digital devices continues to grow, the gap in ICT access and capabilities is still a major challenge, especially between urban areas and 3T (disadvantaged, frontier, outermost) areas (;). One of the efforts to bridge this gap is through investment in the development of digital infrastructure such as BTS towers which play a vital role in expanding signal coverage and connectivity. Mankiw, 2018. International Telecommunication Union, 2023, BPS, 2022, Ministry of Communication and Informatics, 2023.

However, the success of ICT development is not only measured by infrastructure alone, but also determined by the ability of the community to access and utilize this technology productively. Therefore, ICT skills and the availability of ICT access are crucial dimensions in the ICT development index compiled by the International Telecommunication Union. These three elements, namely expertise, access, and infrastructure investment, have great potential in increasing labor productivity, which is an important indicator for a country's economic growth (Gomez). (ITU, 2009), Hanri et al, 2024 Gómez-Barroso & Marbán-Flores, 2020.

In the midst of this dynamic, Indonesia occupies an attractive position: as the fourth largest internet user in the world, but still faces challenges in terms of internet speed and

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equitable distribution of ICT development. This gap reflects that despite the great potential of digital, its impact on productivity has not been evenly optimized. Furthermore, according to data, Indonesia is still ranked fifth in labor productivity in the ASEAN region, far behind Singapore and Malaysia. The following is a graph. (KOMINFO, 2023), International Labour Organization (2022).

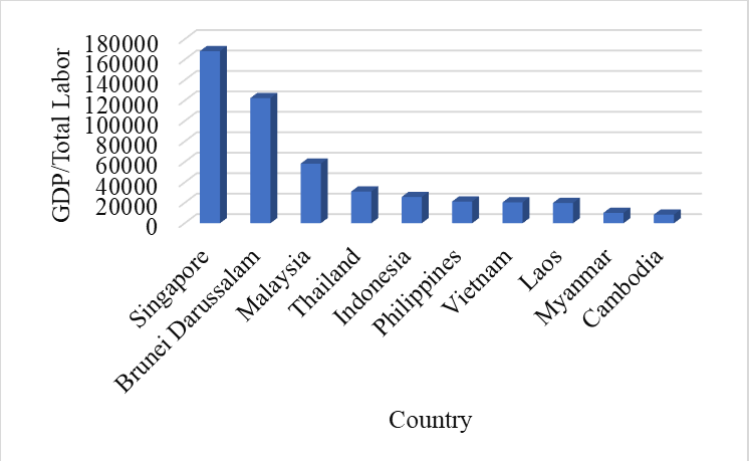

Figure 1. Productivity of Labor in ASEAN 2022

Figure 1 explains that Singapore is ranked at the top as the country with the highest labor productivity in ASEAN, where each worker is able to generate a value of 168,282 dollars. Brunei Darussalam is in second place with a productivity of 122,374 dollars per workforce. Malaysia ranks third with 58,305 dollars. Meanwhile, Cambodia is recorded as the country with the lowest labor productivity in the ASEAN region, with each worker earning only 8,412 dollars. Labor productivity in Singapore, Brunei Darussalam, and Malaysia has a significant difference when compared to Indonesia, even though Indonesia ranks fifth in the list of countries with the highest labor productivity in ASEAN. The following graph illustrates the productivity of the workforce in Indonesia.

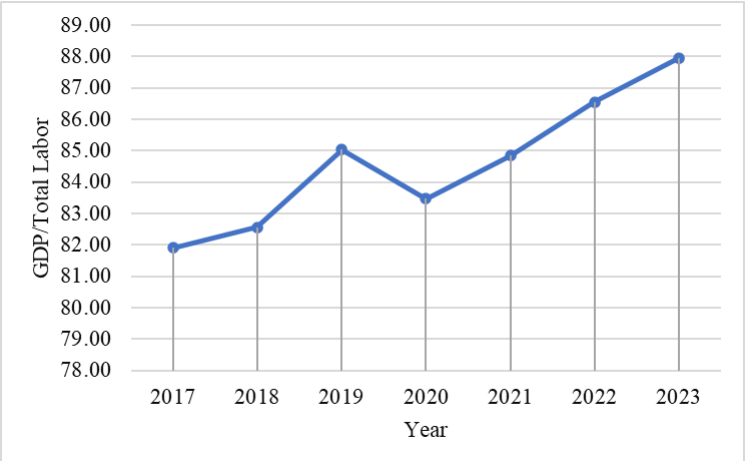

Figure 2. Labor Productivity in Indonesia 2017-2023

Figure 2 shows that, in the period 2017 to 2022, the largest spike in labor productivity occurred between 2018 and 2019, from 82.56 million rupiah to 83.48 million rupiah, an increase of 2.48 million rupiah. However, in the following year, from 2019 to 2020, labor productivity experienced a significant decline. Productivity in 2019 was recorded at 85.04 million rupiah, but decreased by 1.56 million rupiah to 83.48 million rupiah in 2020. Furthermore, from 2021 to 2022, productivity again showed an increase of 1.70 million rupiah, a fairly large increase considering that Indonesia is still in the recovery stage after

the COVID-19 pandemic. In 2022, labor productivity reached its highest point during that period, which was 86.55 million rupiah. This increase is thought to be related to the success of the workforce and companies in overcoming various challenges that arise during the pandemic (Hanri et al., 2024).

Figure 2 indicates that there is a need to strengthen the role of ICT in supporting the efficiency and competitiveness of the workforce in various sectors. One of the main obstacles to labor productivity in Indonesia is the lack of flexibility in the labor market. The problems faced by the labor market in Indonesia include low wage levels for workers, accompanied by very strict labor regulations. In addition, the skills of the workforce in Indonesia are still relatively minimal because the government's training program is not on target. This condition then has a negative impact on labor productivity, because the portion of labor that plays a role in the market cannot be utilized optimally.

In recent years, various studies have shown a positive relationship between strengthening the ICT ecosystem and increasing labor productivity. A study by Gómez-Barroso & Marbán-Flores (2020) and confirms that the adoption of ICT is able to speed up work processes, expand professional networks, and create efficiency in production and service activities. However, this positive effect largely depends on the extent to which the workforce is able to master the digital skills needed. Countries with high levels of ICT expertise tend to be better equipped to adapt to technological disruption and work automation. Conversely, limitations in individual digital capacity can lead to productivity inequality, even increasing the risk of workers being displaced by automated machines and systems. Vu et al (2020).

In addition, investment in infrastructure such as the construction of 4G Base Transceiver Station (BTS) towers has a strategic role in expanding accessibility to digital services. Better access to the internet and communication networks has been proven to increase workforce engagement in the digital economy, especially in remote areas that were previously difficult to reach. According to, there are still more than 9,000 3T regions in Indonesia that do not have equal access to the 4G network. The absence of this infrastructure is a significant structural obstacle in encouraging equal distribution of labor productivity in all corners of the country. KOMINFO (2022).

Departing from these conditions, this study aims to analyze the influence of ICT skills, ICT access, and investment in infrastructure development such as BTS towers on labor productivity in Indonesia. The findings of this study are expected to make an empirical and practical contribution in designing digital development policies that are more inclusive and oriented towards increasing the capacity of the national workforce. In addition, this study is also expected to enrich the literature on the relationship between technology and labor productivity, especially in the context of developing countries.

2. Theoretical Background

This research is based on the theory of human capital by Gary Becker (1964) and Theodore Schultz (1961), which states that human resources are not just labor, but are capital that can be invested through education, training, and experience to increase individual productivity. Formal education, technical skills training, and work experience are examples of human capital investments that can improve individuals' ability to perform complex tasks and adapt to technological changes. In the context of the modern economy, especially in the digital era, the theory of human capital is increasingly relevant because technological advances require the workforce to have higher skills and adaptability to innovation. Digital skills or ICT skills are one of the main components of

human capital today. Workers who have mastery of information and communication technology are able to use software, utilize digital data, and communicate and collaborate effectively using digital technology. (Becker, 1975), (Levy et al., 2003).

A number of empirical studies support the relevance of this theory. According to, investment in ICT infrastructure and the improvement of users' digital skills significantly strengthen economic performance, where access and use of ICT contribute directly to productivity growth. also showed that every 1% increase in the ICT index had a positive effect of 0.357% on labor productivity, with internet use and digital skills as the main components having the greatest impact. Behera et al (2024). Shahnazi (2021).

Furthermore, it found that ICT investment and utilization increase labor productivity not only directly, but also through changes in total factor productivity (TFP) in sectors that use the technology. emphasized that infrastructure investments such as the construction of BTS towers are an important element to expand network access that supports increased added value and work productivity. Thus, the existence of adequate digital infrastructure, sufficient ICT skills, and equitable access are the three main pillars in efforts to increase labor productivity. Mlynarzewska & Borowiec (2021). Vu et al (2020).

In Indonesia, there is still a gap in equitable access to ICT and the level of digital skills of the workforce, especially in remote areas; This results in productivity potential not being optimized evenly across the region. stated that the uneven quality of education and technical training is also an obstacle in the development of effective ICT skills. adding that traditional sectors such as agriculture and manufacturing still lack the intensive use of digital technology so that the influence of ICT skills on productivity in this sector is relatively low. (Ministry of Communication and Informatics, 2023. BPS (2022), Cunningham et al (2022), OECD (2024).

Access to ICT facilitates more efficient work processes through rapid dissemination of information, remote collaboration, and automation of routine tasks (; ;). Infrastructure investments, especially the construction of BTS towers, support better quality and coverage of connectivity, which enables workers and enterprises to improve communication, decision-making, and adaptation to digital technologies (;). Studies show that increased broadband penetration is positively correlated with economic growth, reflecting an increase in labor productivity. Brynjolfsson & Hitt (2000), Walsham & Sahay (2006), Aral et al. (2012), Kumar & Best (2006), Qiang et al. (2009).

This research departs from the issue of the importance of the role of Information and Communication Technology (ICT) in increasing labor productivity in Indonesia, especially through ICT access, ICT skills, and infrastructure investment such as the construction of BTS towers. Although various previous studies have shown the positive impact of ICT on productivity, the realization of these benefits does not automatically occur without the support of adequate access and the ability of human resources to operate the technology.

Some of the problems that arise include the gap in ICT access in Indonesian regions that are not evenly distributed, especially in remote areas, so that not all workers can make optimal use of technology. Variations in ICT skill levels among the workforce affect the effectiveness of technology utilization, so ICT investment alone without skill improvement is not enough to boost productivity. ICT infrastructure investment, such as the construction of BTS towers, which are the foundation of network access, has not always been followed by a significant increase in productivity due to limited skills and utilization.

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Based on this issue, the hypothesis in this study was developed with the assumption that adequate ICT access, through the availability of networks and infrastructure such as BTS towers, will increase the ability of the workforce to access information and digital resources, so that labor productivity can increase. ICT skills or expertise in using technology are a key factor that allows the workforce to optimize the benefits of ICT access to increase efficiency and work output. Investment in the construction of BTS towers as part of ICT infrastructure plays an important role in expanding network coverage and improving access quality, which ultimately has an impact on increasing labor productivity.

3. Methods

This study uses a descriptive method with a quantitative approach, namely multiple linear regression. The data used is in the form of a data panel, which is a combination of Cross Section and Time Series data. Cross Section data is taken from 34 provinces in Indonesia, while Time Series data covers the period from 2017 to 2023. The free variables in this study include ICT access, ICT Skill and ICT Investment. Meanwhile, the bound variable is labor productivity in Indonesia. Here are the equations:

$$PRODit = \beta 0 + \beta 1SKILLit + \beta 2ACCESSit + \beta 3ln(BTSit) + \mu it$$

Where:

PROD : Labor Productivity (Million Rupiah/Workforce)
SKILL : Number of ICT Skills (index)
ACCESS : Total ICT Access (Index)
BTS : ICT Investation (BTS Tower) (Unit)
μ : Error Term
i : 34 Provinces in Indonesia
t : Period (2017-2023)

4. Results and Discussion

4.1 Model Selection

This study evaluated three panel data estimation approaches, namely the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM), in order to determine the most appropriate specification for the analysis. The model selection process involved two specification tests: the Chow test and the Hausman test. The Chow test, which compares the CEM and FEM, produced a probability value of 0.0000, which is lower than the 5% significance level ($\alpha = 0.05$), indicating that the FEM is statistically preferred over the CEM. Subsequently, the Hausman test was applied to distinguish between the FEM and REM, yielding a probability value of 0.0025, also below the 0.05 threshold, confirming that the FEM is superior to the REM. These findings consistently suggest that the FEM is the most appropriate model for this study. Moreover, diagnostic evaluations indicate that the selected model satisfies the classical assumption tests, ensuring the robustness and validity of the parameter estimates.

Table 1. Summary of Model Selection Tests

Test Type	Compared Models	Test Statistic	Chi-Sq./F Value	Prob.	Decision
Chow Test	CEM vs FEM	Cross-section F	715.567046	0.0000	FEM
Hausman Test	FEM vs REM	Chi-Sq. Statistic	14.294651	0.0025	FEM

Source: Author's computation using EViews, 2025

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From the results of the above two tests, it is concluded that the FEM model is the best model for estimation in this study. The test results in this study have passed the classical assumption test. The results of the FEM estimate are as follows.

Table 2. FEM Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	21.47107	8.561703	2.5078	0.0129
SKILL	4.356095	2.715051	1.60443	0.1102
ACCESS	2.078282	0.862752	2.4089	0.0169
Ln(BTS)	4.949906	2.397028	2.06502	0.0402
R-squared	: 0.99435			
Adjusted R-squared	: 0.993338			
F-Statistic	: 982.5768			
Prob (F-statistic)	: 0.0000			

Source: Data Processing Results with Eviews, 2025

Table 2 shows the results of the FEM estimation, and the equation is obtained:

$$PRODit = 21.47107 + 4.356095\ SKILLit + 2.078282\ ACCESSit + 4.949906\ ln(BTSit) + \mu it$$

4.2 T-test

The individual significance of the independent variables on labor productivity in Indonesia was examined using the t-test. The hypotheses for each variable were formulated as follows:

- H_0: $\beta = 0$, indicating no significant effect on the dependent variable.
- H_1: $\beta > 0$, indicating a positive and significant effect on the dependent variable.

Table 3. Summary of t-Test Results

Variable	t-Statistic	t-Table (α=0.05; df=235)	Probability	Decision	Conclusion
ICT Skills	1.60	1.97	0.1102	Fail to reject H_0	ICT Skills do not have a significant effect on labor productivity.
ICT Access	2.40	1.97	0.0160	Reject H_0	ICT Access has a positive and significant effect on labor productivity.
BTS (ICT Investment)	2.06	1.97	0.0400	Reject H_0	BTS (ICT Investment) has a positive and significant effect on labor productivity.

Source: Authors' calculation using EViews, 2025.

The results of the t-test indicate that ICT Skills have a t-statistic of 1.60, which is lower than the critical t-value of 1.97 at the 5% significance level (df = 235), with a probability value of 0.1102. This implies that ICT Skills do not exert a statistically significant effect on labor productivity in Indonesia.

Conversely, ICT Access yields a t-statistic of 2.40, exceeding the critical value, and a probability value of 0.016 (< 0.05), indicating a positive and significant relationship with labor productivity. This suggests that improved ICT infrastructure accessibility is associated with enhanced productivity outcomes.

Similarly, BTS (ICT Investment) records a t-statistic of 2.06, surpassing the critical threshold, with a probability value of 0.040 (< 0.05). This result confirms that greater ICT investment, represented by BTS infrastructure, has a positive and significant influence on labor productivity.

Collectively, these findings underscore that while ICT skills alone do not yield measurable productivity gains, improvements in ICT access and strategic infrastructure investment are critical drivers of labor productivity enhancement.

4.3 F-Test

Table 4. F-Test Results

Statistic	Value	F-Table (α = 0.05; df = 2, 235)	Probability	Conclusion
F-Statistic	982.57	3.03	0.0000	Reject H_0 — ICT Skills, ICT Access, and BTS jointly have a significant effect on labor productivity.

Source: Authors' calculation using EViews, 2025.

The F-test results presented in Table 7 indicate an F-statistic of 982.57, substantially higher than the critical F-value of 3.03 at the 5% significance level (df = 2, 235). The probability value of 0.0000 is well below the threshold of 0.05, leading to the rejection of the null hypothesis (H_0). These results demonstrate that ICT Skills, ICT Access, and BTS (ICT Investment) collectively exert a statistically significant influence on labor productivity in Indonesia. This suggests that the integration of human capital capabilities, infrastructural access, and technological investment forms a synergistic framework that enhances productivity outcomes. The joint significance of these variables reinforces the argument that productivity improvements in the digital era require a balanced combination of skill development, infrastructure accessibility, and strategic ICT investment.

4.4 Coefficient of Determination (R2)

A regression model is said to be good when the R2 value is close to 1 ($0 \leq R2 \leq 1$). Based on the results of the FEM estimate, the R2 value is 0.99, this means that the independent variables, namely ICT skill, ICT access, and BTS, can explain the change in the labor productivity variable by 99%, the remaining 1% is influenced by other variables that are not included in this study.

4.5 Discussion

4.5.1 The Influence of ICT Skills on Labor Productivity

Based on the regression results, ICT skill variables do not have a significant effect on labor productivity in Indonesia. The absence of a significant influence between ICT skills and labor productivity in Indonesia can be explained by looking at the following data:

Table 5. ICT Skill Indicator, 2021-2023 (index)

Indicators	Year		
	2021	2022	2023
Average length of school	8.97	9.08	9.13
Secondary gross participation rates	88.93	88.76	89.37
Tertiary gross participation rate	30.43	30.81	31.02

Source: Indonesian Central Statistics Agency, 2024.

Table 5 shows that the average length of schooling for Indonesians over 15 years old is around 9 years (equivalent to junior high school education/equivalent). This suggests that most of the workforce may not have completed upper secondary or higher education which is usually the basis for mastering ICT skills in greater depth. This limited education can limit the ability of the workforce to develop and apply ICT skills effectively so that it does not have a significant impact on work productivity.

A secondary gross participation rate of about 89-90 percent indicates that most of the high school-age population does go to school, but only about 31 percent reach higher education (D1 to S1). Higher education is usually more closely related to the use of ICT and more sophisticated technology. This low figure shows that only a small part of the workforce actually has the education that supports optimal ICT mastery.

In addition to the length of education, the quality and curriculum of education that has not fully focused on ICT skill development is also a limiting factor. The results of this study are in line with several previous studies. According to research from, improving the quality of education and technical training is very important so that ICT skills can be applied effectively in the world of work. If the education and training curriculum of the workforce is not in line with the technological needs in the field, then the ICT skills possessed by the workforce cannot significantly increase productivity. Cunningham et al (2022)

Productivity related to ICT is highly dependent on the availability and access of technological infrastructure such as high-speed internet, adequate hardware and software. In some regions of Indonesia, especially in less developed areas, this access is still very limited so even though the workforce has ICT skills, they cannot apply them to the fullest (ITU, 2023).

Not all industrial sectors in Indonesia make intensive use of ICT technology. For example, the traditional agriculture and manufacturing sectors may still rely heavily on manual labor and less use of digital technology. Therefore, ICT skills do not have a significant effect on productivity in these sectors (OECD, 2024).

4.5.2 The Influence of ICT Access on Labor Productivity

Based on the regression results, the ICT access variable has a positive and significant influence on labor productivity in Indonesia. This indicates that access to ICT (Information and Communication Technology) fundamentally changes the way the workforce operates, communicates, and collaborates in various sectors. With adequate ICT access, the workforce can improve their work efficiency and effectiveness, which directly contributes to increased productivity. ICT technology allows the dissemination of information in real-time, reducing the time it takes to obtain data and analyze it. The results of this study are in line with several previous studies. According to companies, investing in ICT shows a significant increase in productivity because they are able to optimize business processes and faster decision-making. This speed of information allows

the workforce to reduce waiting time and speed up task completion. Brynjolfsson & Hitt (2000).

ICT provides a variety of communication tools such as email, video conferencing, and collaboration platforms that enable cross-location and time team coordination. According to, extensive access to ICT makes it easier for workers to share knowledge and work together effectively, resulting in an increase in output and work quality. This is very relevant in the era of remote work (remote work) which is now increasingly common. ICT also opens access to digital learning resources, such as e-learning, webinars, and online tutorials that help the workforce improve their skills independently. As shown by, the workforce that is able to take advantage of digital technology tends to have higher productivity because they are more adaptive and skilled in dealing with complex tasks. Walsham & Sahay (2006), Levy et al (2003).

In addition, ICT enables the automation of routine work processes that reduce manual workloads, allowing the workforce to focus on tasks that require creativity and critical thinking. According to , this automation has a positive impact on productivity because it speeds up business processes and reduces human error. ICT access also reduces transaction and communication costs, allowing companies and labor to reach a wider market more efficiently. This allows for increased productivity because the workforce can handle a larger volume of work with the same resources. Aral et al (2012), (Qiang et al., 2009).

4.5.3 The Influence of ICT Investments (BTS towers) on Labor Productivity

Based on the regression results, the BTS variable (ICT investments) has a positive and significant influence on labor productivity in Indonesia. The significant positive influence between ICT investments in the form of BTS tower construction and labor productivity in Indonesia can be explained by looking at investment in the construction of BTS towers, which is an important infrastructure in telecommunication networks, can improve the quality and range of communication signals. This increase in communication access directly affects labor productivity through several mechanisms. Telecommunication infrastructure, especially BTS towers, is the backbone of mobile communication networks that provide data and voice connectivity. Strong connectivity allows for real-time access to information, which is critical in a modern world of work that relies heavily on fast and accurate information.

The results of this study are in line with several previous studies. Studies by show that every 10% increase in broadband penetration can increase GDP per capita by 1.38%, which indirectly reflects an increase in labor productivity. With the construction of BTS towers, the signal will be stronger and the range will be wider, workers can communicate more effectively and quickly, both inside and outside the workplace. Smooth communication makes it easier to coordinate tasks, make decisions, and collaborate between teams, thereby increasing work efficiency (Qiang et al., 2009). Adequate telecommunications infrastructure reduces the need for workers to travel physically which is time-consuming and costly, as they can perform many tasks online. The analysis explains that telecommuting supported by a stable network provides flexibility in time and workplace, which helps workers manage their time more efficiently and reduce fatigue due to travel, thereby improving the quality and quantity of work. Mokhtarian (1991).

The construction of BTS is also a major prerequisite for the adoption of digital technology and automation in the work environment. Reliable connectivity opens up

opportunities for the use of cloud-based technologies, Internet of Things (IoT), and digital productivity applications. Found that good digital access improves workers' ability to access online training, project management platforms, and collaboration software that improves the speed and quality of work deliverables. BTS infrastructure not only plays a role in increasing individual productivity but also strengthens the digital business ecosystem. With a strong network, companies can launch new products, adopt innovative business models, and expand their digital markets. This encourages collective and sustainable productivity improvements. The study confirms that reliable telecommunications infrastructure is positively correlated with the growth of innovation and business efficiency which contributes to economic growth. Kumar & Best (2006).

5. Conclusion

The conclusions that can be drawn from the results of this study are:

1) ICT skills did not show a statistically significant influence on labor productivity in the data and period of this study. This is suspected because the level of education and digital training of the workforce is still uneven and less optimal in improving the ability to use ICT effectively.
2) ICT access has a positive and significant influence on labor productivity. The availability of network and technology access allows the workforce to work more efficiently through better communication, rapid access to information, and effective collaboration.
3) Investment in the construction of BTS towers as part of telecommunication infrastructure also has a positive and significant influence on labor productivity. This infrastructure expands the reach and quality of network access that supports digital activities in the workplace.
4) Together, the three variables (ICT skills, ICT access, and BTS investment) are able to explain 99% of the variation in labor productivity in Indonesia, showing that technology and digital infrastructure factors play an important role in increasing national productivity.

Therefore, in addition to continuing to encourage the development of digital infrastructure such as BTS towers, the government and stakeholders need to focus on improving the quality of ICT education and training to strengthen the digital skills of the workforce so that the benefits of technology can be optimized comprehensively and sustainably.

References

Aral, S., Brynjolfsson, E., & Wu, L. (2012). Three-Way Complementarities: Performance Pay, Human Resource Analytics, and Information Technology. Management Science, 58(5), 913–931. https://doi.org/10.1287/mnsc.1110.1460

Becker, G. S. (1975). Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education (2nd ed.). National Bureau of Economic Research New York.

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

BPS. (2022a). Indeks Pembangunan Teknologi Informasi dan Komunikasi 2021.

BPS. (2022b). Statistik Telekomunikasi Indonesia 2022.
Brynjolfsson, E., & Hitt, L. M. (2000). Beyond Computation: Information Technology, Organizational Transformation and Business Performance. Journal of Economic Perspectives, 14(4), 23–48. https://doi.org/10.1257/jep.14.4.23
Cunningham, W., Moroz, H., Muller, N., & Solatorio, A. (2022). The Demand for Digital and Complementary Skills in Southeast Asia (10070).
Gómez-Barroso, J. L., & Marbán-Flores, R. (2020). Telecommunications and economic development – The 21st century: Making the evidence stronger. Telecommunications Policy, 44(2), 101905. https://doi.org/10.1016/j.telpol.2019.101905
Hanri, M., Sholihah, N. K., & Satyagraha, I. P. B. (2024). Labor Market Brief (4).
International Labour Organization. (2022). World Employment and Social Outlook Trends 2022.
International Telecommunication Union Development Sector. (2023). Measuring Digital Development, Facts and Figures 2023.
International Telecommunication Union. (2009). Measuring the Information Society.
Kementrian Komunikasi dan Informatika (KOMINFO). (2023). Laporan Tahunan Kominfo 2022.
KOMINFO. (2022). Survey Pengunaan TIK 2022.
Kumar, R., & Best, M. L. (2006). Impact and Sustainability of E-Government Services in Developing Countries: Lessons Learned from Tamil Nadu, India. The Information Society, 22(1), 1–12. https://doi.org/10.1080/01972240500388149
Levy, D. H., F., & Murnane, R. J. (2003). The Skill Content of Recent Technological Change: An Empirical Exploration. The Quarterly Journal of Economics, 118(4), 1279–1333. https://doi.org/10.1162/003355303322552801
Mankiw, N. G. (2018). Pengantar Ekonomi Makro. Erlangga.
Minges, M. (2016). Digital Dividends Exploring the Relationship Between Broadband and Economic Growth Exploring the Relationship between Broadband and Economic Growth.
Mlynarzewska, I., & Borowiec. (2021). Direct and Indirect Impact of ICT on EU's Productivity Growth. EUROPEAN RESEARCH STUDIES JOURNAL, XXIV (Special Issue 4), 278–287. https://doi.org/10.35808/ersj/2689
Mokhtarian, PatriciaL. (1991). Telecommuting and travel: state of the practice, state of the art. Transportation, 18(4). https://doi.org/10.1007/BF00186563
OECD. (2024). OECD Digital Economy Outlook 2024 (Volume 2). OECD Publishing. https://doi.org/10.1787/3adf705b-en
Qiang, C. Z.-W., Rossotto, C. M., & Kimura, K. (2009). Economic impacts of broadband (In Information and Communications for Development 2009: Extending Reach and Increasing Impact).
Shahnazi, R. (2021). Do information and communications technology spillovers affect labor productivity? Structural Change and Economic Dynamics, 59, 342–359. https://doi.org/10.1016/j.strueco.2021.09.003
Vu, K., Hanafizadeh, P., & Bohlin, E. (2020). ICT as a driver of economic growth: A survey of the literature and directions for future research. Telecommunications Policy, 44(2), 101922. https://doi.org/10.1016/j.telpol.2020.101922
Walsham, G., & Sahay, S. (2006). Research on information systems in developing countries: Current landscape and future prospects. Information Technology for Development, 12(1), 7–24. https://doi.org/10.1002/itdj.20020