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E-Commerce Road Map and Equal Digital Opportunity in Indonesia

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Abstract

Understanding the program's impact on digital capability growth is considered necessary to support progress in digital inclusion through measured evaluation. This study seeks to understand the influence of regulation on the level of digital opportunity and its growth in Indonesia. Utilizing a descriptive-comparative analysis with the Digital Opportunity Index framework, this study measures digital opportunity through e-commerce among Small and Medium Enterprises across 34 provinces. The results show that while the DOI score at the national level remained stagnant, 21 provinces experienced growth, 12 provinces experienced negative growth, and 1 province remained unchanged. Furthermore, in the opportunity category, 26 provinces and the national level experienced growth, while the other 8 provinces experienced zero growth. The infrastructure category showed that 6 provinces experienced growth, 27 provinces and the national level presented negative growth, and 1 province showed zero growth. The utilization category showed that 33 provinces and the national level experienced positive growth, leaving only one province with negative growth. This research suggests that, to provide continuous support for digital development, the government and related institutions should consider regulations or programs that promote infrastructure development, ensuring it is available and affordable at the provincial level.

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INTRODUCTION

The wide range of digitalisation innovations has impacted various sectors of development, including sources of economic growth. This swift and unprecedented transformation in size, speed, and scope of digital dissemination has reshaped societies and economies, fostering growth and productivity and leading to the emergence of a digital economy (Schwab, 2017; Dahlman, 2016). In this digital economy, digitalisation enhances efficiency in achieving economic growth, especially through the service sectors (Mulaydinov, 2020; Kolesnikov, 2020).

Digital marketplace services benefit related stakeholders, especially customers and sellers (entrepreneurs). The emergence of electronic commerce, known as e-commerce, has fundamentally changed the process of buying and selling goods, not only by transforming physical establishments into internet-enabled platforms but also by improving access to and information about goods and services (Rosario, 2021). The simplicity of processes from purchasing to distribution has attracted both customers and entrepreneurs, alongside broader opportunities for market competitiveness (Jimenez, 2019). E-commerce is perceived to offer significant efficiency gains and higher productivity, positioning it as a crucial component of the digital economy and a catalyst for economic growth (Goyal 2022).

Indonesia, as a developing country, has promising potential for e-commerce to support economic growth. E-commerce is regarded as a pillar of the digital economy, with its GMV expected to contribute $130 billion by 2025, with an average annual growth rate of 49% (Frost and Sullivan, 2018; Das, 2018). Research from Google, Temasek, and Bain indicates that this has positioned Indonesia as the largest and fastest-growing digital economy in Southeast Asia (Davis et al., 2019). On the other hand, the rapid growth of Small and Medium Enterprises (SMEs) offers a beneficial avenue for integrating with e-commerce to achieve economic growth. According to Kotelnikov (2007), SMEs play a significant role in economic growth and innovation. The process begins when SMEs improve their processes and products to gain a competitive advantage, generating greater revenue and profit. These profitable enterprises can tap broader economic opportunities, such as job creation and higher per capita income. This simultaneous improvement leads back to increased consumption and higher revenues for SMEs, reflecting a cycle of innovation and economic growth.

In developing countries, including Indonesia, e-commerce is considered a prominent channel for SMEs to drive business innovation and economic growth (Budiarti, 2021). However, integrating into e-commerce is not as simple as adding a market channel to the strategy; instead, structural change is needed to address the fundamental challenges faced by SMEs (Xie, 2014; Shaw, 1999). Furthermore, it is important to consider that this integration requires not only internal organizational readiness but also external governance to establish a robust ecosystem that realizes its objectives (Kabango, 2015; Tone, 2020; Ma, 2015). Thus, the government has a role in bridging the potential of e-commerce and eliminating barriers to its development (Arfani, 2020).

Responding to opportunities in the digital economy, the Government of Indonesia embraced digitalisation by issuing Presidential Regulation Number 74/2017 (PP 74/2017), commonly known as the E-Commerce Roadmap program, to support e-commerce development. This regulation aims to coordinate instructions and strategic guidance to accelerate the development of an integrated ecosystem for Indonesia's e-commerce from 2017 to 2019. The government sought to support a well-prepared ecosystem to empower e-commerce by regulating relevant stakeholders to facilitate integrated development based on electronic commerce.

Digital opportunities also come with challenges, with one of the main concerns being the digital divide. The digital divide refers to the gap across different socio-economic levels in opportunities and access to technology for

individuals, households, businesses, or geographic areas (OECD, 2011). This digital divide is prone to creating inequality in SMEs' adoption of e-commerce. Over time, such inequality can shape winners and losers in the digital economy if left unaddressed. In the case of SMEs adopting e-commerce, if only certain SMEs have access to the Infrastructure and the necessary skills to use it, then only these groups can benefit from its adoption. These SMEs may gain opportunities to generate income from e-commerce that other groups cannot access. Thus, the digital divide may lead to broader inequalities among SMEs that lack similar opportunities. If the government aims to maximize Indonesia's e-commerce sector's potential, it should consider national and provincial capacities to seize opportunities in the digital economy.

Recently, there have been discussions about opportunities in the digital economy. For example, Ganne (2019) highlights that SMEs have wider opportunities to participate in global value chains through digitalisation; Jahanshahi (2013) examines the benefits of SMEs adopting e-commerce; Tayibnapis (2018) emphasizes that digital convenience requires careful regulation; and Hanna (2018) discusses strategies regarding the role of the state in governing digital transformation. However, measurement of digital opportunity itself prior to its broader development prospects remains relatively unexplored. This study addresses that gap by examining digital opportunity in Indonesia through the following research question: To what extent does the post-implementation of the E-Commerce Road Map program exhibit equal digital opportunity across Indonesia's 34 provinces? To answer this question, the study measures the provincial-level Digital Opportunity Index before and after the implementation of the E-Commerce Road Map program. This study seeks to describe and compare changes in digital opportunity growth across 34 provinces in Indonesia to contribute to the state of the art in digital opportunity for economic growth.

RESEARCH METHODS

This study employs a quantitative, descriptive–comparative approach using secondary data to compare the Digital Opportunity Index before and after the implementation of the E-Commerce Road Map program in Indonesia. The analysis focuses on presenting changes in digital opportunity growth for SMEs across 34 provinces. This study then compares provincial-level growth using the DOI index and its categories to understand the dynamics of change. The importance of comparative analysis in social science lies in its ability to reflect reality and, through equal comparison, construct a better understanding (Azarian, 2011).

This study was conducted from June 2022 to September 2022 using secondary data sourced from the International Telecommunication Union (ITU) and Badan Pusat Statistik (BPS), also known as Statistics Indonesia. BPS-Statistics Indonesia reports were preferred for this study due to their essential content and the provincial-level data they present. The reports of BPS-Statistics Indonesia (2019a), BPS-Statistics Indonesia (2021a), BPS-Statistics Indonesia (2019b), BPS-Statistics Indonesia (2021b), and ITU (2022) were selected to support the analysis.

The selected data period was aligned with the E-Commerce Road Map Program timeline, considering a comparison between the periods before and after implementation to measure differences. Considering that the program came into force in 2017 and was estimated to be achieved by 2019, the ideal measurement years were 2016 (baseline) and 2020 (endline). However, due to common research challenges in developing countries, particularly limited data availability (Cruz-Jesus, 2017), this research required several adjustments. First, according to BPS-Statistics Indonesia (2019c), the E-Commerce Road Map Program improved data availability, with 2018 the first year with accessible data. Second, as data for 2016 were unavailable, the 2018 dataset was used as the starting year of this analysis, as reported in the 2019 publication. There was no adjustment for

the endline year, which remained 2020 and was recorded in the 2021 report.

The collected data were then analyzed using the Digital Opportunity Index (DOI) measurement framework. The ITU and UNCTAD developed the DOI to provide a standardized international measurement applicable in both developed and developing countries. This framework has been applied to measure the digital divide across several themes, such as economic development (Mutula, 2008), e-government (Nkwe, 2012), tourism (Minghetti, 2010), and digitalisation (Katz, 2013). The DOI was chosen for this study despite the availability of other similar tools and methods, such as the Information Society Index, E-Readiness Index, ICT Development Index, Digital Access Index, Networked Readiness Index, ICT Opportunity Index, ICT Diffusion Index, and Digital Opportunity Index (Konova, 2015), for two main reasons. First, this index captures digital divide conditions across provinces and emphasizes transforming challenges into development opportunities (ITU, 2007). Second, this international measurement is designed to be applicable across multiple scales, from international and national to regional levels, provided that the required assessment data are available (ITU, 2005). As the program focuses on e-commerce development at the SME level, well-structured digital opportunity across provinces is expected to support the expansion of e-commerce and encourage SME participation.

DOI is structured into three categories: Opportunity (accessibility and affordability), Infrastructure (devices and network availability), and Utilization (digital use). All three categories comprise 11 indicators based on the formula developed by ITU and UNCTAD (2007).

$$DOI = \frac{Opportunity + Infrastructure + Utilisation}{3} \quad ...(1)$$

Further, the DOI scores were calculated at the provincial level, comprising 34 provinces. Next, the DOI growth was compared with the calculation:

$$DOI\ Growth\ (\%) = \frac{DOI_{2021} - DOI_{2019}}{DOI_{2019}}\ x\ 100 \quad ...(2)$$

The growth marked the program's association with digital opportunity at the provincial level. Nevertheless, due to limitations in data availability, some adjustments were made to indicators in this study across several categories, as explained in the following sections.

RESULTS AND DISCUSSION

Similar previous studies on digital development have been presented by Bachtiar et al. (2020), who note comparable challenges in Indonesia regarding an inclusive digital economy. In addition, Gowasmi (2006) previously calculated Indonesia's DOI level through global comparisons with several countries. This study contributes to the same field by examining the provincial level in greater depth to understand which provinces demonstrated prominent growth following regulatory empowerment.

In order to present the analysis results, several disclaimers need to be highlighted to ensure proper interpretation. The DOI was measured across all 34 provinces and at the national level for comparison. The analysis aimed to include all categories and indicators to approximate the actual Digital Opportunity Index score. However, as mentioned earlier, due to limited data availability, several adjustments were necessary. In the analysis, all three index categories were included, although some indicators required modification. Starting from the Opportunity category, the indicators used were as follows: the first indicator, the percentage of the population covered by mobile cellular telephone networks. The second and third indicators, internet access tariffs as a percentage of per capita income and mobile cellular tariffs as a percentage of per capita income, were combined into a single indicator because the available data reported ICT expenditure without separating mobile and internet spending.

Next, for the Infrastructure category, the indicators used were the fourth, the proportion of households with a fixed-line telephone; the fifth, the proportion of households with a computer; and the sixth, the proportion of households with

Internet access at home. The seventh and eighth indicators were not available at the provincial level. Finally, in the Utilization category, only the ninth indicator, the proportion of individuals using the Internet, was available. The tenth and eleventh indicators, the ratio of fixed broadband subscribers to total Internet subscribers and the ratio of mobile broadband subscribers to total mobile subscribers, were not yet available. In summary, the indicators that could not be included in this provincial-level analysis due to data limitations were: mobile cellular subscribers per 100 inhabitants, mobile Internet subscribers per 100 inhabitants, the ratio of fixed broadband subscribers to total Internet subscribers, and the ratio of mobile broadband subscribers to total mobile subscribers. Nevertheless, all 11 indicators were available at the national level.

All indicators were analyzed at the national level to establish the baseline for the Digital Opportunity Index score and growth rate. An attempt was made to adjust unavailable data by using the national average at the provincial level to fill indicator gaps and obtain a comprehensive DOI score. However, this approach could introduce bias into the DOI score, as the national average might be lower in some provinces and higher in others. Consequently, this would generate bias in provincial DOI scores because the data did not originate from the provinces themselves. Therefore, the adjustment was to exclude indicators for which provincial-level data were unavailable.

The DOI score was calculated and analyzed using an ideal minimum value of 0 and a maximum value of 1.0. This means that scores closer to 1.0 represent better opportunity and connectivity, and vice versa. The DOI score and growth rate for all 34 provinces and for Indonesia at the national level are presented in Figure 1.

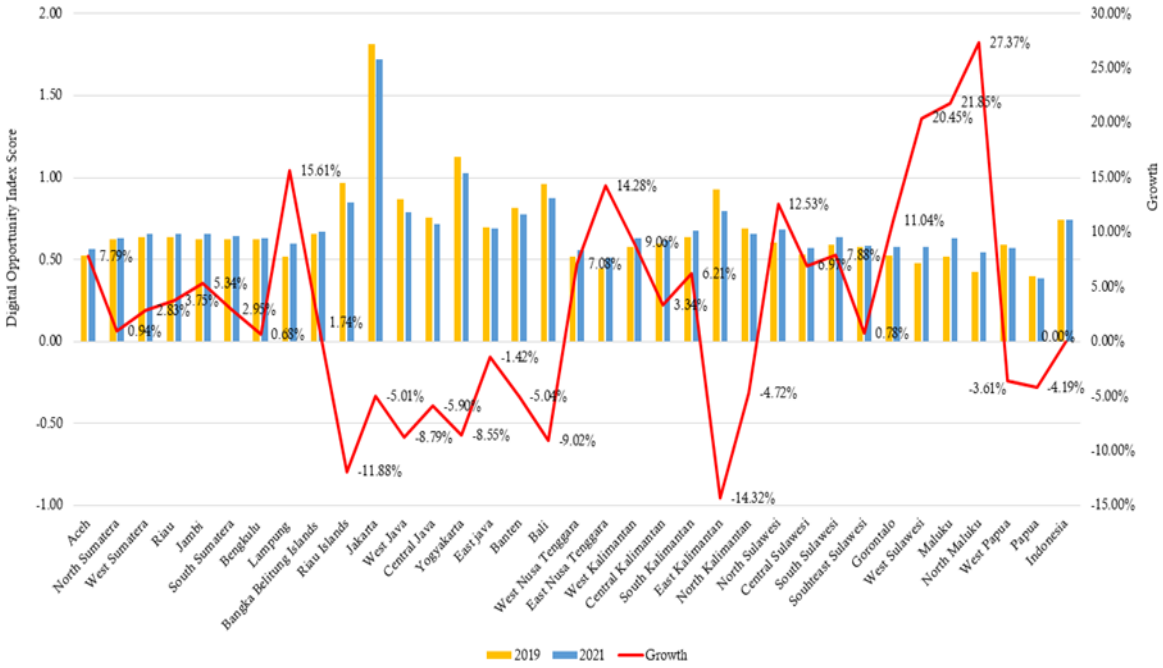

Figure 1. DOI Scores and Growth
Source: Data Processed (2022)

On the left axis, the DOI scores are presented, ranging from 0 to 1.81 in 2019 and from 0 to 1.72 in 2021. In 2019, the DOI scores ranged from 0.40 in Papua to 1.81 in Jakarta, while the national score for Indonesia began at 0.74, serving as the baseline for comparison. From this baseline of 0.74, only 8 provinces had DOI scores above the national average, while 26 had scores below it. This suggests that 0.74 represented a relatively high baseline, which may have occurred because the gap between the highest and lowest scores was substantial. In

2021, at the end of the regulatory period, the DOI score ranged from 0.38 in Papua to 1.72 in Jakarta. The national baseline remained at 0.74, while the number of provinces above the baseline decreased to 7, and those below increased to 27 provinces.

On the right axis, the growth rate is assessed by comparing DOI scores before and after the enactment of the E-Commerce Road Map program. The growth rate of DOI scores ranged from -14.13% to 27.37%. The national DOI score remained unchanged at 0.74. However, 22 provinces experienced growth, ranging from 0.68% in Bengkulu to 25.58% in North Maluku. Meanwhile, 12 provinces experienced negative growth in their DOI scores, ranging from -1.43% in East Java to -14.13% in East Kalimantan.

Furthermore, to better understand the increases and decreases in DOI scores, the three categories were examined more closely. The Opportunity, Infrastructure, and Utilization categories, along with their scores and growth rates across 34 provinces, are presented in Appendix 1. The explanations for each category are provided below.

First, the Opportunity category is presented in Figure 2. Similarly, the left axis shows the category score, while the right axis presents the growth rate of the category score.

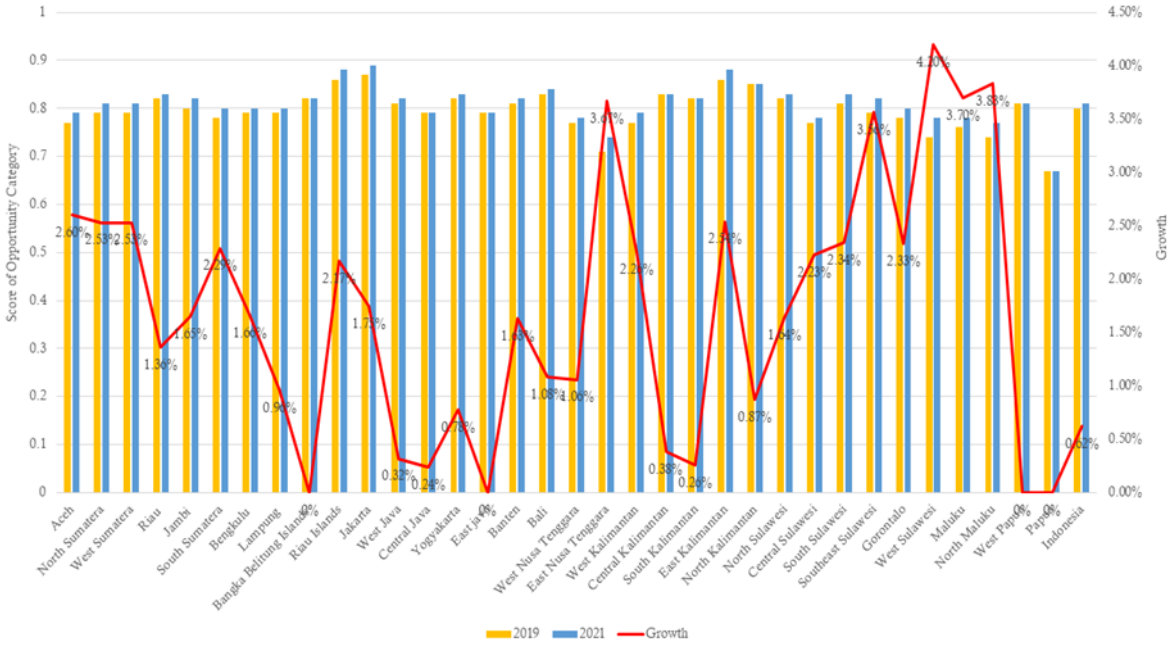

Figure 2. Growth of Opportunity Category
Source: Data Processed (2022)

In 2019, on a scale from 0 to 1, the lowest score was 0.67 in Papua and the highest was 0.87 in Jakarta. The national score for this category in the same year reached 0.80. Moving to 2021, after the program was enacted, the lowest score remained at 0.67 in Papua, while the highest increased to 0.89 in Jakarta. The national score rose slightly to 0.81. Based on this distribution between 2019 and 2021, growth during the program period was measured for this category. At the national level, Indonesia recorded 1.25% growth from before the program's enactment to the post-implementation period. At the provincial level, 26 provinces experienced growth in this category, ranging from 1.20% in Bali to 5.41% in West Sulawesi, with other provinces distributed within this range.

Meanwhile, eight provinces experienced no growth and were considered unchanged in this category, namely Bangka Belitung Islands, East Java, West Papua, and Papua. Secondly, the Infrastructure category is presented in Figure 3.

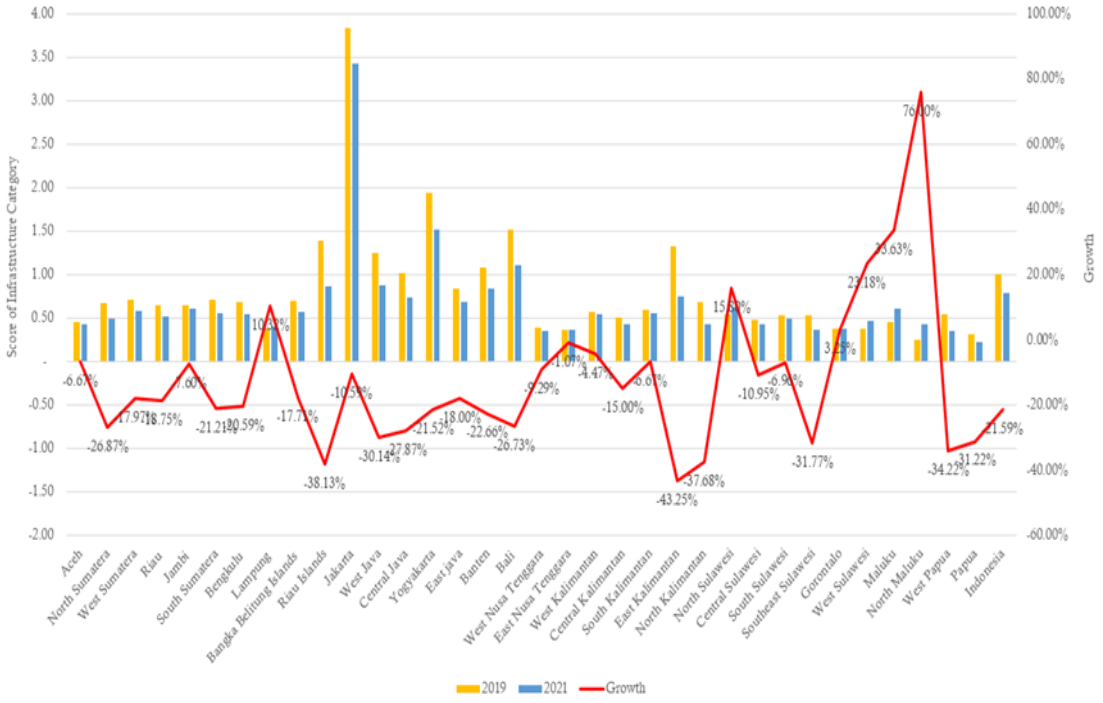

Figure 3. Growth of the Infrastructure Category
Source: Data Processed (2022)

This category in 2019 started at 0.25 in North Maluku and peaked at 3.83 in Jakarta. Meanwhile, Indonesia's national score was 1.00. Moving to 2021, this category began at 0.22 in Papua, the lowest value, and reached 3.42 in Jakarta, the highest. The national score for Indonesia declined to 0.79. Between 2019 and 2021, this category experienced widespread negative growth.

Only six provinces recorded positive growth in this category, namely Lampung, North Sulawesi, Gorontalo, West Sulawesi, Maluku, and North Maluku. While one province remained unchanged, the other 27 provinces experienced negative growth, ranging from -5.26% in West Kalimantan to -43.18% in East Kalimantan. The national score also declined, showing negative growth of -21.00%.

Thirdly, the Utilization category for this index is presented in Figure 4. In 2019, the score for this category ranged from 0.22 in Papua to 0.73 in Jakarta, with other provinces falling within this range. Indonesia's national score in 2019 was 0.48. In 2021, the lowest score increased to 0.26 in Papua, the highest to 0.86 in Jakarta, and the national score reached 0.62. Compared to the previous two categories, this category exhibited substantial growth. Thirty-three out of 34 provinces recorded positive growth in this category, ranging from 17.81% in Jakarta to 65.38% in East Nusa Tenggara. The national score also increased by 29.17%. Only one province experienced negative growth, namely Jambi, with a score of -13.85%.

The analysis results presented to address the research question are pertinent to the DOI score and digital opportunities across all provinces in Indonesia.

Regarding Indonesia's national-level DOI score, there was no increase during the period when the E-Commerce Road Map program was enacted. However, 21 provinces saw increases in DOI scores during this period, while 12 experienced negative growth, and one remained unchanged. When examined across the three DOI structural categories, namely Opportunity, Infrastructure, and Utilization, Infrastructure appeared to be the main contributor to stagnant or declining DOI scores. Meanwhile, the Opportunity and Utilization categories generally increased.

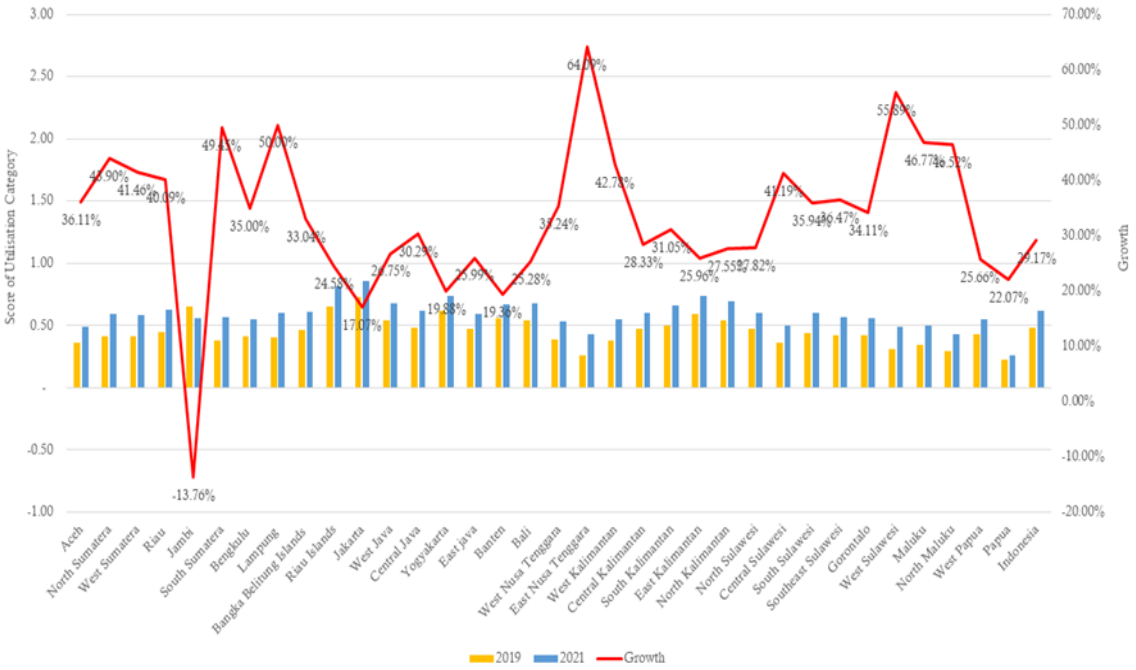

Figure 4. Growth of Utilisation Category
Source: Data Processed (2022)

Based on the calculation, the Opportunity category was derived from the percentage of mobile users and ICT expenditure as a share of income. This suggests that citizens in Indonesia are aware of mobile cellular use and willing to allocate spending toward ICT-related needs. This trend is further supported by the growing Utilization category, reflected in rising Internet penetration. The main concern should be directed toward the Infrastructure category, which showed predominantly negative growth and reflects essential access to technological connectivity.

For example, the DOI score of South Sumatra increased by 3.23% from 0.62 to 0.64, with 2.56% growth in the Opportunity category, 50.00% growth in the Utilization category, and -21.13% growth in the Infrastructure category. This may indicate that people in South Sumatra had awareness and the ability to utilize mobile technology, along with increased Internet penetration, but access to technological Infrastructure did not keep pace with this growth in capability. This decline subsequently affected the overall DOI score for South Sumatra, reducing its potential progress.

Furthermore, based on the analysis results above, the discussion addresses the challenges and opportunities for improving digital development outcomes. First, given significant negative growth in the Infrastructure category, this section examines the available indicators within it. Currently, only the fourth indicator (proportion of households with a fixed-line telephone), the fifth indicator (proportion of households with a computer), and the sixth indicator (proportion of households with Internet access at home) are available at the provincial level. The seventh indicator (mobile cellular subscribers per 100 inhabitants) and the eighth indicator (mobile Internet subscribers per 100 inhabitants) are unavailable. The negative growth may be interpreted as a shift among Indonesian citizens toward mobile Internet access rather than computers or fixed-line telephones, both for communication and for Internet connection packages. This situation is further compounded by the lack of data on alternative connection options such as broadband Internet, which may contribute to the observed negative growth over several years. This highlights the importance of data availability for measuring digital opportunity and supporting

evidence-based policy aimed at achieving equitable digital development across provinces.

Secondly, given the generally acknowledged limited data availability in developing countries, another important implication emerges from this analysis. Referring back to the DOI measurement, where 1.0 represents the maximum score and reflects the optimal condition for indicators and categories, the results may differ due to data limitations and methodological adjustments. As shown in the 2019 baseline DOI scores, Indonesia's national level started at 1.0, while several provinces exceeded this value, including Central Java (1.01), Banten (1.08), West Java (1.25), East Kalimantan (1.32), Riau Islands (1.39), Bali (1.52), Yogyakarta (1.94), and Jakarta (3.83). Understandably, adjustments in calculation may produce values beyond the maximum range. However, it is important to consider the extent of such deviations. Based on the results, Jakarta shows an extreme deviation, exceeding the theoretical maximum by more than three times.

Furthermore, across all three categories, including Infrastructure, Jakarta recorded the highest initial scores among provinces. Nevertheless, this does not necessarily translate into the highest growth rate. This indicates a concentration of digital infrastructure development that is not fully aligned with proportional growth in digital opportunity. If such inequality is overlooked, it may lead to a pattern of centralization, often referred to as Jakarta-centrism. Jakarta-centrism creates the impression that Indonesia's performance is measured primarily by Jakarta's achievements, leaving other provinces underrepresented (Wilantika, 2018). From one perspective, this pattern is understandable because Jakarta, as the capital city, hosts a large concentration of businesses and enterprises, which naturally drives innovation more rapidly than in smaller cities. However, Indonesia's digital development should not be evaluated solely based on Jakarta's performance.

This research demonstrates that other provinces also have strong potential to adopt digital technology. For example, in the Utilization category, the top three growth rates are significantly higher than Jakarta's performance. While Jakarta recorded 17.81% growth, East Nusa Tenggara, West Sulawesi, South Sumatra, and Lampung achieved growth rates of 65.38%, 58.06%, and 50.00%, respectively. These findings indicate that several provinces are making promising progress in harnessing the digital economy and that e-commerce is a feasible pathway, as the Opportunity and Utilization categories show substantial growth. The key implication is the need to promote more equitable infrastructure development nationwide to expand access and build a sustainable e-commerce ecosystem.

Lastly, while the Infrastructure category shows negative growth, the other categories show strong growth, particularly in the Opportunity and Utilization categories. The growth observed in these two categories indicates that digital technology is increasingly accessible and applicable at common societal levels. Through this adaptation, digitalisation appears to hold broader significance in transforming conventional structures into technology-based systems. One example of structural transformation through digital services is discussed in the "Gojek Effect" (Ford & Honan, 2017). Gojek, a ride-hailing start-up similar to Uber and Grab, has improved efficiency by connecting drivers and users through app-based booking services. The widespread adoption of digitalisation has supported Gojek in transforming parts of the informal sector into a more productive system and, in a broader context, has contributed to the development of the sharing economy.

Another example of structural transformation is the digitalisation of e-grocery or fresh produce supply chains. Fresh agricultural products are typically characterized by perishability and small purchasing volumes. Digitalisation has reshaped the supply chain structure into what is often referred to as a short food supply chain (Collison et al., 2019). In conventional systems, the chain typically moves from producer to wholesaler, to a retail distribution centre, to a local distribution centre,

to the point of sale, and finally to the customer. In contrast, internet-based supply chains allow alternative structures in which producers may deliver directly to points of sale or even to customers (Saskia et al., 2015). This new structure enhances organizational linkages and delivery mechanisms, encouraging the emergence of start-ups across areas such as input supply, mechanisation, irrigation, and financial services; quality maintenance; monitoring; traceability; output prediction; and post-harvest management (Kumar et al., 2021; Nuthalapati et al., 2020). These examples illustrate how digitalisation broadens opportunities while enabling structural efficiency. The growth observed in the Opportunity and Utilization categories reflects progress toward such transformations.

In addition, a similar initiative has been developed by a neighboring country, Malaysia, namely the National E-Commerce Strategic Road Map 1.0. The program ran from 2017 to 2020, aiming to double the nationwide growth rate of e-commerce adoption. Although the DOI measurement for this program is not yet available, statistics show significant growth, increasing from a target of 270,000 SMEs to 489,958 SME adopters by the end of the program, representing approximately 181% growth in adoption (DOSM, 2023). The success of this program continued into its second phase, the National E-Commerce Strategic Roadmap 2.0. This achievement was not isolated but the result of Malaysia's broader digital economy transformation strategies since the 1990s across multiple industries. However, according to Lee (2023), despite these achievements, Malaysia still faces similar challenges related to digital divide issues arising from uneven ICT adoption.

This research provides an analysis of DOI scores at both the national and provincial levels, including category growth and comparative assessment. The analysis aims to offer an evidence-based measurement to support policy development regarding the digital economy in Indonesia. Based on these findings and the program's objective to expand e-commerce adoption, the government could further explore strategies to maximize the potential of existing initiatives. In addition to improving Infrastructure across the country to ensure equitable digital opportunities, another important consideration is to leverage the growth in Opportunity and Utilization categories to support SMEs in adopting e-commerce. The adoption of e-commerce can facilitate faster, more efficient distribution of goods and services to wider markets; therefore, strengthening infrastructure development and shaping digitalisation policies should remain a priority to enhance digital opportunities (Hasan, 2021).

The discussion highlights two main considerations related to research limitations. Firstly, in assessing digital opportunity in Indonesia, the measurement relies on the Digital Opportunity Index, which includes the Infrastructure category. In addition, the E-Commerce Road Map Program spanned from 2017 to 2019, and this overlap suggests that the observed relationship between the program and digital opportunity may have been influenced by other government initiatives related to ICT infrastructure. One such initiative is the Palapa Ring Project, a government program aimed at expanding broadband availability across Indonesia, including rural and remote areas with relatively low commercial potential, through an optical fibre network consisting of approximately 35,280 kilometres of submarine cables and 21,807 kilometres of inland cables. Through this effort, the government sought to connect the entire Indonesian archipelago (Antoni, 2019). The project was completed at the end of 2019, and its infrastructure improvements have had positive, significant impacts on Indonesia's Internet connectivity (Handoko, 2021; Eschachasthi, 2021). As this project coincided with the implementation of the E-Commerce Road Map Program and, given the limited studies examining their interaction, it is unclear whether the two initiatives mutually reinforced each other or operated independently. Therefore, when interpreting infrastructure-related effects, there is a potential for bias due to overlapping policy timelines.

Secondly, the COVID-19 pandemic occurred during the program's implementation period. The pandemic began spreading globally in late 2019 and early 2020, according to the WHO (2022), and Indonesia was no exception. The pandemic imposed restrictions on physical interaction, accelerating a shift toward digital use across many aspects of society. The effects of the pandemic on SMEs adopting e-commerce resulted in different income outcomes compared to those that did not adopt digital platforms (Lestari, 2021). This occurred because pandemic conditions necessitated greater reliance on e-commerce to sustain economic activity and meet basic needs (Damuri, 2021), despite varying levels of e-readiness among SMEs (Priambodo, 2021). Consequently, the pandemic may have influenced the Utilization category within the DOI calculation in this study.

CONCLUSION

This study examined digital opportunity measurement associated with the E-Commerce Road Map program using a quantitative descriptive-comparative approach. This study links the two by comparing changes in digital opportunity categories across provinces before and after the program's implementation. This study analyzed the Digital Opportunity Index to reveal the level of digital opportunity across 34 provinces in Indonesia and their growth patterns. The study showed that, in general, DOI scores increased across most provinces in Indonesia. Although the national score remained at 0.74, 21 provinces experienced growth ranging from 1.52% to 25.58%, while 12 provinces experienced negative growth ranging from -1.43% to -14.13%, and 1 province remained unchanged.

The three DOI categories also varied across provinces. The Opportunity category showed mostly positive growth across 26 provinces and at the national level, ranging from 1.20% to 5.41%, while 8 provinces recorded zero growth. The Infrastructure category showed that only 6 provinces recorded growth of 2.70% to 72.00%, while the other 27 provinces and the national level recorded negative growth ranging from -5.26% to -43.18%, with one province showing zero growth. The Utilization category showed that 33 provinces and the national level experienced positive growth ranging from 17.81% to 65.38%, leaving only one province with negative growth at -13.85%. These findings suggest that while more people gained access to digital technology, supported by sharp increases in user engagement, infrastructure capacity did not grow at the same pace. This gap highlights the need for more equitable access to support digital inclusion nationwide.

This research suggests that to ensure continuous support for digital development, the government and related institutions should consider regulations or programs that support infrastructure development, making it available and affordable at the provincial level. In addition, policymakers should consider establishing digital literacy programs, especially for SME entrepreneurs. By addressing these challenges, unmet demands for equal digital opportunities may be better fulfilled, strengthening the digital ecosystem for SMEs. Overall, this study contributes to the growing literature on bridging the digital divide, particularly regarding government regulation and programs in developing countries to promote digital economic growth. Despite its contributions, this study has several limitations. First, it relies solely on secondary data, which limits control over data quality, consistency, and deeper contextual understanding across provinces. Second, the descriptive-comparative design limits causal inference; therefore, the observed changes cannot be attributed exclusively to the E-Commerce Road Map Program.

Based on the study's findings, future research could use mixed-methods designs to better assess causal relationships between digital programs or initiatives and digital opportunity outcomes. In addition, future studies should consider subnational or group-level analyses to examine how digital opportunities vary across regions, firm sizes, and socio-economic groups. Strengthening data availability and integrating mixed-method approaches may further enrich insights for future digital development and digital economy research.

REFERENCES

Arfani, R. N., Hapsari, M., & Perdana, P. (2020). Engaging in the digital economy: issues and agenda in the quest to adopt Indonesia's e-commerce roadmap. *Adapting to the Digital Trade Era, Challenges and Opportunities. New York: World Trade Organization.*

Azarian, R. (2011). Potentials and limitations of the comparative method in social science. *International Journal of Humanities and Social Science, 1*(4), 113-125.

Bachtiar, P. P., Diningrat, R. A., Kusuma, A. Z. D., & Izzati, R. A. (2020). *Who is digital economy for? Toward an inclusive digital economy in Indonesia* (No. 2378). Publications Department.

BPS Statistic Indonesia. 2019a. Statistical Yearbook of Indonesia 2019. Jakarta, Indonesia.

BPS Statistic Indonesia. 2021a. Statistical Yearbook of Indonesia 2021. Jakarta, Indonesia.

BPS Statistic Indonesia. 2019b. Telecommunication of Statics in Indonesia 2019. Jakarta, Indonesia.

BPS Statistic Indonesia. 2021b. Telecommunication of Statics in Indonesia 2021. Jakarta, Indonesia.

BPS Statistic Indonesia. 2019c. E-Commerce Statistic 2019. Jakarta, Indonesia.

Budiarti, I., & Akbar, A. (2021). E-commerce for the Development of Small Medium Enterprises. *International Journal of Research and Applied Technology (INJURATECH), 1*(2), 239-243.

Collison, M., Collison, T., Myroniuk, I., Boyko, N., & Pellegrini, G. (2019). Transformation trends in food logistics for short food supply chains–What is new? *Studies in Agricultural Economics, 121*(2), 102-110.

Cruz-Jesus, F., Oliveira, T., Bacao, F., & Irani, Z. (2017). Assessing the pattern between economic and digital development of countries. *Information Systems Frontiers, 19*, 835-854.

Dahlman, C., Mealy, S., & Wermelinger, M. (2016). *Harnessing the digital economy for developing countries.* OECD Development Centre Working Paper, 334

Das, K. (2018). *The digital archipelago: How online commerce is driving Indonesia's economic development*: McKinsey.

DOSM The Department of Statistics Malaysia. 2023. Malaysia Digital Economy 2023. Putrajaya, Malaysia

Ford, M., & Honan, V. (2017). 15 The Go-Jek effect. *Digital Indonesia: Connectivity and Divergence*, 275.

Frost, & Sullivan. (2018). Digital Market Overview: Indonesia. In: A Frost and Sullivan, White Paper Santa Clara, California.

Davis, S., Saini, S., Sipahimalani, R., Hoppe, F., Lee, W., Girona, I. M., . . . Smittinet, W. (2019). e-Conomy SEA 2019: Swipe up and to the right: Southeast Asia's $100 billion internet economy. *Think with Google, 1*.

Ganne, E., & Lundquist, K. (2019) The digital economy, GVCs and SMEs. In WTO, Technological innovation, supply chain trade, and workers in a globalized world (pp. 121–139). WTO.

Goswami, D. (2006). DOI Applied to Indonesia: Assessing ICT Policy & Regulatory Environment. Digital Opportunity Forum.

Goyal, P., Goyal, K., & Chauhan, A. (2022). Emerging trends of E-commerce perspective in developing countries. *Journal of Positive School Psychology*, 7090–7096.

Hanna, N. (2018). A role for the state in the digital age. *Journal of Innovation and Entrepreneurship*, *7*(1), 5.

Hasan, A., & Mardhani, M. (2021). *An overview of e-commerce adoption in Indonesian SMEs.* Paper presented at the Journal of Physics: Conference Series.

ITU and UNCTAD. 2007. World Information Society Report 2007 Beyond WSIS. Geneva.

ITU Statistics. 2022. COUNTRY ICT DATA. Access on https://www.itu.int/en/ITUD/Statistics/Pages/stat/default.aspx

ITU. 2005. Measuring Digital Opportunity. WSIS Thematic Meeting On Multi-Stakeholder Partnerships For Bridging The Digital Divide. Republic Of Korea, ITU.

Jahanshahi, A. A., Zhang, S. X., & Brem, A. (2013). E-commerce for SMEs: empirical insights from three countries. *Journal of Small Business and Enterprise Development*, *20*(4), 849-865.

Jimenez, D., Valdes, S., & Salinas, M. (2019). Popularity comparison between e-commerce and traditional retail business. *International Journal of Technology for Business (IJTB), 1*(1), 10-16.

Kabango, C. M., & Asa, A. R. (2015). Factors influencing e-commerce development: Implications for the developing countries. *International Journal of Innovation and Economic Development, 1*(1), 64-72.

Katz, R. L., Koutroumpis, P., & Callorda, F. (2013). The Latin American path towards digitization. *info, 15*(3), 6-24.

Kolesnikov, A., Zernova, L., Degtyareva, V., Panko, I. V., & Sigidov, Y. I. (2020). Global trends of the digital economy development. *Opción: Revista de Ciencias Humanas y Sociales*(26), 523-540.

Kononova, K. (2015). *Some Aspects of ICT Measurement: Comparative Analysis of E-Indexes.* Paper presented at the HAICTA.

Kotelnikov, V. (2007). Small and Medium Enterprises and ICT. Asia-Pacific Development Information Programme. e-Primers for the Information Economy, Society and Polity.

Kumar, D., Singh, R. K., Mishra, R., & Wamba, S. F. (2022). Applications of the internet of things for optimizing warehousing and logistics operations: A systematic literature review and future research directions. *Computers & Industrial Engineering, 171*, 108455.

Lee, C. (2023). Strategic Policies for Digital Economic Transformation. *Journal of Southeast Asian Economies*, *40*(1), 32-63.

Ma, J., & Huang, Q. (2015). Does better Internet access lead to more adoption? A new empirical study using household relocation. *Information Systems Frontiers, 17*, 1097-1110.

Minghetti, V., & Buhalis, D. (2010). Digital divide in tourism. *Journal of Travel Research, 49*(3), 267-281.

Mulaydinov, F. (2021). Digital economy is A guarantee of government and society development. *Ilkogretim Online, 20*(3), 1474-1479.

Mutula, S. M. (2008). Digital divide and economic development: Case study of sub-Saharan Africa. *The Electronic Library, 26*(4), 468-489.

Nkwe, N. (2012). E-government: challenges and opportunities in Botswana. *International Journal of Humanities and Social Science, 2*(17), 39-48.

Nuthalapati, C. S., Srinivas, K., Pandey, N., & Sharma, R. (2020). Startups with open innovation: accelerating technological change and food value chain flows in India. *Indian Journal of Agricultural Economics, 75*(4), 415-437.

OECD. 2011. Guide to Measuring the Information Society. OECD

Rosário, A., & Raimundo, R. (2021). Consumer marketing strategy and E-commerce in the last decade: a literature review. *Journal of theoretical and applied electronic commerce research, 16*(7), 3003-3024.

Saskia, S., Mareï, N., & Blanquart, C. (2016). Innovations in e-grocery and Logistics Solutions for Cities. *Transportation Research Procedia, 12*, 825-835.

Schwab, K. (2017). *The fourth industrial revolution. Currency.* Paper presented at the World Economic Forum.

Shaw, M. J. (1999). Electronic commerce: review of critical research issues. *Information Systems Frontiers, 1*(1), 95-106.

Tayibnapis, A. Z., Wuryaningsih, L. E., & Gora, R. (2018). The development of digital economy in Indonesia. *IJMBS International Journal of Management and Business Studies*, *8*(3), 14-18.

The Presidential Decree number 74 year 2017 on Road Map Ecommerce in 2017-2019

Tone, K. (2020). A digital e-commerce approach for optimizing economic equality in Indonesia. *International Journal of Advance Science and Technology*, *29*(6), 532-537.

Wilantika, N., Sensuse, D. I., Wibisono, S. B., Putro, P. L., & Damanik, A. (2018). *Grouping of provinces in Indonesia according to digital divide index.* Paper presented at the 2018 6th International Conference on Information and Communication Technology (ICoICT).

Xie, K., Xiao, J., Wu, Y., & Hu, Q. (2014). *Ecommerce: Channel or strategy? Insights from a comparative case study.* Thirty Fifth International Conference on Information Systems.

Appendix 1

No	Province	DOI			Opportunity			Infrastructure			Utilisation		
		2019	2021	Growth	2019	2021	Growth	2019	2021	Growth	2019	2021	Growth
	Indonesia	**0.74**	**0.74**	**0.00**	**0.8**	**0.81**	**1.25**	**1.00**	**0.79**	**-21.00**	**0.48**	**0.62**	**29.17**
1	Aceh	0.53	0.57	7.55	0.77	0.79	2.60	0.45	0.42	-6.67	0.36	0.49	36.11
2	North Sumatera	0.62	0.63	1.61	0.79	0.81	2.53	0.67	0.49	-26.87	0.41	0.59	43.90
3	West Sumatera	0.64	0.66	3.13	0.79	0.81	2.53	0.71	0.58	-18.31	0.41	0.58	41.46
4	Riau	0.64	0.66	3.13	0.82	0.83	1.22	0.64	0.52	-18.75	0.45	0.63	40.00
5	Jambi	0.63	0.66	4.76	0.8	0.82	2.50	0.65	0.60	-7.69	0.65	0.56	-13.85
6	South Sumatera	0.62	0.64	3.23	0.78	0.8	2.56	0.71	0.56	-21.13	0.38	0.57	50.00
7	Bengkulu	0.62	0.63	1.61	0.79	0.80	1.27	0.68	0.54	-20.59	0.41	0.55	34.15
8	Lampung	0.52	0.6	15.38	0.79	0.80	1.27	0.37	0.40	8.11	0.40	0.60	50.00
9	Bangka Belitung Islands	0.66	0.67	1.52	0.82	0.82	0.00	0.69	0.57	-17.39	0.46	0.61	32.61
10	Riau Islands	0.97	0.85	-12.37	0.86	0.88	2.33	1.39	0.86	-38.13	0.65	0.81	24.62
11	Jakarta	1.81	1.72	-4.97	0.87	0.89	2.30	3.83	3.42	-10.70	0.73	0.86	17.81
12	West Java	0.87	0.79	-9.20	0.81	0.82	1.23	1.25	0.87	-30.40	0.54	0.68	25.93
13	Central Java	0.76	0.71	-6.58	0.79	0.79	0.00	1.01	0.73	-27.72	0.48	0.62	29.17
14	Yogyakarta	1.13	1.03	-8.85	0.82	0.83	1.22	1.94	1.52	-21.65	0.62	0.74	19.35
15	East java	0.70	0.69	-1.43	0.79	0.79	0.00	0.83	0.68	-18.07	0.47	0.59	25.53
16	Banten	0.82	0.78	-4.88	0.81	0.82	1.23	1.08	0.84	-22.22	0.56	0.67	19.64
17	Bali	0.96	0.88	-8.33	0.83	0.84	1.20	1.52	1.11	-26.97	0.54	0.68	25.93
18	West Nusa Tenggara	0.52	0.55	5.77	0.77	0.78	1.30	0.39	0.35	-10.26	0.39	0.53	35.90
19	East Nusa Tenggara	0.45	0.51	13.33	0.71	0.74	4.23	0.36	0.36	0.00	0.26	0.43	65.38
20	West Kalimantan	0.58	0.63	8.62	0.77	0.79	2.60	0.57	0.54	-5.26	0.38	0.55	44.74
21	Central Kalimantan	0.60	0.62	3.33	0.83	0.83	0.00	0.50	0.43	-14.00	0.47	0.60	27.66
22	South Kalimantan	0.64	0.68	6.25	0.82	0.82	0.00	0.59	0.55	-6.78	0.50	0.66	32.00
23	East Kalimantan	0.92	0.79	-14.13	0.86	0.88	2.33	1.32	0.75	-43.18	0.59	0.74	25.42
24	North Kalimantan	0.69	0.66	-4.35	0.85	0.85	0.00	0.68	0.42	-38.24	0.54	0.69	27.78
25	North Sulawesi	0.61	0.68	11.48	0.82	0.83	1.22	0.54	0.62	14.81	0.47	0.60	27.66
26	Central Sulawesi	0.53	0.57	7.55	0.77	0.78	1.30	0.48	0.42	-12.50	0.36	0.50	38.89
27	South Sulawesi	0.59	0.64	8.47	0.81	0.83	2.47	0.53	0.49	-7.55	0.44	0.60	36.36
28	Souhteast Sulawesi	0.58	0.58	0.00	0.79	0.82	3.80	0.53	0.36	-32.08	0.42	0.57	35.71
29	Gorontalo	0.52	0.58	11.54	0.78	0.8	2.56	0.37	0.38	2.70	0.42	0.56	33.33

No	Province	DOI			Opportunity			Infrastructure			Utilisation		
		2019	2021	Growth	2019	2021	Growth	2019	2021	Growth	2019	2021	Growth
30	West Sulawesi	0.48	0.58	20.83	0.74	0.78	5.41	0.38	0.46	21.05	0.31	0.49	58.06
31	Maluku	0.51	0.63	23.53	0.76	0.78	2.63	0.45	0.60	33.33	0.34	0.50	47.06
32	North Maluku	0.43	0.54	25.58	0.74	0.77	4.05	0.25	0.43	72.00	0.29	0.43	48.28
33	West Papua	0.59	0.57	-3.39	0.81	0.81	0.00	0.54	0.35	-35.19	0.43	0.55	27.91
34	Papua	0.40	0.38	-5.00	0.67	0.67	0.00	0.31	0.22	-29.03	0.22	0.26	18.18