



Industry 4.0: Is Indonesia Ready?

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Article Information

Article History:

Received July 2020

Approved August 2020

Published September 2020

Keywords:

Regional Economic, Information and Communication Technology, Industry 4.0

Abstract

Developed countries are racing to propose new concept of technology revolution that will bring more benefit to human life. In industrial level, the concept of industry 4.0 has been introduced and applied by most developed countries. Meanwhile, the developing countries are preparing themselves to adopt this new concept and increase their competitiveness in the global market. Indonesia is not excluded from this euphoria. However a lack of regional economic study becomes barrier, especially the readiness of Indonesia to adopt industry 4.0 remains a big question. This study aims to provide a descriptive analysis of Indonesia readiness for industry 4.0 based on its economic and information communication and technology (ICT) development at provincial level. Data visualization and regional economic portfolio matrix analysis method were employed to analyze secondary data from various valid and reliable sources. Jakarta, East Java, West Java, Central Java, Riau, Banten, South Sulawesi and East Kalimantan becomes the most promising provinces with gross regional domestic product and ICT development index above average. Meanwhile, North Sumatra has gross regional domestic product above the average but ICT development index below the average. Reversely, provinces like West Sumatra, South Kalimantan, North Sulawesi, West Papua, Bali, Riau Islands, Yogyakarta and North Kalimantan have ICT development index above the average but gross regional domestic product below the average. The other provinces out of those that are already mentioned still need to spend more effort to increase its economic performance and ICT development within their region. Industry has to cooperate with government in developing economic from the existing market penetration and create more innovative product that meets the new era of industrial revolution. Then it will attract more investors to come and develop ICT infrastructures, which will eventually change the consumer's behavior into more digitalized society.

INTRODUCTION

The rapid development of technology has pushed all countries to adapt in order to keep being competitive in global competition, while the technology implementation has spread widely to all aspects of human life, not all countries are ready to adopt it due to lack of intellectual capacity and infrastructure. In global level, a new trending manufacturing concept called industry 4.0 has been introduced, which promotes massive use of automation and cyber technology to enhance production output quality and quantity.

Indonesia is pushing itself to implement industry 4.0 revolutionary concept in order to increase its country economy competitiveness in the global market, especially since concept of society 5.0 (Super Smart Society) had been introduced by Japan in 2016 (Skobelev & Borovik, 2017). It indicates that Indonesia must work extra to run after the global trend in industrial development that rapidly evolves over time. The recent industrial development trends are always linked to technology adoption where information communication and technology is an absolute prerequisite. Despite the importance of information

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communication and technology, the readiness of many regions in Indonesia with industry 4.0 remains a big question because a region must have a sufficient human capital and infrastructure to adopt industry 4.0. The unequal economic development has always been classic issue as almost 60% of national economic activity in Indonesia concentrated in Java only and Jakarta as capital city becomes the most dominating national economy driver for so many decades (Faturay et al., 2017). Alternative regions are needed in order to reduce the economy development gap.

Both local and international investors need information where they should invest, while local industries must also be supported by government in order to adopt industry 4.0 (Poma et al., 2020). Therefore, regional economic analysis related to information communication and technology is urgently needed, such studies are still lacking in Indonesia (Faturay et al., 2017). This study aims to understand information communication and technology development of each province in Indonesia which will be presented in more detail with sub topics such as the percentage of internet user, access and infrastructure index and human development index. Combined with gross regional domestic product of each province, this study presents a completed overview of information communication and technology and economic development disparity at provincial level in Indonesia. The provincial study in this area has never been done before. Therefore it becomes main contribution of this research. Investors are assisted by this research output to make digital transformation investment decision as this study presents market attractiveness, human resource availability and infrastructure readiness of each province in Indonesia. Central government can also use this study to formulate policy and development priority in order to reduce unequal development, meanwhile provincial government can use this study as motivator and parameter to increase its regional development in information technology and communication in order to welcome industry 4.0 and society 5.0. The industry can use this research output as baseline of making investment preference and decision, especially those companies that work closely with industry 4.0, the right investment that is well supported by right infrastructure and society will generate big income. The next section presents literature review, method, analysis and discussion, conclusion and recommendation, then limitation of study.

Information and Communication Technology and Industry 4.0

Information and Communication Technology (ICT) is a large terminology that includes all technical equipment for processing and delivering information. ICT covers two aspects, namely information technology and communication technology. Information technology includes all matters relating to the process, use as a tool, manipulation, and management of information. While communication technology is everything related to the use of tools to proceed and transfer data from one device to another. Therefore, information technology and communication technology are two inseparable concepts. Information and communication technology contains a broad sense related to all activities in processing, manipulation, management and transfer of information between media. The term ICT emerged after the combination of computer technology (both hardware and software) and communication technology in the mid-century 20. The combination of two technologies is developing rapidly beyond other fields of technology. Until the beginning of the 21st century, ICTs continue to undergo various changes and have not reached a saturation point (Nwokefor, 2015).

The latest ICT-based industrial revolution is industry 4.0, which was introduced in 2011 to enhance Germany manufacturing competitiveness. The Industrial Revolution 4.0 is a global phenomenon that combines cyber technology and automation technology. The Industrial Revolution 4.0 is also known as "cyber physical system". The key point of industry 4.0 is information and communication technology, which together with artificial intelligence change how people live and interact on global scale. It promotes an increasing interaction between human and machine in order to achieve a better life in all aspects (Sima et al., 2020).

By assistance of information technology in the application process, human involvement can be reduced. Thus, the effectiveness and efficiency of a work environment naturally increases. In the industrial world, this innovation has a significant impact on work quality and production costs, even all levels of society can also get general benefits from this system. It does not only affect manufacturing, but also product and service innovation in the future. Therefore industry 4.0 needs digital society with good connectivity of internet because industry without market does not possibly grow up. In the concept of Industrial Revolution 4.0, there are at least five technologies that become main pillars in developing a digital industry, namely: The Internet of Things,

Big Data, Artificial Intelligence, Cloud Computing and Additive Manufacturing (Pascual et al., 2019).

Gross Regional Domestic Product

Gross Regional Domestic Product (GRDP) represents the size of a region's economy. It is statistical data that summarizes the acquisition of added value from all economic activities in an area in a certain period. GRDP is calculated in two ways, namely based on current prices and constant prices. Current prices based GRDP calculation uses the prices of goods and services in the current year, whereas in constant prices based GRDP calculation uses prices in a given year (base year). Current GDP calculation uses 2018 as a base year. The use of this base year is determined nationally. Gross Domestic Income as one of the economic indicators includes various economic instruments, where the macroeconomic situation of a region is clearly visible with its economic growth, income per capita and various other economic instruments (Giap et al., 019).

Giap et al. (2019) further explain that the existence of these data greatly assists policy makers in planning and evaluation so that development is not misdirected. GRDP figures are needed and need to be presented, because in addition to being used as a baseline of development planning, it is also a barometer to measure the results of development that has been carried out. GRDP is the sum of all expenditures for household consumption and non-profit private institutions, government consumption, gross domestic fixed capital formation, changes in inventory, and net exports in a region in a certain period (usually a year). Net exports are defined as exports minus imports. GRDP is indicator of economic growth rates, per capita income levels, prosperity, increases and decreases in people's purchasing power, illustrates the economic structure and economic potential of the region and others. The regional economy will increase from year to year due to an increase in production factors.

Data Visualization

Interesting data visualization technique has been widely used to communicate data or information by involving as visual objects for example, points, lines, or bars in a graph. According to Evergreen (2019), the main purpose of data visualization is to communicate information to users through selected information charts, such as tables and graphs clearly and efficiently. To present ideas, aesthetic forms and functionality must go hand in hand in order to make readers enjoy when reading our report, providing insights for complex and complicated data sets by communicating key aspects is an intelligent way.

Effective visualization helps users to analyze data and evidence. It makes complex data accessible, understandable and useful. The user can do certain analytical work, such as comparing or understanding causality. Tables are generally used when users will see a certain size of a variable, while graphs of various are used to see patterns or relationships in data for one or more variables. Data visualization is a modern visual communication method. Data visualization is not under any field, can be interpreted in many fields of study, it can be seen as a modern branch of descriptive statistics in research, and also as a basis for other development tools. Data visualization involves the creation and study of visual data representations. It helps researchers to interpret abstracted information in a schematic form, including the attributes or variables of the information unit.

Regional Economic Portfolio Matrix Analysis

Regional economic portfolio matrix analysis was introduced by Wieland (2019) and originated from portfolio matrix, well known as the growth share matrix, developed by Boston Consulting Group to help identifying the growth and decline of business aspect in a company. The original purpose of the analysis was to assess company or business competitiveness. However along with the rapid development of theory, the technique has now been applied to several regional economic contexts (Howard, 2007). There are four quadrants in regional economic portfolio matrix. The following picture below explains the detail of its use in this study, along with explanation for each quadrant.

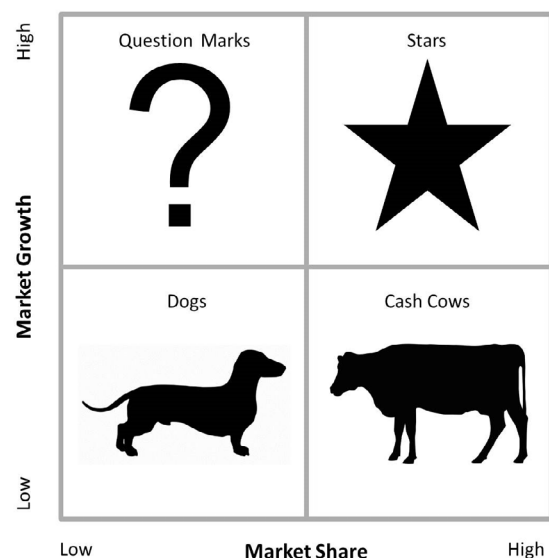


Figure 1. Regional Economic Portfolio Matrix

Quadrant I (question marks): This area is place for samples with low level of performance but high level of economic output, thus provinces that fall in this block must work so hard to increase its information and communication technology development in order to implement industry 4.0 because without enough preparation, the potential market and resource will be wasteful.

Quadrant II (stars): This area is place for samples with high level of performance and high level of economic output, thus provinces that fall in this block are the best choice for technology transformation investment because of their great economic performance and readiness with infrastructure, human resource and information communication and technology literacy. These provinces are expected to keep up their good work.

Quadrant III (dogs): This area is place for samples with low level of performance and low level of economic output, thus provinces that fall in this block must work so hard to increase its economic as well as its information and communication technology development in order to implement industry 4.0 to run after the other provinces.

Quadrant IV (cash cows): This area is place for samples with high level of performance but low level of economic output, thus provinces that fall in this block must work hard to increase its economic output to attract investment, however these provinces are considered ready for industry 4.0 therefore it is very potential choice as alternative to those provinces in quadrant II.

METHODS

This study is classified as an exploratory, cross-sectional descriptive study. The output is presented quantitatively to provide a clear and interesting ranking based overview of information communication and technology development, as well as economic prospect of each province in Indonesia. This study used secondary data from central bureau of statistics Indonesia for information and communication technology development sub index and regional domestic product per province. Secondary data is believed to have pre-established degree of validity and reliability, especially if it is taken from reputable source therefore retesting its validity and reliability is not necessary (Management Study Guide, 2016). Data visualization and regional economic portfolio matrix analysis method were employed

to analyze the data. Since the latest information and communication technology development sub index was released in 2018 by the relevant institution, therefore the overall analysis was focused on 2018 period. A province is required to have good score in access and infrastructure development, use of ICT, human resource skill and gross regional domestic product in order to be ready for industry 4.0.

Information Communication and Technology Development Index

The index for ICT development was calculated by following formula.

$$\text{ICT Index} = 0.4\text{AI} + 0.4\text{USE} + 0.2\text{SKILL}$$

Where:

AI : Access and Infrastructure Sub index

USE : Use sub index

SKILL: Skill sub index

ICT Index is ranged from 1-10

Gross Regional Domestic Product

GRDP was calculated by the following equation.

$$\text{GRDP} = C + I + G + (X - M)$$

Where:

C : Household spending

I : Capital Investment spending

G : Government spending (regional government)

X : Exports of Goods and Services

M : Imports of Goods and Services

Regional Economic Portfolio Matrix Analysis

Regional economic portfolio matrix analysis was employed to provide overview of ICT development and economic disparity between provinces in Indonesia, the following equation is rewritten as follows:

$$\text{Avg. Score} = \frac{\text{ICT Development Index}}{\text{GRDP}} \times 100\%$$

RESULTS AND DISCUSSIONS

Internet User Penetration Rate

The graphic below presents the internet user penetration rate per province. Jakarta has the highest internet user penetration with 65.89% of its population uses internet, followed by Yogyakarta (55.45%), Riau Islands

(53.74%), East Kalimantan (50.25%) and Banten (47.90%), these provinces become perfect alternative regions to Jakarta when it comes to ICT investment. By large number of internet users, these provinces become an attractive market for information and communication technology based business and product, it is also easier to find skill labor and employee with sufficient internet literacy that will contribute in industry 4.0 adoption process. To train people who are familiar with ICT is easier than those who are not.

On the other side, West Nusa Tenggara, West Sulawesi, North Maluku, East Nusa Tenggara and Papua have the lowest internet user penetration. These provinces need to increase its population internet literacy in order to implement industry 4.0 because lack of digital culture can be challenge of industry 4.0 operation in a specific region (Slusarczyk, 2018). A high digital culture can attract outside investors to invest in ICT industry which will fasten the implementation of industry 4.0.

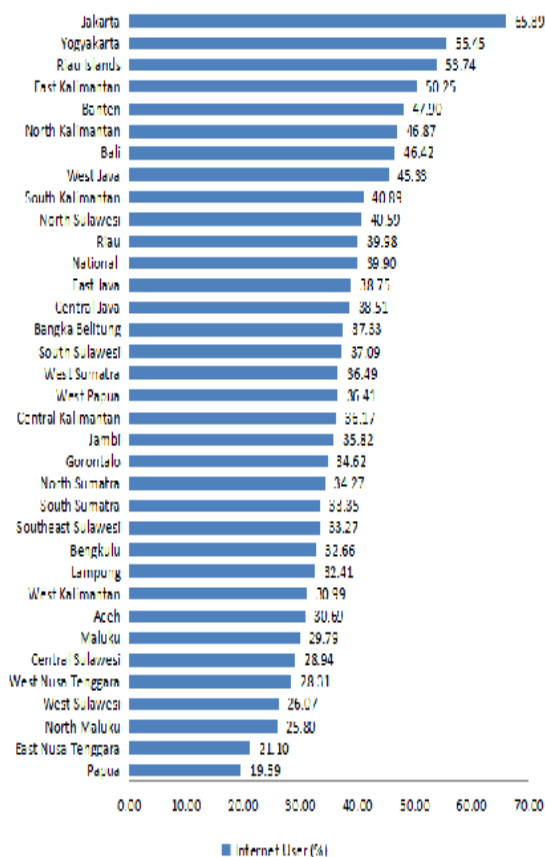


Figure 2. Internet User per Province (% of Population)

ICT Access and Infrastructure

The graphic below presents the ICT access and infrastructure development index per province. The most developed province in the aspect of ICT access and infrastructure is Jakarta with score 7.90, the alternative of Jakarta is Yogyakarta (7.18), Bali (7.22), Riau Islands (6.80) and East Kalimantan (6.77). The access and infrastructure index reflects the readiness level of ICT which consists of five indicators: fixed telephone subscribers per 100 residents, mobile phone subscriber per 100 inhabitants, bandwidth of international internet per user, the percentage of households with computers, and the percentage of households with Internet access.

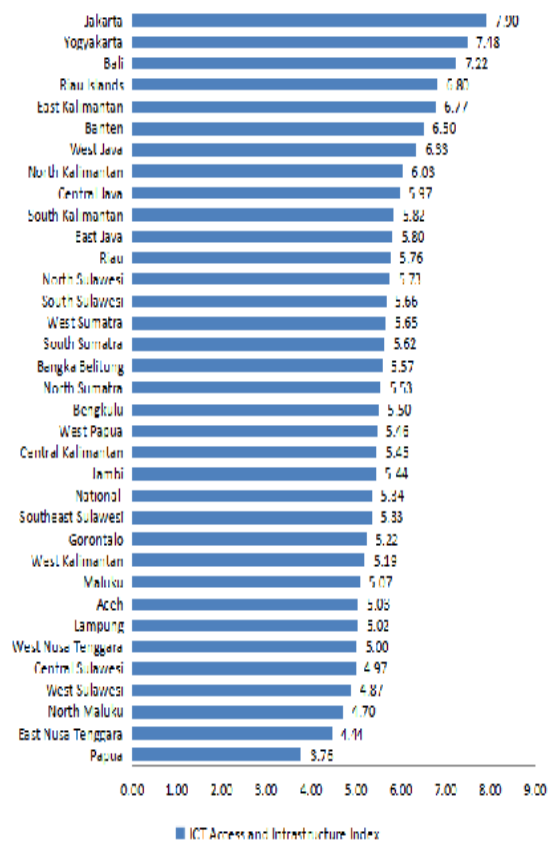


Figure 3. ICT Access and Infrastructure Index per Province

Meanwhile Central Sulawesi, West Sulawesi, North Maluku, East Nusa Tenggara and Papua are the least developed provinces in the aspect of ICT access and infrastructure, it needs government role to collect both private and public financial resource in order to improve the ICT access and infrastructure in its region,

which later will stimulate more people to possess ICT products and support their daily activity with those devices. Lack of access and infrastructure will create fear for investors therefore it will major barrier of industry 4.0 implementation in all aspects, a company cannot individually take of this problem therefore government's role is urgently required because its development program can provide access and infrastructure that the benefit can be collectively enjoyed by all stakeholders.

Human Development

The graphic below presents the human development index per province that reflects life expectancy, education and per capita income of its people in average. Province with the highest human development index goes to Jakarta with score 80.47, and followed by other provinces such as Yogyakarta (79.53), East Kalimantan (75.83), Riau Islands (74.84) and Bali (74.77). Yogyakarta can be the best alternative to Jakarta for companies to search for the highly skilled employees, with a slight difference of human development index, Yogyakarta is recognized as a province that has advanced education quality in Indonesia.

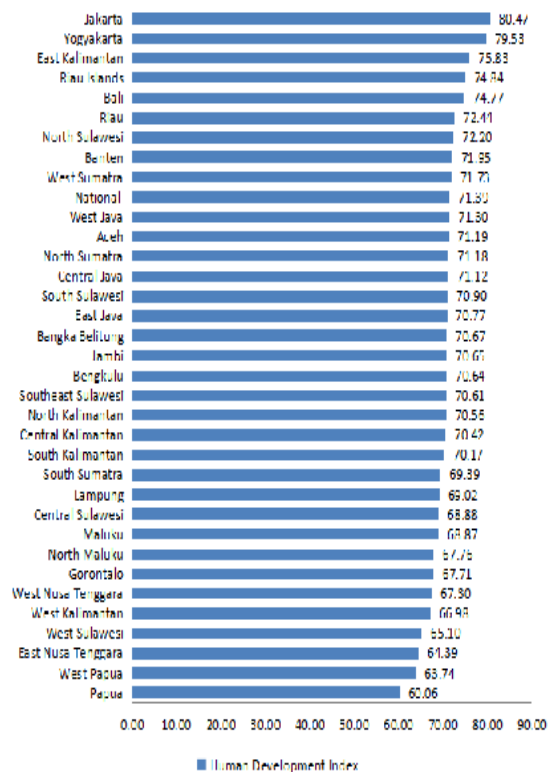


Figure 4. Human Development Index per Province

Nevertheless, there are still several provinces that need more improvement in its human development such as West Kalimantan, West Sulawesi, East Nusa Tenggara, West Papua and Papua. These provinces have the lowest human development index in Indonesia and therefore government must pay attention on these provinces if they want to equally develop the ICT and implement industry 4.0.

Gross Regional Domestic Product

The graphic below presents the gross regional domestic product (GRDP) per province. When it comes to investment, regions with the best economic growth and prospect are always appointed as priority because many companies are already there to make money and therefore investing in region with good economic condition is considered as a safe choice (Susilo, 2018).

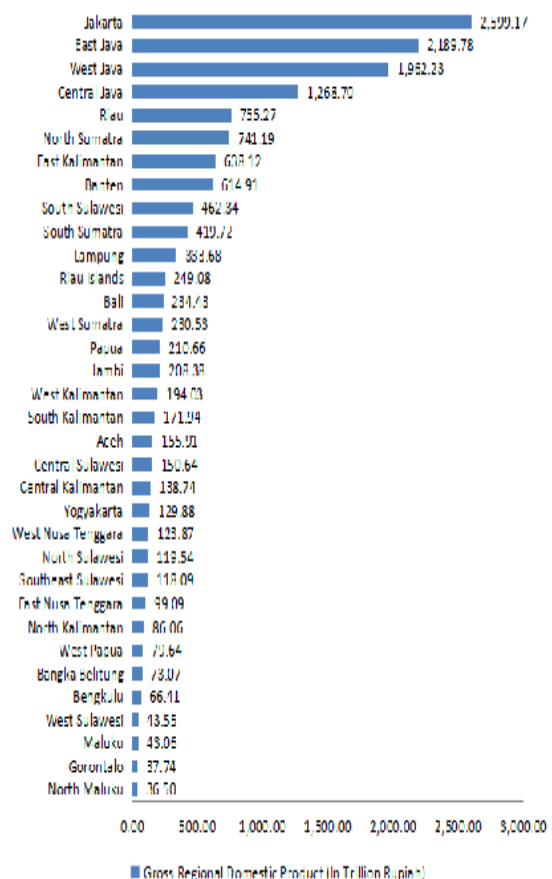


Figure 5. Gross Regional Domestic Product per Province

Jakarta becomes province with the best GRDP among all provinces in Indonesia, its

economic output accounts for 2.599,17 trillion rupiah in 2018. Another province with an astonishing achievement that deserves for public attention is East Java with 2.189,78 trillion rupiah, followed by West Java (1.962,23 trillion rupiah) and Central Java (1.268,70 trillion rupiah). These provinces dominate the national economic output of Indonesia, which ironically also indicates that the current economic activity of Indonesia is still heavily focused on Jakarta and Java only, this economic inequality becomes major issue that is worthy to note. However these provinces are the most potential provinces to implement industry 4.0 at the moment.

Meanwhile, Bengkulu, West Sulawesi, Maluku, Gorontalo and North Maluku are provinces with the smallest GRDP in Indonesia. These provinces still have a lot of chance to increase its GRDP by exploiting its hidden and potential resource so that it becomes more attractive to investors in the future. A better economic growth will also affects other aspects such as education, life quality, digital literacy and others that finally will contribute to fasten the industry 4.0 implementation.

Regional Economic Portfolio Matrix Analysis Result

The figure below presents the regional economic portfolio matrix analysis result based on two attributes which are gross regional domestic product and ICT development index. The analysis resulted in fact that there are several provinces in Indonesia that fall into quadrant II, these provinces are the most promising destination for ICT based investment, along with its leading economic prospect and growth, these provinces are considered as the most ready for industry 4.0. Jakarta has out of question become no. 1 choice that falls into this category, but there are also other provinces such as East Java, West Java, Central Java, Riau, Banten, South Sulawesi and East Kalimantan that are also well developed in its ICT and have good economic prospect. These provinces are the best alternative to Jakarta that has already been crowded by many competitors. High living cost, population, price of property and regional minimum wage in Jakarta become motivation of finding new place for investment and capital city relocation on recently. Central government has planned to relocate its capital city to East Kalimantan therefore it is worthy to get attention (Burke & Siyaranamual, 2019).

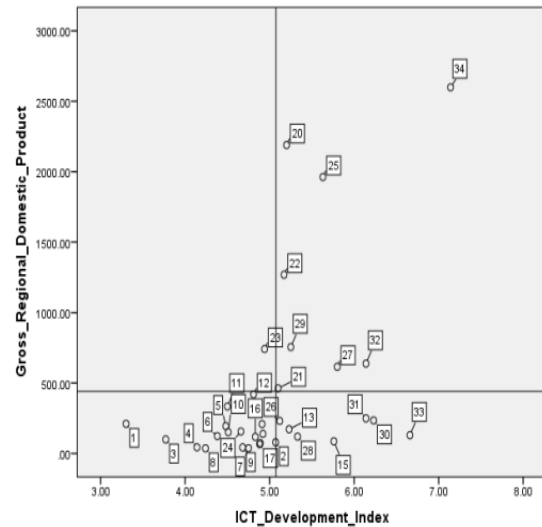


Figure 6. Regional Economic Portfolio Matrix Analysis

Table 1. Code per Province

Code per Province			
1	Papua	18	Jambi
2	West Papua	19	Bangka Belitung
3	East Nusa Tenggara	20	East Java
4	West Sulawesi	21	South Sulawesi
5	West Kalimantan	22	Central Java
6	West Nusa Tenggara	23	North Sumatra
7	Gorontalo	24	Aceh
8	North Maluku	25	West Java
9	Maluku	26	West Sumatra
10	Central Sulawesi	27	Banten
11	Lampung	28	North Sulawesi
12	South Sumatra	29	Riau
13	South Kalimantan	30	Bali
14	Central Kalimantan	31	Riau Islands
15	North Kalimantan	32	East Kalimantan
16	Southeast Sulawesi	33	Yogyakarta
17	Bengkulu	34	Jakarta

Meanwhile, North Sumatra is the only province that occupies quadrant I. Its gross regional domestic product is above the average. However its ICT development index is a little bit below the average. In order to increase its provincial competitiveness, Government must improve their ICT development, the potential is visible but it now depends on seriousness of stakeholders in the province to work a little bit harder so it can reach the area of quadrant II. Reversely, provinces like

West Sumatra, South Kalimantan, North Sulawesi, West Papua, Bali, Riau Islands, Yogyakarta and North Kalimantan have ICT development index above the average but a little bit poor performance when it comes to gross regional domestic product. These provinces that stay in quadrant IV must increase its economic output by exploiting more potential income from their region and these province are really potential as being target for industry 4.0 implementation therefore in the future, there is a big opportunity for these provinces to grow up from technology investment.

The last group is quadrant III which consists of Papua, East Nusa Tenggara, West Sulawesi, West Kalimantan, West Nusa Tenggara, Gorontalo, North Maluku, Maluku, Central Sulawesi, Lampung, South Sumatra, Southeast Sulawesi, Bengkulu and Aceh need more improvement in both economic and ICT development. These provinces need to be development priority of central government in order to massively implement industry 4.0 and reduce economic inequality between one province and another.

CONCLUSIONS AND RECOMMENDATIONS

Jakarta as the capital and a province of Indonesia is out of question the best performing province in Indonesia based on its high gross regional domestic product and ICT development index, but there are also other provinces such as East Java, West Java, Central Java, Riau, Banten, South Sulawesi and East Kalimantan that are also well developed in its ICT and have good economic prospect. Familiarity of the people with information and communication technology in these provinces are the best asset, especially it is supported by access and infrastructure from its government. The coming era of technology transformation requires less employment, but it must be supported by highly skilled people to make the operation goes well. Even if economic inequality still becomes major problem in Indonesia but increasing Indonesia economic competitiveness in global economic scale is also essential.

Government is recommended to supervise and prioritize the development of provinces in the less developed provinces. Transfer of technology from strong province to the weak is also a good policy to deal with inequality issue. Future researchers are suggested to make the same analysis at different level such as city in order to provide more detailed information for stakeholders. They are also expected to add more variable and attributes to study about readiness of each region for industry 4.0 and society 5.0. Another research

and analysis design is also suggested for example instead of conducting the same descriptive study, future researchers can use data from previous periods and make longitudinal research.

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