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Indonesian ict workers: Determinants and strategy to support national digital transformation

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ADB Working Paper Series

INDONESIAN ICT WORKERS: DETERMINANTS AND STRATEGY TO SUPPORT NATIONAL DIGITAL TRANSFORMATION

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Abstract

The development of digital technology provides opportunities for every country to increase its economic growth. Digital technologies are changing the workplace, providing a significant opportunity for nations and companies to boost productivity, efficiency, and growth. The speed of digital transformation will depend on a number of factors, including the economic and social development of a country, its placement within global supply chains, the availability of basic digital infrastructure, competition and new markets, societal acceptance of technologies, and the availability of ICT worker. This paper focuses on the last factor, which is the availability of ICT worker in Indonesia. The paper aims to confirm the determinants which affect the availability of ICT worker in Indonesia. According to this research, the availability of ICT worker in Indonesia is influenced by optimizing the utilization of ICT infrastructure, demographic conditions, economic structures, worker education levels in Indonesia, and the development of entrepreneurship in 33 provinces in Indonesia.

Keywords: adaptation, innovation, technology

JEL Classification: O33, O38

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1. INTRODUCTION

The world around us has been changing on a daily basis along with the development of human civilization. Therefore, technical and technological developments of production are changing as well. Industry 4.0 is a model that shows how industrial production follows the latest developments and changes over time. This implies that in order to beat the competition from all countries without exception, every country should increase its efficiency of resource utilization process in order to produce product at the optimal level. Human resource strategies need to be carefully arranged in order to produce outputs that are able to adapt and apply digital technology.

The development of the industry is growing rapidly over time. Prasetyo and Sutopo (2017) stated that an industrial revolution has occurred up to four times, starting with the first Industrial Revolution that happened in the year 1784. The first Industrial Revolution took place in the UK with the discovery of steam engines and the use of manufacturing machines that replaced the role of human worker. Then, the second Industrial Revolution occurred when the use of electrical resources became the main force of the production machines. The third Industrial Revolution occurred in the mid-1970s when the invention of computer technology was influential in the use of industrial machinery automation. The fourth Industrial Revolution was introduced in 2011 in Germany. The use of industrial technology in this era led to more high-tech industries. The development of 4.0 technology, which leads to digitalization, provides an opportunity for each country to increase its economic growth.

The McKinsey Global Institute (2019), in its report titled “Automation and the Future of Work in Indonesia,” stated that automation technology has changed the working environment by providing significant opportunities for countries and companies to encourage productivity, efficiency, and growth. On the other hand, technology also changes a wide range of existing jobs. The success of the technology will not only create new jobs but can also replace old jobs and change various professions. Automation has the potential to increase the productivity and growth of GDP in Indonesia, increasing the income for the workforce and providing business opportunities for businesses. The positive impact on the economy can help accelerate growth, creating 25 million new jobs in Indonesia by 2030.

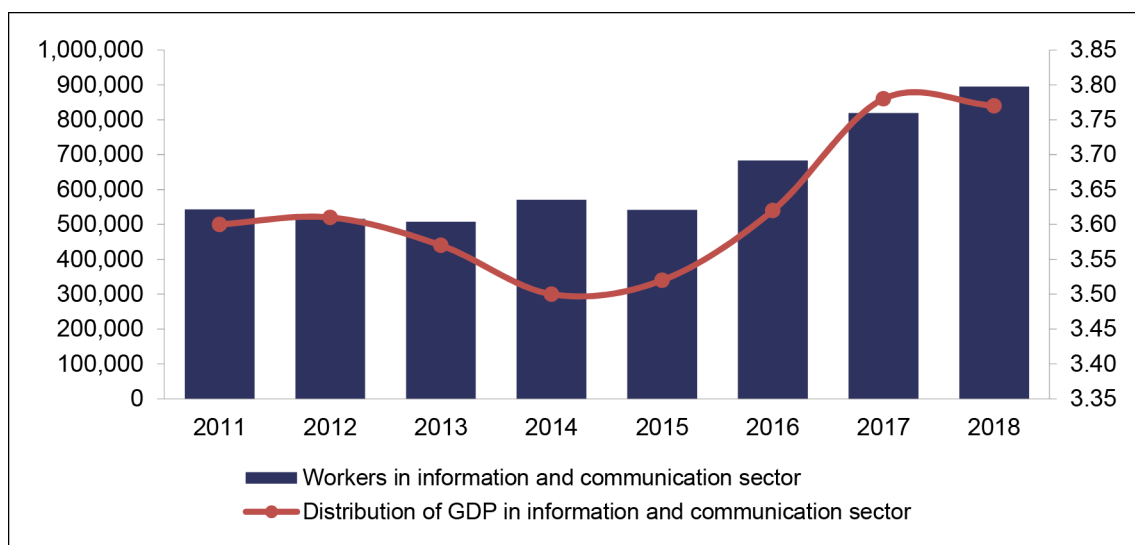
The growth of jobs will likely change the composition of various sectors in the Indonesian economy as a whole. New skills will be needed in this automation era. According to the McKinsey Global Institute Report (2019), in Indonesia and several other developing countries, because of the automation era, the level of worker demand for new types of work will increase while routine and predictable jobs will be replaced by automation. This is also in line with the research of Arntz, Gregory, and Zierahn (2016), which proves that workers with low skills and education will be replaced by automation.

Digitalization of the economy is a driver in the growing demand for ICT specialists across sectors. The availability of worker in the information, communication, and technology (ICT) sector is very important for supporting digital transformation. According to the research of Zemtsov, Baburin, and Barinova (2019) entitled “The Risks of Digitalization and the Adaptation of Regional Worker Markets in Russia,” the indicator that can be used as a reference regarding the readiness to grasp digitalization opportunities is the availability of worker in the information and communication sector.

Figure 1: An Increasing Percentage of Jobs Will Require College and Advanced Degrees

| Education Level | Employment in millions, 2014 | Projected Net Change in Employment (million) | % Change in Jobs | Employment in millions, 2030 |
|---------------------|------------------------------|--|------------------|------------------------------|
| Less than secondary | 31.6 | 11.2 | 36 | 42.8 |
| Secondary | 56.4 | 15.0 | 27 | 71.4 |
| Associate | 17.1 | 6.8 | 40 | 24.0 |
| College | 9.3 | 4.9 | 52 | 14.2 |
| Advanced | 1.7 | 1.1 | 66 | 2.8 |

Source: McKinsey Global Institute (2019).

Figure 2: Distribution of GDP (%) and Workers (thousand) in Information and Communication Sector

Source: Central Bureau of Statistics (2018).

According to the 2018 National Workforce Survey (SAKERNAS) data, the ICT sector employs 894,000 workers. Growth has been greater in other sectors that use ICT rather than in the ICT sector itself, such as in the area of e-commerce, for example, and the market is expanding rapidly led by tech and digital companies such as Tokopedia, Gojek, Traveloka, and Bukalapak. Indonesia is poised to become a location for digital innovation, including in the areas of retail and financial services, with new business models acting as the primary form of innovation (McKinsey Global Institute 2017).

Digitalization is expected to transform many sectors in the future, including financial services and manufacturing. Nevertheless, the demand for workers in the information and communication sector will increase amid this digitalization era. In addition, with the development of the role of the ICT sector in the Indonesian economy, which is reflected in the contribution of the ICT sector to GDP in general, it will continue to increase. The role of an ICT sector that continues to increase will depend on a number of factors, including the economic and social development of a country, its placement within global supply chains, the availability of basic digital infrastructure, competition and new markets, societal acceptance of technologies, and the availability of ICT worker. This paper focuses on the last factor: the availability of ICT worker in Indonesia.

2. LITERATURE REVIEW

Digital technology has changed the work environment by providing significant opportunities for countries and companies to drive productivity, efficiency, and growth. On the other hand, technology also changes the characteristics of existing work. Successful use of this technology will not only create new jobs but can also replace old jobs and change various professions (McKinsey Global Institute 2019). According to Cortes and Salvatori (2018), workers who use computers in their routine work are said to have a faster ability to deal with technological changes (high-ability workers) than workers who do not use computers. Therefore it is said that the workforce adapts more easily to new jobs even though it requires new technological skills. The availability of workers who are accustomed to operating computers such as workers in the ICT sector becomes important in showing the initial readiness to adapt to technology in the era of digitalization. In addition to worker, the number of people who are used to accessing the internet also reflect the readiness to adapt to the digitalization era. This is supported by Oxley and Yeung's (2001) research on 30 countries that found that Internet penetration in a country is positively correlated with the availability of ICT infrastructure in that country. Internet penetration is reflected by the large number of people accessing the Internet in the region.

According to research by Zemtsov, Barinova, and Semenova (2019) in the Russian Federation, the digitalization penetration in the Russian Federation is still quite low compared to other developed countries because of the low population, uneven distribution of economic activity, low incomes, and inadequate availability of technological infrastructure. According to these studies, the low population size affects the speed of penetration of digitalization. The population reflects the demographic conditions of an area and its relationship with the conditions of the employment structure in that region. In addition to demographic conditions, the structure of the economy also influences the readiness to adapt in the digitalization era.

According to research by Moretti (2012) in the United States, it has been found that an area that is dominated by routine economic activities usually found in the manufacturing and agricultural sectors will have a low number of creative workers. This risk occurs in particular when the manufacturing and agricultural sectors have a higher share of manual work and routine operations than those that use technology. In line with Moretti's research, Berger and Frey (2017) show that the dominance of the manufacturing sector in the economy will have a negative impact on the growth of new industries. Meanwhile, according to the study of Barinova, Zemtsov, and Tsareva (2018) in the Russian Federation, the factors that influence the readiness for digital transformation are a conducive entrepreneurial environment, diversification of developing economic sectors, and high investment in human capital. Enabling an entrepreneurial environment in one region is one of the factors that influence digital readiness because it reflects the level of creativity and innovation of the people in the region. Moreover, recently new entrepreneurs have become more interested in using digital technology as part of their business strategy, so this will create new demand for ICT worker.

One important aspect that this generation should be prepared for in facing the challenges of the digitalization era are education. Workers with a higher education level are considered more able to adapt to digital technology. In Indonesia, Higher education is a level of education after secondary education consisting of diploma, bachelor (sarjana), masters and specialized postgraduate programs, and doctorate programs imparted by a higher education institution, which regulates based on the provisions of Act No. 20 of 2003, Article 19, Paragraph 1. More highly educated workers can adapt

more smoothly to digital transformation because it will increase their ability to acquire new knowledge, master new technology, and participate in continuous learning (Chang and Huynh 2016).

According to Lin (2011) research conducted in the United States, a region with a university graduate workforce will be more able to create jobs in new types of industry than workers with lower education. This is also in line with research by Beaudry, Doms, and Lewis (2010) in urban areas of the United States. The research by Beaudry, Doms, and Lewis found that urban areas with a highly educated workforce had a positive effect on the proportion of professionals in technology and information technology. This is because a highly educated workforce is considered more able to adapt to using the latest technology.

3. DATA AND METHODOLOGY

In this study, we use panel data as a combination of time series data and cross-sectional data. Regression that uses panel data is referred to as a “panel data regression model.” Based on a developed hypothesis, the empirical model used to prove factors affecting the amount of worker in the information, communication, and technology (ICT) sector is as follows:

$$\begin{aligned} \ln ICT_{i,t} = & \beta_1 + \beta_2 \ln Diversity_{i,t} + \beta_3 \ln HumanCapital_{i,t} + \beta_4 \ln ICTInf_{i,t} \\ & + \beta_5 \ln Entrepreneurship_{i,t} + \beta_6 \ln EconomicSpecialization_{i,t} \\ & + \varepsilon_{i,t} \end{aligned}$$

where:

ICT is the share of ICT workers in the total regional workforce, %;

i is the Indonesian province;

t is the year;

Diversity refers to variables measuring the diversity of economic activities;

Human Capital refers to variables measuring the concentration of human capital in the region based on education level;

ICT_inf refers to variables measuring the availability of Internet access;

Entrepreneurship refers to variables describing the density of entrepreneurial activity;

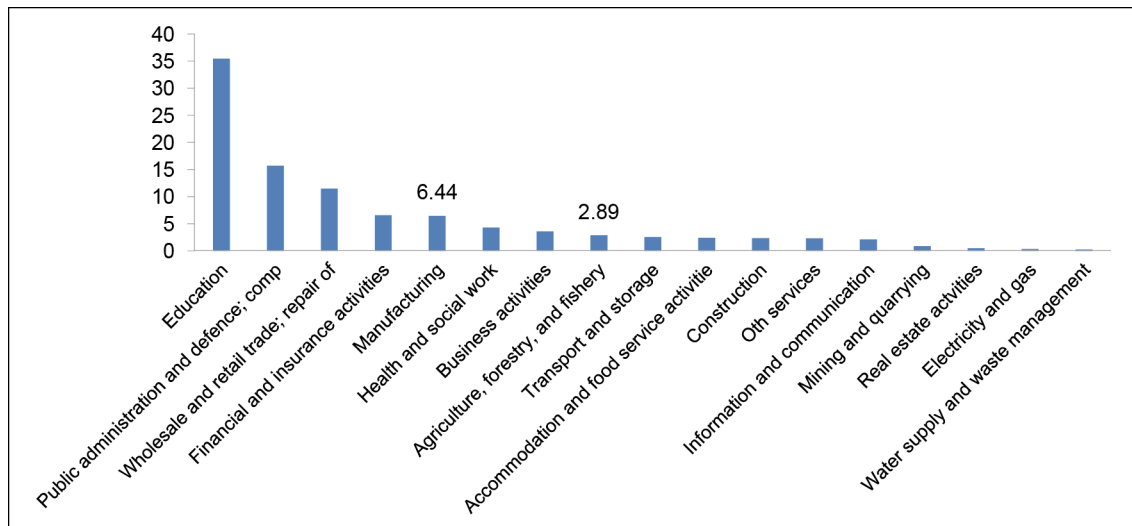
Economic Specialization refers to control variables describing specific features of regional economic structures: the share of sectors where routine and manual work is common, i.e., those where opportunities to apply IT remain few and far between. Shares of workers employed in agriculture and manufacturing were used for this purpose.

We use two indicators to describe the economic specialization variable, namely the share of agricultural plus manufacturing workers, and the share of manufacturing workers. We use the first indicator, i.e., the share of agricultural and manufacturing workers, by following the developed hypothesis from the literature, as explained above. And then we use the second indicator, which is the share of manufacturing workers, because the manufacturing sector has been the highest contributor to Indonesia's GDP in the last five years. So we assume that the manufacturing sector develops faster than the other sector, especially in terms of technological development. And because of that, the workers in the manufacturing sector will be more literate in technology than

the workers in the agriculture sector. We assume that if the development of technology in the economy is fast, it will boost the demand for development in the ICT sector, which will increase the demand for ICT worker.

Furthermore, the ratio of manufacturing workers to agricultural workers averaged 1 to 47 during the period 2011–2018. So if the manufacturing workers are not separated from the agricultural workers as in the first indicator, the effect of development in the manufacturing sector on ICT workers cannot be determined. Additionally, following the developed hypothesis, if the number of highly educated workers increases it will increase the need for ICT services, which in the end will increase the demand for, and also the supply of, ICT workers. Moreover, according to the literature review, more highly educated worker can also adapt more smoothly to digital transformation because it will increase their ability to acquire new knowledge, master new technology, and participate in continuous learning. In this paper we also compare the number of workers with a high level of education in the agriculture sector and the manufacturing sector. Figure 3 shows that the manufacturing sector contributed 6.44% of highly educated workers to the total number of highly educated workers in Indonesia in 2018. At the same time, the agriculture sector only contributed 2.89%. This fact can strengthen our hypothesis.

Figure 3: Distribution of Worker with High Education in 2018
(%)



Source: Central Bureau of Statistics (2018)

We use data from the National Workforce Survey (SAKERNAS) and the National Socioeconomic Survey (SUSENAS), which is conducted by the Central Bureau of Statistics (BPS). The data used from SAKERNAS are: the number of residents in the workforce; the number of residents employed; the number of workers with a higher level of education (specified by education at the Diploma IV, Bachelor, Master, and Doctor level); the number of workers in the information and communication technology sector; the number of workers in the agricultural technology sector; the number of workers in the manufacturing sector; and the number of self-employed workers. Data on self-employed workers are used as an approximation for the number of small enterprises, because data on small enterprises from all economy sectors are not available. The data used from SUSENAS are: the number of regional residents and the number of people with Internet access.

The variables used in this study consist of the share of ICT workers (%) as the dependent variable and some independent variables described in Table 1.

Table 1: Variables Applied in the Model

| Variable | Designation | Indicator | Expected Effect | Source |
|--|-------------|--|-----------------|--|
| Diversity | ln_City | Number of regional capital residents, people | + | Zemtsov, Barinova, and Semenova (2019) |
| Human capital | ln_High_Ed | Share of workers with higher education, % | + | Lin (2011) |
| ICT infrastructure | ln_Int | Share of people with Internet access, % | + | Oxley and Yeung (2001) |
| Conditions for development of entrepreneurship | ln_Firm | Ratio of the number of small enterprises to workforce, units per 10,000 people | + | Barinova, Zemtsov, and Tsareva (2018) |
| Specific features of economic structure | ln_AgMf | Share of workers employed in agriculture and manufacturing, % | – | Moretti (2012) |
| | ln_Mfg | Share of workers employed in manufacturing, % | – | Berger and Frey (2017) |

The time series was limited to 2011 and 2018, due to data for 2019 not being fully available. Data from 33 provinces were used. Table 2 presents descriptive statistics of all the data used in the models, and Table 3 presents pair correlation coefficients for the variables. All the indicators were logarithmized in the model.

Table 2: Descriptive Statistics of the Data Used in the Model

| | ICT | CITY | HIGH_ED | INT | FIRM | AGMF | MFG |
|--------------|----------|------------|---------|---------|----------|----------|---------|
| Mean | 0.46 | 7,622,377 | 8.75 | 19.01 | 3,449.71 | 47.40 | 9.30 |
| Median | 0.37 | 3,980,656 | 8.49 | 16.27 | 3,805.19 | 48.33 | 7.41 |
| Maximum | 2.29 | 48,521,575 | 19.78 | 60.17 | 5,059.66 | 75.01 | 28.10 |
| Minimum | 0.04 | 759,009 | 2.75 | 4.12 | 246.09 | 10.29 | 1.08 |
| Std. Dev. | 0.36 | 10,555,963 | 2.84 | 10.38 | 1,102.85 | 10.98 | 6.13 |
| Skewness | 2.65 | 2.57 | 0.89 | 1.04 | –1.39 | –0.50 | 1.33 |
| Kurtosis | 12.00 | 8.61 | 4.55 | 3.98 | 3.95 | 4.20 | 4.00 |
| Jarque-Bera | 1,199.7 | 637.0 | 61.7 | 58.2 | 95.1 | 26.9 | 89.2 |
| Probability | 3.1E-261 | 4.8E-139 | 3.9E-14 | 2.3E-13 | 2.3E-21 | 1.4E-06 | 4.2E-20 |
| Sum | 122.2 | 2.E+09 | 2,309.5 | 5,017.9 | 9.E+05 | 12,512.7 | 2,455.3 |
| Sum Sq. Dev. | 35 | 2.93E+16 | 2,122 | 28,363 | 3.E+08 | 31,714 | 9,874 |
| Observations | 264 | 264 | 264 | 264 | 264 | 264 | 264 |

Table 3: Cross-Correlation Matrix

| | [1] | [2] | [3] | [4] | [5] | [6] | [7] |
|----------------|-----|------|-------|------|-------|-------|-------|
| [1] ln_ICT | 1 | 0.29 | 0.45 | 0.67 | –0.29 | –0.70 | 0.52 |
| [2] ln_city | | 1 | –0.19 | 0.20 | –0.10 | –0.11 | 0.54 |
| [3] ln_high_ed | | | 1 | 0.64 | –0.33 | –0.58 | 0.21 |
| [4] ln_int | | | | 1 | –0.34 | –0.62 | 0.52 |
| [5] ln_firm | | | | | 1 | 0.33 | –0.22 |
| [6] ln_agmf | | | | | | 1 | –0.48 |
| [7] ln_mfg | | | | | | | 1 |

We develop the panel data regression using a fixed-effect model and a random-effect model. But the Hausman Test results show that the estimators resulting from the random-effect model for all panel equations were inconsistent. So all of the equations

selected were developed with the fixed-effect model. After that, we test whether the models contain a structural break or not. We have done the test by adding a dummy variable to the model. The dummy variable is defined as 1 if the residuals of the model are higher than the mean of the residuals plus 1.5 residuals standard deviation, or less than the mean of the residuals minus 1.5 residuals standard deviation. And the dummy variable is defined as 10 if the residuals of the model are equal to or between the mean of the residuals plus 1.5 residuals standard deviation, and the mean of the residuals minus 1.5 residuals standard deviation. If the dummy variable is significant (indicated by a probability of less than 5%), we can conclude that the model has a structural break. But if the dummy variable is not significant (indicated by a probability of more than 5%), we can conclude that the model does not have a structural break. The results show that none of the developed models have a structural break. After that, we conducted Im, Pesaran, and Shin's unit root test to test whether the model was stationary or didn't contain a unit root. The results show that all the equations were stationary. Table 4 shows the selected panel data equations. The adjusted R^2 were all above 71%.

Table 4: Results

| Variable Type and Codes | | 1 | 2 | 3 | 4 | 5 |
|--|------------|--------------------|---------------------|--------------------|--------------------|-----------------------|
| Constant | | 37.9 [2.074]* | 49.0 [2.706]* | 35.9 [2.083]* | 39.0 [2.263]* | -2.42 [-10.134]*** |
| Diversity | In_City | -2.76 [-2.211]* | -3.28 [-2.740]* | -2.62 [-2.239]* | -2.80 [-2.396]* | |
| Human capital | In_High_Ed | 0.07 [0.335]*** | | | | |
| ICT infrastructure | In_Int | 0.52 [4.030]* | 0.60 [5.352]* | 0.54 [4.473]* | 0.62 [5.490]* | 0.30 [4.747]* |
| Conditions for development of entrepreneurship | In_Firm | 0.14 [1.932]** | 0.18 [2.582]* | 0.13 [2.014]* | 0.14 [2.115]* | |
| Specific features of economic structure | In_AgMf | | -0.78 [-1.737]** | | | |
| | In_Mfg | 0.26 [1.884]** | | 0.26 [1.861]** | | 0.28 [2.045]* |
| Adj. R2 | | 0.714 | 0.715 | 0.715 | 0.712 | 0.711 |
| Schwarz criterion | | 1.435 | 1.416 | 1.414 | 1.408 | 1.395 |
| Durbin-Watson stat | | 2.237 | 2.155 | 2.234 | 2.155 | 2.198 |
| Im, Pesaran, and Shin W-stat | | | | | | |
| Statistic | | -3.72822 | -3.72822 | -3.72822 | -3.72822 | -3.72822008 |
| Prob.** | | 9.64E-05 | 9.64E-05 | 9.64E-05 | 9.64E-05 | 9.64E-05 |
| Correlated random effects – Hausman Test | | | | | | |
| Chi-Sq. Statistic | | 34.487968 | 86.458246 | 33.42948 | 96.43009 | 38.66384 |
| Chi-Sq. d.f. | | 5 | 5 | 4 | 3 | 2 |
| Prob. | | 1.90E-06 | 3.72E-17 | 9.75E-07 | 9.10E-21 | 4.02E-09 |
| Dummy variable for structural break | | | | | | |
| Coefficient | | 0.058988 | 0.017183 | 0.049692 | 0.041200 | 0.01845 |
| t-Statistic | | 1.793062 | 0.615385 | 1.471739 | 1.472369 | 0.56323515 |
| Prob. | | 0.074751 | 0.539032 | 0.143019 | 0.142629 | 0.57395310 |

Note: The number of observations was 264. Growth was measured for 33 provinces in 2011–2018. Variable significance probability is indicated in parentheses (* Probability ≤ 0.05 , ** Probability > 0.05 and ≤ 0.1 , *** Probability > 0.1).

Legend:

In_City – Number of regional capital residents, people

In_High_Ed – Share of workers with higher education, %

In_Int – Share of people with Internet access, %

In_Firm – Ratio of the number of small enterprises to workforce, units per 10,000 people

In_AgMf – Share of workers employed in agriculture and manufacturing, %

In_Mfg – Share of workers employed in manufacturing, %

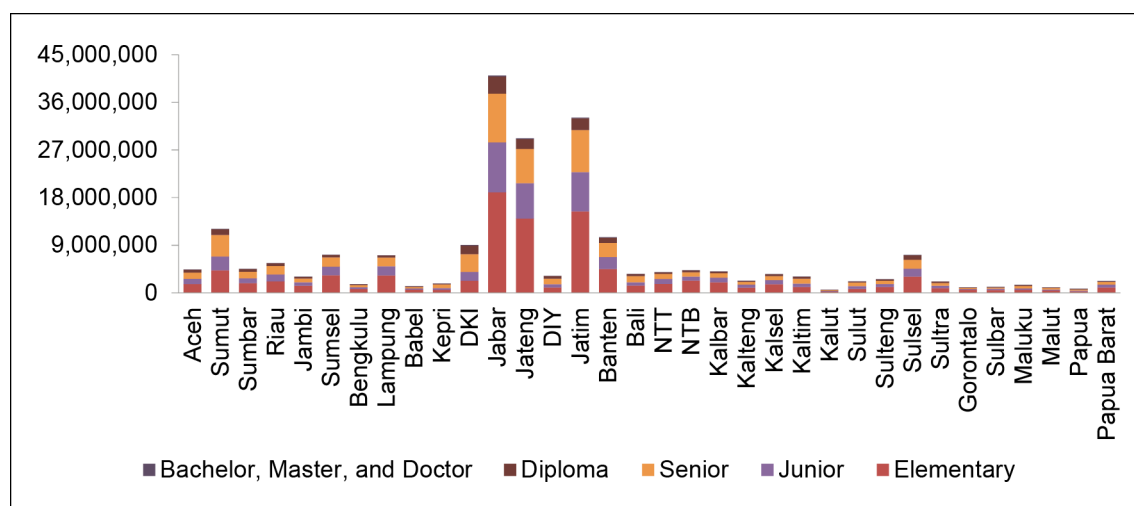
4. RESULTS AND DISCUSSION

The results in Table 4 are consistent with the hypothesis developed, except for the diversity variable. The results show that the roles of factors affecting the emergence of new industries (in our case, information technology) and people's ability to adapt to digitalization described in the literature were confirmed. But the diversity of people and size of the worker market represented by the size of the population in a province negatively affected the emergence of new ICT industries. Such a phenomenon in Indonesia can be described by the education level distribution among the residents.

Figure 4 represents the education level distribution in 2018. Nationally, the proportion of people graduating from senior, junior, and elementary school was 91%. This can explain why the growth in the population negatively affects the growth in the share of people working in ICT industries. This is consistent with our hypothesis that the higher the education level, the greater the ability of people to adapt to technology development. Accordingly, in a province where the population was 1% larger, the share of ICT workers was 2.62%–3.28% lower.

On the other hand, we cannot find a significant effect of the share of workers with a higher level of education on the share of workers in ICT industries. This may be due to the definition of “high education” we used in this model. Commonly the definition of high education is senior high school and above. But in this model we used Diploma IV and above as a high education level. However, the worker population that had graduated from Diploma IV or above to the worker force in 2018 was 8.9%. This is quite low to represent the segment of highly educated workers in the worker force. According to model 1, in a province where the share of workers with a higher education was 1% larger, the share of ICT workers was 0.07% higher, but this number cannot be justified because the variable is not significant in the model. However, from this paper it is found that the direction of the correlation between the level of education and the share of the ICT workforce can be seen. The development of human resources in Indonesia can increase the likelihood of people being able to work as technology users both in the ICT industry and in other sectors needing ICT services.

Figure 4: Distribution of Residents Based on Education Level in 2018

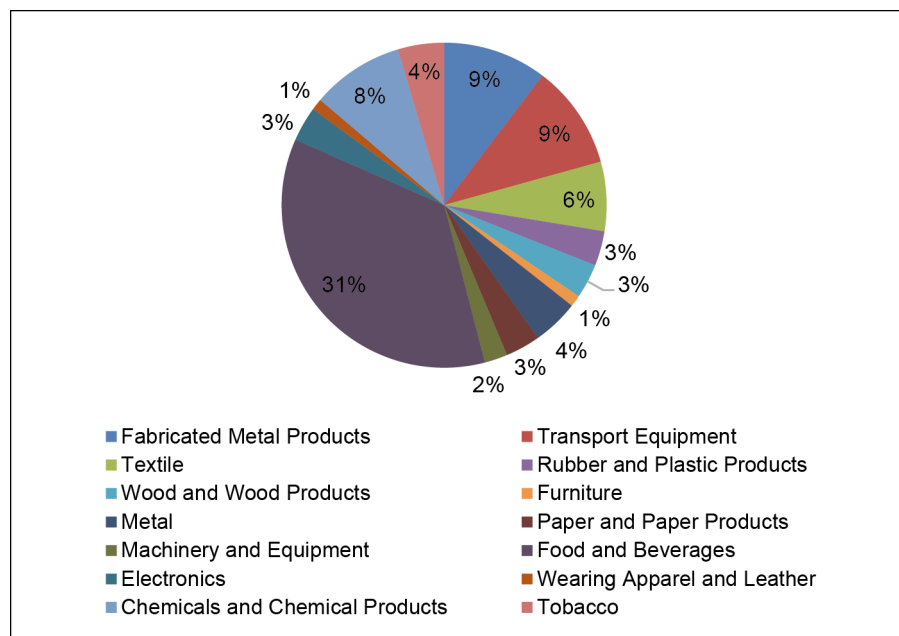


Source: Central Bureau of Statistics (2018).

The models also determine that the ratio of the number of small enterprises to workforce has a positive effect on the share of ICT workers. Accordingly, in a province where the ratio of the number of small enterprises to workforce was 1% larger, the share of ICT workers was 1.13–1.18 % higher. This shows that small enterprises represent creative people who commonly try to discover the most effective and efficient ways of conducting their business. And ICT is one of the most favorable choices to improve effectiveness and efficiency. This means that small and medium enterprises can create demand for ICT services. Some of them also work in the ICT sector as startups.

The share of people who use or can access the Internet is also a significant variable that positively affects the share of ICT workers. This is predictable, especially for Indonesia as an archipelago country. If people cannot access the Internet, their knowledge about recent technology development is lower than that of people who get updates about new technology through the Internet. Since the COVID-19 pandemic began in 2020, Internet access has become an essential need, especially for school-from-home and work-from-home activities. This can be a good opportunity for people who have Internet access, but on the other hand it can be a challenge for people who do not. The absence of Internet access can be a barrier to people getting access other services such as education and government administrative services.

Figure 5: Distribution of Manufacturing GDP in 2018



The results for the share of agricultural and manufacturing workers and the share of manufacturing workers are consistent with our hypothesis before that the share of agricultural and manufacturing workers can negatively affect the share of ICT workers, but the share of only manufacturing workers can positively affect the share of ICT workers. Workers in the agriculture sector who did manual and routine work did not promote the emergence of ICT industries. But the number of workers in the manufacturing sector is proven to positively affect the emergence of ICT industries. This can be explained by the fact that the largest Indonesian GDP shares in the manufacturing sector were contributed by the food and beverage industry, the transport equipment industry, the electronics industry, the pharmaceutical industry, and the

textile industry, as presented in Figure 5. All those industries, except for the textile industry, require workers with high technology literacy. Accordingly, in a province where the ratio of the share of manufacturing workers was 1% larger, the share of ICT workers was 0.26–0.28 % higher. At the same time, in a province where the ratio of the share of agricultural and manufacturing workers was 1% larger, the share of ICT workers was 0.78% lower.

Indonesian Government Strategy to Increase Worker Inputs in ICT Sector

Government programs in Indonesia promote digitalization of the economy. The Indonesian government has recently articulated their visions for how digitalization can contribute to economic growth, societal development, and human resource development, and has launched programs to support efforts in this regard. Various ministries and government agencies have taken action with regard to enhancing ICT education and training. The creation of educational and occupational standards based on industry involvement, the establishment of certification systems, and increased transparency in education and certification could help strengthen the national qualification systems in Indonesia. Several policies and programs have been issued by the Indonesian government, such as the Nongsa Digital Park project in Batam, revamping of vocational education institutions, and improvement of workers' skills through the Kartu Prakerja Program (Coordinating Ministry for Economic Affairs of the Republic of Indonesia 2017).

Nongsa Digital Park (NDP) project in Batam. The park is set to become a digital campus for talents and employers alike and will serve to bridge the tech sectors of Singapore and Indonesia better. The digital economy hub in Nongsa will contribute directly to strengthening Indonesia's tech and innovation talent pool, job creation, and revolving-door commerce.

Revamping of vocational education institutions. A memorandum of understanding (MoU) on vocational education development was signed on 29 November 2016 by five relevant ministries (Ministry of Industry; Ministry of State-owned Enterprises/BUMN; Ministry of Manpower; Ministry of Education and Culture; and Ministry of Research, Technology, and Higher Education). Vocational education institutions were revamped by revitalizing the senior secondary education level/SMK (Sekolah Menengah Kejuruan) and polytechnics. The improvement of the two institutions was carried out by aligning the curriculum with industrial demand and strengthening collaboration with the industries. The aim of revamping the two institutions was to accelerate the skill supply from higher education to vocational education.

Improving workers' skills through Kartu Pra-Kerja Program. The Ministry of Manpower and the coordinating Ministry of Economic Affairs have also implemented a Pre-Work Card (Kartu Pra-Kerja) as a means for unemployed workers and first-time job seekers to receive training. The Kartu Pra-Kerja can fill the gap in workers' life cycle, as well as filling in the gap during changes in labor market conditions, including technological changes, changes in the nature of jobs, and economic structural transformation because of digitalization. In Indonesia, the Kartu Pra-Kerja has the potential to facilitate the skilling, reskilling, and upskilling needed by the workers over their life cycle. If lifelong learning is facilitated, workers can have more flexible choices and can adapt easily to the fluctuating worker market situation that they will face in their lifetimes.

5. CONCLUSIONS

Digitalization will depend on a number of factors, including the economic and social development of a country, its placement within global supply chains, the availability of basic digital infrastructure, competition and new markets, societal acceptance of technologies, and the availability of ICT worker. This paper focuses on the last factor: the availability of ICT worker in Indonesia. According to the results of the research conducted, one of the determinants that affect the availability of ICT worker in Indonesia is the use of ICT infrastructure, which is reflected in the percentage of people who use the Internet in Indonesia. The increasing utilization of ICT infrastructure will further enhance Indonesia's readiness to face the era of digitalization. In addition, another influential factor is the demographic conditions that are reflected in the number of regional capital residents. However, the number of regional capital residents has a negative correlation with the availability of ICT worker in Indonesia because the Indonesian distribution of education is dominated by high school graduates and below. The importance of education is also reflected in the next factor that affects the availability of ICT worker in Indonesia in the era of digitalization, which is the share of workers with a higher level of education in each province in Indonesia. More educated workers will increase the need for ICT services, which in the end will increase the demand for, and also the supply of, ICT workers. Moreover, according to the literature review, more highly educated workers can also adapt more smoothly to digital transformation because it will increase their ability to acquire new knowledge, master new technology, and participate in continuous learning.

Another factor that influences the availability of ICT worker in Indonesia is the existence of a growing entrepreneurial climate, which is reflected by the number of small enterprises that exist. This shows that the increasing number of small enterprises will increase the readiness of Indonesia to face the era of digitalization because an increase in the entrepreneurial climate is closely related to the development of innovation and creativity. Furthermore, recently new entrepreneurs have been more interested in using digital technology as part of their business strategy to improve effectiveness and efficiency, so it will create new demand for ICT worker. The next determinant that affects the availability of ICT worker in Indonesia is the structure of the Indonesian economy, which is reflected in the number of workers in the agriculture and manufacturing sectors. If the number of workers in the agriculture and manufacturing sectors increases it will reduce Indonesia's readiness to face digitalization. The opposite will happen if the number of workers calculated only in the manufacturing sector increases Indonesia's readiness to adapt to digitalization through the availability of ICT worker in Indonesia. Such conditions can be explained because the largest Indonesian GDP shares in the manufacturing sector were contributed by the food and beverage industry, the transport equipment industry, the electronics industry, the pharmaceutical industry, and the textile industry, which required workers with high technology literacy.

Many strategies have been developed by the Indonesian government to increase worker input in the ICT sector in order to support the national digital transformation, such as the Nongsa Digital Park project in Batam, the revamping of vocational education institutions, and improvement of the skills of workers through the Kartu Pra-Kerja Program. Indonesia is poised to benefit greatly from the digital revolution. To accelerate progress, the country's public and private sectors must focus on investments in digital technologies to enhance infrastructure, increase penetration, and boost productivity. The resulting economic impact—USD150 billion annually by 2025—is too large a prize to ignore. Implementing a holistic digital strategy will enable

Indonesian companies to win in the digital age and lift Indonesia's economic growth to the next level.

Furthermore, the Indonesian government should develop a whole-of-government framework that enables and encourages agencies to move towards a more collaborative agenda. Such an approach needs to be both top-down and bottom-up. From the top (central government), developing such a framework means that planning and resource allocation are done taking different constituents into account. The Internet and related communications channels may be the enabling platform for growth, but that doesn't mean that the communications (or digital) agency knows how best to enable education sector growth. Similarly, education officials can be expected to understand what is required in their sector, but should not be expected to understand (a) the rollout of networks and accessibility, (b) the transformational potential of such network access, or (c) the skill sets required for the next generation of citizens growing up as digital natives.

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