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Changes in Indonesia's Economic Structure in the Era of the Industrial Revolution 4.0: Transformation and Adaptation Strategies

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Abstract

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The Fourth Industrial Revolution represents a major transformation phase characterized by digitalization, automation, artificial intelligence, and the integration of cyber-physical systems. This transformation has significantly impacted the global economic structure, including Indonesia. This article aims to analyze the implications of the Fourth Industrial Revolution on changes in Indonesia's economic structure through a literature study. The findings indicate that Industry 4.0 enhances efficiency and productivity through e-commerce, fintech, and the digitalization of the industrial sector, yet it also presents challenges such as digital infrastructure inequality, low technological literacy, resistance among traditional workers, and regulatory frameworks that remain less adaptive. The Indonesian government, through the Making Indonesia 4.0 program, has established strategies to strengthen digital infrastructure, improve workforce skills, and provide incentives for the technology industry. With an inclusive approach, collaboration among stakeholders, and the integration of technology-based education, Indonesia has significant potential to leverage the momentum of the Fourth Industrial Revolution as a driver of sustainable economic growth.

1. Introduction

The Industrial Revolution is a significant milestone in the history of global economic development. Since the 18th century, the shift from manual production to mechanization based on the steam engine in England has transformed agrarian societies into industrial societies. The first Industrial Revolution (Industry 1.0) introduced mechanization, followed by the second (Industry 2.0) with electricity, the third (Industry 3.0) with computerization, and now we are entering the fourth Industrial Revolution (Industry 4.0), which is characterized by the integration of digital technology, automation, artificial intelligence (AI), and the Internet of Things (IoT) (Groumpos, 2021). Each phase of the Industrial Revolution has not only changed production methods but has also had fundamental consequences for the global economic structure. From a global perspective, the Industrial Revolution 4.0 influences almost every economic sector through the digitalization of business models, supply chain efficiency, and the transformation of the labor market.

A World Economic Forum report shows that more than 40% of traditional jobs are at risk of being replaced by automation, while the demand for a workforce with digital skills is increasing rapidly. This phenomenon not only boosts productivity growth but also creates the potential for income inequality and new social challenges that need to be managed. Indonesia, as a developing country, has great potential as well as significant challenges in facing the Industrial Revolution 4.0. The digital trade sector has experienced a surge through e-commerce platforms such as Tokopedia, Shopee, and Bukalapak, which facilitate online transactions with an annual growth reaching 30% (Wijanarka & Sari, 2022). On the other hand, the

transportation and services sectors are also impacted by the presence of digital services such as Gojek and Grab, which have revolutionized public mobility. The change in consumption patterns is further strengthened by the presence of fintech and mobile banking, which enable more inclusive and efficient financial transactions.

However, this great potential is accompanied by a number of structural obstacles. The main challenge lies in Human Resources (HR) who are not yet uniformly proficient in digital skills. Sparrow et al. (2020) emphasize that the majority of Indonesia's workforce is still unskilled in digital technology, especially outside of Java. In addition, the digital infrastructure gap widens the technology adoption divide between urban and rural areas (Morris et al., 2022). Regulations that are not yet adaptive to technological developments, such as data protection and cyber security, also hinder the speed of industrial innovation (Santika, 2021). The Indonesian government recognizes the urgency of this transformation through the Making Indonesia 4.0 program, which is designed to strengthen the competitiveness of national industry through the integration of IoT, AI, and production automation.

The policy emphasizes the development of digital infrastructure, increasing public technological literacy, and providing incentives for industries to adopt new technologies (aminah & Saksono, 2021). Nevertheless, the effectiveness of the policy is highly dependent on the ability of all stakeholders, including industry, education, and the public, to adapt quickly and inclusively. In the academic context, studies on the Industrial Revolution 4.0 in Indonesia have been conducted, but most research is still focused on the potential economic opportunities and technology adoption. This research attempts to provide a literature analysis of the implications of the

Industrial Revolution 4.0 on changes in Indonesia's economic structure, while also highlighting the implementation challenges and necessary policy strategies. With a library research approach, this article seeks to answer the main questions: to what extent has the Industrial Revolution 4.0 changed Indonesia's economic structure, and what strategies need to be taken to optimize opportunities while overcoming the challenges that arise. Thus, this introduction emphasizes that the Industrial Revolution 4.0 is not just a technological phenomenon, but a profound transformation that will determine the direction of Indonesia's economy in the future.

2. Literature Review

2.1. Changes in Economic Structure in the Industrial Revolution 4.0 Era

The Industrial Revolution 4.0 brings about very significant changes in production, distribution, and consumption patterns, which ultimately have a direct impact on the global and national economic structure. According to Wijanarka and Sari (2022), the era of digitalization accompanied by automation encourages the accelerated shift of the economic base from traditional sectors to a modern technology-based economy. This transformation can be observed through the development of various fields, ranging from manufacturing, services, to the financial sector, which are increasingly integrating digital technology as the core of their business processes. In Indonesia itself, this phenomenon is reflected in the increasing contribution of the digital sector to the Gross Domestic Product (GDP), with the most tangible examples seen through the rapid growth of e-commerce,

financial technology-based financial services (fintech), and online transportation platforms that are increasingly popular and widely used by the public.

An official report issued by Kanga et al. (2022) asserts that the development of fintech has significantly boosted financial inclusion. This innovation provides wider access to financial services, especially for community groups who previously faced barriers in obtaining conventional banking services. Nevertheless, this change in economic structure is not entirely equitable. Bai et al. (2021) found that technology adoption is faster in the formal sector than in the informal sector. This condition has implications for widening the income gap between groups of workers and increasing the potential for structural unemployment due to automation. Therefore, although the Industrial Revolution 4.0 presents great opportunities for growth, the problem of unequal distribution of benefits remains a crucial issue in the study of economic structure.

2.2. Challenges and Opportunities for Indonesia

In addition to opening up great opportunities for national economic growth, the Industrial Revolution 4.0 also presents various serious challenges that Indonesia must face. Gayatri et al. (2022) emphasize that the low level of digital literacy is the main obstacle for the majority of Indonesia's workforce in adapting to the accelerating pace of technological change. This condition indicates that the public's ability to understand, operate, and utilize digital technology is still relatively limited. This problem is further exacerbated by the digital infrastructure gap, especially outside of Java, where internet access and technological facilities are not yet evenly distributed, as noted by Groumpos (2021). To address these challenges, the

government is making efforts through the Making Indonesia 4.0 program, which is designed as a national strategy in facing the era of digital transformation.

This program not only emphasizes the digitalization of the manufacturing industry sector but also encourages human resource development, an increase in workforce competence, and strengthens collaboration between the public and private sectors as important actors in development (Santika, 2021). In a global context, Jung (2020) assert that countries that are able to integrate a technology-based education system with long-term industrial policies will have better readiness to face the transformation of the future labor structure. Therefore, the literature emphasizes that Indonesia's position in the Industrial Revolution 4.0 is highly determined by the speed of policy adaptation, the readiness of human resources, and the ability of the government and the public to reduce the digital gap between regions. Thus, existing opportunities can be maximized without leaving certain community groups behind.

3. Methods

This study uses a library research method to analyze the impact of the Industrial Revolution 4.0 on changes in the economic structure in Indonesia. This method was chosen because it is relevant for collecting, reviewing, and interpreting various published scientific sources, in the form of journal articles, books, official institutional reports, and international publications. The data collection process was carried out through several stages. First, literature search using scientific databases such as Google Scholar and national journal portals, with the keywords "Revolusi

Industri 4.0" (Industrial Revolution 4.0), "struktur ekonomi" (economic structure), "digitalisasi" (digitalization), and "Indonesia". The search was focused on the latest publications to ensure the novelty and relevance of the study. Second, literature selection was carried out based on inclusion criteria, namely articles that discuss the relationship between the Industrial Revolution 4.0 and the Indonesian economy, both in terms of opportunities, challenges, and policies.

After the literature was collected, a content analysis was carried out to identify the main themes. The themes that emerged were then categorized into four dimensions: (1) changes in economic structure; (2) labor transformation; (3) infrastructure and regulatory challenges; and (4) government policy strategy. From these categories, a synthesis was then carried out to prepare a comprehensive conceptual framework. The validity of the research was maintained through the use of trusted sources from Google Scholar. With the library research method, it is hoped that a comprehensive picture can be obtained regarding Indonesia's position in facing the Industrial Revolution 4.0, without being limited to primary field data. The limitation of this method is the potential for bias because it only relies on secondary data. Therefore, the interpretation of the research results is carried out critically by comparing findings from various sources. Even so, the library study still makes an important contribution in providing a strong theoretical basis for understanding the dynamics of Indonesia's economic change in the digital era.

4. Results

The Industrial Revolution 4.0 has brought about fundamental changes in Indonesia's economy in a way that is faster and more profound than previous revolutions. The main impact is seen in the transformation of the economic structure, which is shifting from a traditional pattern based on agriculture and labor-intensive manufacturing to an economy based on digital, innovation, and technology. This change is taking place along with the increasing adoption of digital technology, big data, the internet of things (IoT), and artificial intelligence (AI), which are penetrating almost all industrial sectors. This phenomenon confirms that technological developments not only affect production efficiency but also change consumption behavior, business models, and labor dynamics in Indonesia. One tangible form of change in the economic structure is seen in the rapid growth of the digital economy sector. Data from Google, Temasek, and Bain & Company shows that the value of Indonesia's digital economy reached USD 82 billion in 2020 and is projected to exceed USD 130 billion in 2022. This growth is driven by e-commerce, online transportation services, fintech, and other digital services.

Electronic commerce platforms such as Tokopedia, Shopee, and Lazada have become the main drivers of digital consumption growth, shifting people's shopping patterns from conventional to online. This phenomenon not only increases the efficiency of transactions but also expands the market for MSMEs, which previously had limited access to consumers outside their region. Apart from digital trade, the financial sector has also undergone a significant transformation. The presence of fintech, digital wallets, and mobile banking services has accelerated financial

inclusion for the public. The OJK reported that the national financial inclusion rate increased to 85.1%, driven by the use of digital financial applications such as OVO, DANA, and GoPay. This innovation provides access to financial services for community groups who were previously beyond the reach of conventional banking, including rural communities and informal workers. Thus, the Industrial Revolution 4.0 strengthens the function of the financial sector as a driver of economic growth as well as an instrument for equitable access.

In the manufacturing sector, the Making Indonesia 4.0 program is a strategic step for the government to modernize national industry. The focus on five main sectors food and beverages, textiles, automotive, electronics, and chemicals shows that Indonesia is trying to increase global competitiveness through the integration of digital technology in the production process. The application of automation, robotics, and big data in this industry not only reduces production costs but also encourages supply chain efficiency. However, the adoption of technology in the manufacturing sector is not yet uniform, because small and medium industries still face obstacles in terms of investment, infrastructure, and workforce skills (Aminah & Saksono, 2021). Changes in the economic structure are also apparent in the world of work. On the positive side, the Industrial Revolution 4.0 has created new jobs based on digital technology, such as software developers, data analysts, and cyber security specialists.

The Jung (2020) report estimates that around 97 million new jobs will be created globally as a result of digital transformation, including in Indonesia. However, the other side of this change is the increased risk of structural

unemployment. Workers with low skills and routine jobs that can be replaced by machines or algorithms have the potential to lose their jobs. Sparrow et al. (2020) assert that most of Indonesia's workforce is still in the informal sector with limited digital skills, so they are vulnerable to the effects of automation. The digital divide is also a striking issue in the results of this study. Access to technology infrastructure is still very centralized in urban areas, especially on the island of Java, while regions outside Java face limitations in internet connectivity and digital devices. Guo et al. (2018) emphasize that this inequality widens the development gap between cities and villages, so that the benefits of the Industrial Revolution 4.0 are not felt evenly. This phenomenon also raises the threat of a deeper social and economic gap if it is not anticipated through equitable policies.

From a regulatory perspective, the Industrial Revolution 4.0 demands a more adaptive update to legal regulations. The development of fintech, e-commerce, and the use of big data raises issues of consumer protection, personal data security, and ethical issues in the use of artificial intelligence. Santika (2021) notes that Indonesia's regulatory framework still lags behind technological developments, which has the potential to hinder industrial innovation. Slow regulations can actually reduce national competitiveness, because business actors face legal uncertainty in running digital-based businesses. Even so, the Indonesian government has tried to answer these challenges through a number of strategic initiatives. The Making Indonesia 4.0 program has become the main policy milestone, focusing on industrial digitalization, workforce skills development, and improving digital infrastructure. The government also launched the Digital Talent Scholarship program which aims to train the

younger generation in the fields of information technology, big data, and artificial intelligence. In addition, cooperation with the private sector, such as digital platform providers and technology companies, is also becoming more intensive to accelerate the adoption of innovation.

However, the success of this policy is highly dependent on cross-sectoral coordination and the sustainability of the program. Implementation challenges are seen in the still low digital literacy among the public. According to Gayatri et al. (2022), traditional workers' resistance to new technology also slows down the transformation process. Cultural factors and unwillingness to adapt to technological change must be a serious concern, because the success of the Industrial Revolution 4.0 is not only determined by the availability of technology, but also the readiness of humans to use it. In addition, the role of education is a key factor in optimizing the results of the Industrial Revolution 4.0. Technology-based education and digital skills must be integrated early on into the national curriculum. This is important so that future generations are able to adapt to the increasingly dynamic changes in the labor market. Morris et al. (2022) emphasize that without education reform, it will be difficult for Indonesia to catch up in digital competence, even if technology infrastructure is available.

The results of the study show that the Industrial Revolution 4.0 has and will continue to bring about profound changes to Indonesia's economic structure. This transformation creates great opportunities for economic growth through digitalization, e-commerce, fintech, and technology-based industries. However, on the other hand, serious challenges have emerged in the form of the digital divide,

low technological literacy, the risk of structural unemployment, and unadaptive regulations. With an inclusive policy strategy, education reform, and multi-sector collaboration, Indonesia has great potential to make the Industrial Revolution 4.0 a driving force for sustainable economic development.

5. Discussion

The results of the study show that the Industrial Revolution 4.0 is not just a technological phenomenon, but a multidimensional transformation involving economic, social, educational, and regulatory aspects. In the Indonesian context, the emerging impact shows a duality: on the one hand, opportunities for digital economic growth are wide open, while on the other hand there are serious challenges in the form of infrastructure and workforce skills inequality. First, from an opportunity perspective, the Industrial Revolution 4.0 is accelerating the growth of Indonesia's digital economy, which is now the largest in Southeast Asia (Lee et al., 2020). E-commerce, fintech, online transportation, and the startup sector are growing rapidly, creating new jobs while expanding the MSME market. This shows a multiplier effect on national economic growth. However, this success is still centered on big cities, so the risk of inter-regional inequality remains high.

Second, from the labor side, automation cuts routine jobs, but at the same time creates demand for new skills in technology, data analysis, and artificial intelligence (Tyson & Zysman, 2022). In the case of Indonesia, the main problem is low digital literacy and the quality of education that has not been able to keep up with the rapid changes in the world of work. The reskilling and upskilling programs

carried out by the government through the Digital Talent Scholarship deserve appreciation, but their scale is still limited compared to the total workforce of 144 million people. Third, in terms of regulation, there is still a gap between technological innovation and the legal framework that regulates it. Guo et al. (2018) emphasize that issues of personal data protection, cyber security, and AI ethics are challenges that have not been fully answered by the government. Slow regulations have the potential to create legal uncertainty, which can hinder the growth of startups and technology investment. Therefore, regulatory updates are needed that are adaptive, pro-innovation, and prioritize legal certainty for digital business actors.

Fourth, the role of education is crucial in bridging the digital divide. Without curriculum reform that integrates digital skills, Indonesia is at risk of experiencing a worse skill mismatch. Bai et al. (2021) state that one of Indonesia's main weaknesses is the still high resistance of traditional workers to adapting to technology. This indicates that digital transformation is not just about technology investment, but also the transformation of work culture. In general, the discussion shows that Indonesia is in a transitional phase full of challenges. The success of utilizing the Industrial Revolution 4.0 will be highly determined by the ability of the government, industry, and the public to collaborate in creating an inclusive digital ecosystem. If the development strategy only focuses on accelerating technology adoption without paying attention to equitable access and improving human skills, then the potential benefits of this revolution will be uneven and deepen the social gap. Therefore, the most effective strategy is to combine pro-technology policies with pro-human policies.

6. Conclusion

The Industrial Revolution 4.0 has brought about major changes in Indonesia's economic structure, especially through the growth of the digital sector, fintech, and manufacturing modernization. This change creates significant economic growth opportunities, expands access to financial services, and increases the competitiveness of national industry. However, these opportunities are accompanied by major challenges in the form of the digital divide between regions, the risk of structural unemployment due to automation, low digital literacy, and unadaptive regulations. Indonesia has great potential to become a major force in the Southeast Asian digital economy, supported by the largest number of internet users in the region and a rapidly developing startup ecosystem.

However, this potential can only be realized if the government, private sector, and the public are able to collaborate in expanding digital infrastructure, strengthening technology-based education, and formulating regulations that support innovation while protecting public interests. In conclusion, the Industrial Revolution 4.0 in Indonesia is both an opportunity and a challenge. With an inclusive development strategy, an increase in workforce skills, and equitable digital infrastructure, Indonesia can optimize the benefits of this revolution to achieve sustainable, fair, and globally competitive economic growth. Without these steps, this revolution actually has the potential to widen the social-economic gap within the country.

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