STI POLICY AND MANAGEMENT

The Impact of Job Automation on Workers in Indonesia's Garment Companies

Ardanareswari Ayu Pitaloka[a], Luthfina Ariyani[b*], Galuh Syahbana Indraprahasta[a]
[a]*Research Center for Population, National Research and Innovation Agency, Indonesia, 12710*
[b]*Research Center of Economic of Industry, Services and Trade, National Research and Innovation Agency, Indonesia, 12710*

ARTICLE INFO	ABSTRACT
	Job automation through the adoption of more advanced technologies under the fourth industrial revolution (Industry 4.0) has significantly impacted many countries, including Indonesia. In particular, the abundance of Indonesia's human resources, given the country's demographic bonus, is challenged by the skills of workers. In this study, our departure is the potential conflict of the human-technology nexus in Indonesia's garment industry, a labor-intensive line of industry. The objectives of this study are twofold. First, it aims to dissect the multi-level factors in the adoption of Industry 4.0 technology in Indonesia's garment industry. Second, it aims to understand the impact of job automation on labor-intensive workers in Indonesia's garment industry. Based on a number of semi-structured interviews supported by relevant secondary data, this study reveals that multi-level factors do affect the adoption of Industry 4.0 technology and its entailing shift in workers' utilization in Indonesia's garment industry. Instead of replacing workers, Indonesia's garment companies tend to utilize technology as a complementary element. However, there is a need to shift the state of industrial workers, in terms of their mindset and skills.

I. INTRODUCTION

The fourth industrial revolution (Industry 4.0) launched by Schwab (2017) has substantially changed the global industrial systems, marked by dramatic changes in the production and consumption patterns (Bertola & Teunissen, 2018). Nowadays, the convergence between physical and digital environments as part of Industry 4.0 is a wordwide norm in manufacturing industry (Gilchrist, 2016). In the context of garment industry, the adoption of Industry 4.0-related technologies, such as the Internet of Things (IoT)[1], artificial

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[1] IoT is an idea has been made for a network of intelligent objects that is both open and comprehensive, with the capacity to organize themselves autonomously, exchange information, data, and resources, and respond and take action in accordance to environmental circumstances and alterations (Madakam et al., 2015)/

* Corresponding Author. Tel: +62-87897974447
E-mail: luthfina.ariyani@gmail.com

intelligence (AI)[2], big data[3], cloud computing[4], machine learning[5], and blockchain systems[6] has led to industrial efficiency in various sections, including quality control, maintenance, inventory costs, productivity, and lead time of products' value chain (Ariyani et al., 2021).

Garment industry is a highly market-driven industry and is directly linked to the global fashion market (Jo Anderson-Connell et al., 2002). Technological innovation, particularly digital manufacturing, has emerged as a new business model in various industries, altering the utilization of resources, including human labor, equipment, and stakeholders. Under these circumstances, new emerging robots and technology may replace human labor by accelerating various routine and repetitive tasks (Bertola & Teunissen, 2018).

In the context of developed countries, Industry 4.0 technology seems to be regarded as a rational choice due to these countries' relatively lower population numbers and higher-cost labor forces. However, in developing countries, given their large (and still growing) number of human labor, workers may compete head-to-head with machines and technologies (Bogovis et al., 2019; Emont, 2018). Certain types of jobs have the potential to disappear as they can be easily replaced through the adoption of digital manufacturing. This also highly possible to occur in labor-intensive industry, such as garment sector, in which many workers bear the risk of losing their jobs (Emont, 2018).

Routine and repetitive types of work, such as those attached to blue-collar workers, are the most threatened types of work amid the Industry 4.0 era. Blue collar jobs have been widely predicted to be among the jobs most vulnerable to technological change for two reasons (Snell & Gekara, 2022). First, there is a demand to reduce labor costs in labor-intensive industries through the use the cutting-edge technologies, such as robotics, automation, and AI. Second, technology can improve performance in terms of efficiency and reliability in non-cognitive and routine tasks.

In Indonesia, garment sector is one of the leading industrial sectors in terms of labor absorption[7]. However, this industry is currently in quandary state[8]. On the one hand, business development, as well as market demand and fierce competition, force the industry to improve its product quality at a competitive price by adopting cutting-edge technology. On the other hand, the use of technology certainly carries the risk of reducing the need for labor involvement. If humans are expected to work hand-in-hand in harmony with machines or robots, mechanism for upskilling and reskilling must exist both within companies and labor providers, such as by running vocational schools.

In short, in terms of automation implementation, the characteristics of Indonesian workers cannot be compared apple-to-apple to those of developed countries, such as Germany and Japan. The prevalence of developed countries' high wages for labor encourages developing countries to capitalize on economic development prospects within this sector, which offers a surplus of labor and wages that remain feasible for companies (Kim et al., 2006). Latest study by Ariyani et al. (2021) on this issue primarily focused on technology adoption in companies, with limited investigation of company leaders' perspectives on the adoption of Industry 4.0.

Based on the aforementioned background, a more refined understanding of how blue-collar workers are repositioned amid automation trend in Indonesia's garment companies is needed. For this reason, our objectives are twofold. First, we aim to dissect the multi-level factors in the adoption of Industry 4.0 technology in Indonesia's garment industry. Second, we aim

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[2]   AI is a specialized area within computer science that primarily concerns itself with the transfer of human-like intelligence and cognitive processes to machines (PK, 1984).

[3]   Big data encompasses extensive datasets that are distinguished by their substantial magnitude, heightened diversity, and intricate organization, along with the difficulties linked to storing, processing, and visualizing the data for following certain procedures or outcomes (Sagiroglu & Sinanc, 2013).

[4]   Cloud computing has made it possible to perform various tasks online, rather than on desktop computer, and is characterized by its ability to access all of your programs and documents from any computer that is connected to the internet (Mirashe & Kalyankar, 2010).

[5]   Machine learning enables robots in the field to acquire new abilities or adjust to their operating environment autonomously (Bell, 2022).

[6]   A blockchain is a decentralized digital ledger capable of storing any type of data. It requires the user to ascertain and authenticate the legitimacy of the recently incorporated data (Rodeck & Curry, 2022; Xu & Zou, 2021).

[7]   https://kemenperin.go.id/statistik/ibs_indikator.php?indikator=3&tahun=2010

[8]   https://www.bps.go.id/id/statistics-table/2/NzMwIzI=/jumlah-tenaga-kerja-industri-besar-dan-sedang-menurut-sub-sektor--kbli-2020---orang-.html

to understand the impact of job automation on labor-intensive workers within Indonesia's garment industry.

II. ANALYTICAL FRAMEWORK

This study employs a multi-level analysis approach, encompassing macro, meso, and micro levels, which enables a synergistic examination of the phenomena observed (Barbour, 2017). According to Barbour (2017), the macro level is defined by structural and relatively stable phenomena that exert contextual effects, deriving from activities at subordinate levels; the meso level highlights the interplay between macro and micro level; and the micro level focuses on the more dynamic and fluid phenomenon. Accordingly, in order to understand the phenomenon of technological transformation within garment industry, this study postulates the macro level as the global context, the meso level as the domestic context, and the micro level as the organizational context. While numerous studies on garment industry have concentrated on examining single-level analyses (Faris & Nizar, 2021; Mahendrawathi & Nurmadewi, 2021; Setiawan & Poerbosisworo, 2022), this study introduces an alternative perspective by employing a multi-level analysis approach so as to enrich the existing studies on this topic.

As mentioned above, technological transformation towards Industry 4.0 within garment industry and its impact on workers is associated with various elements that may be viewed through three levels of analysis, namely global, domestic, and organizational. For instance, Aribas & Alfaro (2016) argued that technological advancement, globalization, sharing economy, changes of customers' behavior, and market competition play as drivers that influence digital transformation in fashion industry at the global level. Meanwhile, at the domestic level, policy and regulations, business environment, education, and employability are perceived to be associated with industrial transformation towards Industry 4.0 (Tripathi & Gupta, 2021).

Furthermore, Ariyani et al. (2020) elaborated two factors at the organizational level in relation to Industry 4.0 adoption process, namely manage-ment support and workforce competence. In this study, we delve deeper into the organization level, namely by focusing on the impact of Industry 4.0 adoption on employment, especially in the context of workers' skills and job substitution. Peng et al. (2018) in particular identified two perspectives about the impact of automation on workers' skills: upskilling and deskilling. Upskilling is defined as the improvement of workers' skills as they are expected to assume greater responsibilities on complicated tasks (Peng et al., 2018; Piva et al., 2005; Spenner, 1983). Upskilling/reskilling refers to skills development to support the existing (or completely new) job responsibilities (Li, 2022). Upskilling and reskilling activities in companies can be implemented in the form of on-the-job training, certification, and independent learning through open-course programs (Li, 2022). In addition, upskilling and reskilling programs can also involve tertiary institutions and vocational schools through curriculum updates and experiential learning with aim to provide work-ready human resources (Li, 2022). On the other hand, deskilling refers to the deterioration of quality of work and the increasing of unskilled or semi-skilled workers (Cappelli, 1996). Although technology apparently makes jobs more complex, technology can also take over several job functions, thereby simplifying the tasks and encouraging deskilling (Sampson, 2021).

More generally, in relation to automation-workers nexus, there are two views on the nature of technology, namely technology as a substitute element and technology as a complementary element (Nazareno & Schiff, 2021). Technology becomes a substitute element when it is fully capable to perform the works that are used to be operated by human power. In this case, humans do not have enough required skills to perform their jobs. Meanwhile, technology becomes a complementary element if it serves as supporting element to improve the works operated by human.

The presence of technology in various companies is closely related to the skills/abilities/capacities of human resources they have. Along with increasing technological sophistication, companies need to adjust their talent development

strategy in order to fill the skill gap due to technological changes. This adjustment must aim to modify and develop human resource (HR) skills, knowledge, and capabilities so as to enhance their performance (Zayed et al., 2022).

One notable yet recurring concern on this matter is that automation has placed the human workforce to compete with or work along machines and robots (Belloc et al., 2022). Technology is claimed to be able to accelerate major changes on how people work (Mamaghani, 2006). There are substantial risks due to the presence of technology, such as how workers are replaced and how their wages system is affected. This risk may also exacerbate due to certain demographic factors, such as ethnicity, gender, region, and level of education (Korinek & Stiglitz, 2018; Peters, 2017).

There is a skill-biased for workers regarding the presence of technology (Nazareno & Schiff, 2021). For the low-skilled workers, technology tends to substitute their job positions, while for the high-skilled workers, technology will be served as supporting element to their jobs (Nazareno & Schiff, 2021). However, in the context of the garment industry, which is labor-intensive in nature, studies on how workers and technology relate to each other are still rarely conducted, especially in the case of developing countries.

All-in-all, while our study focuses on the analysis at the organizational level, notably regarding automation-workers nexus, we also dissect the other levels to provide a more comprehensive picture of the adoption of Industry 4.0 technology in Indonesia's garment industry. Our analytical framework is depicted in Figure 1.
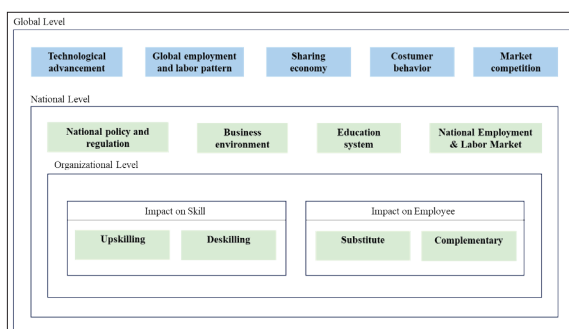

Figure 1. Analytical framework

III. METHODOLOGY

This study employs a qualitative research methodology utilizing a case study technique. The study was conducted at five leading export-focused clothing companies in Central Java and Banten Provinces. The study was conducted in mid-2019 in response to the president's policy introduced at the beginning of 2018, known as "Making Indonesia 4.0". This policy aims to promote industrial transformation by implementing Industry 4.0 technology in five essential industrial sectors in Indonesia, including the garment and apparel industry. The government considers Indonesia will face obstacles in substituting human labor with technology. However, through this policy, there would also be chances to create fresh job opportunities. As an economic backbone, the manufacturing sector is expected to be a catalyst in domestic competitiveness.

This study emphasizes deep discussion on the industry's nowadays issues, namely collecting primary data through interviews with top and mid-level management of companies in formulating strategic policies. Technological investment in labor-intensive industries is typically conducted in long-term (extending decades), and should carefully consider the infrastructural readiness, human resources capability, support from government policy, market demand, and other relevant factors. This consideration indicates company leaders' perceptions of Industry 4.0 adoption and is not solely about complying with government policy to enhance competitiveness.

The data were collected through purposive sampling, which determines a set of informant criteria based on the outcome of the elaboration of ideas and recommendations from the representatives of the Textile Industry Directorate of the Ministry of Industry of Indonesia and the representatives of the Indonesian Textile Association (API). The ideal informants must be those who are involved in technological investment decisions, human resources management, market demand trend analysis, and government policy response. This study examines the responses of policymakers in companies towards government initiatives on the adoption of Industry 4.0 technology. However, workers were not selected as the

ideal informants due to their lack of involvement in decision-making processes. Instead, workers' responses and capabilities were observed through the perspectives of authorities involved in managing human resources inside the company with aim to gather information concerning workers' skills and readiness to adopt new technology.

Interview and focus group discussion (FGD) were conducted to collect data from the following parties: (1) the representatives of the Textile Industry Directorate of the Ministry of Industry of Indonesia, (2) the representatives of the Indonesian Textile Association (API), (3) the representatives of the Ministry of Trade of the Republic of Indonesia, (4) the representatives of garment companies, (5) the representative of the Bandung Textile Engineering College (STTT), (6) the representative of STTT Graduate Association (who is an expert in the textile business), and (7) the representatives of garment production equipment providers. Based on the previously established criteria, 25 participants were selected as the informants.

We have compiled an interview guide that is generally related to the use of technology, changes in work patterns due to the existence of technology, as well as views on the benefits, disadvantages, and threats brought by the adoption of Industry 4.0 technology. We started the interview by asking general questions like 'can you give your opinion on the Industry 4.0 technology that exists in your company?'. We deepened the questions by asking following-up questions like 'can you tell us more about that?'. All data were processed descriptively through simultaneous analysis of interview data and secondary data. Then, the method proceeded to data collection and processing, which included the reduction, organization, interpretation, and triangulation of the data. Overall, the research method process is depicted in Figure 2.
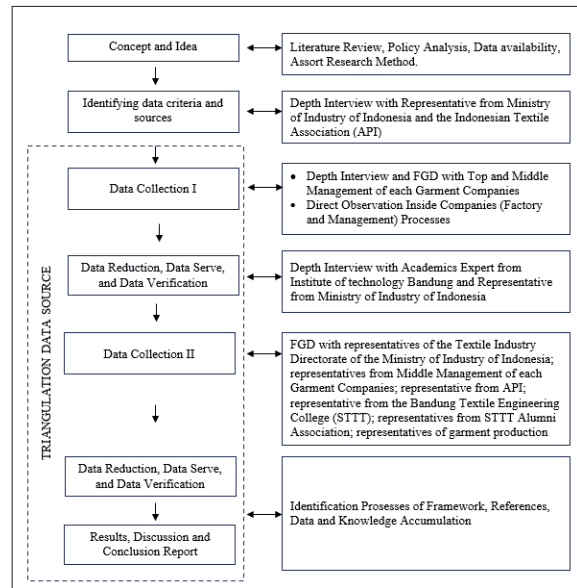

Figure 2. Research method processes

IV. RESULTS

A. Global Environment

1) Technological Advancement in the Garment Industry

In the fashion industry (high fashion and fast fashion), the garment companies' need to adopt Industry 4.0 technology in creating fashion products has begun to exist. However, referring to Figure 3, there are no garment companies in Indonesia that have implemented the technology that emerged from Industry 4.0. In general, garment companies in Indonesia are still in Industry 3.0 phase. However, based on interview results, all companies have made plans regarding gradual transformation in adapting the latest technology in accordance with developments in the global garment industry. This is implemented in order to increase competitiveness in the global market.
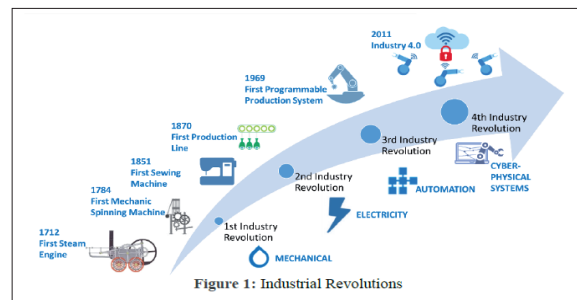

Sources: Gökalp et al. (2018)

Figure 3. Industrial revolution phases

2) Global Employment

In countries with limited human resources and high wage rates, the adoption of Industry 4.0 technology may become a solution for the industry to remain competitive in the market. However, based on the data of average minimum wage in the textile and garment sector (Figure 4), in terms of labor costs, Indonesia continues to benefit even in the absence of advanced technology adoption because the country still has relatively lower labor costs than those of other ASEAN big players, such as Thailand and Vietnam.
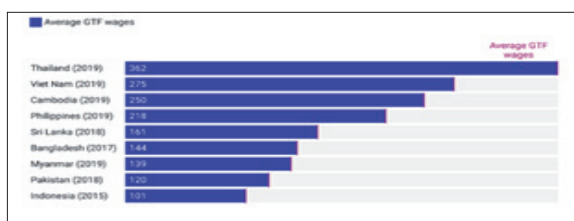
Source: ILO (2022)

Figure 4. Worker's average monthly wage in garment-textile-footwear sector (in US$)

3) Customer Behavior & Market Competition

The existence of export-oriented garment industry is strongly driven by the development within the global fashion industry. Fashion is certainly a highly dynamic sector whereby the trend changes rapidly. As a case in point, the garment industry provides seasonal fashion, such as summer, autumn, winter and spring. This pattern forces the garment industry to distribute their apparels four times a year from the factory to the buyer, putting pressure on a three-month process from upstream (product design) to downstream (product shipping) to ensure that all apparels are ready at the beginning of each season. In general, a 120-day time frame is allocated to bring the high-end fashion runway to the storefront. However, as fashion trends evolve, a new trend known as 'fast fashion' emerges, which refers to the mass production of fashionable items that must reach the end market as soon as possible. This reduced the lead time for seasonal fashion from 120 days to 90 days and 45 days for fast fashion.

Under this condition, the key to prevail the market is by providing rapid and accurate production. In practice, Indonesia's business actors face competition with Vietnam to provide rapid production. One of main obstacles, among others, is that the lead time is very challenging to export the products from Indonesia to the US compared to that of from Vietnam. Export from Vietnam is seven days faster than that of from Indonesia because their transit is in Hong Kong, and Vietnam's trade route benefits from the existence of Hanoi Port to Haiphong Port. On the other side, it is the matter of customizing the products. The challenge is that there is not only about the availability of materials, but also the importance of fast production processes because there are various customizations and digitalizations demanded based on real data.

> *"The challenge of customizing is not only having to always have the materials ordered to be available for the customer, it also has to be produced really fast, because there are various customizations and digitalizations demanded based on real data" (Business Actor-Interview)*

B.   Domestic Landscape

1) Domestic Policy & Regulation

Responding to changing global environment, at the very top policy level, the Indonesian government has issued several measures to support the adoption of Industry 4.0 technology in domestic industrial development. For instance, the Regulation of the President of the Republic of Indonesia No. 18/2020 on National Mid-term Development Plan 2020–2024 and the Regulation of the President of the Republic of Indonesia No. 74/2022 on National Industrial Policy 2020–2024 stipulated the implementation of Industry 4.0 as one of domestic major projects. In particular, the government has supported the adoption of Industry 4.0 in Indonesia's garment industry by launching the "Making Indonesia 4.0 Program". Through this policy, the garment industry was encouraged to be ready for transition to Industry 4.0. It is argued that if the transition to Industry 4.0 succeeds, this industry will provide far more jobs in the future.

> "The digital workforce will increase by 4.5 million in the manufacturing sector and 12.5 million digital workers in the manufacturing support sector" (Ministry of Industry, 2019)

However, the details of how to execute this adoption is still a work in progress. Currently, the Ministry of Industry is revising the National Masterplan of Industrial Development 2015–2035 to incorporate the adoption of Industry 4.0 in Indonesia.

2) Business Environment

In Indonesia, the garment industry business environment has not yet shown a significant transition from Industry 3.0 to 4.0 phase. This condition certainly influences the organizational transformation from a labor-intensive industry to a more advanced industry that based on job automation. One main obstacle to facilitate this transition is the large investments required to adopt the latest technologies. Therefore, companies need support from various parties to meet this requirement (such as easy loans from banks, and supporting regulations related to production machines, taxes, incentives, etc.). Clearly, the recent COVID-19 pandemic has significantly impacted the business, making investments increasingly challenging. Additionally, the onslaught of imported products has further exacerbated the domestic industry's competitiveness. As depicted in Figure 5, up until 2019, Indonesia's textile and garment industry experienced growth. However, during the COVID-19 pandemic, the growth rate of this industry declined significantly. Nevertheless, it is evident that there is a strong recovery as the industry experienced notable improvement in growth in 2022. The same trend is also reflected in the improving export value of Indonesia's ready-made garment exports each year, as depicted in Figure 6.
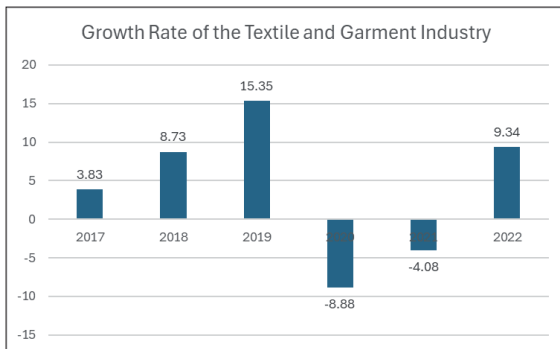
Source: Central Bureau of Statistics, created by Authors

Figure 5. Growth rate of Indonesia's textile and garment
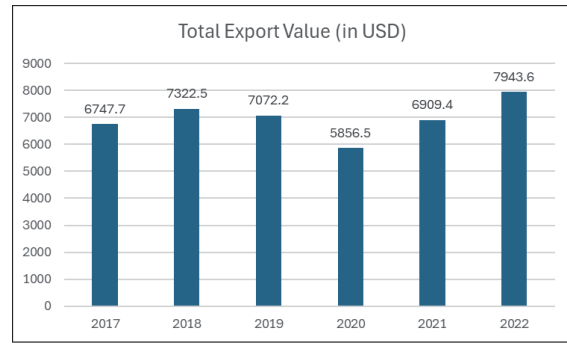
industry

Source: Central Bureau of Statistics, created by Authors)

Figure 6. Export value of Indonesia's garment industry

3) Education System

Many business actors in Indonesia are still dissatisfied with the state of the nation's education infrastructure. Based on the assessment results of their perspective, educational practices in Indonesia have still proven inadequate in producing high qualified graduates and fail to align their curriculum with the current industrial demands.

The second concern is about human resources' willingness to continue learning in responds to (ever-changing) work practices. Despite having large human resources, Indonesia still needs to catch up to other countries due to its human resources' inadequate absorptive capacity into the workplaces.

Furthermore, because the majority of Indonesia's low-wage workers only possess a secondary education background, their readiness to embrace new technology is low. Their capabilities are mostly limited to being merely a "tailor", rather than able to create something that more valuable in their workplaces.

Aside from that, the industry faces challenges, such as secondary graduates' inability to meet the requirements to readily work on the production line, necessitating more time spent to re-train the workers. This is thought to be due to a misalignment between the current educational system and industrial demands, as indicated by curriculum gaps and limited mechanical infrastructure in educational institutions. There are even a lot of people who have graduated from formal and vocational education, but according to

the companies, their qualities are disappointing. The industry essentially requires more human resources with college level graduates because they are considered more qualified in terms of both technical and soft skills. However, if we look at the statistics of domestic school participation rate in Figure 7, it is revealed that participation from college graduates is still very low. This makes it difficult for the garment companies to acquire qualified workers, not to mention the fierce competition from other sectors, as the garment sector is typically not a popular choice for many job seekers. Based on interviews with business actors, diploma graduates have a greater chance of being employed in the garment sector because it is generally assumed that they possess a more thorough understanding of organizations, work systems, and teamwork.
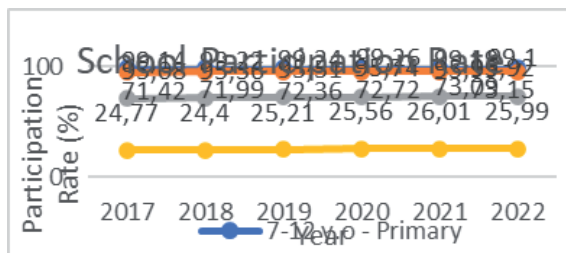
Source:Central Bureau of Statistics, created by Authors

Figure 7. Domestic school participation rate
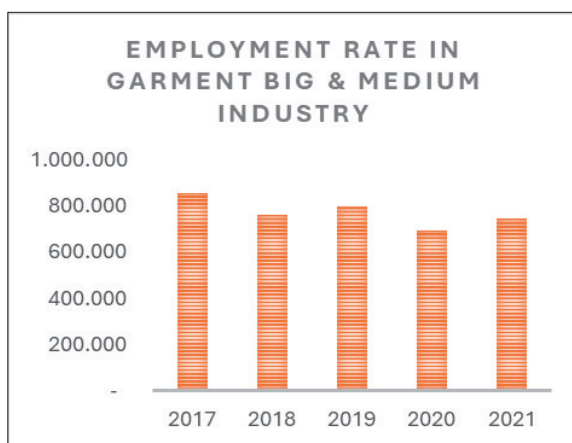
Source: Central Bureau of Statistics, created by Authors

Figure 8. Empoyment rate in Indonesia's garment industry

4) Domestic Employment

Indonesia has a large population with abundant labor forces. As a result, the unfolding of Industry 4.0 (and its entailing set of technologies) and the abundance of workers may become incompatible, as the industry is still required to provide employment. There are differences in employment characteristics between Indonesia and those of other countries. In the case of garment sector, which has a labor-intensive work pattern, the choice to adopt Industry 4.0 technology was partly due to the shortages of labor, thus increasing the cost of human labor. In reality, Indonesia's garment sector is not affected by the issue of labor shortages, as the country actually has demographic surplus, ensuring that human resources are steadily available. Instead, the driver for adopting Industry 4.0 technology in the context of Indonesia's garment industry is because this technology is considered able to provide (1) higher production speed, (2) better quality, (3) more diverse products, (4) higher efficiency, and (5) higher data security. Consequently, the capacity to compete in this sector heavily relies on the domestic industry's ability to follow the prevailing patterns.

As a result, Indonesia is always fixated on common global industry branding practices, such as offering cheap labor. Indonesia's garment industry remains entrenched in an environment where the supremacy of low-cost labor persists. However, if the low-cost labor competition continues, the industry's profit margins will be significantly decreased, eventually causing economic stagnation. On the other hand, Indonesia's garment industry also faces challenge in the form of the declining trend of the workforce numbers from 2017 to 2021, as depicted in Figure 8.

Investing in high-tech machines as part of Industry 4.0 must be balanced with investing in human resources (HR) capabilities. However, regarding this matter, Indonesia's garment industry still faces productivity issue. Based on a general assessment at the garment companies' middle management level, Indonesia's human resource productivity is still below that of global average so that production costs are high, making it challenging to compete with the human resources from other countries. Similarly, the business ac-

tors also highlight that adopting any technology in any business sector without being balanced by increasing human resources capability is also useless. Therefore, one first crucial step to thrive in the global market is by increasing the human resources productivity.

C.   Organizational Level

1) Worker Skill and Management Support

Technological transformation has become unavoidable in Indonesia's garment industry. Several technologies are widely applied in this sector, such as computerized cutting machines, automatic fabric spreading machines, digital product design, and various automated assembly machines (Ariyani et al., 2021). The presence of more advanced technology has had a direct impact on the changes of job patterns. The adoption of advanced technology in the garment factory production line put workers in more challenging circumstances. With more varied product diversification and rapid change as a result of trends, these high-tech machines will have an impact on working methods, speed, and production volume. These factors influence the abilities and skills needed or expected from the workers.

Indonesia's garment companies indeed pay substantial attention for improving their human resources quality. Several garment companies establish vocational schools and provide career opportunities through management development programs for university graduates. This program is a fixed-term training aimed for preparing university graduates to become company leaders. It involves direct engagement of employees across various company departments, with aim to foster their familiarity with the tasks involved, and trigger their critical thinking and problem-solving strategies.

The companies are currently implementing various initiatives to establish vocational schools, in accordance with the Instruction of the President of the Republic of Indonesia No. 9/2016. These efforts aim to contribute to the revitalization of vocational schools, enhance link and match programs, and provide certified skill programs for human resources.

In order to increase labor absorption, the companies perform socialization to relevant stakeholders about the standards and requirements of workers' competency. The companies organize programs where participants such as teachers, high school and vocational school principals, local government officials, central government representatives, and members of the Indonesian Textile Association engage in discussions regarding current market demands.

Meanwhile, there have been reasonably well-established trainings in the form of non-formal development programs, which aimed to improve HR capabilities. Based on the interviews with the representatives of the Ministry of Industry, the enhancement of link-and-match program was achieved through vocational school development programs that encompass training, competency certification, and job placement. The collaboration with the Indonesian Textile Association was conducted at the Industrial Training Center from 2007 to 2019. This program successfully trained and employed a total of 60,000 workers. The Industry Center of the Ministry of Industry has supported this program by providing 300 machines, which are used to train 300 workers every 18 days.

Workers' training has a direct effect on the prevalence of technological modernization toward Industry 4.0, such as changes of patterns in workforce demand. For instance, there is a high demand nowadays for the following jobs: high-skilled technicians for machine operation and repair, competent designers to run computer software, and business and data analysts capable of handling big data analysis to support decision making. This implies that the companies should embrace the emerging trend by providing a variety of knowledge enhancement programs to its employees. This knowledge transfer process is carried out in-house or by sending human resources to corresponding business partners. This is in line with Satrya et al. (2017), who observed from the perspective of female workers as they were given the opportunities to participate in training sessions and were supervised throughout the process.

On the other hand, technological advancement has an effect on the deskilling of various types of labor. Increasing machine productivity reduces the need for workers' involvement because increased productivity reduces both the need for machines and the operators who are responsible for each machine. Throughout various stages of the production process, the machines are replaced with upgraded technology, causing relevant adjustments in terms of workforce. For instance, the operation of four machines by four workers can be replaced by a single machine operated by one worker while still generating the same level of production as the four machines merged. Subsequently, the reduction in labor expenses directly contributes to decreased production costs.

However, the adoption of Industry 4.0 technology is quite useful for execute a variety of jobs, particularly those that are quite complicated and require workers to attend training for certain extended period of time. In fact, job automation can directly accomplish these tasks in much more efficient ways, thereby boosting the productivity.

One thing is certain: increasing workers' capability must accompany the adoption of advanced technology. Companies are adopting a variety of strategies to increase their capacity, including arranging training for workers and potential workers (such as at the high school or vocational school level) in terms of upskilling or reskilling so that they can operate high-tech machines.

Companies also organize the training program by cooperating directly with the government. This training is expected to provide added value for workers by increasing their professional capability so as to preparing them to thrive in the workplaces under current conditions.

2) Need for Soft Skill

A second concern is the worker's attitude and mindset. Based on the current situation, the fundamental problem is that the business actors view this issue as the mentality of human resources in Indonesia.

The demand for goods from Indonesia's garment industry is very high because it is well-known to many buyers that the industry provides good quality, neatness, and clean workmanship compared to that of other countries. Based on the interviews, the competence of workers is very good, especially those who attended vocational schools (both of whom are technically competent and skilled). However, the problem lies in the mentality of human resources. Many garment industry workers do not seem ready to face the industrial work culture.

In several cases, it was found that all human resources had been trained, but not all were willing to change their mindset. In fact, technological mastery must be balanced by improving human resources' attitude and mentality. In this context, if the production processes increase the work burden, the majority of workers will be deciding to resign or quit.

Meanwhile, for unskilled workers, companies provide training opportunities. However, due to global competition, companies cannot afford repetitive training in long period of time. Thus, it is necessary to exclude workers who are unable to adapt quickly after the upskilling process is carried out.

The companies even highlight the main obstacle, namely employees' work ethics, such as lack of loyalty, lack of openness to new challenges, and lack of curiosity and desire to learn. As a result, the garment industry has a high rate of workers' turnover, making it difficult for companies to re-hire employees. Based on companies' data, the employees' turnover rate ranges from 5–7%, indicating a culture of not willing to work with high loads and high pressure in uncertain scheme, especially for workers who come from households that strongly prefer social security to support their lives. Concerning the adoption of Industry 4.0, the main focus of business actors is not solely about investment in sophisticated machines, but perhaps more importantly, investments in improving the quality of human resources to keep up with technological advancements. Thus, in the end, it is the human resources and their readiness that must be prepared so that they can thrive both in the job market and the workplaces.

On the other hand, the socio-cultural aspects also play a role in shaping the soft-skill of work-

ers. Indonesian general culture embraces a collectivist view in social interactions, with strong ties among extended family members. Indonesian families typically emphasize interdependence and prioritize collective aims above individual ones in their interactions. Extended family members have an essential function in shaping an individual's personality and provide numerous kinds of support, such as financial assistance, social connections, and help with childcare and household responsibilities (Riany, 2016). A robust socio-economic safety net inside the family protects individuals from worries about job loss, financial instability, or lack of income as the family members provide all material and immaterial needs. This culture indirectly diminishes individuals' mental ability to always be competitive and motivated to enhance the necessary skills for survival in the workplaces.

V. DISCUSSION

As seen from multiple levels, the results of this study have suggested that Industry 4.0-technological adoption is complementary in Indonesia's garment industry. At the upper level, it is indicated that Indonesia's garment industry has not yet fully transitioned to the Industry 4.0 phase, while the Indonesian government had issued several policies to facilitate this transition.

At the initial level of technological adoption, the process of upskilling and reskilling serves to improve and enhance workers' capabilities, implying that technology will be positioned as a complementary element that supports workers' performance to accomplish various complicated tasks.

So far, the issue of technology as a substitute element for replacing human labor in garment production lines has not been recognized. To date, the technological advancements still have not fully eliminated the role of workers. In addition, all workers are given the equal opportunity to upskill so that they can assume greater responsibilities. Workers who fail the upskilling/reskilling procedure are automatically eliminated from jobs that require high-tech machines. In other words, there must be both the required skills and the

willingness of the workers themselves to continue developing their competence.

Technology as a complementary element is divided into two categories: low-level complementary and high-level complementary. Complementary elements for companies aim to increase market expansion rather than replace workers. Technology as complementary element possesses a profound capacity to increase demand for certain products or services, thus stimulating market expansion. The advanced infrastructure industry players can enhance their product features and create new products while also improving efficiency and productivity. Such enhancements are essential for sustaining market growth and maintaining competitiveness in the global marketplace. For this reason, the demand and need for qualified workers to operate machines will increase. This argument contrasts with a notion by Borjas & Freeman (2019), which suggested that labor demand will decrease due to job automation. However, similar to the results of this study, Aaronson and Phelan (2020) and Borjas and Freeman (2019) argued that jobs with high repetitive patterns will be more vulnerable to be replaced by technologies.

Low complementary technologies tend to require a lot of workers' involvement. These tasks are typically complex and necessitate qualified workers with specific skills and knowledge. For instance, in the design process of garment products, the utilization of Computer-Aided Design (CAD) software stands out prominently. In this case, technology assumes as a facilitator, serving as a tool to streamline and enhance the design process. However, it is the human interference, through their unique identities and characters, which ultimately showcase the products' value. The essence of the design lies inherently within the workers' ability and creativity.

Meanwhile, high-level complementary technologies tend to decrease the need for workers' involvement. However, for the jobs with moderate degree of complexity, worker intervention is still required. Workers' abilities are at risk of being deskilled in this situation. For example, assembling the buttons or other clothes parts is typically repetitive in nature. Thus, this kind of

task is easily replaceable by machines. Similarly, the fabric cutting process, which previously demanded skill and precision from workers, has now been automated using the aid of machines. Due to this technological involvement, workers are no longer required to possess specific technical skills. Instead, they are simply required to adapt and familiarize themselves to operate the machines.

Table 1. The characteristics of the technological complementarity level in Indonesia's garment industry

Factor	Complementarity Level	
	Low	High
Human Resource	Require high workers' intervention. Workers tend to possess higher skills	Require less workers' intervention. Require minimum workers' skill, even workers' deskilling might be occurred
Work Type	Complex and problem-solving tasks	Simple and repetitive tasks
Example of Technology	CAD (computer aided design)	Assembly machine (button assembly, pocket assembly, etc.)

Source: Authors' Own Elaboration

Several studies have identified that companies implement several strategies in order to adapt to technological changes. For instance, Vu et al. (2023) conducted a cross-nation analysis of companies in Vietnam and Bolivia. Their study examined company leaders' perceptions of their employees' readiness for Industry 4.0 technology, employees' responses to the new practices based on Industry 4.0, and their viewpoints on how to handle knowledge acquisition to implement Industry 4.0. The results revealed that regarding the HR aspect, it is necessary to update the knowledge and skills of workers, such as by training and recruiting new workers with qualified competencies so that they can adapt and develop themselves in the workplaces.

VI. CONCLUSION

This study argues that the relationship between workers and technology in the socio-technical system generates a number of novel discourses that require further investigation. So far, few empirical studies have been conducted in Indonesia on the implication of the relationship between workers and the adoption of Industry 4.0 technology in different industries. Considering the state of labor-intensive industries in Indonesia (and their different typologies), as well as the availability of many workers with relatively low wages, it is crucial for the government and all related parties to decide the appropriate level and type of technological adoption. Our study only focuses on the garment industry so that further studies in other industrial sectors may yield different results.

Given the complex relationship between technology and workers, efforts to enhance workers' value through upskilling or reskilling are encouraged. As a result, HR must be prepared to embrace the ever-existing changes in the workplaces by focusing on technological development and innovations that will unavoidably change the routine work culture.

The government must aptly handle this condition by preparing students early on, starting from the senior high school or vocational school level, as well as by providing soft skills and comprehensive skills training in order to equip them with adaptive mindset. Issues related to transition to an industrial society without eroding natural resources as a source of livelihood must also be thoroughly investigated. This topic is considered essential for properly formulating the development direction of the nation's labor force (and human resources more generally), which should become more competitive in the future.

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