



IMPACT OF DISRUPTIVE TECHNOLOGY ON INDONESIA'S WOMEN WORKERS



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ABSTRACT

The advancement of technology has impacted many aspects of life, including how people work. In Indonesia, there is growing interest in exploring the impact of technology on the labor market, yet there is a gap in discussing its impact on women workers. Therefore, this study contributes to shedding light on how disruptive technology affects women's employment, companies' policies related to recruitment and training, women's strategies to balance work and life, and women's leadership. The approach used is more qualitative, utilizing firm-level data from the Centre for Strategic and International Studies' (CSIS) manufacturing survey and in-depth interviews with female workers from various backgrounds. The results suggest that technological disruptions have impacted women workers, but the results are not conclusive. In some cases, women workers are better off, while the situation for others remains the same.

Keywords: disruptive technology, women workers, occupation



I. INTRODUCTION

Technological innovations—e.g. computers, the internet, and cloud computing—proliferate globally, enable change in business models, and enable disturbances in established industries. McKinsey (2013) identified four traits of disruptive technology, namely experiencing breakthroughs, having a broad scope of potential impact, potentially having significant economic value, and substantially transforming the status quo. Goldin and Katz (2007) suggested the possibility of distributional consequences resulting from skill-biased technological advancement. Updated technologies increase the relative demand for more skilled labor. Shifts in skill demand and job profiles affect men and women.

However, in the digital era where automation is more than assembling items in factories, women are facing a higher risk from the effects of automation (Kinder, 2019), such as the changing nature of many jobs and job elimination. Previous studies summarized the possible impact of technology on higher salaries (Warfield, 2018; Rogoff, 2012; Townshend, 2018). The use of new technology increases the productivity of high-skilled workers. High-tech companies can increase the wages of high-skilled workers, while many low-tech companies do not. As there are more men than women in upper management, men are more likely to feel the effects of increased wages.

The impact of technology on female workers can also be examined from a company perspective. This is translated through company policies, starting when automation requires workers with different skillsets as well as different working arrangements to meet business needs. As a consequence, companies adopt various strategies to respond to the new challenges facing their businesses. Companies need more educated people to replace routine workers and traditional workers. This is important as it shows how companies with various levels of technology apply their strategies and policies to secure workers with the appropriate skills for their business. Company policies can relate to hiring, training, and providing facilities.

A company's response to technological change can influence how female workers develop strategies to balance their family and work lives. Technological innovation offers flexibility in completing tasks. This flexibility can break down physical, geographical and social barriers in the workforce and facilitate remote work. This is the impact dreamed of by female workers whose ability to undertake major responsibilities in the workplace is often doubted because at the same time they are expected to follow conservative norms that a woman should not work full time if she has children living at home (Kleven, Landais, and Søgaaard, 2018). With technology, women can work from home and at the same time take care of children and do other domestic tasks. After the birth of children, women workers start to fall behind men in terms of labor force participation, hours of work, and wage levels, as they prefer to find more family-friendly occupations that provide flexible working conditions for parents, or part-time jobs.

Prominent literature on this topic is mainly about developed countries. There is a lack of studies looking at the potential impact of technology on female workers in developing countries, including Indonesia. Therefore, this paper provides a descriptive analysis focused on the impact of technology on four aspects usually seen as key dimensions of gender equality and parity: women's employment and wages; company policies especially on hiring and training; balancing work and family life; and women's leadership. Specifically, the questions to be addressed are whether disruptive technology brings greater opportunities for women to participate in paid work and to earn higher incomes; whether new technology changes companies' policies related to recruitment, training, and female-friendly facilities; whether technological advancements provide flexible work hours for women and enable them to balance their family and work lives; and whether technological advancements create greater opportunities for women in leadership positions. To answer these questions, information and



data are mainly taken from the CSIS manufacturing survey and in-depth interviews with 30 women working in various sectors.

The organization of this report, following the introduction, will be Part II presenting data and methodology, Part III highlighting the literature review, a discussion of the findings in Part IV, and finally the conclusion and policy recommendations.


II. DATA AND METHODOLOGY

This paper uses a qualitative approach, employing two main data sources for analysis—the CSIS manufacturing survey and in-depth interviews. The manufacturing survey is a firm-level survey of 502 firms located in DKI Jakarta, Banten, West Java, and East Java provinces. It was conducted from December 2018 to February 2019 through face-to-face interviews. It used *Statistik Industri 2015*—an annual survey in which the respondents are medium and large firms from the manufacturing industry in Indonesia—as sampling frame and sector, region, and the number of employees for stratification strategy. The selected sectors were food and beverages, garments, footwear, electronics, automotive, and rubber and plastics. These six sectors were selected based on their employment and output proportion of the economy. Following Hogarth (2017), the selected respondents were senior executives with some responsibility for information and technology. The survey aims to capture firms’ perspectives on the state of technology implementation in Indonesia’s manufacturing industries. Information related to employment is useful and insightful in support of a gender study. Unfortunately, obtaining adequate wage data was challenging. Although we interviewed high-level management figures such as CEOs, or mid-level managers in different departments, many of them refused to answer wage-related questions. Consequently, we got a low response rate on that particular topic. To overcome this issue, we asked questions about wages to employees in in-depth interviews. We hope that the balanced perspectives of employers and employees will enrich this study.

The in-depth interviews were held in January to February 2019. The interviews aimed to complement the information obtained from the CSIS manufacturing survey. The 30 respondents were female workers from across Jakarta, Bogor, Depok, Tangerang, Bekasi, and Bandung. The determined criteria for the respondent selection was a minimum of three years’ work experience and being from the manufacturing or service sectors. We acknowledge that the limitations of this sample selection might lead to bias and representativeness issues, but it is sufficient to give a glimpse of how women workers are experiencing technological disruptions and associated impacts both on their jobs and family lives. The interviews also aimed to explore the perspectives of the women themselves, covering what resonates with those at high risk of job elimination or job changes because of automation, including female workers in frontline services and clerical roles, and with women in high-tech occupations. The semi-structured interviews covered several issues, including workers’ opinions on the introduction of technology in their workplaces, company policies on employment and gender, workers’ experiences in balancing work and family life, and finally their perceptions’ on women in leadership positions.

Most respondents (61.29%) were married, while the remainder were single or never married (25.81%) or widowed (9.68%). A majority of the respondents (32.26%) worked in the banking sector, while others were spread across the sectors of e-commerce, automotive, electronics, food and beverages, garments/textiles, and retail.

This paper defines disruptive technology as artificial technology (AI), robotics and automation, 3D printing, cloud computing, and big data. In order to gather information about technology use or



intensity, a self-assessed question was placed at the beginning of the technology section of the manufacturing survey. The rationale of this self-assessed question was, given the high levels of heterogeneity among manufacturing firms in any given sector, that there might be value in controlling for current levels of technology use/technology intensity. Thus, firms were asked to describe their current level of technology adoption (i.e. wherein the “digitalization journey” they were).

Here, the level of technology adoption is divided into three categories: advanced, intermediate, and basic. An advanced company is defined as a company that uses advanced technologies across various operations, which might be fully integrated. These technologies may include real-time web-based relations with suppliers, virtual modelling, machine to machine (M2M) systems, big data, and the Internet of Things (IoT), and ensure that the firm is at least as advanced as its competitors. An intermediate firm is defined as a company that has started to use advanced technologies in specific operations. This type of firm uses technologies that are more advanced than many other firms, but other competitors are ahead of it. A basic company is defined as one that performs many activities through manual work (and paper-based processes) without the use of digital tools. In terms of technologies, the firm may use basic tools such as spreadsheets, email, or basic data collection systems for shop-floor operations.


III. LITERATURE REVIEW

Prominent literature stresses how advanced technologies will change the nature of business and society (Goldin and Katz, 2007; Chinhui, Ujhelyi, and Villegas-Sanchez, 2014; McKinsey, 2014; Debla-Norris and Kochhar, 2018). This has a profound impact on the current and future employment landscape, including job creation and displacement. The most in-demand occupations and specialties in many industries and countries at present did not exist a decade ago (World Economic Forum, 2016). In the future, the rapidity of change is expected to accelerate.

Krieger-Boden and Sorgner (2019) describe two possibilities for how technology affects male and female workers in the digital era. First, automation substitutes routine work such as assembly, operating machinery, administrative work, and interpersonal skills such as research and management. Many studies have supported this framework (Autor et al. 2003; Acemoglu and Autor 2011; Autor 2015). Second, access to digital services such as financial technology and business platforms enables women to traverse traditional boundaries. This makes it easier for them to open businesses and access wider markets.

As part of the labor market, Kinder (2019) argued that women are disproportionately employed in occupations that are highly vulnerable to automation. At a global level, the work of women has a higher possibility of automation than that of men (Brussevich et al, 2018). On the other hand, technology encourages the growth of high-paying jobs that are clearly tied to technology, such as data scientists, computer programmers, and machine learning specialists. It could affect women's participation in the labor market, as this observation offers a window of opportunity for high-skilled women workers.

Unfortunately, many women's role as primary caregivers hinders their participation in the labor market. Schaner and Das (2016) found that women who had young children were significantly less likely to work compared to their childless peers. Paid work requires longer hours or does not offer women the flexibility needed to balance work and family responsibilities. They also showed that even though, on average, wage workers or those who work for an employer in return for a wage, self-



employed workers, and casual workers¹ work a similar number of hours per week, wage workers have a smaller variance in the number of working hours. This reflects less flexibility for this type of work.

Flexibility is an essential aspect for women workers, especially in regards to their work and family life balance. According to Madsen (2003), the need for women workers to balance work and family life aims to avoid family conflict, stemming from competing roles in the work and family domains. Work and family conflicts can lead to feelings that affect wellbeing in both domains. It has been linked to adverse outcomes, such as psychological distress, depression, somatic complaints, and exhaustion. Other factors have also been found to influence work and family conflicts e.g. job satisfaction, life satisfaction, organizational commitment, and turnover (Dawn, Kacmar, and Williams, 2000).

To balance their work and family lives, women need the time flexibility, where they can work and earn an income while performing their responsibilities for the family. Flexible work hours can help working parents to reconcile their work schedules with childcare centers or school hours and could make an important contribution to employees' satisfaction with their work-life balance (Cazes, Hijzen, and Saint-Martin, 2016). The ongoing digital transformation is believed to strengthen women's positions in the labor market because it can offer a more flexible way of working, which could make it easier to combine paid work with care responsibilities. Clark (2000) argued that using technology for work, such as computers and telephones, could help women to integrate their work and family lives, as it enables women to work from home. Working online is often presented as a way to alleviate work-family conflict.

Furthermore, in the workplace, men continue to outnumber women in management positions, especially at the executive level. Unbalanced leadership appears globally, with less than a quarter of women holding management positions globally. The obstacles for female executives are not just because of their individual choices but are also rooted in company biases against women in power. Women are less likely to be hired for manager-level jobs, and they are far less likely to be promoted into them, mainly because women are seen as not competitive enough (Lean In and McKinsey, 2018). In large technology companies, the rate of women's participation is still relatively low. For example, Apple has 20% of female employees in technology, Google has 17% of women in its workforce, and Microsoft, Facebook, and Twitter have 16.6%, 15%, and 10%, respectively. With these low initial numbers, the possibility of women achieving leadership positions is very slim (Kvochko, 2016). The remaining challenge is how to encourage women to apply for higher-level managerial roles.

Efforts to encourage women's involvement in management positions are an important milestone for progress in achieving gender equality at company level. However, previous studies (World Bank, 2014;

¹ Wage workers are defined as people who work for other people or institutions, either permanently or on a contract basis, and receive a wage or salary in terms of money or goods. Self-employed workers work for themselves. Casual workers do not work permanently for other people or institutions and may have had more than one employer in the previous month. A fourth category not mentioned in this report is unpaid/family workers.



McKinsey, 2013) indicate that the number of women who reached the highest rung of the leadership ladder was lower than that of men. The number of men and women workers at entry-level is usually equal. However, the number of women declines at leadership levels, for example at director level.

From this literature review, descriptive and qualitative studies of the impacts of technological disruption are lacking, especially in exploring how female workers perceive the impact of technology on their work and wages, looking at company policies, balancing work and family life, and securing leadership positions within companies. This study will help to understand the humanist side of the impact of technology by gender. Therefore, this research presents a descriptive study based on manufacturing survey data, supplemented by in-depth interviews with female workers in various sectors. Thus, this study contributes to providing an overview of how technology has so far affected the female workforce in Indonesia.



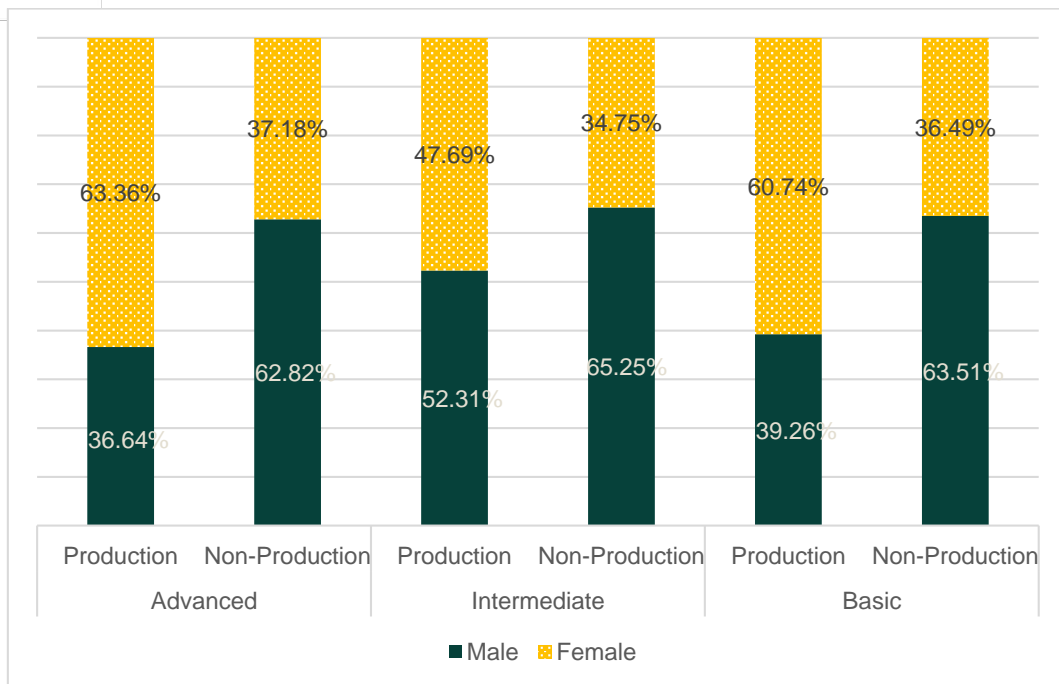
IV. DISCUSSION ON FINDINGS

A. Women's Employment

The CSIS Manufacturing Survey was conducted in several subsectors, including garments, footwear, electronics, automotive, food and beverages, and rubber and plastics. The survey respondents consisted of 33.57% food and beverage firms; 22.91% garment firms; 15.74% footwear firms; 10.56% each for firms in automotive, and rubber and plastics; and the remaining 6.57% were electronic firms. The survey respondents were dominated by companies in labor-intensive subsectors—such as food and beverages, garments, and footwear—which are also known as female-intensive sectors. Unsurprisingly, the results of the CSIS manufacturing survey show that 50.26% of the total workers (production and non-production) were women and 49.74% were men. Although female workers dominated across these six manufacturing subsectors, they were concentrated in production in the garment, footwear, and electronics subsectors. Men dominated production work in the automotive, food and beverage, and rubber and plastics subsectors, as well as non-production work in all subsectors. Many cultures perceive tasks such as sewing and mending to be feminine activities (Tager, 2016). Fuentes argued that women are considered tame, easily manipulated, and willing to do tedious and repetitive assembly work (as cited in Tager, 2016), so it is not surprising that women are preferred in some occupations.

Figure 1 illustrates the distribution of workers by gender, occupation, and technology adoption. For production workers, the share of women is 60.74% in basic companies and 63.36% in advanced companies. While for non-production workers, the share of women is 36.49% in basic companies and 37.10% in advanced companies. Companies adopting an intermediate level of technology had a lower proportion of female production and non-production workers, at 47.69% and 34.75%, respectively. After grouping workers by gender and level of technological adoption in companies, it was found that the number of female workers is higher than male workers in companies adopting basic and high technology. Meanwhile, in companies using intermediate technology, there are more men than women. This indicates that technological advances do not necessarily increase women's participation; it depends on the type of technology used, which then influences the skills needed in the operation of technology. A potential explanation is the existence of occupational segregation in which women tend to work in low-paid and low-skilled sectors. In addition, there are also stereotypes about women's and men's aspirations and abilities that influence the perceptions and behavior of employers (BetterWork, 2018). For example, when production processes are more technology-intensive, the work is considered to be more skilled and better paid, and thus a higher proportion of men are employed in those occupations. However, at an advanced level of technology, it is possible that more women will be employed due to the changing skills or abilities needed.

Figure 1: Share of Workers by Gender, Occupation, and Technology Adoption




Source: Author's calculations based on CSIS manufacturing survey

In addition, in-depth interviews indicate a mixed picture of the impact of disruptive technology on women's employment. The impacts depend on the industry and occupation or the bundling of tasks (i.e. routine cognitive, routine manual, non-routine or interpersonal, and technological types of tasks).

In the banking sector, digitalization facilitates the work of men and women. "This IT-based work can accommodate all genders," said one respondent specializing in e-banking. "There used to be four tellers at the branch; now there are only two to three people. Gradually these workers were converted to marketing because there was a trend where fewer customers came to the branch because of the role of technology. So the bank, which used to pay for workers in operational fields, now focuses on developing technology," the respondent added. Another respondent working in the credit card section supported this statement. However, that respondent explained there had been different impacts on that section, saying, "In the credit card section there has not been a reduction in employees because a lot of work is done in the field to conduct investigations." This statement reflects that disruptive technology has the potential to shift the demand for workers from those who perform manual tasks (e.g. tellers) to those who carry out interpersonal tasks such as marketing, authorization, and risk assessment.

The complementary nature of advances in technological communication facilitates workers with interpersonal skills, such as marketers, brokers, financial planners, and sales representatives. For example, marketers are more efficient in reaching potential customers. As a respondent explained, "Previously, the marketers had to 'move' to approach prospective buyers by carrying out advertising brochures and experiencing traffic jams on the streets. Now, it is easier to reach potential customers through social media. New applicants will visit the dealer if they want to physically see the automotive goods in demand." The use of email and cloud computing also benefits female workers who carry out routine tasks such as administration. Unfortunately, technology has not had a significant impact on women who work in customer service.



As for the manufacturing sector, digitalization has turned machine production into work that is lighter and easier to handle. This allows women to complete work previously undertaken only by men. However, some types of work in the garment and footwear subsectors are still done manually because, according to workers, no new technology is being used.

Next, the second aspect to elaborate upon is wages. It is worth noting that, as explained in the section on data and methodology, researchers often experience difficulty in obtaining accurate information on wages. Nevertheless, from the collected data, this study provides some insights. The first finding, as shown in Table 1, is that on average women receive lower wages than men, but that at a certain level of management in some subsectors they earn higher wages than their male counterparts. For instance, the female-to-male wage ratio in electronics and automotive for staff, junior managers, and mid-level managers is greater than 100. This means that the average female wage is higher than the average male wage. Moreover, women's wages are relatively lower than men's in subsectors that are labor-intensive and dominated by female workers, such as garments, footwear, and food and beverages. A potential explanation for this is that, from a supply-side view, the high number of female workers has decreased the price of labor and thus their wages.

Table 1: Ratio of Female-to-Male Average Wage by Subsector and Position

POSITION	SECTOR						
	Garments	Footwear	Electronics	Automotive	Food and Beverages	Rubber and Plastics	All
STAFF/OPERATOR	90.08	86.26	103.49	105.81	94.25	96.83	93.79
JUNIOR MANAGER	94.98	106.10	101.04	101.72	91.14	92.54	97.20
MID-LEVEL MANAGER	104.20	111.52	105.50	113.82	107.88	117.24	108.20
SENIOR MANAGER	66.75	89.94	76.68	59.87	110.11	81.63	81.77

Source: Author's estimates based on CSIS manufacturing survey

The second interesting finding is that, on average, the female-to-male wage ratio tends to approach 100 as companies adopt a higher level of technology. This indicates a smaller gender pay gap. Table 2 illustrates the detailed condition of the average monthly wage. Women earn a higher monthly wage in mid-level management. However, for other positions, their wages are still lower than men's. The gender wage gap at senior management level is worse than at entry-level management.

Table 2: Average Wage by Technology Adoption, Gender, and Position (in IDR)

Technology Adoption Level	Worker	Position				
		All	Staff/operator	Junior manager	Mid-level manager	Senior manager
Advanced	Female	5,926,907	3,505,229	4,490,000	8,825,000	15,800,000
	Male	7,148,857	3,505,229	4,580,000	7,723,077	19,600,000
	Ratio (F/M)	82.91	100.00	98.03	114.27	80.61
Intermediate	Female	4,836,190	3,209,751	4,573,860	7,578,723	15,884,211
	Male	6,048,627	3,212,032	4,695,467	7,088,406	16,583,333
	Ratio (F/M)	79.96	99.93	97.41	106.92	95.78
Basic	Female	3,246,876	2,260,010	3,378,385	5,494,118	7,247,614
	Male	4,161,853	2,535,680	3,566,842	5,121,429	8,824,286
	Ratio (F/M)	78.02	89.13	94.72	107.28	82.13

Source: Author's estimates based on CSIS manufacturing survey

Furthermore, Table 3 provides insights about average wages in relation to technological adoption level. We examine the impact of technology on wages by comparing the average female wage in companies with different types of technological adoption. On average, female wages improve by 82.54% from a basic to advanced adoption of technology. From basic to intermediate companies, the increase is 48.95%. The highest impact of technological adoption is at senior manager level, where the increase in the average wage was 118% for an advanced level of technological adoption and a 119.16% rise for intermediate companies. Significant differences between the increase of the average wage between an intermediate and advanced level of technological adoption occur for mid-level managers, with a 60.63% increase of advanced technology and a 37.94% rise for intermediate technology.

Table 3: Female Wage Comparison by Level of Technological Adoption

Type of comparison	All-female workers	Staff/operator	Junior manager	Mid-level manager	Senior manager
Advanced compared to basic adoption	82.54%	55.10%	32.90%	60.63%	118.00%
Intermediate compared to basic adoption	48.95%	42.02%	35.39%	37.94%	119.16%

Source: Author's estimates based on CSIS manufacturing survey

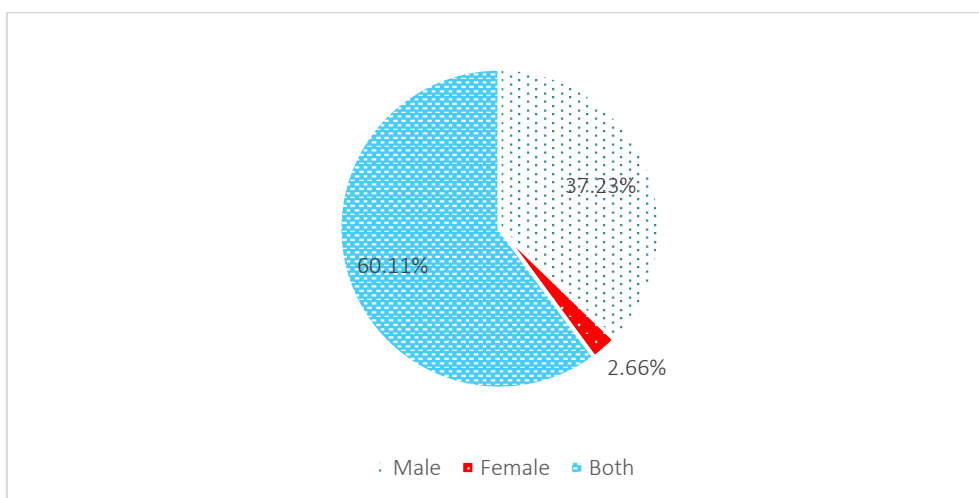
B. Company Policies

The impacts of technology in the workplace, such as computerization, depends on the type of tasks workers undertake. Autor, Levy, and Murnane (2003) suggest it has a substitution effect for workers who execute routine tasks, while it complements workers in performing non-routine tasks that demand problem-solving, communication skills, creativity, and flexibility. However, our study did not find any supporting evidence for this implication. The result of in-depth interviews indicates that, from the workers' point of view, there is no significant change in the recruitment process. In their opinions, most companies hire and recruit based on the company's needs. The assessment is still conventional and mainly based on education, experience, and the specific capabilities of prospective employees.

Nonetheless, there is a difference among companies working with digital platforms. For entry-level positions in digital companies, i.e. e-commerce, applicants are required to have higher-level skills in IT, not just familiarity with digital equipment. A respondent working for a digital platform mentioned that she had a background in IT and was also required to have good skills in personal relations, as her tasks included dealing with partners and consumers. Recruitment and selection are mostly conducted online. Face-to-face interviews with employers are conducted at the final stage of recruitment. From the respondents' perspective, they did not observe any different recruitment standards or processes between male and female applicants. Regarding skills, from the company perspective, a slightly greater percentage of companies claim it is easier to find a computer and IT skills in male candidates (38.3%) than in female candidates (36.8%). Likewise, for specific job skills, 29.8% of companies argue that it is easier to find relevant skills in men, while 23.7% of companies felt the same for women. The results of this survey imply that companies' perceptions of ease or difficulty in finding certain abilities among men and women is different, yet relatively similar.

To catch up with technology that requires workers to have new skillsets, companies provide training and retraining. Investment in training for women was low (Fitzenberger and Muehler, 2015). Figure 6 shows the percentage of training participants. Of 188 trainings identified through the CSIS manufacturing survey, most (60.1%) were conducted for all workers. Training for male workers (37.2%) was higher than training for female workers (2.7%). Training intended only for women includes skills in sewing, production processes, as well as big data, cloud, and machine operations. Training specifically for men mostly related to engine and machine operations. Moreover, companies also provide extensive training to avoid mass layoffs, or to avoid having to replace existing workers with new recruits.

Figure 2: Share of Training Participants by Gender

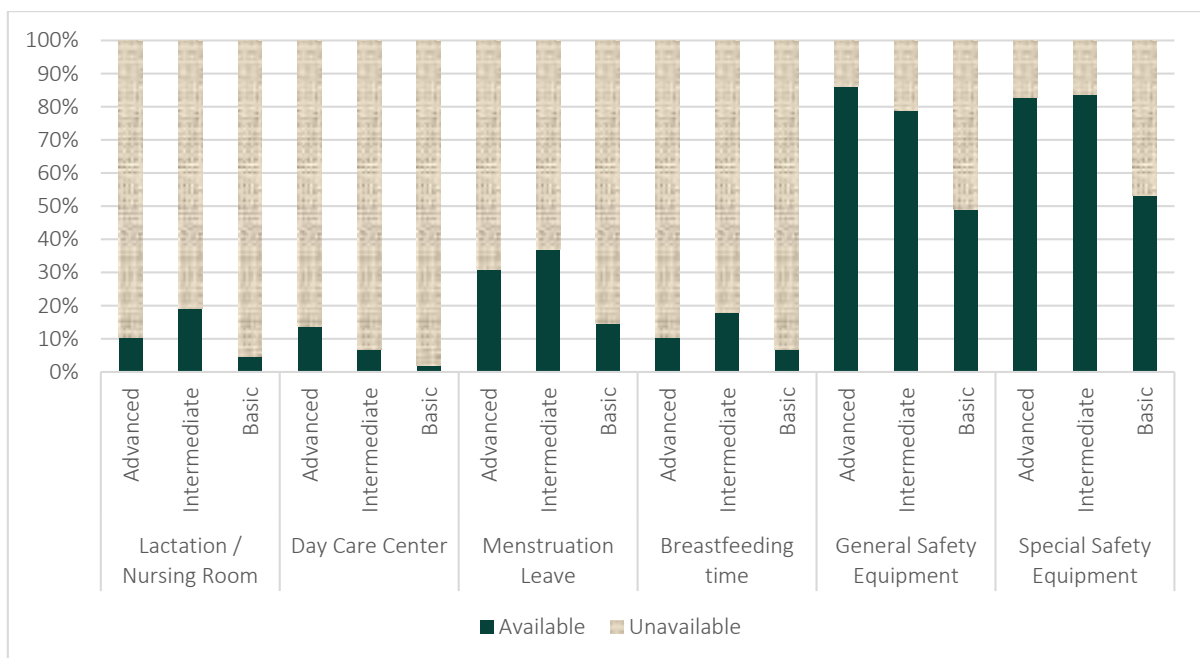


Source: Author's calculations based on CSIS manufacturing survey



Companies provide not only training but also facilities to improve their workers' performances. Facilities that are targeted to women, especially those who have children, can support their participation in the workplace. As exhibited in Figure 3, only a few supporting facilities are available at companies whose level of technology is still in the early stages. In terms of security equipment, both general and special, a majority of companies with any level of technology provide it. More specific female-friendly facilities are still rarely available in the workplace. Less than 50% of companies provide lactation rooms, daycare centers, and breastfeeding breaks. Companies that provide such facilities are mainly those adopting advanced and intermediate technology. The most popular female-friendly policy is menstruation leave. However, from interviews with female workers, it is known that this opportunity is rarely taken because workers are not aware of the policy or feel they do not need to take it.

Figure 3: Availability of Female-Friendly Facilities in Workplaces, According to Level of Technology



Source: Author's calculations based on CSIS manufacturing survey

C. Balancing Work and Family

Women who work in the formal sector (manufacturing and services) with a moderate level of technological application do not enjoy time flexibility in their roles. One worker said it was true that technology had accelerated her work, making it easier and quicker to complete her tasks. However, despite this increased efficiency, she could not go home sooner, as her company's rules dictate an eight-hour workday for all employees.

Another respondent working in the cutting section of a garment factory supported that argument by saying that new technology enabled her to cut more pieces in the same period of time than the previous technology. Although she could produce more than before, she was still required to stay at the factory until the end of the workday. This rule applies to all workers, both men and women.



All employees are required to fulfill their working hours. Hence, the basis of employment is not the work output but the working hours, as workers still go home according to their usual working hours. In this case, by operating new machinery, employers enjoy more benefits than the employees, as the use of technology improves companies' productivity and saves on production costs. With new machinery that can produce more than traditional methods, workers do not need to work overtime. This saves costs but for women workers, it means losing potential additional income from overtime.

Thus, for women wage workers in non-platform based services, the introduction of new technology does not change their work hours or affect their time flexibility. Women working in platform-based services and digital products, e-commerce and creative jobs (software developers, data analysts, bloggers, and marketing designers) were found to benefit from more flexible work time and various other types of flexibility.


One respondent working as a creative officer in e-commerce said her work hours were flexible, although she had to go to the office every day. She had the freedom to arrange her own schedule without specified start and finish times. She usually arrived at her office at noon after taking care of her children, and returned home after a few hours. She also did not have to finish her tasks at the office, but could complete some from home. The most important factor is that she must be able to finish her tasks on time. This means that the company's policy is performance-oriented, requiring the completion of work targets rather than obliging workers to adhere strictly to particular work hours.

Another respondent working for an online shop explained that she was allowed to only go to her office when physical meetings were scheduled. The flexible time allowed her to do other things if she needed to. "It gives me a sense of freedom, where I myself can control my time and my life, and not my employer," she said. For on-demand work, high-level skills that match with technology demands play an important role. Technology supports workers to communicate with their employers from home, yet sometimes it can be disruptive and annoying. For that respondent, it did not matter where and when she worked, as long as she performed well and delivered.

Another type of flexible hours allows women workers to decide when they will start and finish, as long as they work a total of 40 hours per week. This arrangement could be considered to be better than having fixed times for starting and finishing work, as defined by an employer.

From the above discussion, it can be concluded that access to and use of flexible work schedules are strongly associated with intensive use of information and communication technology (ICT) at work, as ICT facilitates flexible time schedules as well as working from home. Women in occupations that intensively use ICT have greater time flexibility compared to workers in companies with low or moderate technology. Most female wage workers using an intermediate level of technology are not able to enjoy flexible working hours because companies tend to stick to the rules regarding work hours, rather than implementing a result-oriented policy.

Employers' policies are essential in promoting workplace flexibility, but in the Indonesian context, it would be difficult to request flexible work arrangements because that would require changes to the structure of production and to management approaches. Therefore, the government should play a role by asking companies to support more flexible work hours for female workers, for example by identifying tasks that can be done on a flexible schedule, through the exchange of best practice and information campaigns promoting changes in workplace culture. The government can also encourage companies to identify jobs that can be done from home. Another effort would be to include flexible time in work agreements. Without the availability of tasks that can be done on a flexible schedule, a significant number of women workers will continue to be excluded from the labor market, which means a lot of potential labor is not being utilized. Changing this could help to foster more gender-balanced career paths and thus reduce wage inequality.



D. Women's Leadership

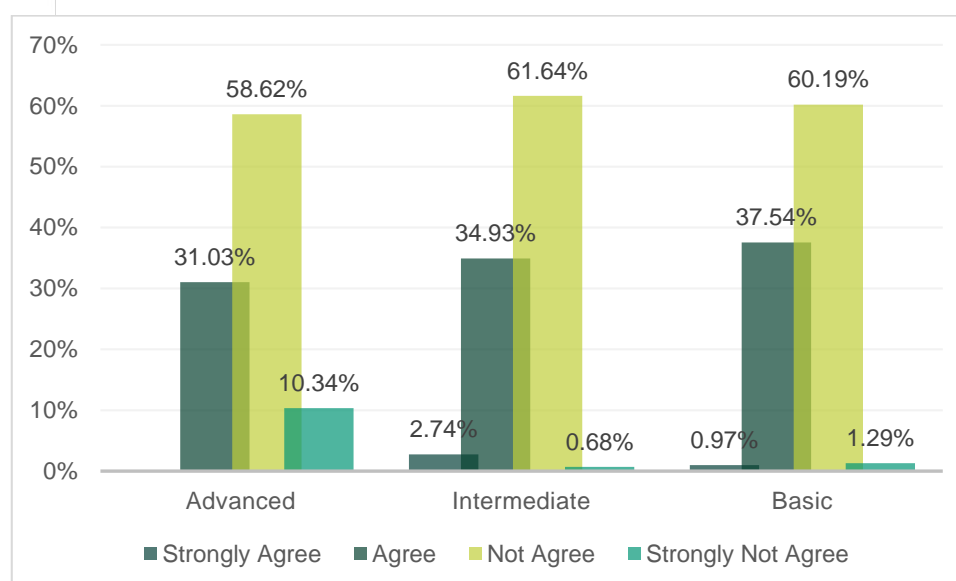
In-depth interviews suggest that women workers experience equitable workplaces. They argued that workplaces are fair and offer support to women. Women workers think their companies are doing an adequate job because disrespectful behavior toward women is often or always addressed quickly, and promotions are based on fair and objective criteria.

Although the number of women managers is not as high as men, most of the interviewed women stated that women are well represented in leadership positions in their companies. This finding reflects that from the employees' perspective, in general companies support gender balance. However, the critical question is how companies translate their support into concrete efforts to achieve gender equality in the workplace, such as keeping women in the talent pipeline and achieving high-level positions.

Figure 5 illustrates that the manufacturing survey reveals that at each level of technology, more than 60% of companies disagree that women will refuse a promotion to a leadership position. This means that, according to companies, most women will accept leadership positions if they are offered them. In high-tech companies, the confirmation is even stronger, with nearly 70% disagreeing with the statement that women will refuse if they are offered a lead role. This reveals women's readiness to assume leadership positions. However, 38%-40% of companies agreed that women often refused such offers. It can be interpreted that, according to companies, one in three women will refuse a leadership role if offered. Women are equally as interested in being promoted as men, and they ask for promotions at comparable wage levels. However, women are often hampered by self-confidence and aspirations. It is less likely that women aspire to reach top executive level, with its accompanying pressures. Women's barriers to occupying leadership positions in companies can also come from other sources. The Pew Research Center survey reveals that the main barriers for women not in top leadership roles in business are double standards, companies that are not ready to promote women to high-levels, and hesitance to hire women.

Our respondent's explanation supported this finding, as she argued that women tend to refuse to become a leader if the position is available outside of Java or in another city, requiring them to leave their family. It is difficult for a woman to move her whole family to another place because her husband cannot quit his job just to follow his wife, according to the respondent. Men can be stationed in any location as a man can bring his family with him if his wife is willing to quit her job to follow her husband, the respondent added.

Figure 4: Opinions on Women Refusing Promotions to Leadership Roles



Source: Author's calculations based on CSIS manufacturing survey

In line with previous studies (World Bank, 2011; OECD, 2017), this study shows that, in general, in each category of companies, there are fewer female workers in higher levels of management. Table 4 illustrates that at entry-level in companies with advanced, intermediate, and basic technology, women and men are represented roughly equally, with the proportion of female workers between 50%-61%. However, at each subsequent step, the representation of women declines and drops off sharply at senior levels. The number of men who manage to climb the career ladder is higher than women, who hold around 25%-30% of senior leadership positions in companies of all technological levels. In general, women are still underrepresented at the executive level. These details indicate obstacles for women in rising to high-level positions.

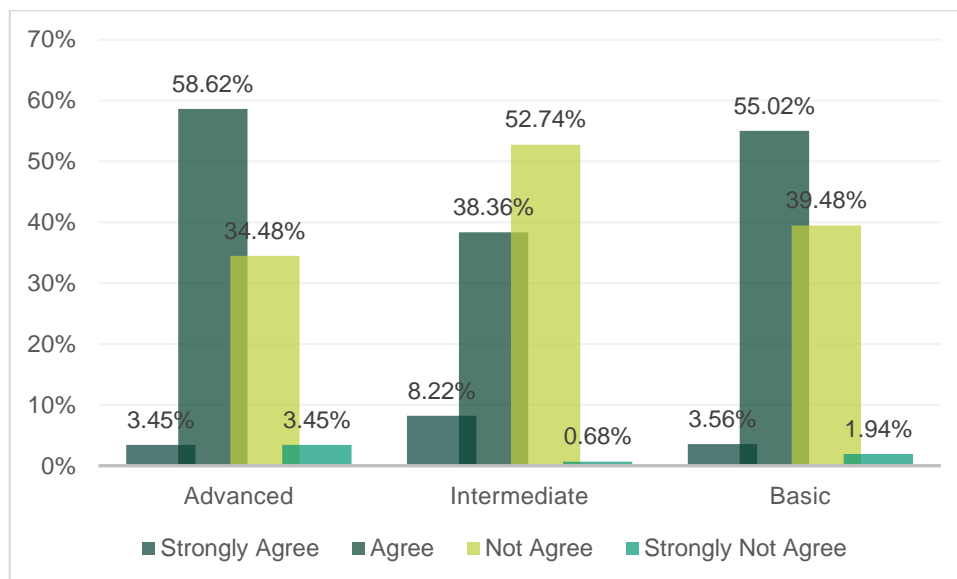
Table 4: Workers by Position, Gender, and Technology Adoption

Position	Number of Workers		Ratio of Female Workers (in %)
	Male	Female	
Advanced			
Staff/operator	12,145	19,054	61.10
Junior manager	368	230	38.50
Mid-level manager	140	63	31.00
Senior manager	42	17	28.80
Intermediate			
Staff/operator	23,919	27,535	53.51
Junior manager	1,778	769	30.19
Mid-level manager	1,170	423	26.55
Senior manager	249	56	18.36
Basic			
Staff/operator	10,704	11,039	50.77
Junior manager	604	343	36.22
Mid-level manager	575	340	37.16
Senior manager	353	125	26.15

Source: Author's estimates based on CSIS manufacturing survey

Although in general companies provide equal access and opportunities to both men and women to become corporate leaders, companies still consider men to be better than women in terms of leadership. Figure 6 confirms this observation by showing that more than 62% of technologically advanced companies view men's leadership as better than women's. In companies with a basic level of technology, 58.58% of companies agree, while among companies with an intermediate level of technology, around 46.58% view men's leadership as better than that of women. This finding is exciting, given that several other studies reveal that both men and women can be effective leaders (Zenger and Folkman, 2012). Not advancing women to leadership roles is sad for talented women, but also tragic for companies that face an unfortunate loss of talent, creativity, and innovation (McCullough, 2014).

Figure 5: Perception that Men's Leadership is Better than Women's Leadership

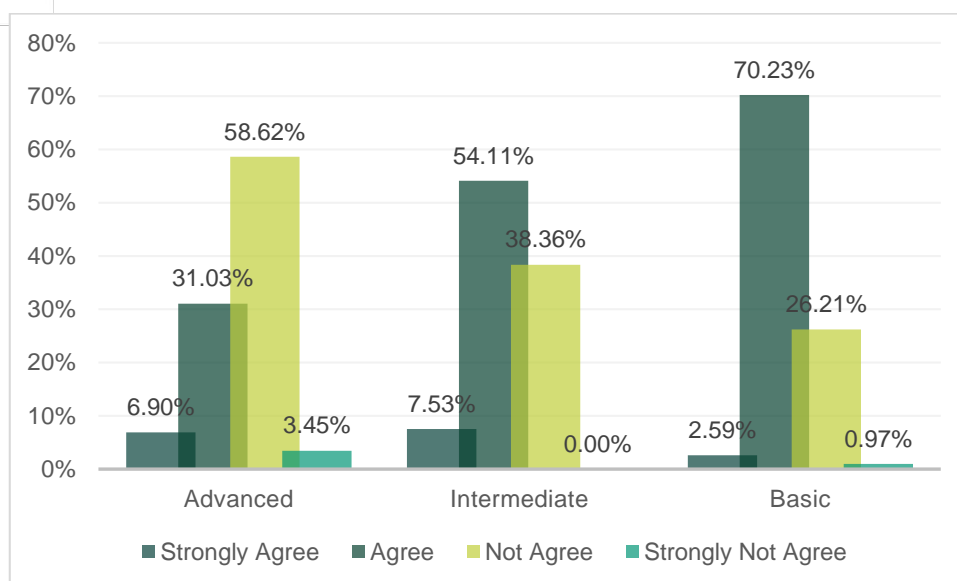


Source: Author's calculations based on CSIS manufacturing survey

A study by the Pew Research Centre on women and leadership revealed that the public has expressed skepticism about whether women are able to overcome the obstacles that keep them out of top leadership positions, at least in business. Women's historically low participation in the labor market means they have relatively few role models to look to in all industries (Pew Research Center, 2015).

Another explanation for women's underrepresentation in elite leadership positions points to the undervaluation of women's effectiveness as leaders. This is shown by our finding that 72.82 % of basic companies and 61.64% of intermediate companies strongly agree or agree that women are more concerned with feelings than rationality. A slightly different opinion is shown by companies with advanced technology, as 62.07% do not agree with the opinion that women are more concerned with feelings than rationality.

Figure 6: Perception that Women are More Concerned with Feelings than Rationality




Source: Author's calculations based on CSIS manufacturing survey

Leadership positions have always been regarded as men's positions as they require special qualifications and characteristics associated with male stereotypes, such as achievement orientation, rationality, and autonomy. Women leaders are seen not to be effective because characteristics often associated with female stereotypes, such as concern for others, affiliative tendencies and emotional sensitivity, do not fit the requirements needed to become a leader as represented by males. The fact that high-tech companies mostly do not agree with gender stereotyping shows that their evaluation of leadership performance is not gender biased but based on objective criteria. Both men and women can lead effectively.

V. CONCLUSION AND POLICY IMPLICATIONS

This study provides a picture of how technology advancements affect women workers in several sectors and occupations. However, before proceeding to the conclusion, it is necessary to note the exploratory nature of this study, which utilizes a more qualitative approach based on two primary sources of information, namely the CSIS manufacturing survey and in-depth interviews with workers from various sectors. Considering that, a closer look at the impact of technological disruptions on women's employment suggests a mixed picture.

The CSIS manufacturing survey results indicate that adopting a higher level of technology does not necessarily increase women's participation, but this depends on the type of technology used, which influences the skills needed for operating the technology. The impacts also depend on industry and occupation. In the banking sector, disruptive technology has the potential to shift demand away from workers who perform manual tasks, toward those performing interpersonal tasks. In manufacturing, even though digitalization enables women to complete traditionally male tasks, some tasks are still done manually as the companies have not updated the technology they used. Moreover, on average, women tend to receive higher monthly wages in companies adopting a higher level of technology, regardless of their position.



In addition, this study reveals that, from the employees' perspective, there is no significant change in the recruitment process between men and women. However, in order to catch up with technology, companies conduct training for both genders, where specialized training for men is offered far more than special training for women. Employers also provide extensive training to avoid mass layoffs.

In terms of women's strategies to balance their work and family lives, although technology improves productivity and effectiveness, it does not have an effect on time flexibility for most women workers. Hence, women still face problems in dividing their time between work and family.

Furthermore, despite companies' support for equal opportunities for both men and women, women are underrepresented in leadership. However, this study confirms a general acceptance of women's leadership in high-tech companies, which gives hope that with companies becoming more and more advanced, there will be more chances for women to occupy leadership positions.


The above findings indicate that, in Indonesia, technological disruptions have impacted women workers, but the results are not conclusive. In some cases, women workers are better off, while others are still in the same position.

This study suggests some policy implications. First, educational institutions have to prepare students in line with industry needs caregiver and provide information on what skills will be needed in the longer term. Second, we need to pay special attention to women workers with low skills in labor-intensive industries. Third, within the framework of anticipating disruptive changes, the government and companies should prepare a road map with actions aimed at narrowing the gender gap in various industries. Fourth, to support women's dual role as caregivers and workers, providing appropriate childcare for women workers is essential to ensure sustained career progression toward top management. In terms of balancing work and family life, it would be helpful if companies regulated and promoted flexible working hours. This policy may ease women's efforts to combine paid work with domestic responsibilities. Finally, companies should continuously support women's career paths by offering equal opportunities to both men and women to become top business leaders.



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