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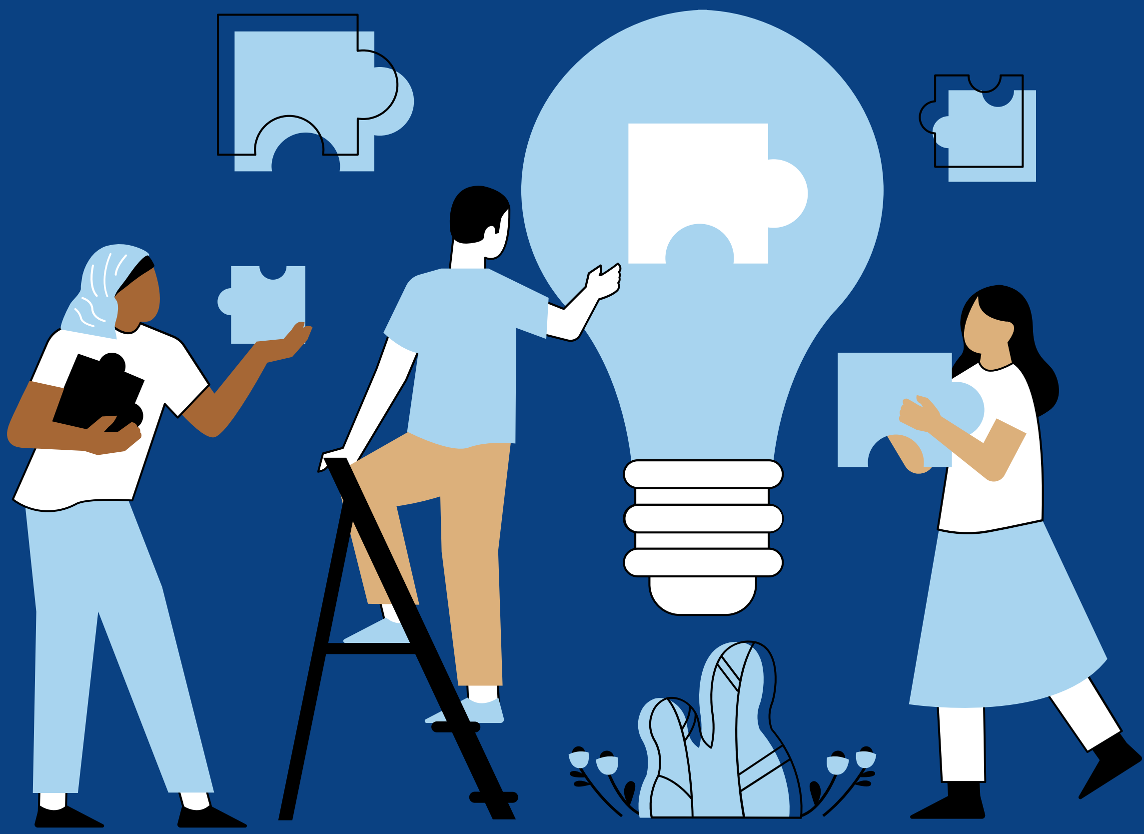

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China's proliferation of robotic manufacturing, its implications on the working population, their limitations and China's policy solutions

This report has been written for The Future of Work Lab by

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ABOUT THE INTERNSHIP

The Future of Work Lab hosts talented Master's student interns who lead projects across a range of future of work issues. The interns produce policy reports covering pressing and timely topics in this area. Our interns are trained in advanced analytical, research and report-writing skills as well as collaboration, teamwork and interpersonal skills.

Currently interning at the Future of Work Lab, Kimberley is nearing completion of a Master of Public Policy and Management at the University of Melbourne. Driven by a dissatisfaction with contemporary responses to chronic and global inequities, Kimberley is conducting research on the impact of new technologies on working populations. Though drawing primarily on the current Chinese context, this research intends to broaden the discussion on the future of work as a whole. By taking a critical approach to evaluating current policies, as well as technological trends and their workplace- implementations, that Kimberley seeks to develop future-facing policies that will address some of the most crucial problems of today and tomorrow.

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ABBREVIATIONS

MiC 2025: Made in China 2025

MIIT: Ministry of Industry and Information Technology

OECD: Organisation for Economic Co-operation and Development

ILO: International Labour Organisation

EXECUTIVE SUMMARY

China is in the race to lead the fourth industrial revolution. In 2015, China's Ministry of Industry and Information Technology released one of the world's most ambitious national policies, 'Made in China 2025,' which seeks to transform China into a manufacturing powerhouse by 2025 by upgrading its processes to automation. Many local governments have started campaigning for robots to replace human workers in manufacturing by providing subsidies to private enterprises with strong ties with government officials. In the recent decade, China has become the global leader in industrial robotics. Its industrial robotic instalment levels accounted for 44 per cent of the global robotic instalments in 2020. Alas, many workers have been culled by manufacturing giants, yet the central government appears to be muted on unemployment, social security, and labour protection issues. This report investigates the implications of robotic manufacturing and provides policy recommendations for the issues identified unique to the recent technological changes. This report seeks to make a meaningful contribution and broaden the discourse on the future of work within the global political context. Most importantly, other emerging economies like Mexico, India and Argentina looking to make the technological shift may find important lessons from the Chinese case.

INTRODUCTION

Since the invention of the steam engine, our quality of life has drastically transformed. It was once common for people to take up menial and dangerous tasks such as collecting radioactive materials and lifting heavy weighted objects, which are time taxing and burdensome on the human body. Today, these arduous tasks are now being done by technologies that allow humans to focus on other tasks that are less physically demanding, less time consuming and less demeaning and dull. We live in the so-called era of the Fourth Industrial Revolution (Benanav 2020); Moore, Upchurch & Whittaker 2018). Algorithms can now respond to customer service inquiries, and machines can interpret complex data within seconds no human can do. This era is "characterised by a fusion of technologies that is blurring the line between the physical, digital and biological spheres" (Schwab 2016, cited in Moore, Upchurch & Whittaker 2018). In other words, humans have a symbiotic relationship with machines and AI that is increasingly permeating our day-to-day life. Technologies and AI are already ubiquitous in many workplaces. These have drastically transformed the nature of work in warehouses, legal firms, mining and construction sites, operating theatres, farms, seaports, and in the sky (Bastani 2019; Srnicek & Williams 2016; Khalili 2021). The race to lead the Fourth Industrial Revolution is to broaden the range of areas and tasks technologies can function.

In recent years, academics and analysts have rightly speculated an accelerated rise in automation and new technologies such as Artificial Intelligence (AI) and industrial robots in many industries worldwide from 2020 to 2030 (World Economic Forum 2020a; Frey & Osborne 2017; Cheng et al. 2019; Stronge et al. 2019; Acemoglu & Restrepo 2018). More importantly, the COVID-19 pandemic has attracted many more businesses to take up technologies and AI to face-to-face contact, stabilise the global supply chain and domestic production, cut labour costs and increase productivity (World Economic Forum 2020a; Scarpetta & Pearson 2021; Georgieff & Milanez 2021).

While technologies can liberate us from specific tasks and create highly rewarding jobs, their omnipresence is engendering public concerns over their socio-economic implications on the future of work (Acemoglu & Restrepo 2018; De Stefano 2019; Nedelkoska & Quintini 2018). In researching the impact of automation in the Organisation for Economic Co-operation and Development (OECD) countries, Nedelkoska and Quintini (2018) found that 14 per cent of jobs are at high risk of being automated across 38 countries. The figures vary across countries. In Australia, 36 per cent of jobs are at high risk of automation, while the figure is 6.5 per cent for Norway (OECD 2021; Scarpetta & Pearson 2021). Meanwhile, 32 per cent of jobs were estimated to be on track to being profoundly transformed by technologies and will require workers to learn new skill sets (Georgieff & Milanez 2021; Nedelkoska & Quintini 2018). Occupations at a greater risk of being redundant include labourers in manufacturing, construction, mining, transport, and food preparations (Nedelkoska & Quintini 2018). However, all these estimations are predominately within the scope of advanced economies. Whereas there remains to be limited research on the future of work in emerging economies (Soto 2020; Lüthje 2019).

Research on technological advancement in emerging economies remains porous (Carbonero, Ernst & Weber 2020; Lei 2019; Soto 2020). Considering that so much of our globalised market depends on the manufacturing sector in emerging economies, hence their ability to influence our global political economy, it is worth investigating how these economies are deploying technologies and how they impact their political economy.

This report investigates China's proliferation of robotic manufacturing, its implications on the working population and the broader global economy, and its limitations. The report aims to provide a complete understanding of China's case study by drawing on contemporary literature and primary databases such as the International Federation of Robotics (IFR). The report is structured as follows; section 1 will illustrate China's technological rise and how it compares to its global competitors. Section 2 provides an overview and an examination of the key drivers of China's technological shift. Section 3 seeks to answer the question 'How does China's industrial upgrading compare to the experiences of advanced economies' shift to automation in the past?'. Following this, in Section 4, the report will discuss the implications of robotic manufacturing and warehouses on the working population. This report will also explore the limitations of industrial robots in Section 5. Then lastly, the report will make policy recommendations for the government and those reviewing the case to consider.

SECTION 1 – CHINA'S RISE IN ROBOTISATION

As an emerging economy, China is also the global leader in industrial robotics, and its usage of robotics is comparable to the level of advanced economies (Soto 2021). Since 2013, China has been the largest market for industrial robots globally (IFR 2021). Where over 70 per cent of the world's electronics and computers are produced, China's manufacturing sector is seeing a radical technological transformation (Chen et al. 2019). In 2011, one of the largest Chinese electronics manufacturers, 'Foxconn Technology Groups', declared a determined three-year plan to diminish the human labour force with one million robots (Huang & Sharif 2017). Later, in 2015, the Ministry of Industry and Information Technology (MIIT) released one of the world's most ambitious national plans, Made in China 2025 (MiC 2025). One of the goals stated in MiC 2025 was for China to produce "100,000 industrial robots per year eventually and achieve a density of 150 robots per 100, 000 workers by 2020" (State Council 2015, cited in Cheng et al. 2019, p.77). A year later, in 2016 alone, China sold around 30 per cent of the global market for industrial robots, which amounted to 87,000 units (Cheng et al. 2019). This shows that China is already achieving its goal if we also count the unsold robots. In the same year (2016), over half of Foxconn's total workers in Kunshan, Jiangsu Province, were retrenched due to robotisation (Huang & Sharif 2017). In 2018, over 80 per cent of China's robots were operating in the manufacturing sector (Cheng et al. 2019; Huang 2018).

According to the International Federation of Robotics (IFR) (2021) database, China, Japan, the United States, the Republic of Korea and Germany made up the top five markets of industrial robotics in 2020. Seventy-six per cent of industrial robots installed globally belonged to these countries (IFR 2021).

Forty-four per cent of the world's total instalment of industrial robots belonged to China alone in 2020. While only 108,436 were installed in the Americas and Europe together, 168,377 units were installed in China (IFR 2021).

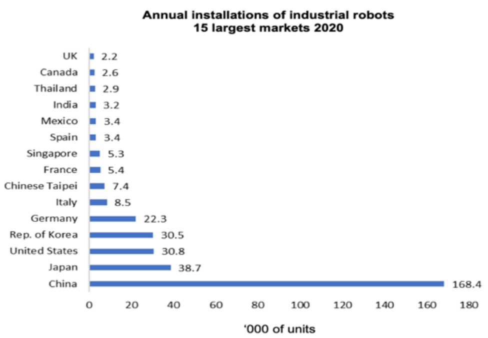

Figure 1: Annual installations of industrial robots. Source: International Federation of Robotics 2021

As of 2020, China's operational stock of robots was 943,233 units which is a strong growth of 21 per cent compared to the year before (IFR 2021). This is also the most robust growth compared with Japan which is the second-largest market.

Japan's instalment only grew five per cent in 2020 and only accounted for 10 per cent of the global instalments (IFR 2021).

The United States is the third biggest market, accounting for eight per cent, the Republic of Korea's instalment of robots came close to eight per cent, and Germany's instalment accounted for six per cent (IFR 2021).

China has the highest number of instalments and has exceeded other leading markets, all of which are advanced economies. China has installed more industrial robots than Japan, the United States, the Republic of Korea, and Germany combined.

Moreover, China's registered robotics firms have grown exponentially from 221 in 2005 to 6,478 by the end of 2015 (Cheng et al. 2019). Between 2013 and 2015, the number of robotics firms doubled each year (Cheng et al. 2019).

In 2020, the density of industrial robots had reached 68 units per 10,000 manufacturing workers in China (Soto 2020); this is similar to the levels seen in advanced economies like the United Kingdom and Australia (Soto 2020), which makes China the most successful in its emerging economy cohort.

SECTION 2 – AN OVERVIEW OF THE FACTORS DRIVING THE TECHNOLOGICAL SHIFT

The report has looked at the pace of China's transition to robotisation, and now this report turns to the key factors driving this ambitious shift. The shift is underpinned by increasing wages indicative of the ageing population and regional labour shortages, state policies, and market demands (Lüthje 2019; Cheng et al. 2019; Soto 2020; Lei 2021; Huang & Sharif 2017).

2.1 AN AGEING POPULATION AND INCREASING LABOUR COST

China's economic rise was partly due to its cheap labour market that was influenced by a 'demographic dividend', in other words, a surplus of workers (Huang & Sharif 2017; Lei 2021; Cheng et al. 2019; Bastani 2019). However, in recent years, due to China's ageing population and its shrinking working-age (15-64 years) population, the cost of labour has soared (Cheng et al. 2019). China has experienced the highest cumulative real wage growth between 2008 and 2017 compared to all advanced economies, as shown in figure 2, a graph taken from the ILO (2020). Wages in China have more than doubled between 2008 and 2019 (ILO 2020). Interestingly, the Chinese economy shares many similarities with advanced economies since the adoption of automation technologies is "a response to the scarcity of (middle-aged) production workers in countries where the labour force is ageing rapidly, such as Germany, Japan, and South Korea" (Acemoglu & Restrepo 2018, p.11).

In contrast, developing economies have been slow to adopt automation technologies because of their young and cheap labour market (Soto 2020; Acemoglu & Restrepo 2018). Robots have become imperative for businesses to keep the cost of production down when wages are increasing rapidly due to their diminishing working population. A study on wages in emerging economies such as China, Mexico and Brazil predicted that wages would continue to grow and that the cost of robots would be cheaper than employing people (Soto 2020); this, in turn, makes a technological shift perceived to be necessary for specific vital stakeholders.

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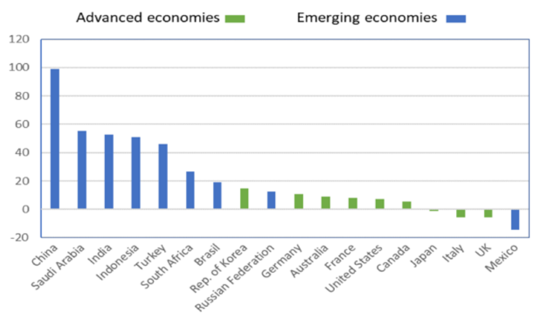

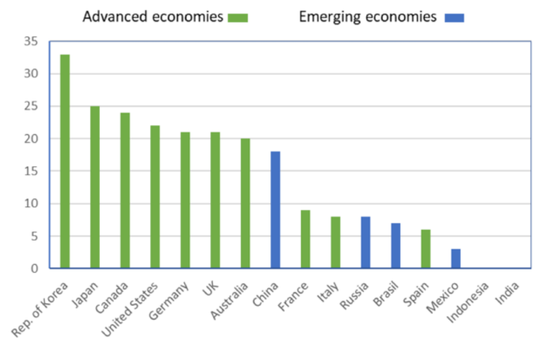

Figure 2: Cumulative real wage growth 2008-2017. Source: ILO Global Wage Report 2018/19

Figure 3: Labour-cost savings from adoption of advanced industrial robots (% 2025). Source: The Boston Consulting Group (The Shifting Economics of Global Manufacturing: How a Take-off in Advanced Robotics Will Power the Next Productivity Surge, 2015).

2.2 HOW THE MADE IN CHINA 2025 INITATIVE PROVIDED THE IMPETUS FOR THE FOURTH INDSUTRIAL REVOLUTION IN CHINA

Two years after Germany released its national plan 'Industry 4.0' in 2011, the MIIT released its "Guidance on the Promotion and Development of Robot Industry", which aimed to develop several world-leading companies in China. Germany's Industry 4.0 has served as a reference point in the genesis of MIIT's 2013 initiative and China's national industrial policy, MiC 2025. MiC 2025 was released in 2015 by the MIIT with the input of around 20 other ministries (Cheng et al. 2019; Huang & Sharif 2017). The national policy is an expansion of the 'Guidance on the Promotion and Development of Robot Industry', that goes further to accelerate and put forward a more explicit strategy for an 'innovation-driven development' as well as reiterating China's intention to shift their "economy from export-led to domestic market-based growth" (Lüthje 2019, p.204). MiC 2025 is a policy that seeks to decrease China's reliance on foreign markets and become self-sufficient by heavily investing in their own companies for innovative developments, particularly for industrial robots (Lei 2021; Butollo & Lüthje, 2017). As well as developing higher numbers of industrial robots, MiC 2025 emphasises transforming China to become a global leader in manufacturing by 2025 by improving their overall domestic manufacturing process, from increasing production to developing high-end products. Put simply by The State Council (2015, para. 3), the key priorities of MiC 2025 are "improving manufacturing innovation, integrating technology and industry, strengthening the industrial base, fostering Chinese brands, enforcing green manufacturing, promoting breakthroughs in ten key sectors, advancing restructuring of the manufacturing sector, promoting service-oriented manufacturing and manufacturing-related service industries, and internationalising manufacturing".

Moreover, much like the advanced economies such as Germany and the United States, China wants to achieve an innovation-driven and value-added industrial sector, however, "through intelligent manufacturing backed by automated factories and big data" (Huang & Sharif 2017, p.55). This is an ambitious plan that mirrors Germany's Industry 4.0. However, one of the key differences is that while Germany aims to digitalise its manufacturing sector (BMWK 2022), China does not (Lei 2021). It is also important to note that "most automation projects in China are at the 'industry 3.0' stage, which highlights partial automation using programmable controls and computer, as opposed to the 'industry 4.0' stage outlined in the German plan" (Lei 2021, p.6). Despite this, MiC 2025 reveals China's aspiration and ambitions to secure its competitive position in the global market.

Furthermore, MiC 2025 is a national agenda that is disseminated across all localities wherein local governments develop their version of industrial policies to meet the national priorities (Lei 2021). It is the local governments that finance the majority of the programme by providing subsidies for research, training facilities, infrastructure, buildings or land (Lüthje 2019). For example, a local government in the city of Dongguan released a policy called 'Replacing Humans with Robots' (*jiqi huanen*) and promised to provide 10–15 per cent subsidies to registered firms to enhance their manufacturing equipment (Huang & Sharif 2017). Government subsidies are offered as incentives for businesses to upgrade their manufacturing process and are also the main driver of the growing number of registered robotics manufacturers since the early 2010s (Lei 2021; Cheng et al. 2019).

2.3 PRIVATE ENTERPRISES

Privately-owned Chinese enterprises such as the mass manufacturing company Foxconn Technology Groups and e-commerce giants Ali Baba and JD.com are predominately driving China's robotic revolution. Soon after the exposé of Foxconn's high rates of workers' suicide in 2010 (Chan & Pun 2010), the company announced its three-year plan in 2011 to replace its human workforce with one million industrial robots (Huang & Sharif 2017). Automation has become a strategy for Foxconn to overcome its issues of labour control and occupational safety (Butollo & Lüthje, 2017). Many mass manufacturers are at the forefront of the technological revolution as they seek to decrease their low-skilled workforce with robots and machines as well as slow down wage growth and increase their revenue (Lüthje 2019; Srnicek & Williams 2016).

Furthermore, automation has been written into private policies before the MIIT released MiC 2025 and 'Guidance on the Promotion and Development of Robot Industry', so it is conceivable that the private sector has played a tremendous role in the conceptualisation of MiC 2025. Private enterprises and the government have a strong symbiotic relationship in implementing MiC 2025 (Lei 2021). Government subsidies are liberally given to businesses with "little mechanism to oversee policy implementation" (Lei 2021, p.10), and government subsidies are more likely to be given to companies with connections to government officials (Lei 2021). In their research, 'The China Employer-Employee Survey', which sampled 50 robotic firms in China, Cheng et al. (2019) found that 35 per cent of the firms have a CEO who is affiliated with the Communist Party, even though only 12 per cent of the surveyed firms are state-owned enterprises. This, as Lüthje (2019) notes a characteristic of China's emergent capitalism or, as Lei (2021) asserts, 'China's techno-developmentalism that has "led to a symbiotic state-capital relations that marginalise low-skilled workers" (p.2). Private enterprises are tremendously influencing the technological transition and have wielded dominant power in public policymaking in China.

SECTION 3 – CHINA'S INDUSTRIAL UPGRADING IN COMPARISON TO THE EXPERIENCES OF ADVANCED ECONOMIES' SHIFT TO AUTOMATION IN THE PAST

As stated above, in section 1 of this report, China's level of industrial upgrade is comparable to advanced economies like the United Kingdom and Australia, and the nation is facing similar demographic trends to the Global North when they shifted to automated production in the 1960s. Thus, it is worth comparing the difference between China's experience of automation in our contemporary time and the experiences of the Global North in the past to understand better what is ahead for China's future work.

Countries such as Germany, the United States, the United Kingdom and Japan have achieved automation production from the 1960s and the 1970s with the presence of strong union activism (Huang & Sharif 2017, Lei 2021). In the United Kingdom in the 1960s, Prime Minister Harold Wilson advocated for a democratic policymaking process to ensure that the shift to automation would benefit the entire nation, not just businesses or a few people (Lei 2021). This was the same sentiment shared by President Lyndon B Johnson of the United States in 1964; thus, the drafting of public policies involved a broader range of voices, including trade unions (Lei 2021). Even in Japan in the 1970s, when Nissan adopted automation in their production, the Nissan Union played an instrumental role in developing its policies around labour conditions and standards (Morris-Suzuki 1988).

On the other hand, China has not included a broad range of stakeholders in the development of MiC 2025. It is important to note that although the MiC 2025 was drafted by 20 other ministries, the Ministry of Education, the Ministry of Labour and Social Security, trade unions and the Labour Bureaus were excluded (Lüthje 2019; Huang & Sharif 2017). Its main stakeholders in constructing the policy are the government, talents, and firms (Lei 2021). This highlights the exclusion of workers and the silence on unemployment, social equality, and labour protection issues.

SECTION 4 – IMPLICATIONS OF RISING ROBOTIC MANUFACTURING AND WAREHOUSES ON THE WORKING POPULATION

4.1 CHARACTERISTICS OF THE CURRENT WORKFORCE IN THE MANUFACTURING SECTOR

In 2019, The demographic composition of China's manufacturing sector is slightly different across various workplaces. However, low-skilled young and migrant workers dominate the manufacturing labour force (Lüthje 2017; Lei 2021; Unger & Siu 2019). China's internal migrant workers- those who have migrated from rural China to urban areas, make up 60 per cent of the construction and manufacturing sectors (ILO 2022; Huang 2022). In 2018, around 90 million or 31 per cent of workers in urban manufacturing factories were migrant workers (Unger & Siu 2019). However, the number of migrant workers has fallen as migrant workers only accounted for 27 per cent of the manufacturing workforce in 2020 (China Labour Bulletin 2021). This could result from an ageing population, the COVID-19 pandemic that has restricted movement, and the aggressive adoption of industrial robots in manufacturing that has replaced jobs (China Labour Bulletin 2021; Huang & Sharif 2017; Lei 2021).

Although the ages of workers do vary between 20 and 40 years across various warehouses, young workers in their 20s make up the majority of the workforce (Lei 2021). More prominent manufacturers, as Lei (2021) identifies, tended to have stricter restrictions on the maximum age. At the same time, smaller manufacturers do not restrict age (Lei 2021). Young women are more likely to be employed in the production process because of their nimbler hands, while men were employed for heavier labour tasks (Unger & Siu 2019). Unger and Siu (2019) explain that factory managers maintain the view that young women are more obedient and have the physical strength to work longer hours with higher productivity rates than women over the age of 24 years. Although, when interviewed, a factory manager said they prefer workers in their 30s because they are more stable and less likely to leave (Unger & Siu 2019).

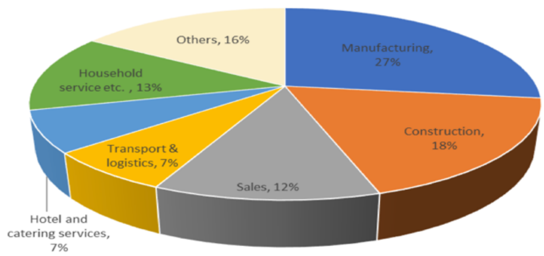

Figure 4: Employment of migrant workers by sector 2020. Source: China Labour Bulletin 2021

4.2 WORKERS' PERCEPTION OF CHINA'S TECHNOLOGY ADOPTION

The report has elaborated on how the government and employers have been the ones to be pushing for the technological revolution in China; therefore, it is worth considering the views of manufacturing workers. According to Lei's (2021) extensive research on the perception and decision-making of local governments, manufacturers, and low-skilled workers on automation under China's techno-developmentalism, young workers were the least critical of their local government's human-robot substitution campaign. One worker who supports the policy says, "when robots can replace humans, that means China achieves advanced technological development and can compete with other countries." (Lei 2021, p.14). When asked about their job security, most young workers state that they do not intend to stay in the industry for long to warrant any concern (Lei 2021). Most workers saw their manufacturing job as temporary and the robotic revolution necessary for China's economic progress. However, workers in their 30s share a differing view of the state's policy. Lei (2021) finds that these workers were more concerned about their job security because most of them were parents and had failed to find better jobs for themselves in the past. Low-skilled young workers, who make up most of the labour force, are optimistic about the prospect of China's technological shift, whereas the workers in their 30s are pessimistic. Though in Huang's (2018) research, after presenting the facts on the impact of automation on jobs to the workers in Dongguan, workers started questioning why the government only offers subsidies to firms, yet displaced workers are given nothing. This highlights the workers' disdain for the policy implementation when made aware of the implications of automation.

4.3 SHIFTING NATURE OF WORK

In general, workers within industries at high risk of automation are predominately low-educated and of low socio-economic status (Georgieff & Milanez 2021). Workers will need to be reskilled to be prepared for the future of work. According to the 'Future of Jobs Report 2020' published by the World Economic Forum (2020a), half of all employees will need to be reskilled by 2025. Moreover, workers with critical, analytical and creative thinking skills, as well as human-centric skills, which are traditionally taught in higher education, will be in greater demand in future work (World Economic Forum 2020b; De Stefano 2019). In other words, as new technologies proliferate, the once considered low-skilled labour force will evolve to be 'middle to high skilled' to service these technologies in the workplace. Although China has been investing in training programs, in their analysis, Chen et al. (2021) and Huang (2018) find that China will need to expand its training facilities to achieve its vision of intelligent manufacturing and to mitigate job polarisation adequately. Up until 2017, Huang and Sharif (2017) and Lüthje (2019) also observed that there had been no credible evidence offered by the Chinese government and companies on how many workers will be upskilled and how many jobs will be replaced. Even though the Chinese government have been aware of the shortage of skilled workers (Huang 2018), the threat of job displacement has not been mentioned in official documents (Lei 2021).

Further, without government intervention to mitigate the impacts of automation on job security, De Stefano (2019) and Stronge et al. (2019) warn us that the technological shift will further exacerbate the existing wealth disparity by increasing job displacement and job polarisation. Chinese migrant workers make up almost 30 per cent of the manufacturing labour force and are the most disadvantaged as they have little access to higher education before beginning work (Unger & Siu 2019). With an insufficient number of training facilities as well as little to no access to higher education for migrant workers, automation is causing job polarisation and increasing the employment rate, which this report will further elaborate on in the following section.

4.4 EMPLOYMENT RATES

So far, the MiC 2025 campaign has been painting a positive vision for China's technological progress; however, the aggressive adoption of industrial robots in recent years has created detrimental consequences for the working population. Although MiC 2025 has been promoted as a panacea for China's rising labour costs and diminishing working population, Huang & Sharif (2017) find that the so-called 'labour shortage' is but a myth. China has the most extensive internal migration globally (ILO 2022). According to China's official data, there were 286 million internal migrant workers in 2020 (China Labour Bulletin 2021). This is greater than the estimated figure for 2018, which was 282 million (China Labour Bulletin 2018, cited in Unger & Siu 2019). What is illustrated here is the rise of the migrant worker population. As Huang and Sharif (2017) assert, there is a surplus of migrant workers in China that is "far from being exhausted" (p.63). Recently, migrant workers have formed unions and demanded wage increases, workers' rights, and recognition. In 2010, 1800 workers at the Honda Auto Parts Manufacturing plant went on strike for 17 days, forcing managers to accede to their demand for an increase in their wages by 32.4 to 70 per cent (Huang & Sharif 2017). Therefore, as Huang and Sharif (2017) argue, "the so-called labour shortage reflected workers' growing marketplace bargaining power rather than a real shortage in the labour supply" (p.64). Nonetheless, the average age of migrant workers was over 46 years in 2020 (China Labour Bulletin 2021). This is to say that there will be a labour shortage soon, if not now.

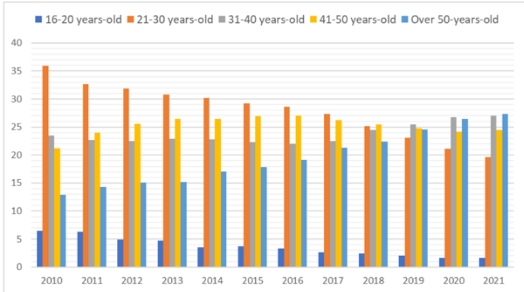

Figure 5: Age Distribution of Migrant Workers 2010-2020 (%). Source: China Labour Bulletin 2021

Furthermore, many companies have drastically reduced their workforce within the past decade. A JD.com warehouse in Shanghai, which would usually hire 400 to 500 employees, now the warehouse only has five workers to service the robots (Houser 2018). As Huang and Sharif (2017) discover, one factory had reduced its workforce by 80 per cent when it adopted robotics. Moreover, since the implementation of Dongguan's 'replacement of workers with robots' policy in 2014, by the end of 2015, the Dongguan government stated that it had reduced 71,000 jobs (Cheng et al.2019). In 2017, the population of Dongguan, a city where 80,000 manufacturers are based, shrank by 70 per cent (Huang & Sharif 2017). Those were mainly migrant workers who were employed in factories (Huang & Sharif 2017). Butollo and Lüthje (2017) find that more than 50 per cent of the manufacturing workforce has been reduced in some home-appliance factories due to automation. All these portray a dire and heavy impact of automation on employment. Automation is, in a way, serving to produce a larger surplus of workers that, as Srnicek and Williams (2016) claim, is only "beneficial to the capitalist interests" as "they serve as a disciplinary tool against the working class" in the way that it keeps wages low and workers disposable" (p.98). This seems true in the Chinese case, as real wages are increasing for Chinese workers (Soto 2020).

SECTION 5 – LIMITATIONS OF INDUSTRIAL ROBOTIC ADOPTIOIN

Although the mainstream discourse predominantly portrays the benefits of automation technologies, they certainly have some limitations. First, as noted in section 4.3, the large-scale adoption of robots requires a highly skilled workforce. In 2016, the 'Development Planning Guidelines for Manufacturing Talents' issued by the central government projected that there would be a gap of 3 million skilled workers to service automation technologies by 2020 (Huang 2018). In 2021, Ke and Li (2021) observed that only seven per cent or 48 million of the total employed population (170 million skilled workers) in China are highly skilled. Successful adoption of robots will require a greater number of high-skilled personnel. Technological upgrading itself, as Huang (2018, p.56) rightly puts it, "is not a linear and smooth process, but is subject to gaps and disruptions".

Despite the proliferation of robots, manufacturers have realised their limitations. Foxconn, for instance, has experienced frequent breakdowns and problems with their 'Foxbots' in their Kunshan plant, where the company culled 60,000 workers in 2016 (Huang 2018). An explanation for this is that robots have long been designed for heavy tasks, whereas these new manufacturing robots that deal with lighter tasks are a recent phenomenon (Lei 2021). The frequent updating of electronics products demands the robots that produce them to be constantly redesigned to keep up with the production trend (Lei 2021). This makes the process of robotisation complicated and costly. In an interview with Lei (2021), a manager from one of the many manufacturing firms that have ambitiously adopted robots laments that their "robots often break delicate and expensive components" and further states that, "from the process, I have realised that the human body is magic" (p.11). More importantly, electronic devices become increasingly delicate and require higher levels of precision and flexibility which humans are only capable of doing (Huang 2018). In addition, the rapid growth of robotic firms and the little evaluation made of them, have, in turn, undermined the quality of robots (Cheng et al. 2019; Lei 2021). In this case, humans are considered more versatile and economical than robots. Although robots have been drastically adopted in the 2010s, their take-up may slow down in the coming years due to the realisation of the limited capacity of robots and the lack of skilled workers available to service them. Consequently, as Lei (2021), Haung and Sharif (2017), and Cheng et al. (2019) learn that several manufacturers have relocated to Southeast Asia, where there is a younger and cheaper labour market.

SECTION 6 – POLICY RECOMMENDATIONS

By this point, the report has found that China has been achieving its policy goal of becoming a global manufacturing powerhouse by providing subsidies to non-state enterprises for their technological innovation as well as upgrading their manufacturing processes. China has become the worldwide leader in industrial robotics as robotic manufacturing has proliferated in the past decade. In 2020, its industrial robotic instalments levels accounted for 44 per cent of the global robotic instalments.

At a glance, automation is a great strategy to overcome the issue of increasing labour costs and, ostensibly, a diminishing working population. However, the rapid replacement of humans with robots has implications. These robots have limitations that have driven manufacturers to relocate to countries with a cheaper labour market. It is important to note that MiC 2025 has been dramatically embraced by CEOs of private enterprises who mainly have a strong connection to local government officials. This indicates the undemocratic nature of China's policymaking that favours a particular group of citizens. Consequently, large manufacturers such as JD.com and Foxconn have radically transformed their workforce, resulting in mass unemployment within a short period. This has dire outcomes such as increasing wealth inequality, social inequality, and job polarisation that policymakers need to address. In response to these issues, this report identifies three policy solutions for the consideration of the Chinese government and other invested stakeholders, as well as other emerging economies that seek to make the technological transition.

I. DEMOCRATISE POLICY MAKING

Firstly, it has become clear that MiC 2025 was motivated by rising labour costs and labour shortages. However, these ideas were predominantly voiced by a specific group of people. While employers receive government subsidies to replace their human workers with robots, displaced workers are not granted compensation. The reason for this is the absence of trade unions along with the Ministry of Labour and Social Security and the Ministry of Education in the policy decision-making. In turn, the issues of labour protection, unemployment, and social equality have been ignored. Ultimately, MiC 2025 was developed in the best interest of employers. Policymakers must involve a broader range of stakeholders in their consultation and create a system of public negotiation in their policymaking process.

II. A SHORTER WORKING WEEK WITHOUT A LOSS OF A FULL-LIVING WAGE

A shorter working without a loss of a full-living wage is considered a pragmatic policy solution to slow and smooth the transition to automation and ensure an equitable future of work. This is a policy strategy that can address the issues of unemployment, labour protection and the limits of industrial robots. Instead of drastically reducing the number of workers, companies should consider reducing their working week. Like Spain, the government could provide monetary and reconstructive support for the transition to a four-day workweek that benefits both the employers and employees (Kassam 2021). The positive outcome of a shorter working week has been praised by private companies such as Microsoft in Japan and Shopify in Canada, which have seen their productivity rates increase (Sng et al. 2021).

III. DEVELOP A LIFELONG LEARNING SYSTEM

One of the limitations of robotic adoption is the lack of a skilled labour force that can service them. The technological revolution requires an advanced level of competencies, yet only seven per cent of China's total employed population are highly skilled. This means policymakers must increase their investment in tertiary education. As identified in section 4.3, access to tertiary education is still limited and inaccessible for migrant workers, who make up almost 30 per cent of the manufacturing labour force. A lifelong learning system can be supported with an education subsidy scheme for employers and employees. In this way, employers are incentivised to educate their workers, while workers do not have to risk losing a full-living wage when enrolled in training.

APPENDIX

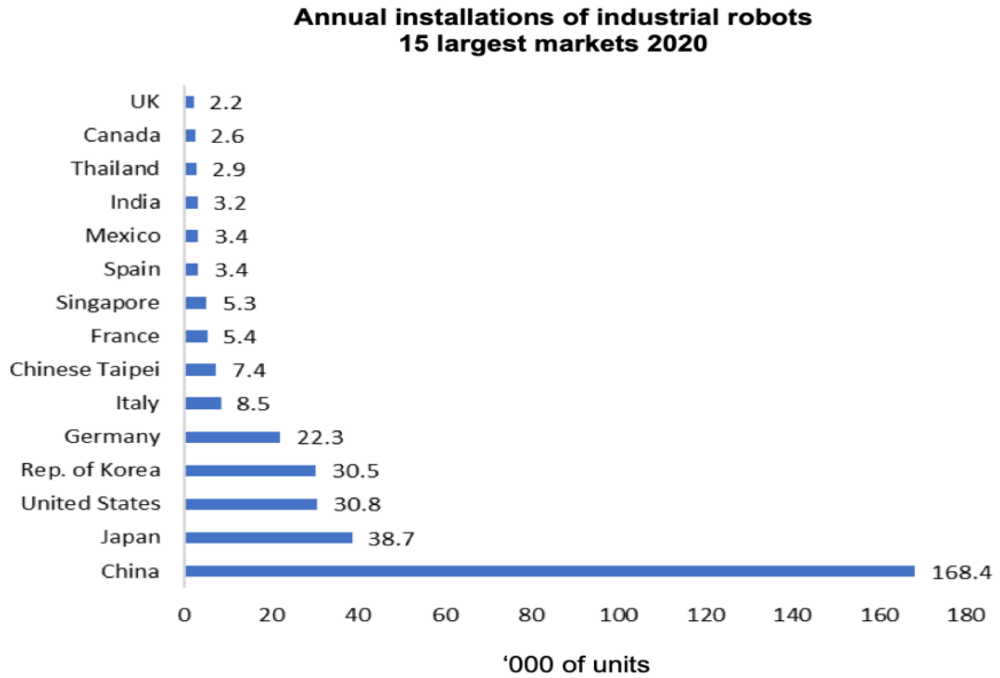

Figure 1: Annual installations of industrial robots

Source: International Federation of Robotics 2021

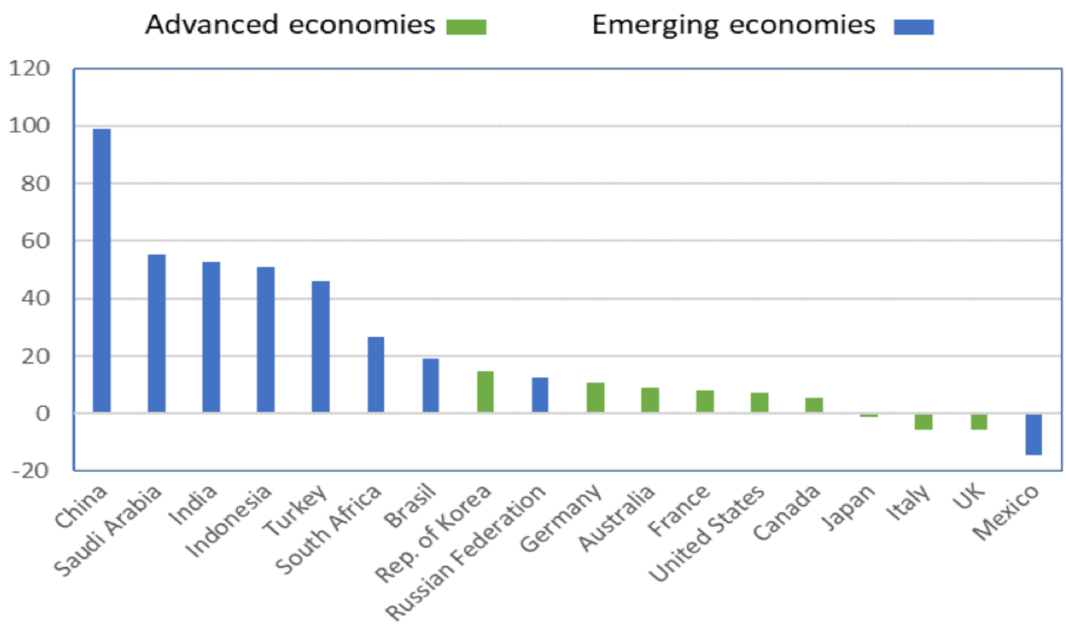

Figure 2: Cumulative real wage growth 2008 - 2017

Source: ILO Global Wage Report 2018/19

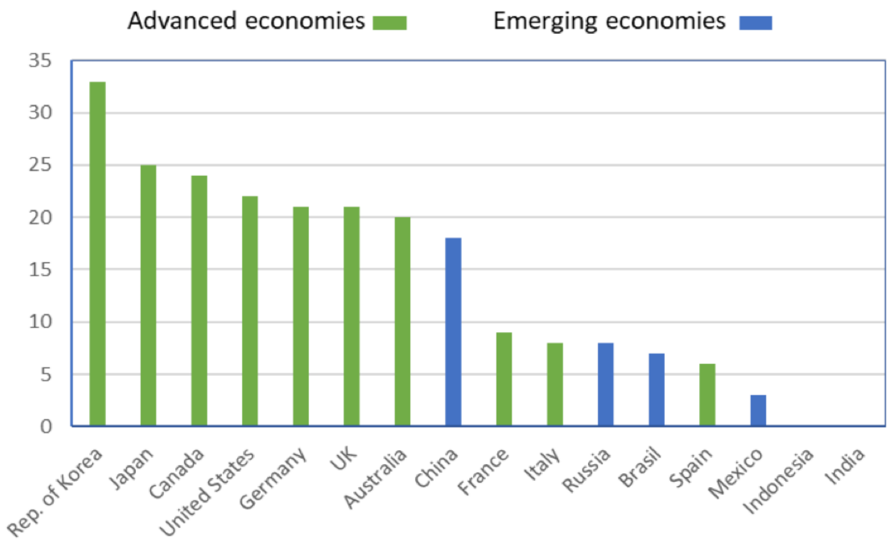

Figure 3: Labour-cost savings from adoption of advanced industrial robots (% 2025)
Source: The Boston Consulting Group (The Shifting Economics of Global Manufacturing: How a Take-off in Advanced Robotics Will Power the Next Productivity Surge, 2015).

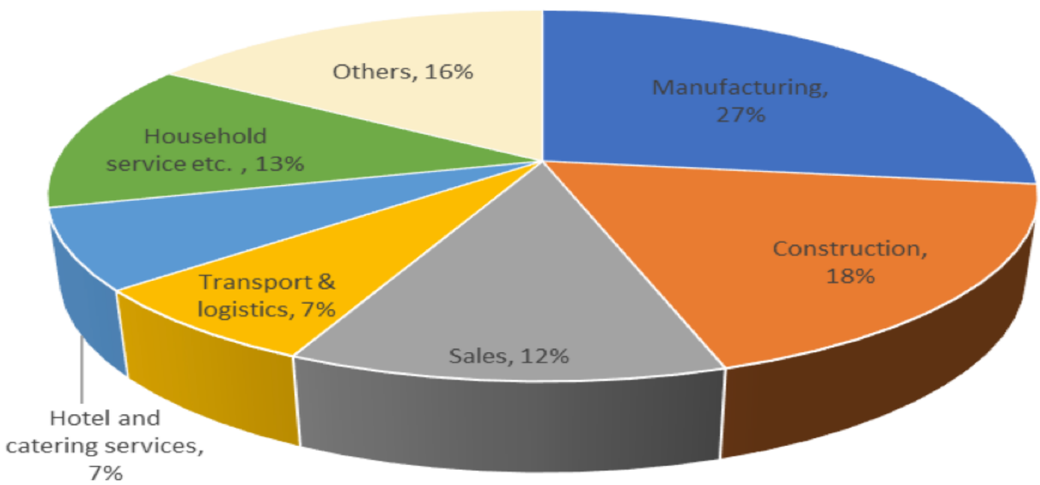

Figure 4: Employment of migrant workers by sector 2020
Source: China Labour Bulletin 2021

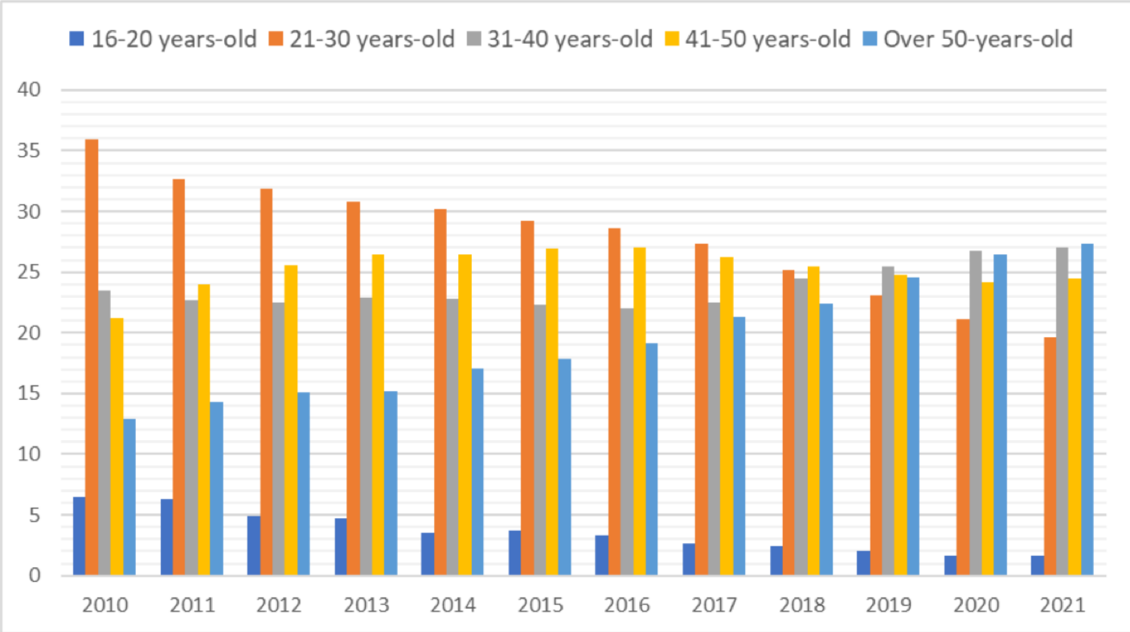

Figure 5: Age distribution of migrant workers 2010-2020 (%)

Source: China Labour Bulletin 2021

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