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In spite of the myth that China has a fundamentally unlimited pool of low-cost workers from the countryside, starting from the early 2000s, employers in certain areas of the country found themselves dealing with periodic shortages of labour—a phenomenon commonly known as a ‘labour famine’ (民工荒). The causes of such shortages include changes in the demographic structure of the Chinese population induced by the One-Child Policy, the higher educational levels achieved by Chinese workers in a market that still largely needs unskilled labour, the growing labour demand in less-developed areas that drained the workforce from more advanced regions, and the persistent precariousness of the migrant life. At the same time, increased labour activism was driving up wages. To address some of these issues, firms began to adopt technological upgrading. By 2013, China was already the world’s largest market for industrial robots. Two years later, in 2015, the central authorities released the ‘Made in China 2025’ plan, a three-step strategy aimed at moving China up the value chain by 2025 and making it a leading manufacturing power by 2035. This essay examines how this technological upgrading is affecting Chinese workers.

Replacing Humans with Machines

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In 2015, the inauguration of a ‘workerless factory’ in Dongguan made headlines in China’s major newspapers.¹ On the shopfloor of a mobile phone module manufacturer, conveyor belts were staffed not by dispirited and sweating workers, but by robots executing repetitive pre-programmed tasks. This ‘futuristic’ scenario made the firm eligible for subsidies offered by the local government’s ‘Replacing Humans with Machines’ (机器换人) policy.

In the mid 2010s, amid growing concerns about shortages of migrant workers and labour unrest, governments in various industrial cities in China issued policy incentives similar to Dongguan’s efforts to push manufacturers to upgrade their technology.² China became the largest market for industrial robots in 2013, but the pace of robotisation further accelerated in 2015 after the central government launched the ‘Made in China 2025’ (MiC 2025) plan—an initiative that aimed to promote automated manufacturing as a means of moving Chinese industry up the global value chain. By 2019, 140,500 new robots were sold nationwide—a twofold increase from five years earlier.³

How technological upgrading affects workers, however, remains a controversial issue, as testified by the decades-long debate about whether automation technologies are labour-substituting or labour-augmenting.⁴ The Chinese case has captured global attention not only because of the potential risks imposed on such a huge workforce, but also due to a surging wave of labour activism happening alongside the robotisation process.⁵ Will Chinese workers fight for a proper share of the ‘robot dividend’? How will China’s trajectory of technological upgrading differ from that of the Global North? The purpose of this essay is to analyse the impact of industrial automation on Chinese workers. Based on both my own field research and a review of recent studies, this essay will develop a discussion in two parts: first, it will gauge the impact of industrial automation on employment and labour skills; second, it will assess workers’ reactions to the new technologies.

The Impact of Automation on Employment

Although Chinese firms have been engaging in technological upgrading for only a few years, the labour-substituting effect has been quite alarming. My own research in four factories in Dongguan identifies a dramatic reduction in the labour force, ranging between 67 and 85 percent per production line.⁶ Dongguan official data show that, by early 2017, about 200,000 workers had been made redundant by the 2,698 awarded upgrading programs, translating to a replacement rate of seventy-four workers per program.⁷ A recent study of 299 manufacturing firms that adopted technological upgrading in Guangdong Province showed each firm fired an average of ninety-six employees, accounting for 9.58 percent of the total workforce.⁸ On the shopfloor, about 80 percent of positions could easily be replaced with machines.

However, so far, we have not witnessed a large number of the workers made redundant by technological upgrading being thrown onto the streets. There are several reasons. First, firms upgraded their equipment gradually rather than resorting to wholesale shifts to new automated lines. Such incremental arrangements gave companies time to adjust workers' positions and limit new recruitment.⁹ Second, taking advantage of migrant workers' high turnover rate and specific wage structure, most employers did not have to actively dismiss workers, but used other tactics to force workers to quit on their own initiative. For instance, in the case of Dongguan, overtime pay usually accounts for about two-thirds of a worker's average monthly income. An employer who wants to make workers redundant need only reduce their overtime tasks to push them to resign, with the additional advantage for the company of not having to pay otherwise mandatory severance pay. Third, a few firms were able to absorb the surplus labour by expanding their production lines; however, that is contingent on the firm's position in the value chain as well as its broader market status. For instance, in the automotive industry, carmakers who reap the lion's share of profits may be more able to boost production than lower-tier suppliers. However, since 2017, in the face of a massive decline in growth and mounting overcapacity, workers' employment security has started to come under threat even in the Chinese car industry.

Impact on Workers' Skills

The impact of automation on workers' skills is equally controversial. Since Harry Braverman inaugurated the de-skilling thesis in the 1970s, many of his followers have demonstrated how the introduction of automated technologies facilitates the separation of 'concept' and 'execution', forcing machinists to change from being craft workers to operators who are deprived of any planning responsibility.¹⁰ In contrast, the 'high skills' hypothesis argued that computerisation would augment workers' intellectual skills, such as responsibility, socialisation, and responsiveness to fast-changing situations.¹¹ Later, both these arguments were criticised for their technological determinism.¹² William Form proposes that skill changes depend on the 'type of technology, industrial organization, product and labor markets, labor union strength, business power, and many other factors.'¹³ Therefore, the introduction of advanced machines alone does not automatically raise labour skills; the provision of training remains essential.¹⁴

In the case of China, researchers have revealed the difficulties operators have to confront to improve workers' skills. Deng and Xu have argued that, contrary to the conventional belief that automated machines alleviate manual drudgery and therefore facilitate women's upskilling and empowerment, women workers are offered much less inhouse training than their male counterparts because most employers uphold an ideology of gender stereotyping that considers women to be 'fearful of machines' or deficient in logical thinking.¹⁵ Yong has shown that, in the firms that adopt automation, managerial personnel and technical engineers receive more training than operators: thirty-two and twenty-six days, respectively, for managers and technicians, versus nine days for workers.¹⁶

Similar to Braverman's observation, the process of de-skilling is quite prominent among skilled craftspeople in China. Autor, Levy and Murane have demonstrated that automation substitutes routine tasks that can be accomplished by following explicit rules while complementing workers in solving nonroutine problems.¹⁷ My research has discovered that skilled craftspeople are often the main target for job replacement due to their high wages and enhanced bargaining power. For example, in Dongguan,

a veteran carpenter earns between 6,000 and 8,000 yuan per month, while a proficient helmet shell cutter makes 5,000 yuan per month—much higher than the local average of 3,489 yuan in 2015. In the automotive industry, multiskill work (多能工) systems and job rotation have helped workers develop comprehensive skills that make them difficult to replace. However, after technological upgrading, although most of these versatile workers can keep their positions, as automation largely simplifies work, they have become less valuable to employers.¹⁸

The MiC 2025 initiative has laid out how China should transform from a manufacturer known for its quantity to one renowned for quality through the development of ‘Four Base’ (四基) sectors: core infrastructure components, advanced basic technology, core basic materials, and industrial infrastructure technology. Such a transition requires not only the engagement of research and development engineers, but also, more importantly, skilled workers who possess factory processing experience. This is because the complexity of the material world rejects any simple codification, requiring instead the participation of highly motivated, experienced workers.¹⁹

However, considering that China’s past development path has hinged on labour-intensive production and low-skill manual work, many manufacturers are either slow or reluctant to take up labour retraining. Among the eight manufacturers I studied in Dongguan, only one invested in training workers, and this was because the company engages in high-precision metalwork that requires substantial levels of skill in the production process. Mr Zhou, the owner of a firm that produces high-end parts for optical-fibre communication equipment, chose to automate to achieve *quality* improvement, not just larger output. Building on his previous experience working in a state-owned enterprise, he set up an inhouse apprenticeship program to train skilled workers who, after training, could handle tasks such as changing fixtures and jigs, adjusting computer numerical control machines and, eventually, participate in designing the production process.²⁰ He understood that, while technology was important, the true value of the machines could be harnessed only if the technology was combined with the relevant and appropriate human-embedded skills. In his words: ‘Machinery is something everybody can buy, but a good production process [工艺流程] needs to be designed. One component is hardware and the other is *software*.’ As a

small and medium-sized enterprise, the case of Mr Zhou's company is quite exceptional. Given the high turnover rate, very few employers in Dongguan are willing to invest in workers' training.

Workers' Reactions to Technological Upgrading

The above discussion shows how industrial automation leads to a trend of labour substitution and de-skilling. But how have workers reacted to the introduction of advanced machines? Recent research has revealed that most frontline operators maintain an indifferent or even welcoming attitude towards automation. According to a survey conducted by Yang and Luo among car suppliers in the Pearl River Delta in 2017, almost 75 percent of frontline production workers believed it was rational for their enterprises to automate, with only about 20 percent disagreeing.²¹ Another survey, conducted among workers employed in the manufacturing industry in nineteen cities in Guangdong Province, indicates that more than half of the informants considered themselves replaceable with automation in the next five to ten years.²² However, only about 28 percent worried about unemployment, while 62 percent thought it would be easy to find a new job.

Most workers I interviewed internalised the mainstream discourse on automation as social and economic advancement, thus viewing technological upgrading as inevitable progress. Mr Gang, a migrant worker from Henan Province employed in an electronics factory in Dongguan, whom I interviewed, highlighted the advantages of automation in these terms:

I used to be a farmer. Initially farming was manual work. The crops 100 farmers grew were not enough to feed 100 people. Now [with machines], two farmers can feed 100 people. With automation, fewer workers will be needed as per capita productivity increases.

In the aftermath of a spate of suicides at Foxconn in 2010, the owner, Terry Gou, announced he would introduce one million robots to replace workers (see Jenny Chan's essay in the present volume).²³ My colleagues and I interviewed some workers still employed by the firm in 2018 and were surprised to find they were indifferent to these developments, as exemplified by the following exchange:

Q: Do you feel worried about being replaced with robots?

A: Not quite. To be frank, nobody has forged a strong sense of belonging to the factory. We don't feel at home here. [If I am dismissed,] I can just go to other places.

In comparison, skilled workers, who are more affected by automation and also encounter greater difficulties finding another job given their seniority, tend to show their anxiety. For example, a senior worker in a factory that manufactured bicycle helmets worried about job displacement as robotisation shortened the training period for learning how to cut venting holes from six months to only three days. Several firms changed their payment system from piece rates to time rates as the pace of work became dependent less on a labourer's skills and motivation, and more on the cycle time preset in the machine. One worker in an electronics factory whom I interviewed lamented: 'Previously human beings controlled the machine. We could work according to our own pace. Afterwards, machines control humans.' This means workers not only fail to assert their agency through the 'making out' game described by Michael Burawoy as a form of competitive game workers play in piece-rate labour regimes, but also find it difficult even to passively slow the pace of work.²⁴

Still while quite a few skilled workers voiced their discontent with automation, very few were actually taking action to defend their rights. In this essay, I will discuss the only two cases of collective action that veteran workers undertook over technological upgrading. These cases reveal the barriers these workers encountered in technological decision-making.

Case One

This first case took place in Factory D, a furniture company in Dongguan, where some veteran workers organised a work stoppage to express their anger over automation. Before 2008, the factory produced conventional doors; however, as the Global Financial Crisis hit the domestic real estate market, the boss decided to shift to the production of high-end fireproof doors. The firm then had to accelerate the process of automation as it turned out the special doors needed to be laminated with asbestos—a cancer-causing substance.

In 2011, the factory owner introduced a semiautomatic veneer pressing machine that could accomplish a series of tasks from glue application to

pressing the asbestos together. Before automation, veteran workers in the veneer pressing unit were paid at a piece rate, earning about 6,000 yuan per month. In the first month after automation, increased productivity helped boost workers' salary to more than 8,000 yuan. The owner quickly began recruiting younger workers, who were paid only 3,000 yuan per month. The head of the pressing unit became angry because his unit was composed mostly of workers who had been at the plant for more than four years and even a few who had joined the factory at its inception in 2002. After a quick discussion with his fellow workers, the unit head decided to call a strike early one morning. He successfully used his authority to gain the support not only of veteran workers, but also of newly recruited younger ones. They halted production for about two hours before the owner came to yell at them: 'Do you still want to work here or not? If you choose to quit today, I will settle your wages.' The veteran workers suddenly realised they were no longer the backbone of the factory and their skills no longer granted them strong bargaining power. Aged in their forties, most feared that, if they were fired, they would have great difficulty finding another job and therefore quickly returned to their positions. Each striking worker was fined 100 yuan as punishment. After the strike, the owner accelerated the automation process to cover operations of painting and cutting. Later, in their bimonthly assembly, the owner scolded the workers: 'You are just a speck. The factory won't stop without you.'

China's Trade Union Law mandates that twenty-five or more employees must be allowed to form an enterprise trade union as a branch of the umbrella national organisation, the All-China Federation of Trade Unions. However, as a domestic private firm, Factory D did not have a trade union. Therefore, workers had to resort to a wildcat strike to assert their demands. In contrast, workers in the second case study, Factory T, an auto parts supplier with Japanese investment, were able to turn to the trade union as the channel for bargaining.

Case Two

Located in Guangzhou, Factory T manufactures metal frames for car seats for a Japanese auto brand. Due to the increasing wages of welders, in 2011–12, the factory began to introduce welding robots. Since the firm has an enterprise trade union that represents workers to collectively bargain for wage increases every year, a welder with ten years of seniority will make an income double that of a novice.

After robotisation, the management began to request welders be demoted to operators, which meant the 350-yuan subsidy for welding skills would be terminated. As this subsidy was added to the basic income, overtime pay and other benefits would be reduced accordingly. However, as the firm had a collective bargaining system, all important policies had to be passed with workers' consent and many welders refused to sign on to the new policy. After more than a year of back-and-forth negotiation between the trade union and the management, a compromise was reached in which manual welders who performed tasks that robots failed to do would receive a reduced subsidy of 250–300 yuan, but welders-turned-operators would still be offered a low subsidy of 120 yuan.

Workers found it hard to interpret this outcome as a 'victory' for their side because they had already seen the workforce in the factory shrink from 1,000 to 700 in the previous few years. Moreover, the new recruits largely had precarious tenure, including agency workers, temporary workers, and student interns. The firm had already asked some senior workers to quit, promising a severance fee of $n+1$ months' salary (with 'n' being the number of years of employment). However, most workers rejected this offer as they knew that, with their open-term contract, they were eligible to receive $2 \times n$ months' wages.

Mastering the Machines

From the 1960s to the 1980s, under strong union activism and welfare state labour protection, industrial upgrading in the United States and Japan brought the 'beneficial' effect of increased wages, although the negative consequences of worker de-skilling and union weakening should not be overlooked.²⁵ In contrast, when the robotic revolution took off in China after the 2008 financial crisis, migrant workers, who had contributed a 'labour dividend' to the national economy in the previous decades, suddenly realised they were doomed to be replaced with robots.

While most frontline operators considered industrial automation to be an inevitable trend, some veteran workers began to question the legitimacy of using machines to replace and degrade labour. However, despite the surge in strikes since the early 2010s (see Chan and Hui's essay in the present volume), we have not seen many reported strikes in which workers demanded a fair share of the 'robot dividend'. The two cases involving workers' collective action described in this essay prove that these activities were at best 'defensive' rather than 'proactive', as workers

only demanded the maintenance of current levels of benefits rather than a reasonable share of the surpluses gained through automation.²⁶ Recent research has confirmed that for some firms that adopted robots, wage increases have lagged far behind the growth in productivity, while in other firms, wages remained stagnant or were even slashed.²⁷

Responding to the question of why the government subsidised only the firms that upgraded and not the displaced workers, an official from Dongguan's government told me: 'Now people petition the State Bureau for Letters and Visits to complain about wage arrears and runaway bosses. I haven't heard any case of a petition due to replacement by machines.' His words were revealing, suggesting that fighting for 'robot dividends' had rarely entered into workers' agendas. In most firms, workers have not engaged in the decision-making processes on automation in any form.²⁸ Even for those firms that have collective bargaining in place, automation is a topic seldom touched on. One union chair at a leading auto supplier even claimed: 'If our company has 1,500 employees instead of 2,000, but profitability remains at 10%, each employee would receive more pay and benefits.'²⁹ The trade union's focus on immediate economic gains rather than workers' long-term power epitomises the sense of economism that Braverman criticised.

While industrial automation seems new to China, early in the nineteenth century, Marx pointed out that technological upgrading under capitalism meant the exploitation of 'dead labour'—that is, work ossified in the form of a machine—over human workers. However, affected by the mainstream ideology of technological determinism, Chinese workers were slow to see through the meaning behind projects of 'replacing humans with machines.' Only when workers understand the nature of 'dead labour' can they truly become masters of machines.