Platform Capitalism "Made in China"? Intelligent Manufacturing and the Restructuring of Work

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Paper submitted for international workshop
"Technological Innovations and Social Change: The History of Automation and the Future of Work in East Asia, 1960s-2010s"
Hong Kong University of Science and Technology
May 11 2018

First draft! Please do not cite, quote or circulate!

With the demise of neo-liberalism in the wake of the world financial and economic crisis 2008-09, the revival of manufacturing and the protection of manufacturing jobs has figured prominently on the political agenda of the U.S. and other industrialized countries. Whereas protectionist rhetoric has become dominant over the neo-liberal free-market discourse, China has developed a master plan to transform its vast manufacturing base from low-cost export production to highly automated advanced manufacturing. Massive industrial modernization shall put China on equal footing with leading economies and promote global production networks under Chinese leadership.

The strategy has been outlined in a comprehensive government document under the title "Made in China 2025" (MiC 2025) and the related plan to develop advanced digital communications, called "Internet plus", in 2015. At its center is the promotion of ten emerging industrial sectors, namely new energy, robotics and advanced information technologies, in which China has strong competitive potentials. The strategy picks up important lessons from China's recent success stories in more traditional industries such as high-speed railways or home appliances, as well as in emerging sectors such as solar energy, wind turbines, or

smartphones.

MiC 2025 has raised new concerns about China's quest for global supremacy and technological protectionism. The Trump administration has made this program the key target of its "trade wars", Secretary of Commerce Wilbur Ross called it "a threat to American genius". [1]

However, a closer look at the socio-economic conditions of manufacturing modernization suggests more sober perspectives. Instead of leaping into the brave new world of digital manufacturing, the refurbishing of low-cost mass production for low- to mid-end markets with advanced information technologies seems to be the dominant scenario in China. As we will explain, the conditions of a middle-income society with relatively low wages for large parts of the industrial workforce shape China's trajectory of manufacturing innovation. Artificial intelligence, Big Data and China's vast e-commerce platforms, have recently been hailed as the main drivers of China's manufacturing innovation. Platform capitalism seems to promise a quick fix for China's continued weakness in quality manufacturing.

The transformation of work, labor markets and industrial relations, however, has been largely omitted from the strategies and political decisions under MiC 2025. This reflects the ongoing social asymmetries in China's socio-economic rebalancing[2] and appears as a major obstacle to sustainable manufacturing innovation. If policy makers fail to address the issue of workforce development, labor-market adjustment and the related institutional changes in industrial relations, China's economy will likely remain stuck in what is called the middle-income trap.

This article will try to shed some light on this neglected connection. We will trace basic contours of the "digital revolution" in manufacturing and explain the political and economic conditions of its implementation in China. From this context, we will look at some core projects of manufacturing automation under MiC 2025 and the related strategies to "replace humans by robots", and relate this to China's recent push to develop the "industrial internet". In the conclusion, we will discuss the importance of decent work in the age of digital manufacturing and spell out policy implications for current discussions on trade and manufacturing jobs.

The "4th Industrial revolution"?

Today's discussions about the future of manufacturing are awash with visions of revolutionary change. Digital technologies would create a world of smart factories that are seamlessly interconnected with consumers and suppliers around the world. Consumers could create or design products to their tastes. Intelligent robots would work along with human workers at the shop floor to mass-produce

[1] Financial Times, September 27, 2017

[2] See Boy Luethje and Christopher A. McNally, "China's Hidden Obstacles to Socio-Economic Rebalancing", *Asia Pacific Issues. Analysis from the East-West Center,* No. 120, October 2015.

quality goods at incredible speed and varieties. Factories would be integrated into the platforms for new generations of products and sharing of services and resources, driven by artificial intelligence, cloud computing and big data applications.

This brave new world has been described with concepts such as digital manufacturing, Internet of Things (IoT) or Industry 4.0. The latter is seen as the most advanced vision of manufacturing automation, created and proposed by the machinery-making industry and the government of Germany.

Industry 4.0 describes the digitalisation of manufacturing as the "fourth industrial revolution" after the advent of the steam engine in the early 19th century, the combustion engine and electricity around 1900, and information technology in the 1950s. Production would no longer be performed by machines and assembly lines, rather than "cyber-physical systems", as presented in an increasing number of experimental factories around the world[3].

German sports shoe maker Adidas, for example, runs a model plant which receives data of individual customers' shoe size and foot anatomy from 3D scanners in sales outlets. Highly flexible production equipment can produce the shoes according to the customer's order and deliver them in record time. In aircraft manufacturing, world leaders Boeing and Airbus make rotor blades for jet engines by a new technology called 3D printing. The physical part is created directly from the digital blue print, eliminating all mechanical work and process control. In China, home appliance makers Haier and Midea let customers design refrigerators or air conditioners according to their specifications on fancy websites. The products are delivered from "Internet factories" with highly developed capabilities of customer-specific manufacturing and ordering of supply parts.

Promises and concerns

Whether these new technologies will really spearhead a comprehensive industrial revolution remains to be seen. The different concepts describe diverging strategies and pathways by governments and industry in the respective countries. Yet, a globally dominant paradigm has not emerged.

For the moment, it seems most appropriate to define digital manufacturing as an emerging socio-technical paradigm of production. One can compare it to Henry Ford's system of mass production in the 1920s or the Japanese system of Lean Production in the late 1980s, which at their time became best-practice models propagated by business and engineering schools. Such a paradigm develops through different economic and social conditions in manufacturing regions around the world, and is shaped by the political power relations in the respective

[3] Acatech - National Academy of Science and Engineering, *Securing the Future of German Manufacturing Industry. Recommendations for Implementing the Strategic Initiative Industrie 4.0.* Sponsored by the Federal Ministry of Education and Research. Berlin, 2013.

countries .[4]

The promises are huge, and so are the concerns.

Concern no. 1 is the fear of massive job losses. Popular literature on the "new machine age"[5] predicts a new round of jobless growth and massive attacks on middle-class jobs, blue-collar as well as white-collar. Such concerns have also emerged in developing countries that form the main manufacturing centres for global production networks. For South East Asia the potential of job reductions in export manufacturing industries has been estimated as high as 45% (Thailand) to 70% (Vietnam), according to a recent study by the ILO[6].

Concern no. 2 is the impact on production systems and value chains. Some studies promise a partial return of manufacturing to industrialized countries, since digital production drastically reduces wage costs and favours proximity to end-user markets. At the same time, the "middle men" in global production networks, such as the big Hong Kong trading houses that coordinate suppliers for global brands and retailers, may be eliminated, as e-commerce giants like Amazon or Ali Baba connect small and large producers directly to the consumer. However, this may also reinforce the control over suppliers by brand-name and e-commerce firms, resulting in even more competition between manufacturers and workers at the low-end of global supply chains.

A key question, therefore, is whether digital manufacturing will go along with be restructuring of global and regional value chains that allow manufacturing innovation in economically, socially and ecologically sustainable ways. The conditions of this process will decide about the impact of the new socio-technological paradigm on economic growth, labor markets and work.

Made in China 2025

A historically new element in the impeding transformation of manufacturing is in the role of emerging economies. In the wake of globalisation, China, Southeast Asia and and similar economies have become global hubs for low- to medium-cost manufacturing. For the first time in the history of modern capitalism, developing economies take part and shape an emerging paradigm of manufacturing.

This shift is exacerbated by the continuing problems of finance-driven capitalism

[4] Florian Butollo and Boy Luethje, ""Made in China 2025": Intelligent Manufacturing and Work",Kendra Briken, Shiona Chillas, Martin Krzywdzinski, Abigail Marks (eds.): *The new digital workplace. How new technologies revolutionise work (*London: Palgrave McMillan, 2017).

[5] Brjynjolfsson, Erik, and Andrew McAfee: *The Second Machine Age. Work, Progress, and Prosperity in a Time of Brillant Technologies* (New York: Norton, 2017)

[6] ILO study SE Asia

in advanced economies, which has resulted in a serious lack of investment in manufacturing and of industrial policies in developed countries. In Germany, for instance, government investment into new manufacturing infrastructures has been strikingly low, not more than 200 million euros since the inception of Industry 4.0 in 2012.

"Made in China 2025", therefore, appears to be the most ambitious and comprehensive project in the global arena to develop intelligent manufacturing. The program is a coordinated effort between government at all levels, research institutions and industry to create an advanced industrial base in ten key emerging industries. It is a centerpiece of China's strategy of "innovation-driven development" that has been promoted since 2013 to accelerate the economic rebalancing from export-led to domestic-market-based growth[7].

MiC 2025 assembles a broad spectrum of industrial actors. The concept does not bet on creating national champions from restructured state-owned enterprises - a strategy that had failed in industries such as automotive, telecommunications equipment and others. It gives a strong role to China's new rising multinationals in mid- and high-technologies such as solar systems, wind turbines, LED, household appliances or, most prominently, in telecommunications and advanced internet services. MiC 2025, therefore, reflects the increased importance of large non-state-owned enterprises, such as Huawei, Haier or BYD, as drivers of innovation and marks a substantial change in economic power relations in China.

Germany's Industry 4.0 strategy serves as the main reference point and model. However, MiC 2025 is not merely a program to promote robots and factory automation. It rather aims at the development of entire new industrial sectors and thereby reflects a strong orientation on value chains. As president Xi Jinping has made clear in several speeches, the ultimate goal is to build global production networks under Chinese leadership[8].

However, the strategy has its weaknesses.

On the one hand, it lacks vertical integration. As many other technology programs of the Chinese government, MiC 2025 is driven from the top, but bottom-up dynamics remain weak. The main problem here is not a lack of market orientation and a focus on state-owned enterprises. Rather, the coordination between industrial policies at central and local levels is highly deficient. Local governments play a key role in financing much of the program, mainly by providing infrastructure and subsidies for land, infrastructure or research and training facilities. But there is hardly any coordination of the development of value chains within and between the emerging new industrial clusters.

[7] Luethje and McNally ibid.

[8] Xi Jinping (2016), *Zai sheng bu ji zhuyao lingdao ganbu xuexi guanche dang de shiba jie wu zhongquanhui jingshen zhuanti yantao banshang de jianghua* (Speech at leading provincial cadres studies meeting to promote the spirit of the 5th central committee meeting of the 18th party congress). Beijing: Xinhua.

On the other hand, MiC 2025 lacks horizontal integration with broader topics of social, labor, urban and environmental politics. Most strikingly, the Ministry of Labor and Social Security, the Ministry of Education, the All China Federation of Trade Unions, other mass organizations, and the related experts have been mostly absent from the drafting and the execution of the program. The key question of training, workforce development and the related changes in labor, social security and other relevant laws has not been addressed and is institutionally excluded. Vocational training can be identified as the main problem here, since conditions in China's technical colleges are notoriously poor and skill standards weak.

In this perspective, MiC 2025 reflects the diverging, often contradicting dynamics between top-down and bottom-up policies, which have been described as typical for China's emerging capitalism and its regulation[9]. Provincial and local governments provide a large proportion of the resources, but have to compete for research projects and recognition from central government authorities at the same time. Strategic goals are translated into quantitative targets under the five-year plan, which are often unrealistic and difficult to meet. Over expansion and wasteful competition are the consequence. China now has more than 40 industrial parks specialised in production of industrial robots and almost nearly 2000 suppliers of robotics and components, but only few of them are competitive.[10]

Catching up or forging ahead? Automation at the shop-floor[11]

How does China's push for digital manufacturing play out at the shop floor? The present picture is highly differentiated among industries and companies at various levels of value chains. These differences reflect the segmented nature of industrial upgrading and innovation, which is characteristic for China's emerging variety of capitalism. The pathways of manufacturing innovation are essentially shaped by the different regimes of production at company level, including work organization, workforce recruitment and labor relations. One key line of division is in the use of low-wage labor of mostly rural origin.[12]

Large state-owned enterprises and joint ventures often already have highly automated manufacturing operations. Most car factories in China, for example, feature state-of-the art production technologies and work schemes that were imported with the booming of the auto industry during the last decade. Workers in core factories are relatively well paid and trained, but work pressure has often

[9] Christopher A. McNally, "Refurbishing State Capitalism: A Policy Analysis of Efforts to Rebalance China's Political Economy", *Journal of Current Chinese Affairs*, No.4 (December 2013): 45-71.

[10] Mercator Institute for China Studies, *Made in China 2025. The making of a high-tech superpower and its consequences for industrial countries.* MERICS Papers on China, No. 2, Berlin, 2016

[11] The following summarizes results from our ongoing field study program under the Volkswagen Endowed Chair Industrial Relations and Social Development at Sun Yat-sen University. To date, roughly thirty field studies have been conducted, most of them in the Pearl-River Delta. For a systematic explanation see Butollo/Luethje 2017

[12] Boy Luethje, Siqi Luo and Zhang Hao, *Beyond the Iron Rice Bowl - Regimes of Production and Industrial Relations in China*, Frankfurt/New York, Campus, 2013.

become intense and auto makers heavily use temporary workers to keep wage costs down. Given the high level of automation, there is not much incentive to introduce new models of digital manufacturing and innovation in production and supply chains.

L*arge, mostly private-owned brand-name firms and multinationals* have successfully grown with product innovations adaptive to the domestic market. But their manufacturing has been relatively simple and labor-intensive, employing large numbers of low-paid migrant workers. Among these firms incentives to modernise manufacturing and supply chains are high, a number of them have developed national pilot factories for digital manufacturing under MiC 2025. Some companies have also been involved in high-profile acquisitions of foreign technology companies, such as Midea's takeover of the German robotics firm Kuka.

Among the vast *labor-intensive assembly industries* - still the backbone of China's exporting economy - incentives for manufacturing modernisation mainly result from rising minimum wages, regional labor shortages and increased quality demands from customers. Many small and medium-sized firms have started to employ digital automation equipment and simple, relatively cheap robots, mostly provided by Chinese equipment makers and heavily subsidised by local governments. Such companies typically work at the bottom of supply chains for global or Chinese brand-name firms and need quick return on investment under continuing price pressures.

Against this background, much of the recent automation activities in China's factories can be characterized as "catching up" with international standards of manufacturing organization, rather than "forging ahead". There has been a surge in computerized manufacturing data control systems, but this kind of digitalization remains far from intelligent manufacturing based on flexible robots, artificial intelligence and big data networks. Most automation technologies are at the stage of "industry 2.0 or 3.0, but not 4.0", as Midea-CEO Fang Hongbo explained in recent media interviews.[13]

The rapid development of data network technologies so far has not lead to significant changes in production networks that would allow suppliers to climb the value chain. In the auto industry, high-tech manufacturing in the core plants and among global first-tier suppliers goes along with heavily labor-intensive manufacturing of wheels, spark plugs and car electronics. In PCs and smartphones, China's top brands such as Huawei or Lenovo mostly rely on the same type of subcontracted manufacturing as their role models from Silicon Valley like Apple or Cisco. Large-scale contract manufacturers like Foxconn with their notorious labor practices continue to dominate China's production in IT.

[13] *Handelsblatt*, July 7/8/9, 2017, p. 13

"Platform Capitalism" with Chinese characteristics?

The dominance of existing models of globalised mass production recently has been challenged by China's giant Internet companies. Ali Baba in particular promotes concepts of customer-driven manufacturing (C2B) with individualized orders or mass customization derived from customer ratings in its huge databases[14]. The future integration of manufacturing into e-commerce would push innovation and break the dominance of global retailers, such as Wal-Mart, and their middlemen and create huge opportunities for small and medium enterprises, hailed as the Chinese version of "industry 4.0"[15].

The focus of public policy discussions in China has recently shifted from visions of the digital factory without workers to the development of critical infrastructure and advanced data networks and platforms, i.e. artificial intelligence, cloud computing and the "industrial internet". Government documents and some highly publicized government-industry conferences in 2017 illustrate this direction and give prominence to China's internet giants BAT as promoters of intelligent manufacturing. A national conference in Guiyang, the capital of rural Guizhou province (now the largest location for data server farms in China), featured the CEOs of Ali Baba and Foxconn as champions for the national drive into cloud computing and big data. Several government documents were released on that occasion[16].

In the wake of the 19th Party congress a host of new plans by provincial governments to accelerate cloud computing in manufacturing was released. Guangdong province with its 20 million manufacturing workers is planning to bring 200.000 enterprises into cloud-based manufacturing platforms within 2018-2020.[17] In December 2017, Ali Baba announced to establish its industrial internet research center with more than 1.000 software developers in Guangzhou. Various local governments, such as Foshan Nanhai, have set up IoT-platform development centers. [18]

China's accelerated efforts in this field are part of a massive global rush to develop data platforms for manufacturing, mostly known as "industrial internet" or "internet of things". Those are basically operating systems for industrial equipment with apps to connect machines, data centers and control devices in factories, shipyards or construction sites, similar to Android, Apple IoS or other platforms for consumer smartphones. They are promoted by major providers of advanced manufacturing equipment, such as Siemens with its "Mindsphere" plat-

[14] Tu Zipei (2017): "Jiqi huanren" bu dengyu "zhineng zhizao", *Nanfang Zhoumo* ("Robot replaces men" does not equal "intelligent manufacturing". *Southern Weekly),* October 13, 2016, p. C24.
[15] Ali Research (Ali Baba Yanjiuyuan), *Xin jingji jueji. Ali Baba san wan yi de shangye luoqi,* (The New Economy Rising. The Business Logic of Ali Baba's Three Trillion). Beijing, China Machine Press. 2016.
[16] *China Daily*, June 2, 2017
[17] Guangdong Sheng Zhengfu (Government of Guangdong Province): Guanyu yinfa Guangdong Sheng shenhua "Hulian Wang+Xianjin Zhizaoye" fazhan (About the promotion and deepening of the "Internet+Advanced Manufacturing" project). Guangdong sheng zhengfu wenjian (Guangdong Provincial Government Document) No. 23, 2018. www.gd.gov.cn
[18] Nanfang Ribao, 2017-11-22.

form, General Electric (Predix), or Bosch (IoT Suite), software makers such as Microsoft or SAP, and Internet firms like Amazon or Ali Baba. In China currently about 25 such platforms are under development, major players are Ali Baba, Tencent, Huawei, but also large industrial firms such as Sany, Haier and Foxconn.

Cloud computing and IIoT platforms have the potential to promote entirely new business models in the organization of manufacturing and value chains. "Platform capitalism"[19] is being promoted as a mode of profit generation in manufacturing. Similar to cloud services (such as Amazon Webservices) or car rental platforms (such as Uber or Didi), manufacturing control systems, supply chain management and advanced industrial equipment can be used and configured as "shared service"; and different users can interact to create new products, applications and production networks. The larger the number of users the more useful the service becomes, and the higher the profit potentials for the platform provider. As in other sectors of the "sharing economy', platforms are disseminated through low entry costs and easy access for users, subsidized from other profitable businesses or large-scale speculative capital investment. Consequently, industry experts expect that only a small number of industrial internet platforms will survive and dominate[20].

It can be expected that China's large internet firms, especially those with a background in e-commerce and logistics, have huge advantages in the development of such digital manufacturing platforms. Existing clusters of e-commerce-oriented manufacturing, such as Ali Baba's Taobao Villages, provide a favorable basis to position e-commerce as basis for digital manufacturing and create future "Ali Factories", especially for small- and medium-sized enterprises that lack the resources to invest in expensive automation equipment and manufacturing management systems. Chinese internet firms can be considered as potential global market leaders, providing another opportunity to leapfrog developed industrial economies and their competitive advantages in advanced manufacturing.

Politically, this shift seems to reflect a subtle, but important reorientation in China's industrial policy strategies. The change in perspectives is related to the fact that the transition of many labor-intensive industries into advanced digital manufacturing is difficult to achieve. Digitalization of factories is only happening gradually, even in advanced industries and countries like Germany. Some industries, such as garment manufacturing, seem to be largely "resistant" against digitalization and robotization. A recent study by international trade unions points to diverging scenarios of change for major manufacturing industries, depending on their economic conditions and level of technological development[21].

Rather than pursuing the illusionary goal of replacing labor-intensive manufacturing altogether, protagonists of intelligent manufacturing in China increasingly focus on the recombination of labor-intensive manufacturing with highly ad-

[19] Srnicek, Nick (2017): *Platform Capitalism*. Cambridge UK: Polity Press.
[20] PLM Portal, January 27, 2018
[21] IndustriAll Global Union (2017): The Challenge of Industry 4.0 and the Demand for New Answers. Working Paper. Geneva: IndustriAll.

vanced technologies and digital network architectures from the side of distribution and supply-chains. This form of restructuring seems to develop as a typical trajectory in China and a shaping force of future models of digital manufacturing with Chinese characteristics in the global arena.

Decent work or automation on the cheap?

From the perspective of manufacturing, the lack of horizontal integration with labor market, skill, wage and migration policies is a key weakness of MiC 2025. Important policy questions remain unaddressed both at national and local levels - not only reform of vocational training, but also of HR management, wage and incentive systems, appraisal of skills, workplace safety, workplace privacy as well as further reform of labor laws[22].

Some of the relevant Chinese labor laws have been extended in recent years and improved protections for workers in the case of mass lay-offs, workplace safety and employment of temporary workers. However, current discussions are dominated by demands to discontinue key provisions of the 2008 Labor Contract Law in order to facilitate the massive job reductions underway in state-owned heavy industries and coal mining[23].

At the same time, Chinese government and research institutions have not provided any valid assessment of the potential labor market effects of Made in China 2025. As East-West Center economist Dieter has noted in a recent paper, the relevant statistics are hopelessly scattered between various government agencies[24]. Therefore, labor-market, social-security, training and other policy needs resulting from digitalisation of manufacturing can hardly be assessed.

To be sure, insecurity about the job impact of digitalisation are widespread throughout the world. But our ongoing research on current automation projects and policies in China[25] clearly indicates that massive job cuts are ahead at least in certain industries and regions.

- In predominantly state-owned manufacturing industries, such as automotive, job impacts of digitalization still appear relatively minor. Since many factories already feature high levels of automation, digital technologies can be introduced gradually.

- Among private Chinese and multinational mass manufacturers with large low-wage labor forces job effects from transformation of labor-intensive to auto-

[22] For an excellent evaluation see Ronald C. Brown, "Implications of Robotisation and Digitalisation on MNC Labor Supply Chains in China", *Tsinghua China Law Review, Vol. 9:01,* pp. 186-209
[23] "China public outcry of finance minister comments", *Financial Times* , March 16, 2016
[24] Dieter Ernst, "Advanced Manufacturing and China's Future for Jobs", *East-West Center Working Papers,* No. 8, 2016
[25] Butollo and Luethje 2017, op. cit.

mated manufacturing are potentially much heavier. In some model "Internet factories" of home appliance makers over 50% of the manufacturing workforce has been cut in the wake of automation already.

- Job reductions are potentially highest among labor-intensive small and medium enterprises. Here, relatively simple automation equipment massively replaces semi- and low-skilled labor. A recent study of the "robot-replaces-men" program in the city of Dongguan, the center of export manufacturing in South China, found job reductions in such companies between 67 and 85 percent, often affecting the workers with the best skills and bargaining positions.[26]

The situation in Guangdong illustrates the negative effects of top-down industrial policies. With its ambitions to become China's leading region in factory automation the provincial government propagates Made in China 2025 under the slogan "robot replaces men". City governments pick this up and make the replacement of workers a top criterion in their local plans to subsidize procurement of robots. Improvement of working conditions, training and retraining as well as skill standards usually do not figure as important goals. The problem of job cuts and retraining are mostly ignored, since they affect migrant workers who have no long-term local residence.

The local implementation plans thereby create incentives for job reductions and factory automation "on the cheap". The city of Dongguan reported that during the first year of its "robot-replaces-man" plan 1262 participating companies raised labor productivity by 65% on average and cut 71.000 jobs by the end of 2015[27]. With a working population of more than 5 million in this city, the local labor market may absorb these job losses for the time being. On the long term, however, serious problems may evolve. And many no-name assembly companies may get squeezed between rapidly increasing capital costs from automation and continuing profit pressures from global or Chinese buyers[28].

These developments, and especially the shift to the industrial internet as platform of future manufacturing, raise a number of new questions for labor-process as well as value-chain research. One is whether and to which extent the Chinese model of internet-based manufacturing automation will produce a continuation and extension of sweatshop-like working conditions in manufacturing, as a compliment or perhaps an alternative strategy to heavy displacement of workers through "manless factories". Comparable tendencies in Europe have been described as "Amazonization" of industrial work, where workplaces and factories in traditional manufacturing, such as automotive, are becoming more and more similar to the flexibilized, de-skilled environments of modern logistics centers[29].

[26] Naubahar Sharif and Yu Huang, "Upgrading the Workshop of the World: Incentives and Barriers for Industrial Automation in Dongguan" … *get reference after publication* …
[27] ibid.
[28] For an excellent study of such effects see Florian Butollo, *The End of Cheap Labour? Industrial Transformation and 'Social Upgrading' in China,* Frankfurt/New York: Campus.

[29] Butollo, Florian, Martin Ehrlich and Thomas Engel (2017): Amazonisierung der Industrie-

We may wonder whether "Taobaoization" of manufacturing work may become the dominant trajectory to combine advanced data networking technology with low-wage work in China.

Conclusions: Another race to the middle?

In recent academic research, China's pathway of innovation has been aptly described as a "race to the middle"[30]. The most innovative Chinese companies have dynamically adapted new technologies, created their own innovations in product design and marketing and combined this with low-cost mass manufacturing. New indigenous brand names became leaders in the mid- and lower tiers of China's domestic market, but competition has been fierce and manufacturing often remained labor intensive.

Can MiC 2025 create new pathways of innovation and transcend the race to the middle? In our opinion, three key obstacles remain. They are a heritage of China's export-oriented development model since the 1990s and its recent strategies to rebalance growth and social development.

- Automation and manufacturing innovation remain scattered, reflecting the segmented structure of value chains of "imported" models of lean production and modular manufacturing in China's key industries. Product innovation, therefore, is widely disconnected from manufacturing innovation.

- Low-road strategies of automation continue to dominate at the shop floor, fostered by the deep segmentation of labor markets and weakly institutionalized standards of pay and decent work.

- Top-down government policies provide incentives for such low-road automation strategies designed to achieve quick return on investment and ambitious quantitative targets.

Digital manufacturing technologies do have significant potential to change the structure of value chains based on flexible specialization of technologically sophisticated suppliers, improve cooperation within production networks and relocate production closer to end markets. For China, this could entail a big leap forward to redesign the spatial structure of production and to overcome the over-concentration of manufacturing along the Eastern seaboard and in a few urban centers in central and western provinces. Digital manufacturing, therefore, could ease pressures for large-scale urbanisation and the related problems of la-

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arbeit? *Arbeit, 26(1):* pp. 33-59

[30] L. Brandt, and E. Thun (2010), "The Fight For the Middle: Upgrading, Competition, and Industrial Development in China", *University of Toronto, Department of Economics: Working Paper 395*).

bor migration.

From the point of view of manufacturing, this opens perspectives of competition between industrial districts based on competing capabilities of innovative companies and skilled workforces. However this would require a substantial shift in the direction and setup of industrial policies. Instead of the present top-down approach, industrial policies "from below" would be needed that integrate technological upgrading with strategies to develop skilled workforce and rebalancing of labor markets. Strong clusters of manufacturing exist in many regions in China, but their dynamics need to mobilized by innovative public policies that strategically tackle the problem of low-skilled work in labor-intensive industries.

Industrial cities in the Pearl-River Delta, for example, could support industrial upgrading by making subsidies for automation equipment conditional upon improvements in working conditions, skills and retraining of workers. Long-term development of skilled industrial workforces could be supported by granting permanent residence (called hukou) to migrant workers who graduate from vocational training programs. Last but not least, the provincial and local trade unions could enforce standards of decent work and accelerate the implementation of collective bargaining in privately owned enterprises, as foreseen under the Guangdong collective bargaining guideline of 2015.

Such approaches exist, but the innovative potentials of digital manufacturing for sustainable growth remain unexplored due to the lack of institutional reform and the dominance of short-term profit pressures from global and domestic markets.

From this perspective, however, the situation in China reflects the structural impediments of the so-called '4th industrial revolution" at the global level. Trump's neo-liberalism plus protectionism on the one side and China's top-down industrial modernization without decent work on the other in certain ways are complimentary. Both shift innovation to the network and the highly financialized world of "platform capitalism", rather than pursuing long-term investment policies to transform manufacturing and strategically develop the potentials of decent work, relocation and environmental sustainability inherent to the most advanced capitalist forces of production.

In this sense, the recent shift to internet-based automation scenarios in China reproduces and adds new facets to the disconnect between product and manufacturing innovation that had been inherent to most models of globalized manufacturing since the 1990s. Made in China 2025 may achieve significant innovation in all kinds of digital technologies, but fail in its basic goal to advance Chinese manufacturing and develop sustainable advantages in quality manufacturing and product creation. In a world that continues to be driven by financialized innovation and short-term profit expectations of stock and money markets this may not be a real problem for capitalists, but China's large manufacturing workforce will have to bear the burden of this kind of restructuring.

Advanced manufacturing cannot support sustainable ways of automation, if it does not go along with substantial restructuring of value chains and a reversal of

the economic and social segmentations produced by dominant models of globalized manufacturing. This, of course, includes upgrading of work and refurbishing of labor standards. There will most likely be job losses, but the key problem is to find the right mix of automation and higher skilled labor for sustainable long-term growth. Manufacturing jobs in developing as well as in industrialized economies can only be protected by making them better and by improving conditions for large sectors of the working population.