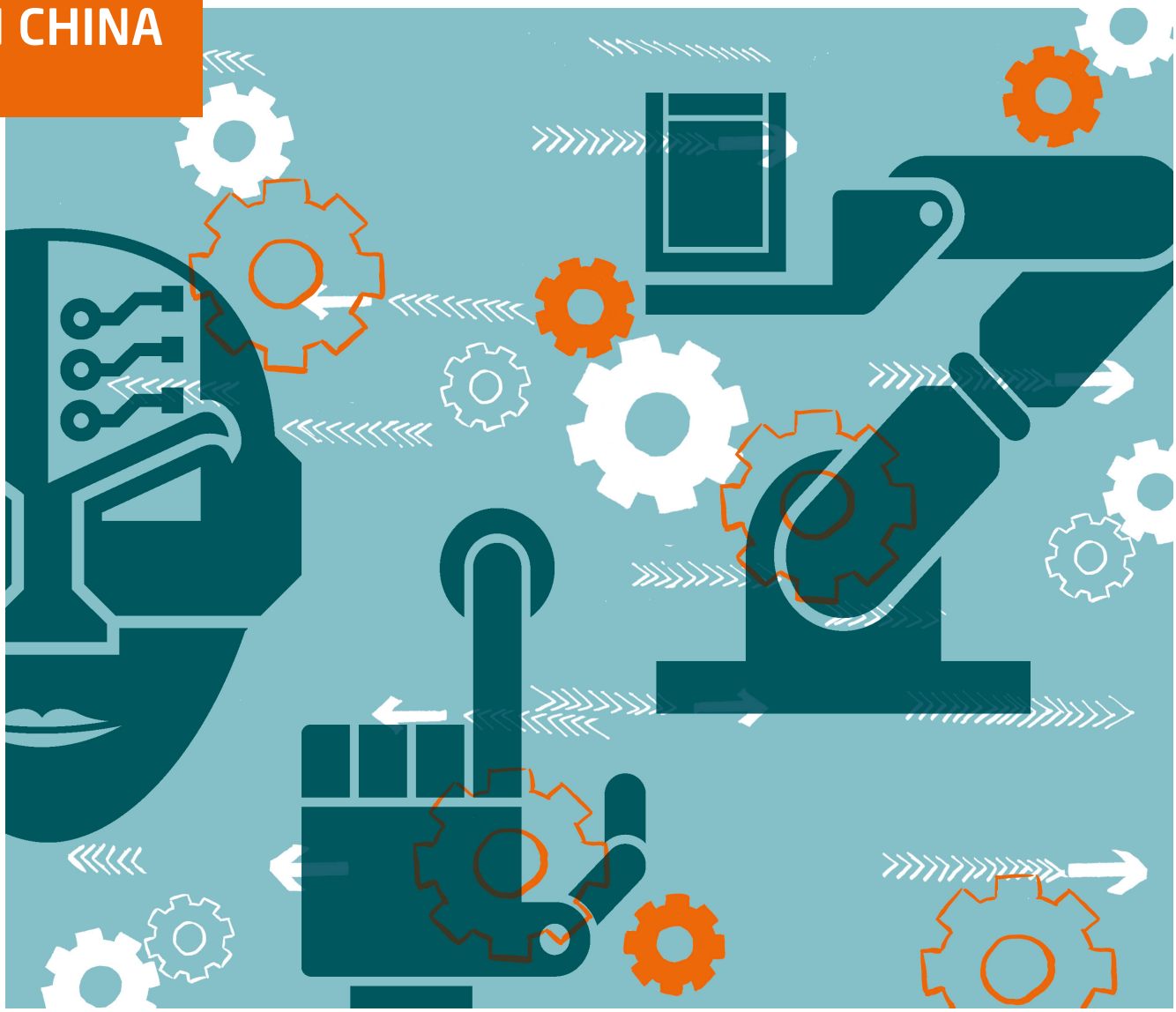
MERICS
PAPERS ON CHINA



EVOLVING MADE IN CHINA 2025

China's industrial policy in the quest for global tech leadership

Max J. Zenglein | **Anna Holzmann**

No 8 | July 2019

merics
Mercator Institute
for China Studies

EVOLVING MADE IN CHINA 2025

China's industrial policy in the quest for global tech leadership

Max J. Zenglein | **Anna Holzmann**

Content

Exhibits:

Textboxes:

Acknowledgements

This report owes thanks to many colleagues at MERICS as well as external experts. Without their valuable feedback and support we would have not been able to complete our year-long research effort. We are very grateful for the support and insights we have received during our research trips to China, Japan and Taiwan. However, due to privacy issues we will only name MERICS staff.

We are grateful for comments and recommendations given by Frank N. Pieke (Director), Mikko Huotari (Deputy Director), and Kristin Shi-Kupfer (Director of the Research Area on Public Policy and Society). Their expertise helped us to improve our argument and the structure of the report.

We would like to especially acknowledge the extensive contribution by Claudia Wessling (Head of Publications and Product Development) and her team in producing this report. Special thanks go to Alexandra Hinrichs (Graphic Designer) for creating the many exhibits as well as Gerrit Wiesmann for editing the text. Many thanks also to Kerstin Lohse-Friedrich (Director of Communications) and the communications team for their support in rolling out this report.

We are also indebted to the research support by our interns: Aymeric Mariette, Fynn Heide, and Andreas Mischer.

Finally, we would like to point out that the authors bear sole responsibility for this report and any remaining errors.

Max J. Zenglein and Anna Holzmann

Berlin, July 2019

Executive Summary

FROM BLUEPRINT TO IMPLEMENTATION: "MADE IN CHINA 2025" IS HERE TO STAY

Four years ago, China launched an ambitious plan to become a leading global technological superpower by 2049. Party and state leader Xi Jinping himself made the strategy "Made in China 2025" (MIC25) his signature project, reflecting how crucial it is to China's future development. The strategy defines ten core industries, such as robotics, power equipment and next-generation IT, in which China wants to achieve major breakthroughs and create globally competitive companies.

Backed by industrial policy, massive financing, and subsidies in the hundreds of billions of US dollars, both state and private companies aim to build the technological foundations of the "China Dream," a revitalization of the nation the Chinese Communist Party (CCP) has been promoting vigorously under Xi ahead of two important centenaries. For the party's 100th birthday in 2021, China aims to become a moderately prosperous nation, while for the 100th anniversary of the People's Republic of China in 2049, it aspires to become a "global manufacturing", "cyber", and "science and technology innovation superpower".

In Western industrialized countries, China's ambition has caused considerable irritation. Businesses and experts assessed that China was using unfair business practices and stealing technology in its efforts to become the world's tech superpower. MIC25 has fueled concerns that foreign competitors would be pushed out of the lucrative Chinese market and face fierce competition in third markets, while China becomes not only more competitive in innovative sectors of its own domestic economy, but also as the market shares of Chinese companies abroad grow.

China has responded to this criticism from abroad by toning down its references to the plan. Beijing directed media coverage and official statements on MIC25 to be dialed back. Even the name "MIC25" and trigger words such as "self-sufficiency rate", considered indicative of China's efforts to replace foreign products and tech, were largely dropped from policy papers. Xi did not mention "Made in China 2025" at this year's Central Economic Work Conference, nor did Premier Li Keqiang in the Government Work Report for the annual National People's Congress – two key events Chinese leaders traditionally use for setting strategic directives.

DROPPING THE RHETORIC OF MIC25 IS STRATEGIC

China has not at all abandoned its goal of catching up with Western industrialized countries

This is a tactical move: China has not at all abandoned its economic – and strategic – goal of catching up with Western industrialized countries and gaining a competitive edge in high-tech and emerging technologies. Four years after its official launch, the strategy has moved from blueprint to implementation. The MIC25 program is here to stay and, just like the GDP targets of the past, represents the CCP's official marching orders for an ambitious industrial upgrading. Advanced economies around the globe will have to face this strategic offensive.

In the last decade, China's growth has continuously slowed. In 2018, the economy expanded by 6.6 percent, the weakest pace since 1990. The country also risks being caught in the middle-income trap, a problem many developing countries faced when rising wages eroded their comparative advantage, making them unable to compete with the productivity and innovation of advanced economies. For China's leadership, there is no alternative to substantially upgrading its industrial and economic base. It has to keep growth levels above 6 percent until 2021 to fulfill its promise of prosperity and maintain its legitimacy.

MIC25 IS ROOTED IN EAST ASIAN DEVELOPMENT APPROACHES AND CONSTANTLY ADJUSTED TO CHANGING REALITIES

To some extent, China and MIC25 follow the blueprint of Japan, South Korea, Singapore and Taiwan in breaking through the ceiling of low-tech and labor-intensive manufacturing that restricts the growth of developing and emerging economies. This "East Asian development model" is characterized by industrial policies that target strategic sectors, and a strong government that effectively aligns business interests (state-owned as well as private) with national targets. Using this template, China hopes to successfully overcome the middle-income trap and reduce its reliance on foreign technology.

Taking the Asian Tiger nations – South Korea, Taiwan, Singapore and Hong Kong – as an example, MIC25 aims to move more sophisticated parts of the value chain and high-caliber research and development into China. If successful, it would replicate achievements of the electronics industry in other high-tech sectors. In electronics and ICT, companies like Haier, Lenovo, Huawei, or DJI have today become international household names.

Because of its comprehensive and adaptive nature, the efficiency and success of MIC25 are difficult to evaluate. Since 2015, there have been setbacks due to planning mistakes that resulted in overcapacities and inefficient allocation of funds.

But its implementation gained momentum two years ago in response to a slowdown of GDP growth and the unfolding trade dispute with the United States. The strategy is constantly being adjusted to newly emerging challenges. By the end of 2018, the Chinese government had issued a total of 445 authoritative documents detailing implementation measures. Local governments continue to be highly active translating Beijing's national vision into local directives.

Chinese policy makers have also constantly readjusted the ambitious targets for increasing domestic market share in certain innovative sectors. According to the Technology Roadmap 2017, specifying the implementation of MIC25, China wants to reach a 90 percent market share for new energy vehicles (NEV) and an 80 percent share for IT products for vehicles by 2025. Other targets include a certain number of patents per 100 million CNY in revenue, and the development of quality brands.

CHINA IS DETERMINED TO DOMINATE SMART AND EMERGING TECHNOLOGIES

Chinese companies from more traditional high-tech sectors like aerospace, machine tools, or software engineering face the challenge of catching up with foreign competitors. They do not prioritize the development of top-notch products and global leadership and are content to overcome existing technology gaps by building up sufficient (as opposed to state-of-the-art) domestic expertise.

This is completely different for sectors crucial to the fourth industrial revolution currently unfolding worldwide. In smart manufacturing, digitalization and emerging technologies, China wants to leapfrog and leave foreign competitors behind. Technology gaps in these fields are more fluid, and China sees the opportunity to assume a leading position right from the start. The tables have already started to turn: Today, China is setting the pace in many emerging technologies – and watches as the world tries to keep pace.

China is setting the pace in many emerging technologies

China has forged ahead in fields such as next-generation IT (companies like Huawei and ZTE are set to gain global dominance in the roll-out of 5G networks), high-speed railways and ul-

tra-high voltage electricity transmissions. More than 530 smart manufacturing industrial parks have popped up in China. Many focus on big data (21 percent), new materials (17 percent) and cloud computing (13 percent). Recently, green manufacturing and the creation of an "Industrial Internet" were given special emphasis in policy documents, underpinning President Xi Jinping's vision of creating an "ecological civilization" that thrives on sustainable development.

China has also secured a strong position in areas such as Artificial Intelligence (AI), new energy and intelligent connected vehicles. The electric vehicle (EV) battery market is a powerful example of how quickly such dynamics may unfold and global value chains are absorbed. In 2017, seven of the top ten EV battery companies were Chinese, accounting for 53 percent of the global market share. The expansion of China's battery manufacturing capacities is in the pipeline and could amount to three times that planned in the rest of the world.

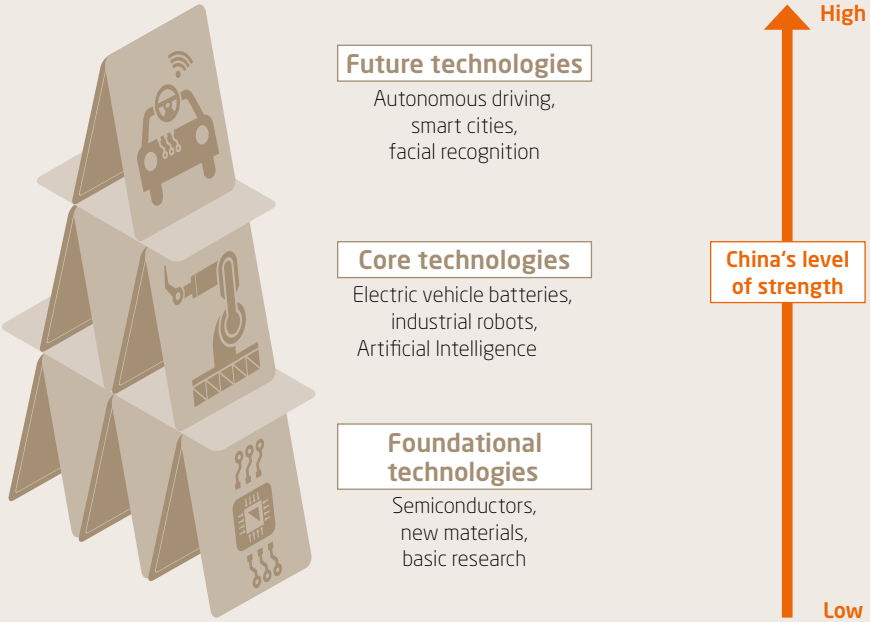
FOREIGN TECH DEPENDENCY IS CHINA'S ACHILLES HEEL

The Chinese government pushes the development of future technologies by providing financial support and by creating demand through, for instance, beneficial regulations or tax incentives to quickly turn ideas from niche industries into products suitable for mass consumption.

However, dependency on foreign core components is still a major bottleneck for China's national tech ambitions. Its industry has considerable weaknesses in mastering foundational technologies essential for developing an advanced high-tech sector in certain areas, especially for the digital economy. This vulnerability is most evident in the fields of new materials, semiconductors and key components for advanced machinery and machine tools. Chinese tech firms have already experienced considerable difficulties when cut off from access to chips or other high-tech components from abroad, as US trade measures against companies like ZTE and Huawei recently illustrated.

House of Cards: China's future ambitions stand on shaky ground

Dependence on foreign high-tech know-how remains high



Source: MERICS

Chinese planners are engaging on several levels to eliminate these weaknesses. First, the country invests heavily in research. In 2018, the country spent around 300 billion USD on research and development, nearly 2.2 percent of GDP. Sheer scale in absolute figures might, at some point, give China an advantage over smaller industrialized countries that spend much less. As a percentage of GDP, China's R&D spending has already surpassed that of the EU (2.1 percent).

Second, the government is pushing to more centrally coordinate the implementation of MIC25 and related industrial policies. Each region is assigned to focus a particular aspect of tech development. Unlike previous national economic policy plans, MIC25 attaches more importance to private companies, entrepreneurship and market mechanisms while at the same time improving the competitiveness of state-owned enterprises (SOEs) that are still considered crucial for the innovation drive. In the eyes of China's leadership, this is part of an effort to optimize China's hybrid state capitalist system. But many contradictions associated with simultaneously strengthening market forces and the role of the state remain unresolved.

CHINA MOBILIZES REGIONS AND PRIVATE COMPANIES TO MAKE MIC25 A SUCCESS

The Chinese government has learned from setbacks and mistakes

Since the official launch of MIC25 in 2015, the Chinese government has tried to learn from setbacks and mistakes. In moving from blueprint to implementation, the strategy is constantly being updated. In 2018, for instance, China's Ministry of Industry and Information Technology (MIIT) listed its key focal points:

- Establishing local specializations and "MIC25 National Demonstration Zones"
- Industrial Internet, emerging industries, establishing world-class industry clusters
- Innovations in basic general technologies
- Establishing manufacturing innovation centers
- Fiscal support mechanisms

Pilot projects related to MIC25 serve as key drivers for the introduction of new technologies into the real economy. In the past two years, around 90 percent of the almost 4,000 projects were announced. Since the inauguration of the first MIC25 pilot city in Ningbo (Zhejiang), 30 more have been established nationwide. Each is tasked with developing specific MIC25-related industries. A government plan details over 50 sub-industries and 115 industrial sub-fields, ranging from jet engines to functional fiber and products using China's Beidou navigation system.

In 2018, the so-called MIC25 National Demonstration Zones (NDZ) were introduced as upgraded versions of pilot cities and city clusters. The majority (65 per cent) of China's most promising top-20 smart manufacturing hubs have emerged from these zones. In addition, the innovation center scheme envisions 40 national-level "core" centers and numerous "supplementary" centers at provincial level.

China's current advances in many technological areas would not have been possible without the flourishing private sector, the origin of most innovative business models particularly in the digital economy. Industrial policies like MIC25 seek to pair market vitality with strategic ambitions. The development of business models involving AI, alternative energy vehicles, facial recognition, big data, and digital payment and communication systems was mainly driven by private companies vying for business opportunities. The state has created the space for this entrepreneurial spirit to thrive by pursuing a light regulatory approach.

Chinese state-owned enterprises (SOEs) continue to play a critical role for the development of strategic industries and high-tech equipment associated with MIC25. In so-called key industries like telecommunications, ship building, aviation and high-speed railways, SOEs still have a revenue share of around 83 percent. In what the Chinese government has identified as pillar industries (for instance electronics, equipment manufacturing, or automotive) it amounts to 45 percent. The success or failure of SOE reforms will therefore have a direct impact on the ambitious MIC25 endeavor.

Increasingly, the private sector is expected to contribute to improving the competitiveness of state assets. Pilots in mixed ownership reform have seen private companies taking stakes in some of China's largest SOEs. In another effort to improve their operation, the government strives to achieve consolidation through mergers of private and state-owned entities.

IT REMAINS DIFFICULT TO PUT A PRICE TAG ON MIC25

MIC25 is backed by a large variety of financial tools far beyond classical industrial subsidies

China is investing hundreds of billions in making MIC25 a success, but it is difficult to put a price tag on the strategy. Far beyond classical industrial subsidies, the implementation of MIC25 is backed by a large variety of financial tools, ranging from insurance compensation schemes to tax incentives, facilitated SME financing, and direct funding for MIC25-related demonstration zones and (pilot) projects.

Major state-owned banks such as the China Construction Bank (CCB), the Industrial and Commercial Bank of China (ICBC) and the China Development Bank (CDB) offer financing. In November 2016, CDB pledged an estimated 300 billion CNY to the implementation of MIC25 over the next five years. Reportedly, in March 2018, there were more than 1,800 government industrial investment funds with an aggregate size of about three trillion CNY.

The variety of financing schemes, often involving local governments, SOEs and banks, make a precise estimate almost impossible. Local authorities clearly tend to overstate the size of collected funds in order to signal compliance with central government policies, and funds pledged are often much higher than those eventually deployed.

EUROPEAN PARTICIPATION IN CHINA'S TECH AMBITIONS IS A DOUBLE-EDGED SWORD

China's MIC25 strategy is mainly a domestic policy aimed at boosting indigenous capabilities. It is complemented by outward-facing approaches to secure access to foreign know-how and reduce tech dependency. To reach its ambitious goal of moving entire high-tech production cycles into the country, China is pursuing a multi-pronged approach in dealing with foreign partners. These can be categorized in three groups:

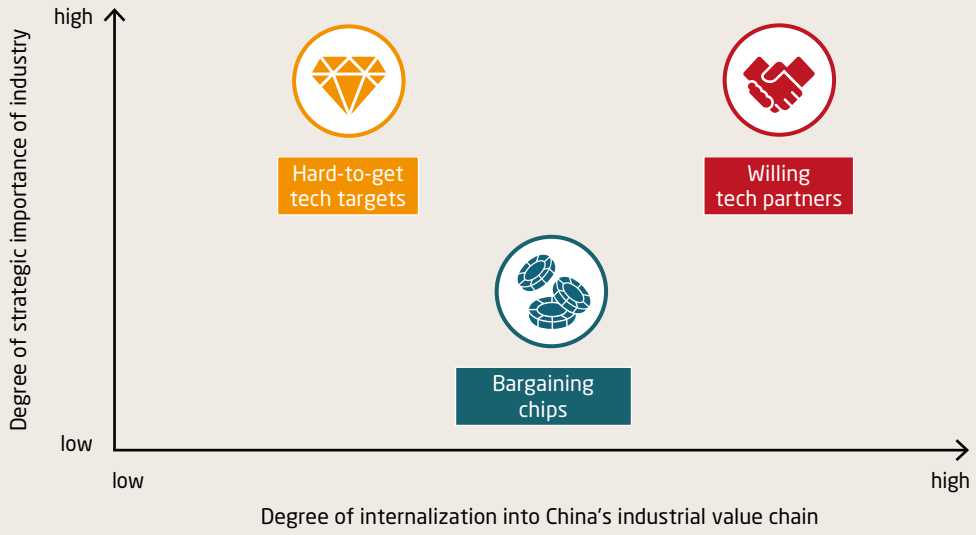
Bargaining chips: These are foreign companies in industries that China's economic planners consider to be of lower strategic value. This is the case for consumer goods such as restaurant franchises or retail. The automotive sector has also moved into this category, as much of its production has already moved to China and is less important for further upgrading. Measures like dropping the joint venture requirement in the automobile sector are used by Chinese interlocutors as bargaining chips in reciprocity negotiations. But they are far less significant for foreign companies than they would have been a decade ago.

Willing tech partners: The Chinese government strives to convince foreign companies to move the most sophisticated parts of their value chain to China, with the aim of upgrading domestic industry and either directly or indirectly leading to the desired incorporation of

value chains into the economy. The consumer electronics sector is an example of the successful implementation of this strategy: China started off merely assembling products but now produces more sophisticated foundational technology and other key components.

Hard-to-get tech targets: Leading foreign tech companies that retain the most important parts of their value chains outside China are more difficult to approach. In seeking access to their know-how and technologies, the Chinese government uses different strategic approaches, such as a) attracting companies with offers of improved market access or more lenient joint-venture requirements, b) acquiring companies or know-how crucial for MIC25 via Foreign Direct Investment, c) head-hunting or even industrial espionage or cyberattacks. In 2018, 58 percent of the value of Chinese FDI in Europe could be attributed to core industries of the MIC25 strategy.

China's strategic grid of engagement with foreign partners
Approach depends on strategic value for tech transformation



Source: MERICS

MIC25 IS ALREADY AFFECTING EUROPE'S INNOVATION ENVIRONMENT

Foreign companies with sought-after technology can currently benefit from China's industrial upgrading. However, governments, policy makers and companies should look beyond short-term business opportunities and take more systemic effects into account. China's innovation offensive will affect the competitiveness of other nations in many high-tech sectors. Its dynamics are already affecting Europe's innovation environment and industrial foundations on several levels:

- China's pulling ahead in emerging technologies will change the market environment for European companies. This is already visible in areas such as AI, electric vehicles (EVs) and the EV battery industry.
- The ability to offer more competitive prices for technology that might not be top-notch but that is good enough will put pressure on European companies in a broader set of industries, also in third markets.

- Companies have started to divert R&D to China, especially in emerging industries. Europe will feel the heat of this shift: Carmakers like BMW, VW and PSA have already opened up facilities for electric vehicle R&D in China.
- Fierce competition from Chinese companies might erode the profitability of European companies and limit their ability to fund R&D. This could slow innovation in Europe, allowing Chinese companies to close existing technological gaps at an even greater pace.

EXEMPLARY WILLING PARTNER: GERMANY BACKS CHINA'S INNOVATION OFFENSIVE IN BUSINESS AND RESEARCH

Germany is one developed nation whose economic base could be directly threatened by China's ambitions. MIC25 is geared towards replicating the German concept of Industry 4.0. Sino-German tech, industrial and innovation collaboration ranges from fundamental research to more hands-on training and tech application. Attracted by generous conditions offered by Chinese counterparts, (mostly technical) universities and non-university research organizations such as Fraunhofer Society, Max Planck Society and the Helmholtz Association of German Research Centers are key actors in research collaboration with China.

So far, there has been little discussion over who profits most from this intense cooperation. Many German actors seem to neglect the risk of unwanted technology and know-how transfer in fields crucial for the advancement of their own industries.

EUROPE CAN LEARN FROM EAST ASIA

Compared to a geographically distant Europe, China's immediate neighbors are already experienced in dealing with China. Europe can learn from this approach and their experiences. China's East Asian neighbors must manage a far more sophisticated set of challenges: they depend strongly on China economically and at the same time need to consider issues of national security. This is reflected, for instance, in a restrictive approach to investments from and research cooperation with China. Compared to Europe and the US, Chinese investment flows with East Asian countries are largely a one-way street. Taiwanese and Japanese investment in China is 26 and 35 times larger, respectively, than Chinese investment in both countries.

With China becoming more of a competitor in recent years, clear limits were put in place that defined the scope of cooperation. Although the responses are not identical, many have taken measures to safeguard technology, for instance by introduction of strict investment regulations for acquisition of high-tech companies and guidelines on preventing intentional and unintentional knowledge transfer, or the development of incentives to reduce companies' dependence on Chinese market. The examples of the leading industrial nations in East Asia also show that taking active measures to safeguard key interests and know-how does not necessarily result in a breakdown of economic relations.

RECOMMENDATIONS

Our analysis shows how China's industrial innovation is in full swing. MIC25 is here to stay. European industrialized countries need to find answers for dealing with the cooperative and competitive aspects of China's offensive:

1. Improving Europe's innovation system without copying China

- Combine joint EU responses with small-group efforts of leading member states to improve Europe's innovation system and better exploit opportunities from current technological changes.
- Improve policy support for applied research by private entities. A better regulatory environment and financial instruments should stimulate research and technology adaptation in Europe.
- Facilitate greater research collaboration within the EU. Take steps to improve coordination and collaboration in Europe's innovation landscape.

2. Doubling-down on the EU's nascent China strategy for more economic sovereignty

- Reassert core liberal values for a China strategy by defining areas of mutual interest as well as division.
- Prepare for negative (economic) consequences in defense of EU's core interests.
- Establish an efficient and reliable coordination mechanism to foster greater alignment between Brussels institutions and member states.
- Strengthen cooperation with like-minded countries and advanced East Asian economies to advance global fair competition and technology standards.

3. Fine-tuning European China strategies to address high-tech competition

- Recognize China's persistent top-level push for tech independence and spell out conflicts of interest.
- Use China's persisting dependence on foreign technology as leverage to promote European interests.
- Initiate steps to limit dependence on critical components from China.
- Strengthen the role and coordination of European business associations in assessing China's high-tech policies and developing responses.

4. Safeguarding research and technological know-how

- Review and monitor Sino-European agreements on science and tech cooperation.
- Define criteria for government-initiated science and technology cooperation.
- Introduce better safeguards against technology transfers.
- Require mandatory reporting for cooperation in highly sensitive areas, also in basic research.

1. China's industrial policy at a crossroads

1. China's industrial policy at a crossroads

China is currently facing a critical crossroads in its endeavor to achieve the ambitious developmental targets for 2049, the centennial of the founding of the Peoples' Republic of China (PRC). Despite its remarkable economic growth over the past decades, the People's Republic still faces major challenges. With a current GDP per capita of around 10,000 USD, China is an upper-middle income country according to the United Nations (UN) classification.[1] Despite its remarkable success China is still at risk of being caught in the middle-income trap, just like many developing countries before, which lost not only their comparative advantage due to rising wages but also their ability to compete with advanced economies in terms of productivity and innovation.

The "Made in China 2025" (MIC25) strategy released in May 2015 was designed to help overcome precisely this challenge. The Chinese government has set out to establish a strong, national innovation system. Backed by a forceful industrial policy that constantly strives to improve capital allocation, policy coordination and tech-related innovation, the aim is to propel China through the middle-income trap and transform the nation into a globally competitive manufacturing superpower largely independent of foreign technology. But the Chinese Communist Party (CCP) is also driven by a deeper political motivation: it needs to ensure China's economic well-being to legitimize its increasingly tight grip on the country.

The strategy strives to turn China into a global hub for high-tech industries

Exemplary success stories like the East Asian development model and related industrial policies, shed light on Beijing's steadfast attachment to MIC25 and related policies.[2] Just like GDP targets of the past, MIC25 represents the CCP's official marching orders for China's industrial upgrading.

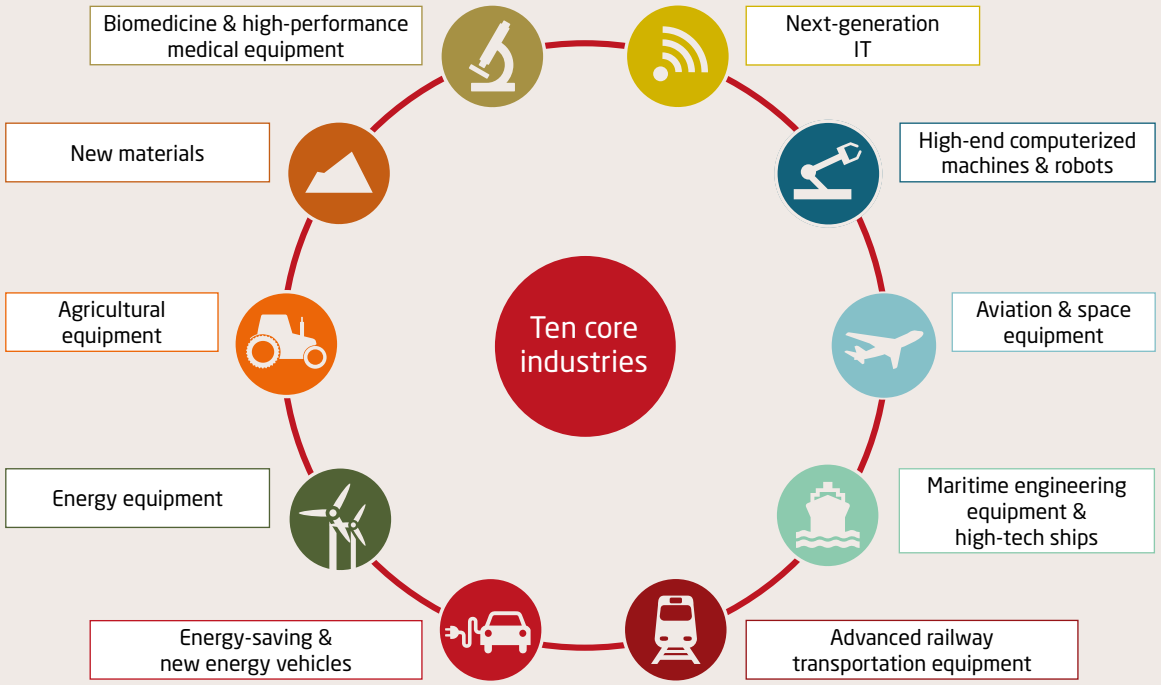
1.1 "MADE IN CHINA 2025" SEEKS TO LOCALIZE HIGH-TECH VALUE CHAINS

MIC25 represents an industrial policy blueprint for building a world class innovation system and achieving global dominance in key technologies. At its core the strategy defines ten priority industries, including aerospace, robotics and power equipment, in which China wants to achieve major breakthroughs over the next decades (see exhibit 1). MIC25's stated ambition is to pursue an innovation-driven and talent-based approach that puts quality first, promotes green development, and supports not only future-oriented, but also traditional, industries. In practice, the strategy sets specific market share targets for Chinese companies, and defines strategic priorities (战略任务) and support mechanisms (战略支撑) that extend far beyond the ten core industries. Using smart manufacturing as a backbone, the strategy strives to turn China into a global hub for high-tech industries, absorbing and localizing entire value chains.

Over the past 40 years, China has proven that it can succeed in doing this. This is probably best illustrated by China's electronics industry, which was originally focused on the simple assembly of a wide range of products like personal computers and mobile phones. Today, the sector has developed highly specialized clusters of both foreign- and domestically-owned original equipment manufacturers (OEMs). Similar to the Asian Tiger nations – South Korea, Taiwan, Singapore and Hong Kong – more sophisticated parts of the value chain were integrated to include research and development (R&D) and the creation of globally successful brands. Chinese companies like Haier, Lenovo, Huawei, or DJI have today become international household names.

Exhibit 1

Ten core industries set the basis of Made in China 2025
China has set ambitious targets



Main steps	Milestones
2025	Major manufacturing power
2035	Global manufacturing power
2049	Leading manufacturing superpower

Source: State Council

It remains to be seen if China can balance the level of control for the state, reduce the deficiencies of its industrial policy and build a globally competitive innovation system. The China model aims to defy persistent beliefs that an authoritarian regime cannot develop a competitive and innovative economy. If the CCP is successful, it will provide other countries with an alternative economic model based on a heavy involvement of the state and constrained market forces.

1.2 FOUR YEARS INTO MIC25: MEASURED PROGRESS IN INDUSTRIAL UPGRADING

Amid slower economic growth and the increasingly fierce trade dispute with the United States, the implementation of MIC25 gained momentum two years ago. More a guiding master plan than a concrete instruction, the strategy has been and is constantly being adjusted to newly emerging challenges. Yet, the long-term objectives of upgrading national tech capabilities and of creating opportunities for technological leapfrogging remain unchanged.

The comprehensive and adaptive nature of MIC25 makes it inherently difficult to evaluate the strategy's efficiency and success as a whole. A plethora of individual targets was set as part of MIC25. They are industry- or tech-specific and fluctuate between highly aggregated or exceedingly detailed levels. Examples include market share targets for Chinese technology, target quotas for smart equipment usage, a certain number of patents per 100 million CNY in revenue, and the development of several quality brands. Progress assessments of MIC25 will thus vary greatly depending on the chosen parameters and individual sectors.

China has already forged ahead in fields such as 5G networks (next-generation IT), high-speed railways (advanced railway transportation equipment) and ultra-high voltage electricity transmissions (energy equipment). However, critical weaknesses have yet to be overcome, in particular, regarding the development of home-grown foundational technology, most notably in advanced semiconductors.

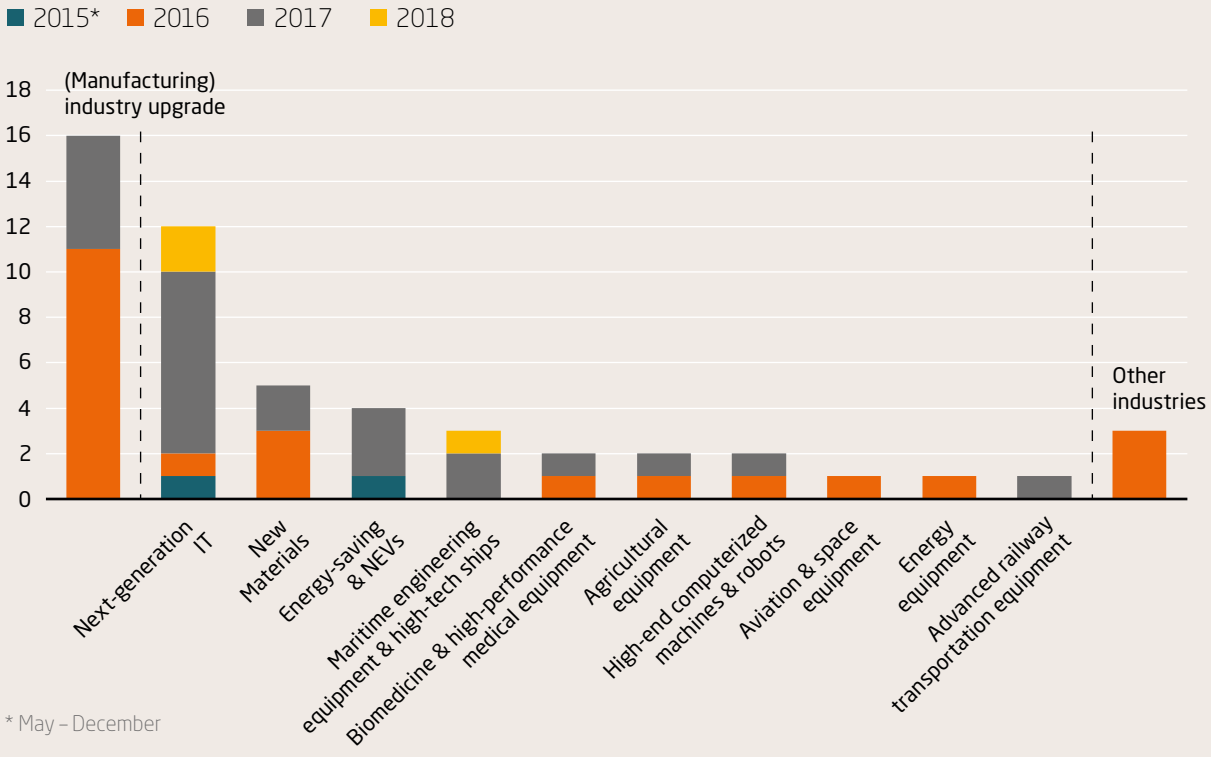
The ten core industries of MIC25 are clearly not all pursued with the same intensity (see exhibit 2). In recent years, it has become apparent that China is prioritizing efforts in emerging industries and other fields conducive to the country's digital and high-tech ambitions, especially in areas related to next-generation IT and materials. Policy efforts, however, focus on a general upgrade of manufacturing capabilities.

The MIC25 strategy and the embedded web of industrial policies should be assessed as a tool to steer the behavior of companies and local governments along these broad and shifting national priorities. Measured against such a yardstick, there are clear inefficiencies, but altogether MIC25 is now established as a forceful catalyst for industrial upgrading.

Exhibit 2

MIC25 policy plans prioritize digital and emerging industries

Number of national-level action and development plans



* May – December

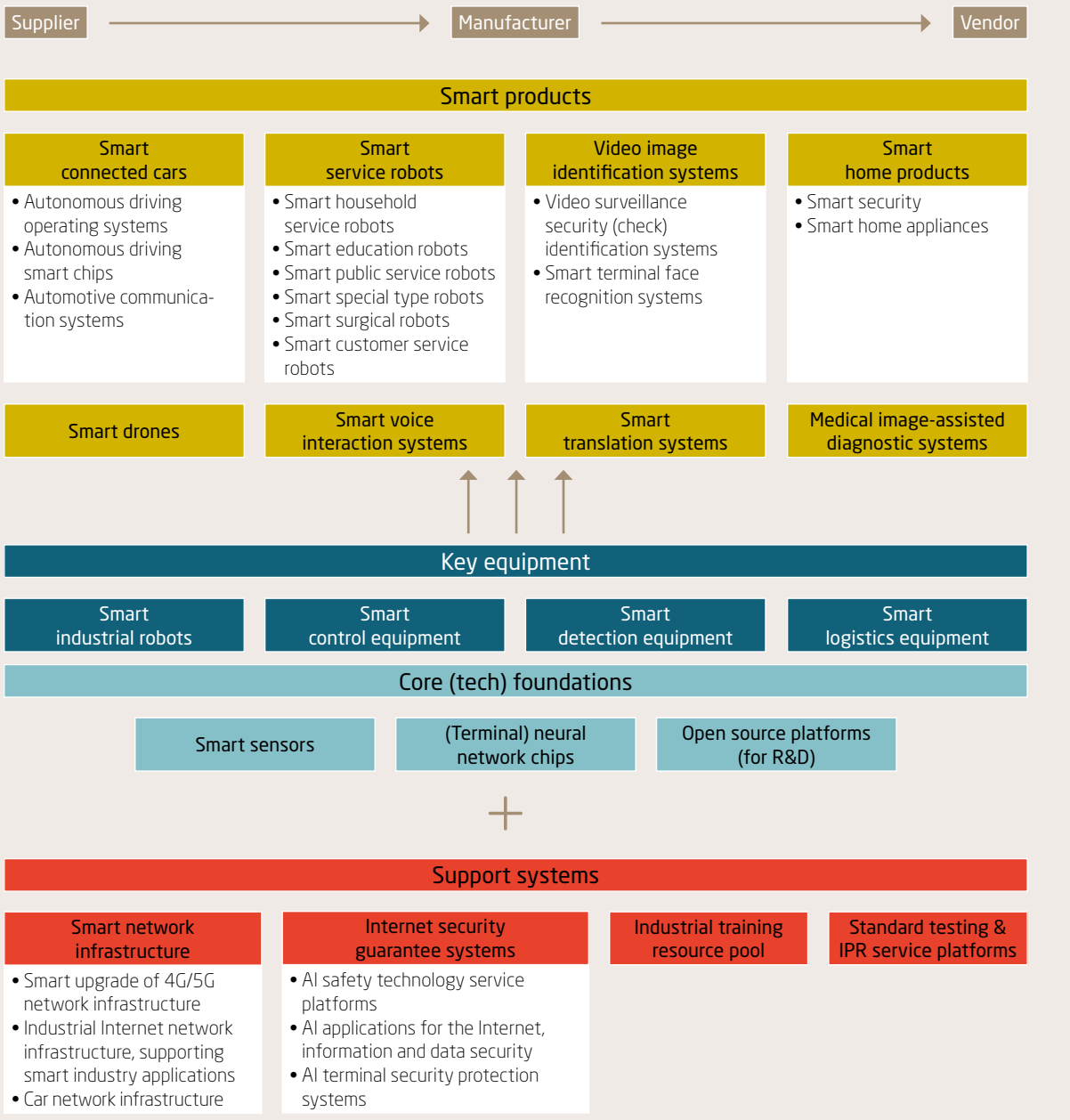
Source: MERICS

Looking at this bigger picture, two industry-spanning priorities covered by MIC25, smart manufacturing and AI, have developed rapidly and are likely to have important medium- and long-term structural effects. By now, more than 530 smart manufacturing industrial parks have popped up in China. Most of them focus on big data (21 per cent), but new materials (17 per cent) and cloud computing (13 per cent) feature prominently, too.[3] AI is part of MIC25's next-generation IT industry and covers a broad range of interconnected fields that span virtually everything from hardware to software and tech applications such as facial recognition or interconnected vehicles (see exhibit 3).

Exhibit 3

China is building a complex next-generation AI industry

Policy focus on broad scope of tech developments



Source: MIIT

1.3 CATCHING UP AND LEAPFROGGING: A DIFFERENTIATED APPROACH TO CONQUERING HIGH TECH

The implementation of MIC25 benefits from an increasingly sophisticated, technologically capable and large domestic market. There is sufficient demand and potential competition within the country, especially in traditional high-tech sectors, including aerospace, machine tools, or software engineering, to compensate for technological deficiencies.

Despite some improvements in areas such as high-speed railways or telecommunication Chinese companies from these traditional high-tech sectors struggle to compete internationally and are faced with the challenge of catching up with their foreign competitors. National policies regarding these sectors reflect that China's planners have in a way put up with this situation. They do not pursue the development of top-notch products and global leadership in these fields with the same vigor and rather seek to overcome existing technology gaps by building up sufficiently capable (as opposed to state-of-the-art) domestic expertise.

From this point of view, lagging one or two generations behind the global technological frontier is deemed acceptable. Despite the deficiencies Chinese planners see more immediate opportunities to emerge as a serious global competitor due to its large domestic market and growing international clout. One example is the production of passenger jets: both the single-aisle C919 and wide-body CR929 are set to take market share from Airbus and Boeing, first in China, but increasingly on global markets over the next ten years.

When it comes to emerging technologies and digitalization, China aspires to leapfrog and overtake foreign competitors. In 2016, the Central Committee of the CCP and the State Council jointly issued an "Outline of the National Innovation Driven Development Strategy (国家创新驱动发展战略纲要)". The concept outlines the ambition of using the dynamics to leapfrog and get ahead of other nations.[4] The technology gaps in emerging industries are more fluid, and China hence sees the unique opportunity to assume a leading position right from the start. The tables have already started to turn. Today, China is setting the pace in many emerging technologies – and watches the world trying to keep up.

China aspires to leapfrog and overtake foreign competitors in emerging technologies and digitalization

China has already secured itself a strong position in areas such as AI, new energy (electric and hydrogen) and intelligent connected vehicles. The government pushes the development of future technologies by providing financial support and by artificially creating demand through, for instance, beneficial regulations or tax incentives to quickly turn ideas from niche industries into products that are suitable for mass consumption.

The electric vehicle (EV) battery market serves as a powerful example of how quickly such dynamics may unfold and global value chains are absorbed. In 2017, seven of the top ten EV battery companies were Chinese, accounting for 53 percent of the global market share. Further expansion of China's battery manufacturing capacities in the pipeline could amount to three times that planned in the rest of the world.[5]

In many of these rapidly developing emerging tech areas, a build-up of overcapacities (supply outstripping demand due to overzealous top-down planning) is likely, but could have perverse positive effects for China. A build-up of (over)capacities could help Chinese companies gain a dominant foothold in, first, the domestic and, second, the global market. By absorbing the value chains early on, know-how can now be generated in China. Foreign companies then have little choice but to be locally present if they want to benefit from these dynamics.

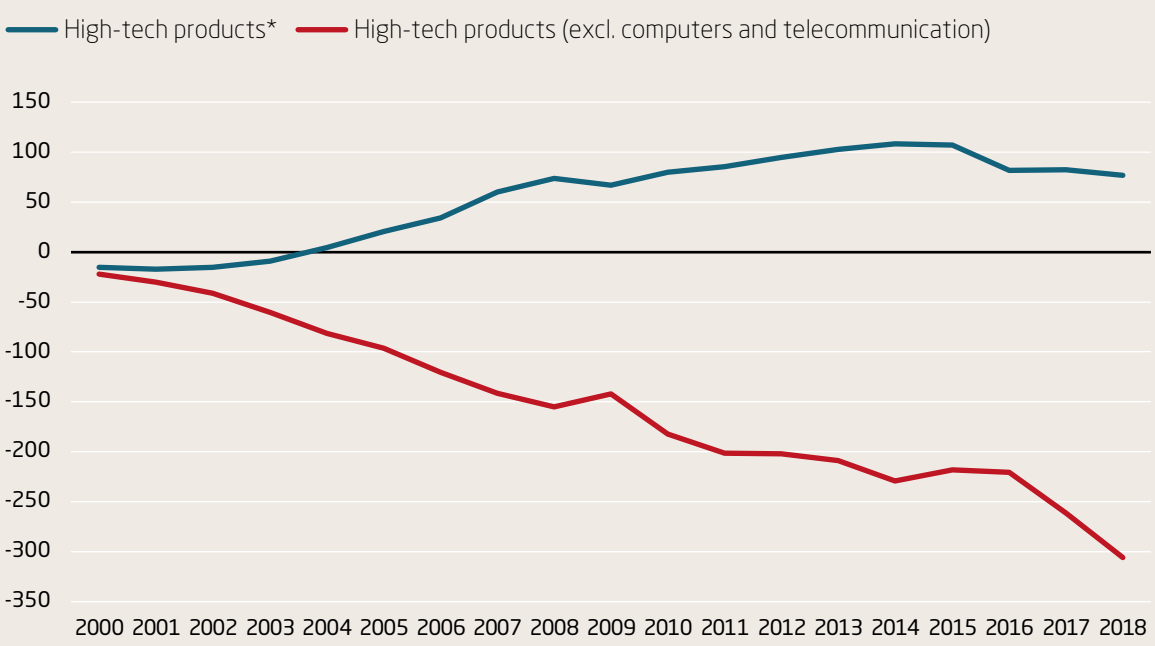
1.4 FOREIGN TECH DEPENDENCY IS CHINA'S ACHILLES HEEL

Even though the country is particularly strong in the application of future technologies, its dependence on foreign high-tech products remains a major bottleneck for national tech ambitions. The most advanced components and machinery still need to be imported. Adjusted for computers and telecommunication equipment, China's reliance on foreign technology results in a negative trade balance, according to the Chinese National Bureau of Statistics' (NBS) own definition of high tech, which includes the high-end spectrum of biotechnology, life science and technology, opto-electronics, electronics, computer-integrated machinery, and aerospace (see exhibit 4).

Exhibit 4

China's high-tech innovation relies on foreign components

Strong dependence results in negative trade balance (in bn USD)



*According to NBS definition: Biotech, life science, opto-electronics, electronics, computer and telecoms, chips, aerospace

Source: NBS

If China wants to establish a sound foundation for more advanced, future technologies, then it has to master these "basics" largely independent of foreign input. But the country still has a long way to go. China still suffers from considerable weaknesses in mastering foundational technologies necessary for enabling technological progress. This vulnerability is most evident in the fields of new materials, semiconductors and other key components for advanced machinery and machine tools.

Building the underlying ability in basic research takes time and remains a major weak spot despite a steady increase in research and development spending. In 2018, China spent around 300 billion USD on R&D, nearly 2.2 percent of GDP. It aims to increase this share to 2.5 percent in 2019. As percentage of GDP China's R&D spending has already surpassed that of the EU, which is currently at 2.1 percent.[6]

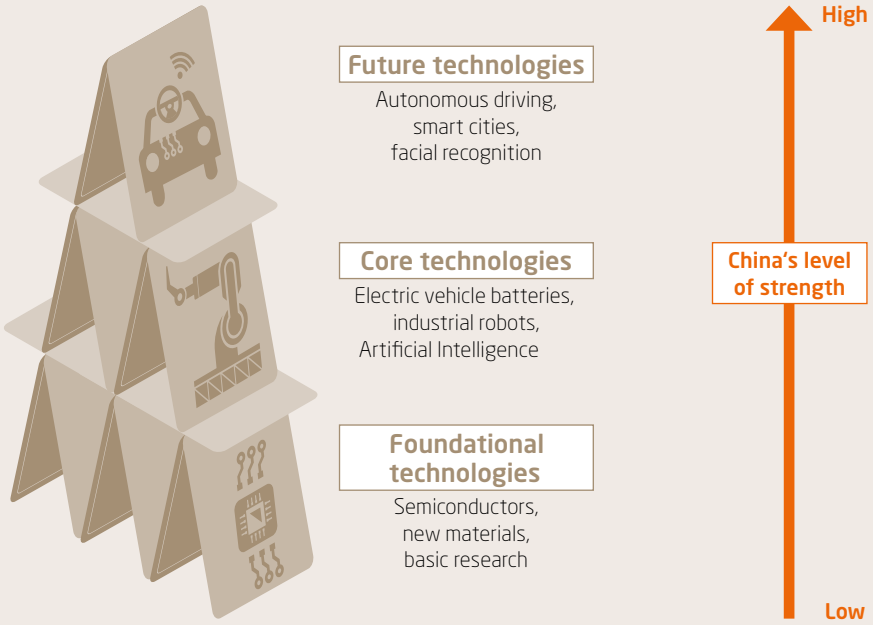
Despite this steady increase, China still needs to overcome hurdles in matching quality. Chinese companies still achieve lower yields on intangible investments, including R&D, IPR, designs and business processes compared to advanced economies.[7] However, despite lower efficiency, the sheer volume in absolute figures of R&D spending might, at some point, give China an advantage over smaller industrialized countries that spend much less (see exhibit 5).

China's technological progress would suffer a serious setback if access to foundational technology were permanently disrupted – regardless of China's prominence in the application of such technologies to certain industries such as facial recognition and autonomous driving.

Exhibit 5

House of Cards: China's future ambitions stand on shaky ground

Dependence on foreign high-tech know-how remains high



Source: MERICS

Chinese tech firms have already gotten into serious trouble when cut off from access to chips or other high-tech components from abroad, as US measures towards companies like ZTE and Huawei have proved in the ongoing trade row. As of this writing in June 2019, the US administration is rolling out steps for stricter export controls of emerging and foundational technologies as proposed by the US Bureau of Industry and Security (BIS) in November 2018. New controls could also see an expansion of so-called deemed exports, i.e. transactions involving controlled technologies in which these do not leave the country, which will further limit the access of Chinese nationals to foreign know-how (see exhibit 6).

Access to core components and technology is a prerequisite for China's advancement in emerging industries. Applying industrial policies like MIC25 to reduce dependency on foreign providers will therefore remain an integral part of all Chinese economic strategies.

Exhibit 6

Targeting China's weak spots

Export controls for certain technologies and sectors as proposed by US Department of Commerce

Category	Sub-Categories
Biotechnology	• Nanobiology • Synthetic biology • Genomic and genetic engineering • Neurotechnology
Artificial intelligence (AI) and machine learning technology	• Neural networks and deep learning • Evolution and genetic computation • Reinforcement learning • Computer vision • Expert systems • Speech and audio processing • Natural language processing • Planning • Audio and video manipulation technologies • AI cloud technologies • AI chipsets
Position, navigation, and timing (PNT) technology	-
Microprocessor technology	• Systems-on-chip (SoC) • Stacked memory on chip
Advanced computing technology	• Memory-centric logic
Data analytics technology	• Visualization • Automated analysis algorithms • Context-aware computing
Quantum information and sensing technology	• Quantum computing • Quantum encryption • Quantum sensing

Category	Sub-Categories
Logistics technology	• Mobile electric power • Modeling and simulation • Total asset visibility • Distribution-based logistics systems
Additive manufacturing	• 3D printing
Robotics	• Micro-drone and micro-robotic systems • Swarming technology • Self-assembling robots • Molecular robotics • Robot compliers • Smart Dust
Brain-computer interfaces	• Neural-controlled interfaces • Mind-machine interfaces • Direct neural interfaces • Brain-machine interfaces
Brain-computer interfaces	• Neural-controlled interfaces • Mind-machine interfaces • Direct neural interfaces • Brain-machine interfaces
Hypersonics	• Flight control algorithms • Propulsion technologies • Thermal protection systems • Specialized materials
Advanced Materials	• Adaptive camouflage • Functional textiles • Biomaterials
Advanced Materials	• Faceprint and voiceprint technologies

Source: US Department of Commerce

2. Readjusting China's trajectory for global tech leadership: MIC25 in implementation mode

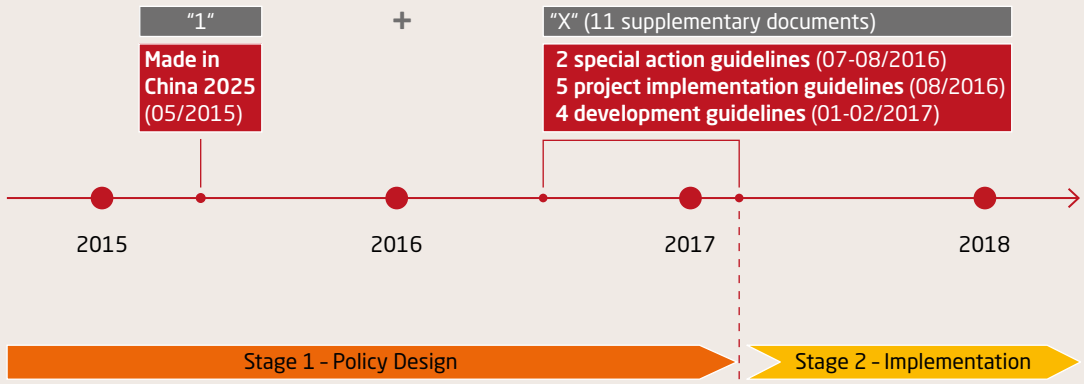
2. Readjusting China's trajectory for global tech leadership: MIC25 in implementation mode

Since the introduction of MIC25 in mid-2015, the strategy has progressed from policy design to actual implementation. As the flagship policy to propel China's industrial modernization, the strategy and how to implement it continue to be highly contested internally. At the same time, MIC25 has also moved to the center of international attention and is facing heavy external pressure, which in turn shapes the way Chinese policy makers depict and communicate about it.

During the first two years, Beijing focused on arranging the initiative's "top-level policy design" (顶层设计). Under supervision of the "Leading Small Group for Establishing a Manufacturing Superpower" (LSG, 国家制造强国建设领导小组), a set of core documents officially known as "1+X" was put in place. This policy system consists of the initial MIC25 plan (referred to as "1") and eleven supplementary documents specifying the rollout (referred to as "X"; see annex).[8] Upon the release of the final document in February 2017, MIC25 had progressed from the stage of policy design to actual implementation[9] (see exhibit 7).

Exhibit 7

From policy design to implementation
Stages of Made in China 2025



Sources: Xinhua, State Council Development Research Center

At the outset of MIC25, Chinese leaders were quite outspoken about their ambitions to transform their country into a global tech leader. International criticism and pushback caught them largely by surprise. As a response, by summer 2018, the Chinese government set out to downplay China's ambitions for global leadership and had taken measures to appease foreign concerns over the strategy.[10]

Media coverage and official statements on the issue were dialed back upon directive from Beijing.[11] Trigger words such as "MIC25" (中国制造2025) and "self-sufficiency rate" (自主率), considered indicative of China's efforts to replace foreign products and tech with "Made in China" substitutes, were largely dropped from policy papers and economic target-setting. The strategy was even removed from the most recent list of central policy priorities pegged for local implementation in 2019,[12] and it was not mentioned at all by party and state leader Xi Jinping at the Central Economic Work Conference 2019 or by premier Li Keqiang in the

Government Work Report 2019.[13] Some even speculated the MIC25 program could be abolished altogether (see table in annex: "Change in rhetoric, but no change in meaning").[14]

An incident in March 2019 indicated that the strategy is also highly contested internally. Lou Jiwei, the former Minister of Finance (2013 – 2016) and a staunch supporter of a stronger interplay of market forces in the Chinese economy, publicly criticized MIC25 for its unrealistic aims and overall inefficiency. He even called the initiative a waste of taxpayers' money.[15] It is conceivable that this public criticism was a factor when he was later replaced as the head of China's national social security fund.

In the long run, internal debates on China's true tech capabilities and the best way forward are likely to be more important than external pressure and rhetorical adjustments. Toned-down rhetoric and rebranding efforts do not imply any change to China's overarching strategic goals. The government will stick to President Xi's announcement in 2018 to turn the country into a world leader in science and technology.[16] The ongoing trade dispute and fierce long-term technological competition with the US are likely to propel Beijing's ambitions for the targeted development of national capabilities, indigenous innovation and technological independence. Meanwhile, the implementation of MIC25 continues in full swing.

2.1 CHINA HAS CREATED A NETWORK OF MUTUALLY REINFORCING INNOVATION POLICIES

Local governments are highly active in translating Beijing's national vision into local directives

The body of national policy documents promoting MIC25 is enormous. By the end of 2018, the Chinese government had issued 445 authoritative documents.[17] The majority was released in 2016 (39 percent) and 2017 (36 percent), while only 48 (11 percent) were published in 2018. In addition, local governments were highly active in translating Beijing's national vision into local directives (see exhibit 8).

The mission of MIC25 is manifested in various policy documents that go far beyond outright implementation plans (see exhibit 9). The strategy has permeated other major campaigns such as Internet+ (互联网+), a State Council initiative launched in 2015 that strives for greater connectivity and digitalization in eleven areas including manufacturing, and China's AI ambitions.[18] All these undertakings feed into one another, forming a network of mutually reinforcing policies that not only seek to accelerate the upgrade of China's entire economy, but also to turn the country into a global manufacturing (制造强国), cyber (网络强国) and science and technology innovation superpower (科技创新强国).[19] Unlike previous national economic policy plans, MIC25 attaches much more importance to private entrepreneurship (especially that of small- and medium-size enterprises, SMEs) as well as market mechanisms (see exhibit 10).

Finally, domestic measures are closely interlinked with China's efforts to set global technological standards. Largely off international radars, the General Administration of Quality Supervision and Quarantine (AQSIQ) and the Standardization Administration of China (SAC) commissioned research on how to increase China's influence on international standard-setting. Since March 2018, the Chinese Academy of Engineering (CAE) started its consultative work on China Standards 2035 (中国标准2035) – the action plan for China's standardization strategy.

Exhibit 8

The MIC25 top-down policy avalanche

Oriented towards the national MIC25 strategy, almost all provinces and municipalities (28 out of 31) released their own implementation plans. They vary in scope (e.g. number of key industries), priorities, target values and supportive measures. The Zhejiang example shows that efforts become more targeted the lower the administrative level (see exhibit). The MIC25 plan of Yuyao, a county-level city under the jurisdiction of Ningbo, focuses on only four industries (new equipment, next-generation IT, new materials, and new energy & new energy-saving). The city's ambitions are generally in line with that of Ningbo. The city's MIC25 targets, however, are very aspiring – proposing, for example, the highest share of R&D expenditure for manufacturing. Tailor-made MIC25 plans represent a means for local governments to steer regional development in desired directions whilst demonstrating their devotion to Beijing's strategic goals. However, they do not necessarily come with a novel approach. All too often, already existing local initiatives are simply rebranded to become part of and profit from the national MIC25 movement. Such behavior hints at the stiff competition for central funds and national prestige that largely drive local governments. For example, Hangzhou, the capital city of Zhejiang province, explicitly states the aim of establishing a "Made in Hangzhou" quality brand ("杭州质造"品牌) in its MIC25 plan in order to set itself apart from other cities.

Focused efforts for innovation on lower administrative levels

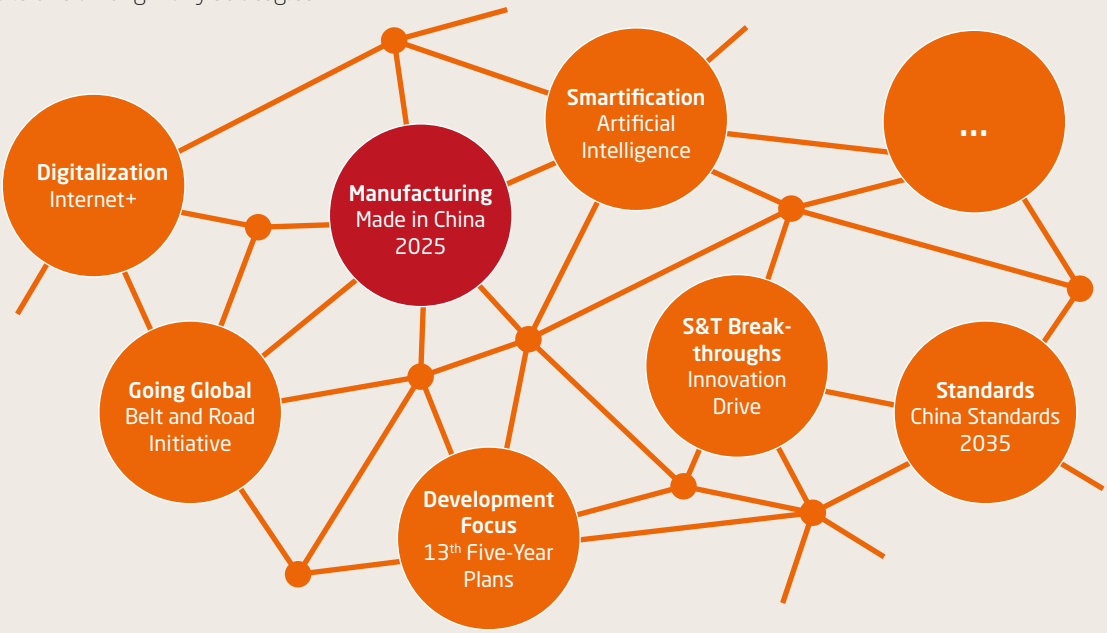
Comparison of MIC25 plans at different levels of government

Level	China national	Zhejiang province	Ningbo city	Yuyao county-level city
Number of focal industries	10	11	6	4
Characteristics	Industry categories not taken up at lower levels	Selection of focal industries		
	• Aviation & space equipment • Energy equipment • Agricultural equipment	• Green petrochemicals • Fashion & textile industry • Application-specific ICs & new components • IoT, cloud computing, big data & industrial software	• Traditional superior industries • Emerging industries • Productive service industries	• New equipment • New energy & energy-saving
Number of patents/ core business income of 10 billion CNY	2020: 70 / 2025: 110	2020: 80 / 2025: 120	2020: 105 / 2025: 150	2020: 110 / 2025: 150

Sources: State Council, Zhejiang local governments

Exhibit 9

China's industrial innovation policy network
MIC25 is one among many strategies



2.2 BEIJING IS ADJUSTING PRIORITIES IN ADVANCING ITS INNOVATION OFFENSIVE

The architects of MIC25 have learned from successes and setbacks in implementing the strategy and have adjusted its goals on several levels. The Technology Roadmap, which outlines the tech ambitions of MIC25, has been thoroughly updated (see textbox 1), government officials have set priorities, and hundreds of pilot initiatives have been launched to serve as examples of implementation.

Textbox 1

The MIC25 Technology Roadmap

The National Manufacturing Strategy Advisory Committee (NMSAC, 中国制造强国建设战略咨询委员会) released the initial "Made in China 2025" Key Area Technology Roadmap (中国制造2025重点领域技术路线图) in September 2015, updated in 2018. The roadmap caused a stir in industrialized nations because of the domestic (aka "selfsufficiency targets") and global market share targets it set for Chinese home-grown technology. In other words, the document spelled out areas in which foreign competitors are to be substituted for Chinese alternatives at the domestic and the global scale. Officially, the roadmap was drafted by more than 400 academic and industry experts. The document was given political weight by Vice-Premier Ma Kai and it was explicitly described as authoritative (权威性) in a joint NMSAC & CAE report for Chinese government officials.[20]

Market share targets have been increased in areas where China is well-positioned to compete

The revised version of the Technology Roadmap refines priority areas for domestic S&T efforts in light of recent technological developments and China's growing need for greater autonomy. In areas where China sees itself wellpositioned to lead the global competition, such as the energy-saving and new energy vehicle (NEV) industry, market share targets have been increased. For NEVs, for instance, China hopes to gain a domestic market share of 90 percent by 2025 (see exhibit 11). Such targets may also have a signaling effect for the role China hopes its home-grown technology will play on the global market.

Overall, the updated roadmap stresses the aspects of new materials and manufacturing equipment apt for "smartification" (智能化) that are needed to upgrade the ten core industries of MIC25. A greater emphasis on Chinese products with their own intellectual property rights (IPRs) further substantiates the focus on strengthening China's national innovation capabilities.

Apart from technological and industry-specific priorities that have evolved over the past four years, the central government has defined key tasks to drive the implementation of MIC25. Similar to the Technology Roadmap adjustments, the focal points of related governmental work have been adapted. According to Miao Wei, head of the Ministry of Industry and Information Technology (MIIT), the MIC25-related key foci for 2018 are:[21]

- Optimizing capital allocation by developing new financing mechanisms for industrial policy purposes
- support of local specializations and the establishment of MIC25 National Demonstration Zones
- Industrial Internet, emerging industries and the establishment of world-class industry clusters
- innovations in basic general technologies (基础共性技术) applicable within and across industries
- the establishment of manufacturing innovation centers and quality brands
- fiscal support mechanisms
- more opportunities for foreign investors

The implementation of "pilot demonstration projects" is an important indicator for Beijing's shifting priorities and adjustments. Since 2015, China's central government has launched at least 20 different types of projects related to the strategy (see exhibit 10). These receive state financial support and are key drivers for introducing new technologies into China's real economy. About 90 percent of the almost 4,000 projects have been officially announced over the last two years.

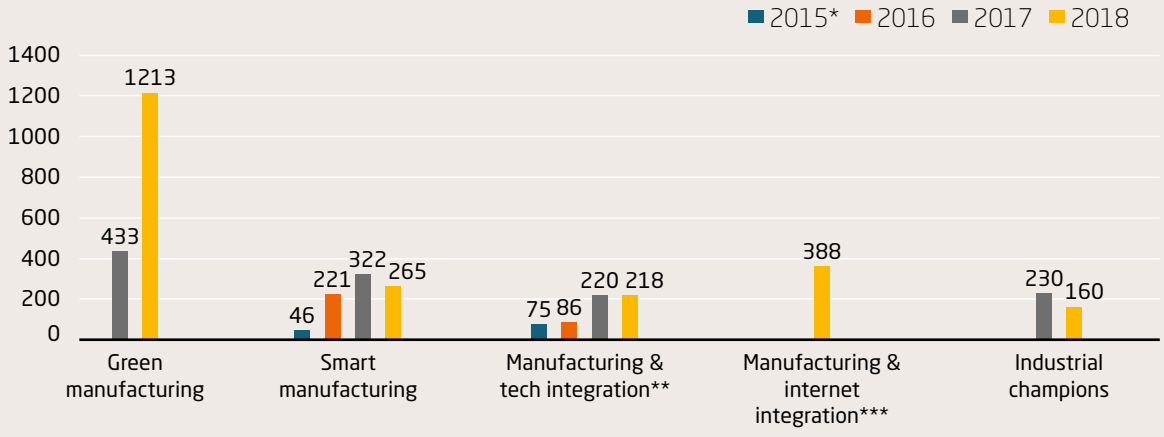
Exhibit 10

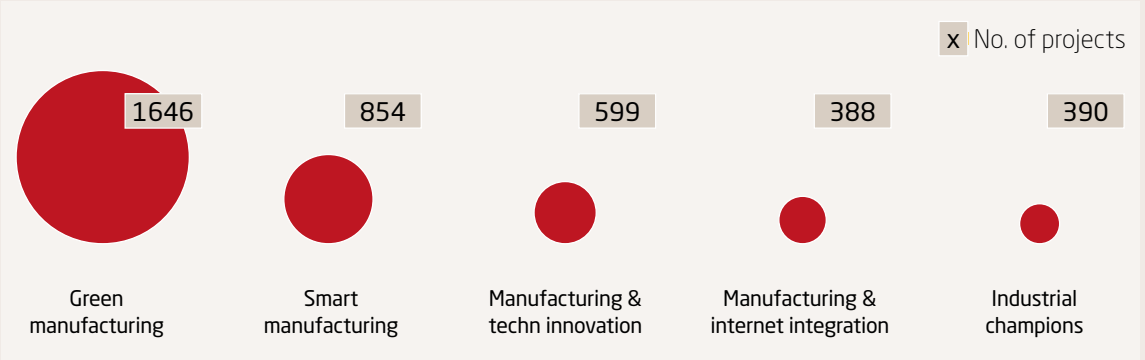
Pilot projects promote the cause of MIC25

Manifold activities in industrial high-tech sectors bline

Green manufacturing	Smart manufacturing	Manufacturing & tech innovation	Manufacturing & internet integration	Industrial champions
• Green factories • Green industrial parks • Green supply chain management (demonstration companies) • Green product design	• Smart manufacturing • Comprehensive standardization • New business application • Sino-German smart manufacturing cooperation**	• Tech innovation (demonstration enterprises) • Manufacturing "mass entrepreneurship & innovation" platforms • Hackerspaces*	• Integration management system • Cyber-physical systems (CPSs) • Cloud solutions for key products & equipment • E-commerce platforms • Industrial Internet • Big Data (industry development & services)	• Manufacturing enterprises • Products • Incubators

New pilots in several sectors have been launched since 2015





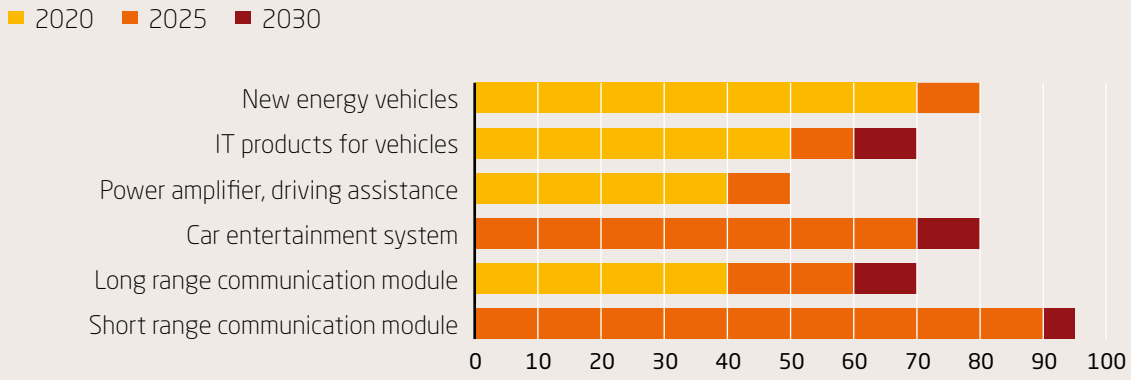
* May – December
** incl. Hackerspaces (2018 data n.a.)
*** incl. Industrial Internet and Big Data Industry Development, excl. Sino-German smart manuf. Cooperation (added to smart manuf.)

Source: MIIT, MOF, MOST

Exhibit 11

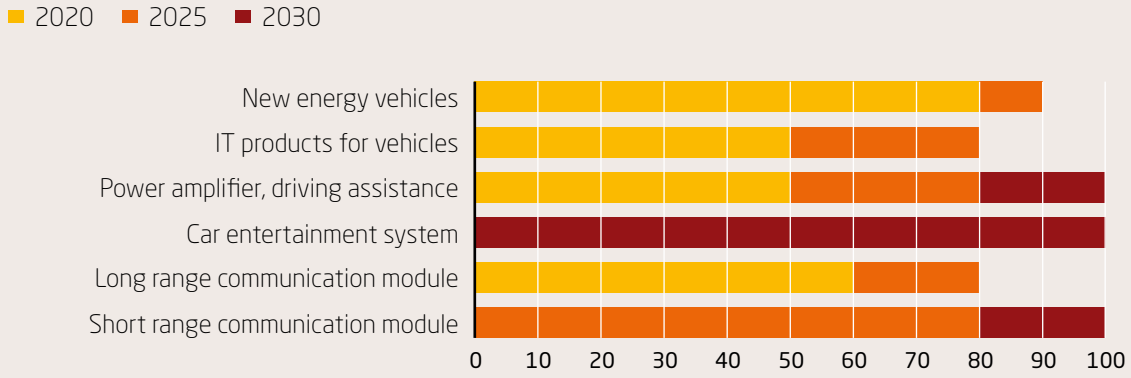
Roadmap 2015

New energy vehicle industry, domestic market share (in percent)



Roadmap 2017

New energy vehicle industry, domestic market share (in percent)



Source: National Manufacturing Strategy Advisory Committee

In August 2016, the first MIC25 pilot city was launched in Ningbo, Zhejiang province. A total of 31 pilot cities have been established so far. Last year, a special focus was placed on setting up MIC25 National Demonstration Zones (NDZs, 中国制造2025国家级示范区). Initially proposed by Premier Li Keqiang in July 2017, they represent upgraded versions of pilot cities and city clusters.[22] NDZs serve as model cases for how to best implement and promote MIC25 based on local conditions. Indeed, the majority (65 per cent) of China's most promising top-20 smart manufacturing hubs have emerged from such pilot areas.[23]

A detailed breakdown of the number and focus of the project areas illustrates Beijing's priorities. Special emphasis has been given to green manufacturing since 2017, underpinning President Xi Jinping's vision of creating an "ecological civilization" (生态文明) that thrives on sustainable development. Creating an "Industrial Internet" (工业互联网) also gained priority since 2018 as part of China's digital rise. However, what looks promising on paper does not always translate into measurable results in the real economy, as visits to a few pilot projects in Jiangsu, during the course of this research in 2018, indicated.

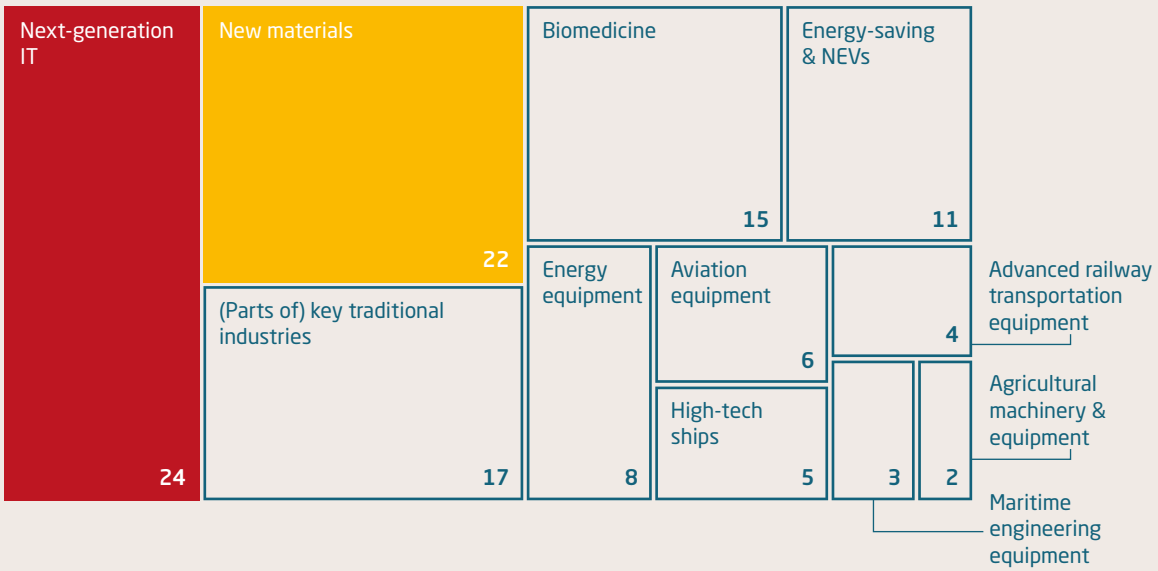
2.3 BEIJING WANTS TO CENTRALLY COORDINATE LOCAL INNOVATION

Experiences in the initial phase of MIC25 have shown that local authorities compete to prove their commitment to the national campaign. Uncoordinated competition has, in the past, resulted in overcapacities and inefficient allocation of funds. As a result, the government is pushing for a centrally coordinated but intra-regionally differentiated implementation of MIC25 which aims at putting local comparative advantages to best use. Establishing advanced industry clusters and national demonstration zones – two top priorities the government cited in 2018 for accelerated MIC25 implementation[24] – are a primary means to this end.

Under Beijing's supervision, each of the 31 provincial and municipal governments should leverage specific strengths in MIC25-related industries using a plan that details over 50 sub-industries and 115 industrial sub-fields, from aviation engines to products using China's Beidou navigation system. The distribution of industry specialization plans across local governments highlights Beijing's prioritization of next-generation IT and new materials (see exhibit 12).

Exhibit 12

Beijing wants industrial development to focus on next-generation IT & new materials
Number of provinces/municipalities focusing on certain sectors



Source: MIIT

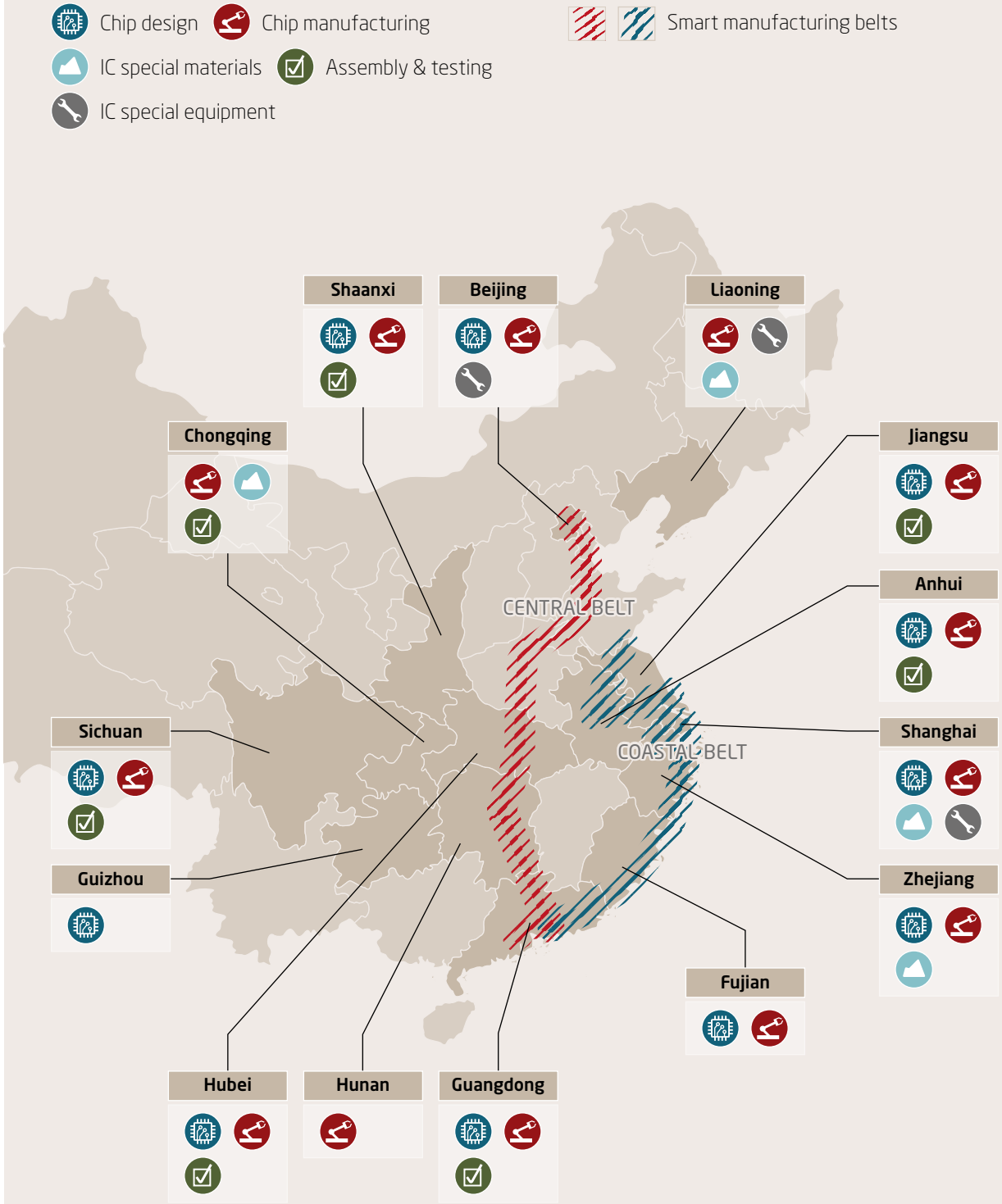
Despite the efforts to improve coordination using a centrally-devised blueprint, it remains to be seen if pushing, e.g., for an IC focus in almost half of all provinces and municipalities will be effective in avoiding misallocations and overcapacities (see exhibit 13).

The clustering of regional manufacturing activities is complemented by measures to strengthen innovation capabilities, with a system of about 700 state key laboratories (国家重点实验室)[25] meant to strengthen basic research and a comprehensive network of manufacturing innovation centers (制造业创新中心), both to be established by 2025.[26]

The innovation center scheme envisions 40 national-level "core" centers and numerous "supplementary" centers at provincial level (see exhibit 14).[27] These centers are meant to leverage corporate alliances and focus on the entire innovation chain – from research to commercial application – of industry-specific, cutting-edge technologies and related services.[28] By now, 12 national centers have been launched. The interim milestone of having 15 such centers in place by 2020 is thus well within reach.

Exhibit 13

China's vision for a homegrown chip industry
Regional foci of IC-related production

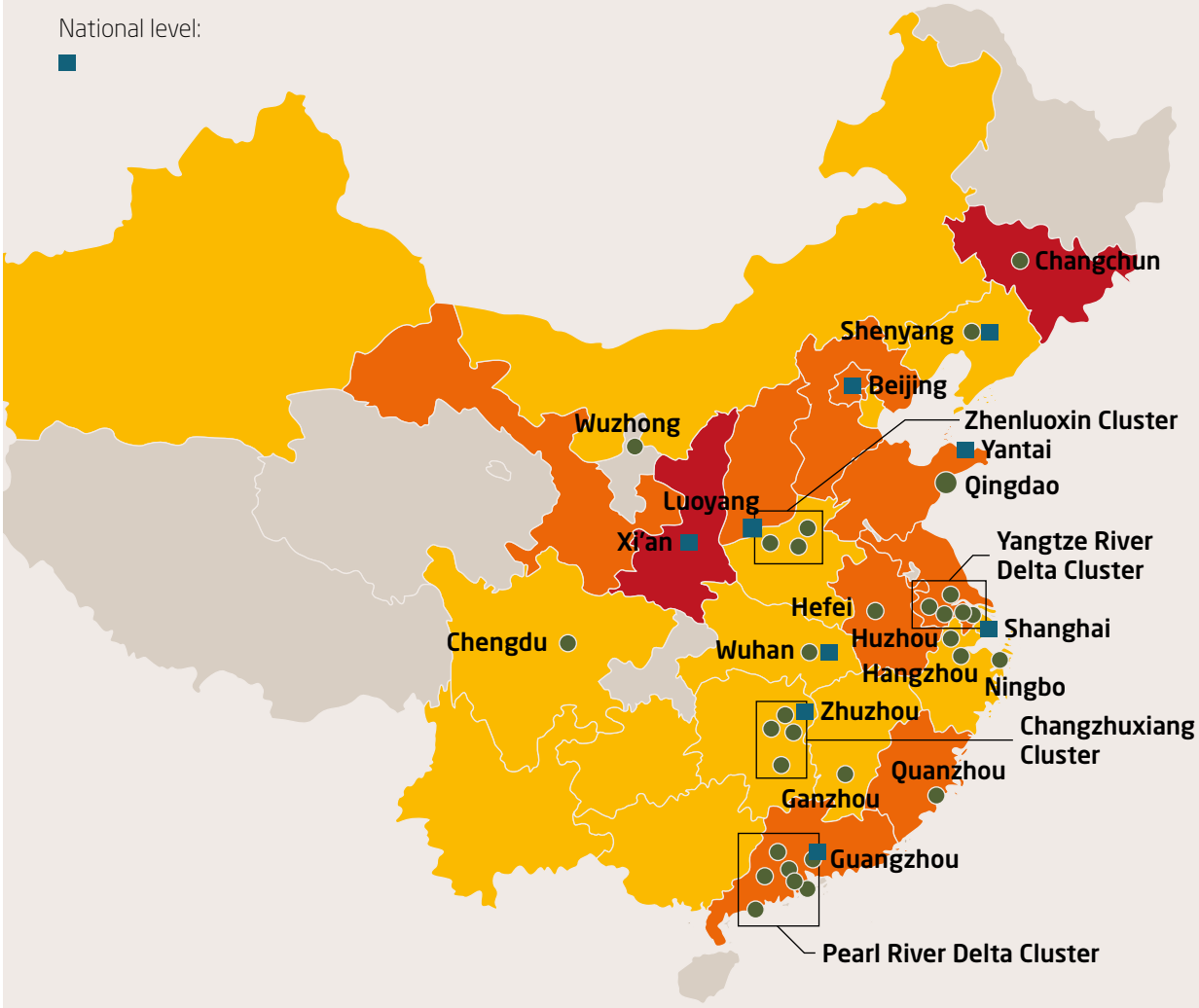


Sources: MIIT, Chinese research institutes

Exhibit 14

"Made in China 2025" materializes in a nationwide network

Manufacturing innovation centers and demonstration areas



12 manufacturing innovation centres				
Beijing Batteries (06/2016)	**Shenyang (Liaoning)** Robots (01/2018)	**Xi'an (Shaanxi)** 3D printing (08/2016)	**Yantai (Shandong)** (Automotive) light-weight material forming technology & euipment (04/2019)	
Zhuzhou (Hunan) Advanved railway transportation equipment (01/2019)*	**Guangzhou (Guangdong)** Print & flexible displays (01/2018)	**Luoyang (Henan)** Smart agricultural machinery	**Shanghai (Shanghai)** Chips (07/2018) Smart sensors (07/2018) Maritime equip-ment (09/2018)*	**Wuhan (Hubei)** Information & optoelectronics (04/2018) Digital design (10/2018)

* Approved

Source: MERICS

3. Optimizing China's state-private industrial innovation nexus

3. Optimizing China's state-private industrial innovation nexus

The implementation of MIC25 is embedded in a political and reform context that strongly impacts the trajectory of the strategy and, more broadly, China's industrial innovation path. Recent policy debates, which have been unusually public, indicate that long-standing tensions between the proponents of more market- and more state-led approaches are increasing. Similar to other policy-fields, conservative economic nationalists are suspicious of too-radical reforms, while those in favor of more far-reaching reforms press for a strengthening of market mechanisms.

It is likely that Chinese leaders will continue to operate with the following flexible policy mix that will balance these competing forces and accordingly affect the overall layout and implementation of MIC25:

- Leveraging the private sector's strength in innovation and profitability
- Optimizing capital allocation by developing new financing mechanisms for industrial policy purposes
- Improving the performance and reinventing state-owned enterprises (SOEs) with the help of the private sector and mega-mergers

The policy adjustments are an acknowledgement of the strengths of market mechanisms in increasing efficiency and productivity and building a competitive innovation system. At the same time, CCP leaders and institutions are likely to continue exerting strong influence on all economic actors in the pursuit of national strategic targets to increase technological capabilities.

3.1 LEVERAGING THE PRIVATE SECTOR FOR NATIONAL GOALS

China's industrial policy seeks to pair market vitality with strategic ambitions. Formally, private companies therefore play a crucial role in the implementation of the MIC25 strategy and the development of high-tech sectors (see table in annex: "State-owned and private enterprises divide the leadership in MIC25 core industries amongst themselves").

The development of industries such as AI, alternative energy vehicles, facial recognition, big data or digital payment and communication systems was mainly driven by the entrepreneurial spirit of private companies vying for business opportunities. The Chinese state is taking a comparatively light regulatory touch with regard to the development of emerging technologies and digitalization. Companies enjoy a high level of autonomy to develop business models, engage in fierce competition and aim for profitability.

Given the strength of the private sector in key emerging industries, CEOs of relevant companies such as Alibaba, Baidu, Huawei and Tencent are able to exercise some level of influence on the direction of CCP policymaking in these fields. The internet plus strategy (互联网+) and a stronger emphasis on AI was largely driven by private tech companies. This does not, however, amount to a fundamental shift in the power relationship between the private sector and the state. From the CCP's perspective, China's private tech companies will have to align their business with overarching national goals related to national competitiveness, but also to securing supply chains and developing emerging dual-use technologies for surveillance and military purposes.

China's private tech companies have to align their business with national goals

In recent years, the government has increased pressure on China's private sector to contribute to the MIC25 mission. The private sector is expected to deliver in areas in which state-owned enterprises have failed. As soon as a company becomes a leader in a sector of national strategic importance, it is expected to contribute to reaching national goals and to team up with the government by, among other things, aligning investments and R&D closely with government policies. One prominent example was the recruitment of a national AI team by the Ministry of Industry and Information Technology in 2017 involving internet giants Baidu and Alibaba and the AI companies iFlyTek and SenseTime.

China's industrial policy evolution with MIC25 at its heart aims to build an innovation ecosystem with market elements that is capable of mastering the challenges China's economic and technological development will face in the decades to come. However, strengthening the market's role while preserving effective CCP's control over the economy entails major contradictions. Establishing party cells in private companies will enable the party to influence a company's operations. Absent of political reform, China's private companies risk becoming agents of an authoritarian regime and being turned into quasi-SOEs.

Expanding the role of the state also risks undermining the success of China's private companies. Greater state intervention may lead to operational decisions which are not driven by market demand or profitability. China's leadership has recently reaffirmed the importance of the private sector in an effort to regain trust of the entrepreneurs. The ambition to integrate the private sector in its innovation strategy still leaves many unanswered questions for the county's leaders to solve.

3.2 MIC25 IS A TESTING GROUND FOR DIFFERENT FINANCING VEHICLES

It is difficult to put a price tag on MIC25 - but it is likely to be expensive

It is difficult to put a price tag on MIC25 but for sure it is likely to be expensive. Going far beyond classical industrial subsidies, the implementation of MIC25 is backed by a large variety of financial tools, including insurance compensation schemes, tax incentives, facilitated SME financing, and direct funding for MIC25-related demonstration zones and (pilot) projects.

Major state-owned banks such as the China Construction Bank (CCB), the Industrial and Commercial Bank of China (ICBC) and the China Development Bank (CDB) offer financing for MIC25 key projects.[29] Some have also signed strategic cooperation agreements with state bodies such as the MIIT or NDRC. In November 2016, CDB pledged an estimated 300 billion CNY over the next five years towards implementing MIC25.[30]

The Chinese government also uses national investment funds to support strategic goals and channel financing into the development of key industries (see annex). The most prominent example is the state-affiliated National IC Industry Investment Fund (国家集成电路产业投资基金). It raised 139 billion CNY in the first round in 2014 and aimed for up to 300 billion CNY in the second round in 2018.[31] The Chinese leadership generally uses such national funds to endorse investments in emerging industries and facilitate innovative S&T achievements.

On a ministerial level, special financial vehicles play a major role in driving forward sector-specific developments. In 2016, the MIIT and MOF launched a fund to spur China's industrial upgrading (工业转型升级《中国制造2025》资金). MIIT announced up to 25 key tasks for funding in 2017 and 2018 in order to boost China's manufacturing innovation capabilities (e.g. for semiconductors and smart sensors), support breakthroughs in new materials, and

improve industrial service platforms as well as overall supply chain coordination.[32] This type of financial support alone was expected to amount to at least 10 billion CNY in 2017, according to media reports.[33]

In March 2018, there were also reported to be more than 1,800 government industrial investment funds with an aggregate size of about 3 trillion CNY.[34] The wide variety of these financing schemes, often involving local governments, SOEs and banks, makes a precise estimate almost impossible. This can partially be attributed to local authorities' tendency to overstate the size of collected funds in order to signal compliance with central government policies. Funds pledged are often much higher than those eventually deployed.

China's leaders seem to a certain extent aware of inefficient use of funds and the possibility of misappropriation. A lack of competitive funding and uneven access to capital in a financial system dominated by state-owned banks continue to be key obstacles for private enterprises trying to deliver on shared MIC25 goals.

To improve the efficiency of capital allocation in general, but also for the implementation of the MIC25 strategy, government agencies have introduced new administrative measures and guidelines. This includes the MIIT's "Work Program for the Key Tasks of Innovation in the New Generation of Artificial Intelligence Industry" (新一代人工智能产业创新重点任务揭榜工作方案), which aims to streamline funding application processes. The Cybersecurity Administration and Securities Supervision has relaxed some guidelines (关于推动资本市场服务网络强国建设的指导意见) to improve access to capital markets for innovative companies.

The government strengthens market mechanisms to help financing the most qualified companies

In order to match financial sources and streamline the allocation of funds, the Chinese government also set up a dedicated MIC25 project database (《中国制造2025》重大项目库).[35] With the help of this database, more than 600 projects received funding amounting to around 400 billion CNY in 2017.[36]

At the same time, the government strengthens market mechanisms to help financing the most qualified companies. By fostering a more sophisticated financial system geared towards equity and bonds markets as well as venture capital it tries to support technological innovation and advance market competition.

Despite all these efforts, there are sufficient indications that the enormous amount and wide variety of high-tech state funding runs the risk of crowding out private funds and starving out innovative, small companies.

3.3 MAKING STATE-OWNED ENTERPRISES MORE EFFICIENT SERVANTS OF INDUSTRIAL POLICY

Chinese state-owned enterprises continue to play a critical role for the development of strategic industries directly associated with the MIC25 policy. Many industries which the Chinese government labels as either "key industries" (including ship building, aviation, high-speed railways) or "pillar industries" (including electronics, equipment manufacturing and automotive) remain dominated by SOEs.

Since 2013, the SOE share of revenues among listed companies in these two broad categories has only mildly declined (from ~90% to ~83% for "key industries" and ~53% to ~45% for "pillar industries").[37]

But their persistent inefficiency has made SOEs a target for reforms. The latest round following the Third Plenum in 2013 was clearly intended to facilitate modernization of SOEs in order to make them more productive in reaching MIC25 targets in key industries.

This doubling down on SOEs by Chinese leaders, also for the future development of MIC25, contrasts strongly with the general picture of a declining efficiency of SOE's struggling to perform.

To deal with this problem, the State-owned Assets Supervision and Administration Commission (SASAC) has rolled out a great variety of measures to improve the performance, both in terms of financial efficiency as well as output, of companies under direct control of the central government. While the renewed efforts preserve the status of SOEs and to a large extent the level of control by the government, they also emphasize a transformation into more capable organizations for delivering both on national strategic goals as well as on profitability.

SOE ownership reforms and strategic mergers have direct effects on MIC25 implementation

Aside from new forms of state capital management, SOE ownership reforms and strategic mergers have the most direct effects on MIC25 implementation. Increasingly, the private sector plays a role in improving the competitiveness of state assets. By teaming up with more profitable and innovative private companies, China's SOEs are introduced to greater market pressures. Most prominently, pilots in mixed ownership reform have seen private companies taking stakes in some of China's largest SOEs in sectors like energy, telecommunications and defense. In 2019, a hundred additional SOEs will be screened for possible mixed ownership.[38]

In another effort to improve the operation of SOEs, the government has introduced a wave of consolidation through mergers. These serve two main purposes: First, they help to support strategically important SOEs and provide the state with a prominent role in steering industrial policies and the economy more broadly. Second, creating national champions of a significant market size helps to shape formidable competitors on international markets. Examples of this include the merger of China's two rolling stock manufacturers as the China Railway Rolling Stock Corporation (CRRC) in 2015, the merger of China Nuclear Engineering & Construction Corp (CNEC) into China National Nuclear Corporation (CNNC) in 2018, and the proposed merger of ChemChina and Sinochem.

SOE reforms are certainly not new and face massive internal structural barriers and vested interests. A new official debate has been emerging since October 2018 (formally endorsed by Li Keqiang at the National People's Congress in March 2019) on the need for "competitive neutrality." This would involve even more attempts to level the playing field for private, and in theory, also foreign companies, and could therefore affect the MIC25 policy environment quite dramatically. Based on the track record of the past five years, it seems extremely likely, however, that MIC25 will continue to have a strong SOE face going forward.

4. European participation in China's tech ambitions is a double-edged sword

4. European participation in China's tech ambitions is a double-edged sword

China's MIC25 strategy is mainly a domestic policy aimed at boosting indigenous capabilities. China complements this with a series of outward-facing approaches to secure access to foreign know-how and technologies, with the goal of bringing technological value chains into the domestic economy and reducing dependency on foreign partners.

The chosen approach depends on the relevance of a particular industry for China's national strategic targets (see exhibit 15). The greater the technological gap, the more important it is for Chinese companies to gain access to foreign know-how. There are three main patterns in how China views foreign companies for the goal of reaching its industrial policy targets.

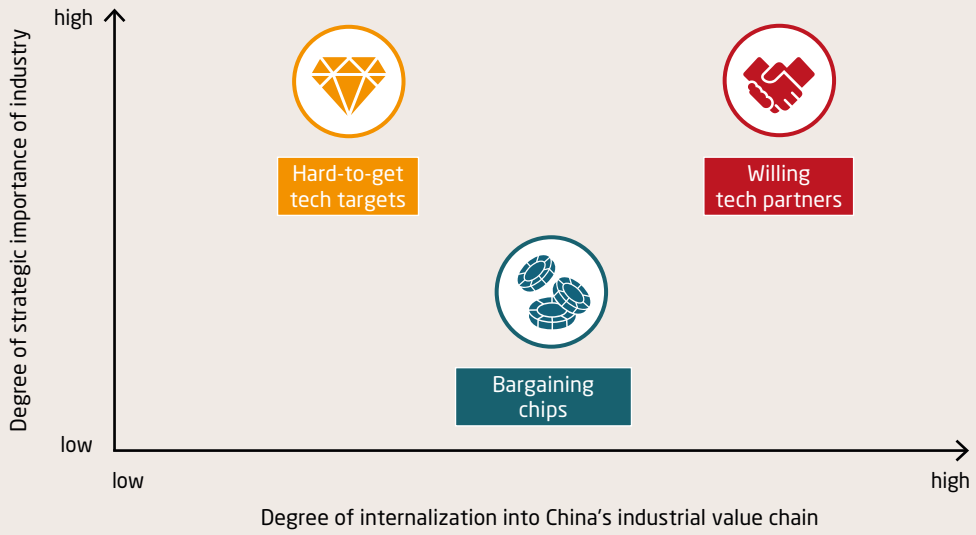
4.1 BARGAINING CHIPS, HARD-TO-GET TARGETS, OR WILLING FOREIGN PARTNERS: CHINA PURSUES BESPOKE STRATEGIES FOR EACH

Bargaining chips: These are foreign companies in industries that China's economic planners consider to be of low strategic value. Whether their value chains and technology have been integrated into China's domestic economy is of little relevance. This has been the case for many consumer goods, including businesses like restaurant franchises or retail outlets.

A more recent example has been the decision to drop China's joint venture requirement in the automobile sector. This step would have been far more meaningful a decade ago, when China still depended on foreign carmakers for access to high-quality combustion engine production. Today the sector has lost relevance in efforts to upgrade China's industry, as domestic companies are already well-positioned in the emerging electronic vehicle (EV) market.

Exhibit 15

China's strategic grid of engagement with foreign partners
Approach depends on strategic value for tech transformation



Source: MERICS

However, opening a limited number of sectors to foreign companies and investors still serves a purpose, as these sectors can be used as bargaining chips in negotiations with foreign governments. China can thus signal to international partners that it is committed to further liberalizing its economy.

Beijing strives to convince foreign companies to move sophisticated parts of their value chain to China

Willing tech partners: The Chinese government strives to convince foreign companies to move the most sophisticated parts of their value chain to China, in order to upgrade domestic industry and either directly or indirectly result in incorporating these value chains into the domestic economy.

The consumer electronics sector is one area in which this strategy has been successful. China started out assembling products but has now proceeded to more sophisticated areas including R&D and production of key components.

China's sheer market size and the allure of government-supported initiatives do indeed make it seem attractive for foreign companies to expand their activities in China. Being a first mover in this market can be highly lucrative. Likewise, helping build up industries targeted by China's industrial policy can be a profitable endeavor for foreign suppliers.

But those thinking of moving core business to China must also consider the price: the more dependent companies are on the Chinese market and the more eager they are to participate in flagship projects, the more leverage the government will have over them.

Hard-to-get tech targets: Leading foreign tech companies that retain the most important parts of their value chains outside China are more difficult to approach. Access to their high-value technology is considered particularly beneficial to strengthening China's industrial base. The Chinese government is working on several levels to gain access to the know-how and technologies of these hard-to-get targets:

(a) *Attract:* China may be willing to make concessions in order to very selectively improve the business environment for such companies. Measures include, for example, improved market access or more lenient joint venture requirements. Foreign companies have responded to such steps: Rolls-Royce is considering to set up a jet engine assembly in order to secure a contract for supplying the wide-body airliner CR929. BASF decided to build a 10 billion USD production facility after China dropped a previously existing joint-venture requirement.

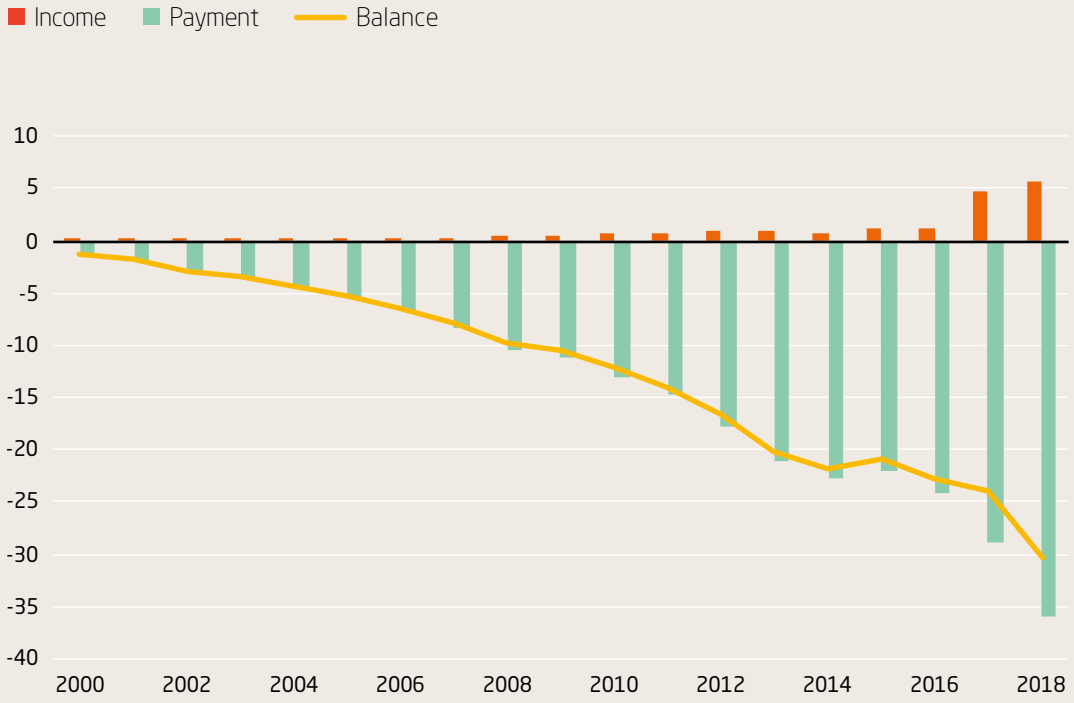
(b) *Acquire:* In areas where the government cannot lure foreign companies to China, it takes an external strategy. China's increasing acquisitions of foreign high-tech assets are the most visible feature. These have accelerated rapidly since the launch of MIC25 in 2015. In 2018, 58 percent of the value of Chinese foreign direct investment (FDI) in Europe could be attributed to core industries of the MIC25 strategy.[39] Faced with greater international scrutiny of Chinese mergers and acquisitions (M&A), Chinese actors will likely resort to other channels, including venture capital investment, legally licensing intellectual property rights, and institutional cooperation with international partners in R&D.

Data from Rhodium Group suggest that Chinese venture capital investments to the US rose to 3.2 billion USD in 2018 compared to 2.1 billion USD in 2017.[40] (see exhibit 16).

Exhibit 16

China is hungry for foreign intellectual property rights

Payments for IPR has increased dramatically



Source: SAFE

Access to technology through legally licensing intellectual property rights as well as institutional cooperation with international partners in areas of R&D are other possible vehicles to circumvent stricter investment screening. As a result, the deficit for IPR royalties has ballooned from 1.3 billion USD in 2000 to 30.2 billion USD in 2018.

(c) *Attack:* For key technologies that are most difficult to access, China may resort to aggressive approaches like industrial espionage or corporate cyber-attacks. A softer approach might consist of talent acquisition and head-hunting key research staff from companies or academia to work in China. China has been actively poaching Taiwanese semiconductor experts and has been accused by the German Office for Information Security (BSI) of hacking German companies.

4.2 CHINA'S TECHNOLOGICAL RISE OFFERS NEW BUSINESS OPPORTUNITIES FOR FOREIGN COMPANIES

China's economic development boosted demand for more advanced products, creating substantial business opportunities for foreign companies. So far, a great majority of them willingly handed over parts of their technology to secure market access. The larger the technological gap, the better this arrangement worked. Foreign business people and politicians have for some time perceived MIC25 and China's ascent up the value chain as offering further opportunities for foreign companies.

Foreign companies with sought-after technology can, in fact, benefit from China's industrial upgrading. Previously, China had little more to offer than cheap labor and a fast-growing market, but now the incentive structure has changed. Foreign companies can benefit from preferential treatment, innovative market dynamics, and Chinese support policies. Survey data by the European Chamber of Commerce indicates that foreign participation in MIC25 is highest in areas where China lacks know-how.[41] However, China's accommodating attitude remains strategically selective. The more sophisticated the technology and the more R&D involved, the better the incentives. These moves must not be misinterpreted as proof of a growing openness toward foreign companies in general.

With a shrinking technological gap and backed by strong industrial policies, the dynamic Chinese market has turned into the new technological frontier in some areas, including smart manufacturing and EVs. For many executives, participation and deeper engagement within China therefore seems inevitable. And indeed: China's industrial upgrade provides individual companies and other organizations with great business opportunities. However, it is advisable to look beyond entrepreneurial profit and take more systemic effects into account, as China's innovation offensive will affect the competitiveness of other nations in many high-tech sectors.

4.3 MIC25 IS ALREADY AFFECTING EUROPE'S INNOVATION ENVIRONMENT

Regardless of the primarily domestic focus of China's industrial policies, the dynamics of strategies like MIC25 are already affecting Europe's innovation environment and industrial foundations. The division of labor between China and its international trade partners, especially in high-tech areas, is currently changing on several levels.

The days in which foreign brands are generally seen as superior to Chinese competitors are over

First, China's efforts to pull ahead in emerging technologies will change the market environment for Europe's companies. This is already visible in areas such as AI, Electric Vehicles (EV) and the related battery industry. Chinese decision makers consider European and other foreign companies necessary in areas in which their expertise is still needed. Nevertheless, the aim is for Chinese companies to dominate the market. The days in which foreign brands are generally seen as superior to Chinese competitors are over.

Second, in many traditional high-tech sectors, Chinese companies have closed the technological gap enough to compete with more advanced foreign companies, even on global markets. The ability to offer a cheaper price for technology that might not be top-notch but that is good enough, will add pressure on European companies in a broader set of industries. As Chinese companies move up the value chain through a combination of market forces and government support, they will be able to cater to demand in third markets – often at more competitive prices.

Third, Europe's industrial foundations are increasingly feeling the effects of this. Corporate R&D activities are shifting to China, posing challenges to developed economies across the globe. This is particularly true for emerging industries, whose global value chains are currently taking shape in China. Carmakers like Germany's BMW and VW or France's PSA have opened up R&D facilities for electric vehicles in China. The country is on the verge of becoming the global hub for EV vehicles, with the help of foreign companies.[42] Chinese start-ups in this sector, like Byton and NIO, were founded by or with foreigners.

European companies with strategies based on economic rationale and which operate on market principles do not have access to massive state backing that their Chinese counterparts have. Government incentives and funding allow Chinese companies to move faster, and the resulting strong competition may erode the profitability of European companies and limit their ability to fund R&D. As a result, innovation dynamics in Europe could slow down, allowing Chinese companies to close existing technological gaps at an even greater pace.

The solar industry is one illustration of how Europe lost out to Chinese competitors, despite its strong technological fundamentals. In 2019, seven of the top ten solar panel manufacturers are Chinese and the once strong industry has nearly disappeared in Europe. Faced with forceful Chinese strategies like MIC25, Europe's innovation landscape will face even stronger competition in a wider range of advanced industries.

5. Exemplary willing partner: Germany supports China's advance in business and research

5. Exemplary willing partner: Germany supports China's advance in business and research

Germany is a good example of a developed nation whose economic base could be directly threatened by China's industrial ambitions. Despite rising competition between the two countries, their respective economic development and comparative advantages are still widely viewed as complementary in Germany. Germany's favorable industrial base, including hidden champions, is seen as well-matched with China's (financial) resources and business opportunities.

As of today, German know-how and companies' willingness to cooperate form an important cornerstone for China's global tech ambitions.[43] For China, Germany is the main point of reference for smart manufacturing. MIC25 is clearly geared towards replicating Germany's industrial digitalization and automation policy Industry 4.0.[44] By now, the terms smart manufacturing (智能制造) and Industry 4.0 (工业4.0) have virtually become synonymous in Sino-German dealings. Beijing has singled out Germany as a preferred partner – and German companies and experts are often willing to reciprocate.

German know-how and companies' willingness to cooperate form a cornerstone for China's global tech ambitions

Sino-German tech, industrial and innovation collaboration is embedded in a framework of high-level political exchanges and involves key actors from the German political, economic and academic spheres.[45] The German government sets the larger framework for public and private cooperation with China. More than 90 cooperation agreements were signed at regular Sino-German government consultation meetings since 2011. Activities range from research and training to more hands-on tech application in a wide range of fields that are crucial for China's industrial upgrading (see exhibit 17).

Against the backdrop of China's tech ambitions and their close link to the country's geopolitical rise, Sino-German cooperation in basic and applied research is a particularly critical field to watch.

Universities – especially those with a technical focus – and non-university research organizations, such as the Fraunhofer Society, the Max Planck Society and the Helmholtz Association of German Research Centers, are key actors in this regard. They operate at the juncture of government (general orientation and funding), academia (know-how) and business (commercialization of results). Notably, Xi Jinping described Helmholtz institutions as models for the development of national laboratories in China.[46]

Other key actors of bilateral S&T cooperation include technical universities such as TU Darmstadt and the Karlsruhe Institute of Technology (KIT), which have a particularly strong focus on the promotion of Industry 4.0 – not only in Germany, but also in China.

Exhibit 17

German actors contribute to China's technological advance

Examples of Sino-German R&D cooperation

	Institutional actors	Areas of engagement	Examples	
			MIC25-related focus	China-related activities
Enabling framework	Government (federal, state and city level)	• Promotion of bilateral cooperation	• Smart manufacturing/ Industry 4.0 • Transportation • Energy • Education and research	• Memoranda of Understanding (MoUs) • Strategic partnerships, incl. sister cities • Periodic consultations • Funding of joint research and related activities via cooperation facilitators (see below)
	Cooperation facilitators with state-affiliation	• Services for international cooperation • Talent mobility • Joint research promotion • Research funding (public funds)	• Smart manufacturing/ Industry 4.0 • Engineering • Natural sciences • Life sciences	• Support of international research trainings and joint interdisciplinary research – incl. mentoring, mutual visits, exchanges, and workshops • Joint graduate colleges in cooperation with German and Chinese universities • Joint Sino-German Center for Research Promotion (CDZ) of the German Research Foundation (DFG) and the National Natural Science Foundation of China (NSFC) in Beijing, for cooperation in basic research • "Strategic Partnerships and Thematic Networks" program of the German Academic Exchange Service (DAAD), for funding of research projects and partnerships
Implementation	Technical universities (TUg)	• Basic and applied research	• Smart manufacturing/ Industry 4.0 • Electronic control systems • Cyber-physical systems • Mechanical engineering • Nanosciences • New-energy vehicles and batteries • New materials	• Explicit China focus – incl. (strategic) university partnerships • Local offices in China, promoting e.g. market access and development • Double degree programs and joint graduate schools • Talent exchanges, deployment and trainings • Joint research projects, groups, labs, and centers • Cooperation agreements with research institutions and companies
	Non-university research organizations	• Basic research	• Chemistry • Physics • Biomedicine • Computational biology	• China as priority region, including explicit China strategies, local offices and joint project centers in China • (Strategic) cooperation agreements with ministries, universities, academies and provinces in China • Local research and partner groups • Talent scouting, exchanges, trainings • Market development, licensing and contract research for industrial partners • Cooperation between the Fraunhofer Institute for Manufacturing Engineering and Automation (Fraunhofer IAO) with the Chinese state Key Lab for Intelligent Manufacturing Systems Technology • Helmholtz's "Initiative and Network" Fund, e.g. for joint reserach groups and strategic partnerships
		• Applied research	• Smart manufacturing/ Industry 4.0 • Engineering • Automation • Cloud computing • AI applications in robotics	
		• Basic & applied research	• Aeronautics • Transport • Health	

BWA: Federation for Economic Promotion and Foreign Trade (Bundesverband für Wirtschaftsförderung und Außenwirtschaft)
CDHK: Chinese-German College for Postgraudate Studies (Chinesisch-Deutsches Hochschulkolleg)
CDZ: Sino-German Center for Research Promotion (Chinesisch-Deutsches Zentrum für Wissenschaftsförderung)
CSC: China Scholarship Council
DAAD: German Academic Exchange Service (Deutscher Akademischer Austauschdienst)
DFG: German Research Foundation (Deutsche Forschungsgemeinschaft)
GIZ: German development agency (Gesellschaft für Internationale Zusammenarbeit)
NSFC: National Natural Science Foundation of China
TUg: Excellence in Engineering and the Natural Sciences – Made in Germany: nine leading technical universities in Germany

Source: MERICS

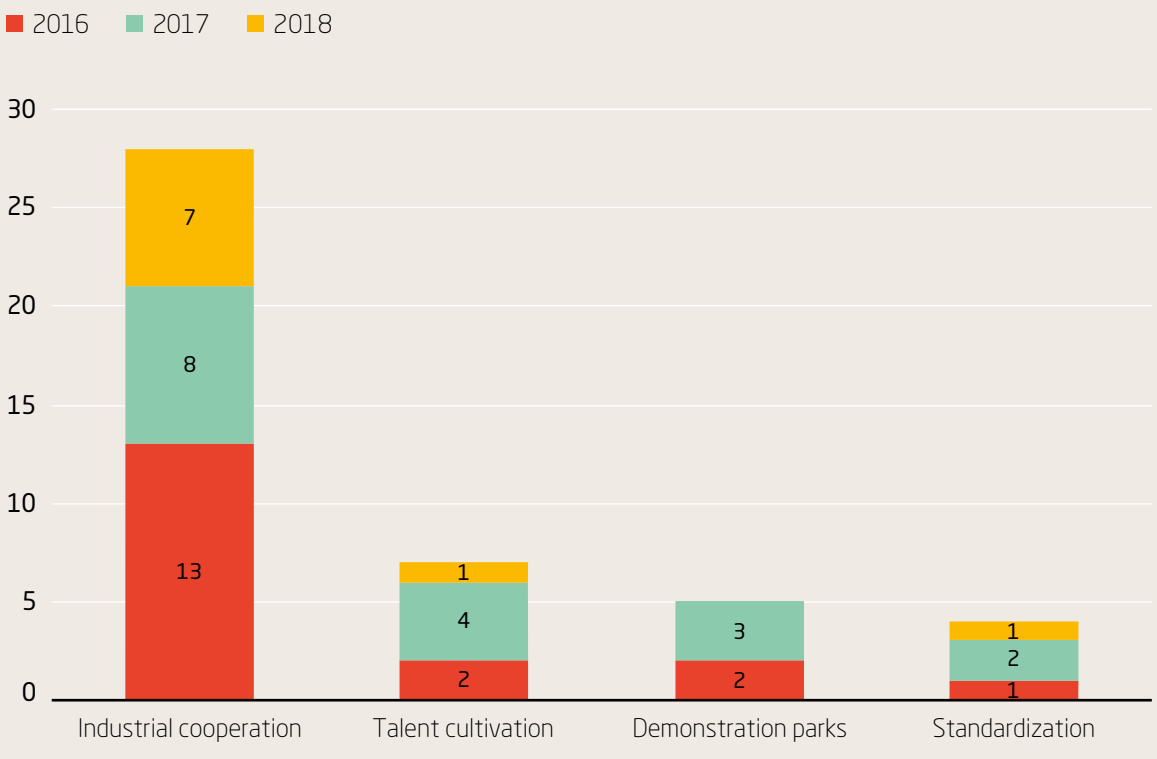
Sino-German cooperation at company level is another important driver of smart manufacturing-related developments in China. Since 2015, the MIIT has announced annual lists of smart manufacturing pilot demonstration projects (智能制造试点示范项目). Germany is the only country with a separate project category in the lists (see exhibit 18). More than 50 German organizations have participated, probably hoping their engagement will one day translate into competitive advantages on the Chinese market. As early as December 2015, a dedicated China-Germany Equipment Manufacturing Industrial Park was established in Shenyang, Liaoning province, as "a demonstration area integrating [the] development strategies of 'Made in China 2025' and German Industry 4.0." [47]

Since 2016, the German development agency, "Deutsche Gesellschaft für Internationale Zusammenarbeit" (GIZ), has been commissioned as the German implementation partner of the Sino-German Industry 4.0 project, which tracks and promotes smart manufacturing developments in China and seeks to "create a better framework condition for German and Chinese companies in the field of Industry 4.0 and 'Made in China 2025'."(see exhibit 18)[48]

Exhibit 18

Sino-German pilot projects focus on industrial cooperation

Number of MITT-awarded pilots with German participation



Source: MIIT, GIZ

6. Strategies for coping with "Made in China 2025" – Learning from East Asia

6. Strategies for coping with "Made in China 2025" – Learning from East Asia

In the past four years since "Made in China 2025" was officially launched by the State Council and Prime Minister Li Keqiang, the strategy has, despite many setbacks, moved from blueprint to implementation. This analysis has shown how China's industrial innovation is in full swing. MIC25 is here to stay – and European industrialized countries need to find answers for dealing with the cooperative and competitive aspects of China's offensive.

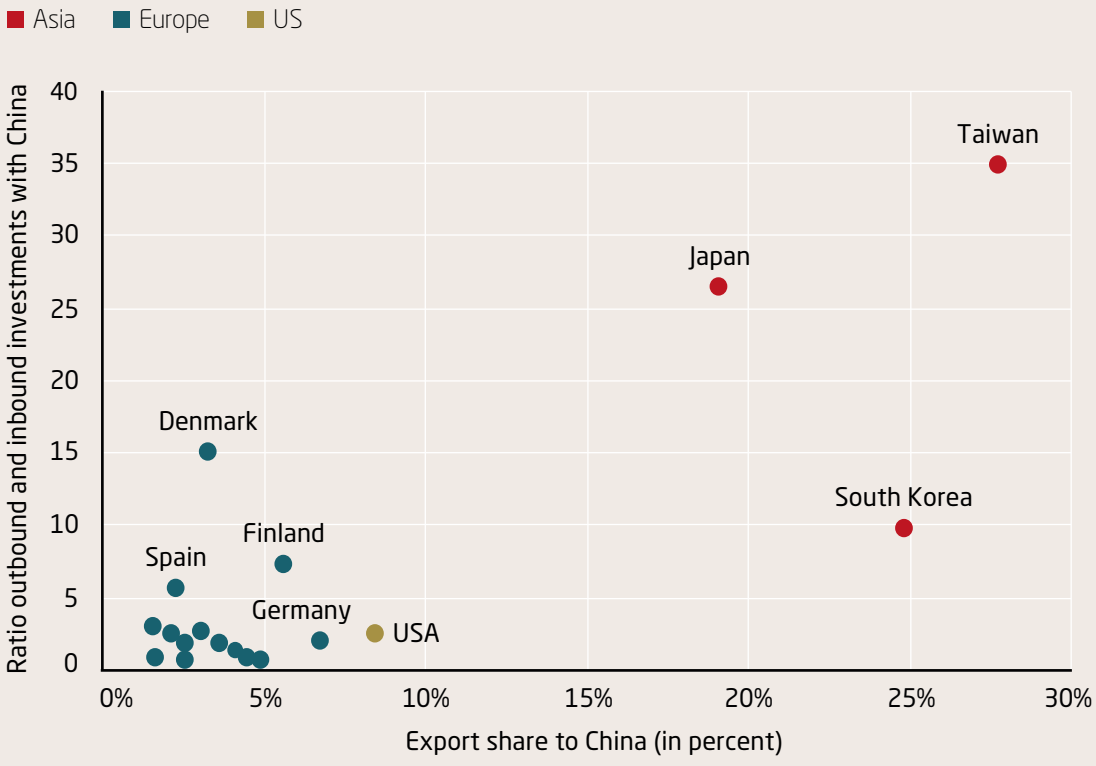
Compared to a geographically distant Europe, China's immediate neighbors are already experienced in dealing with this increasingly assertive country making not only economic but also geopolitical claims. Europe can learn from this approach and their experiences.

Japan, Taiwan, Hong Kong (prior to the handover in 1997), and to a lesser degree South Korea, are much more closely intertwined with China's economy. The PRC is an important export destination, comprising 19 percent of Japan's, 24.9 percent of South Korea's, and 27.7 percent of Taiwan exports in 2017. China is also a vital source of profits due to the heavy investments its companies have accumulated over time. According to data from China's Ministry of Commerce, investments from Japan, Taiwan and South Korea accounted for an average of nearly 17 percent of total annual utilized FDI between 2000 and 2010. In contrast, investments from Europe and the US accounted for 5 and 6.5 percent, respectively (see exhibit 19).

Exhibit 19

Asia is feeling the heat much more than Europe

Importance of economic relations with China



Source: MERICS based on China's Ministry of Commerce, UN Comtrade, Bureau of Foreign Trade of Taiwan

China's East Asian neighbors must manage a far more sophisticated set of challenges: they depend strongly on China economically and at the same time need to consider issues of national security. This is reflected, for instance, in a far more restrictive approach to investments from and research cooperation with China. Compared to Europe and the US, Chinese investment flows with East Asian countries are largely a one-way street. Taiwanese and Japanese investment in China is 26 and 35 times larger, respectively, than Chinese investment in both countries. Compared to the EU and the US, they are less open to such investment, because they see China as far more than a mere economic actor.

In dealing with its neighbors China has already weaponized economic power in retaliation for political developments it perceives as unfavorable. For example, it imposed economic punishments after territorial disputes with Japan over the Senkaku Islands (or Diaoyu in Chinese), the deployment of the US THAAD missile system in South Korea and the election of Taiwan's Democratic Progressive Party (DPP) candidate Tsai Ing-Wen. A more pronounced threat from China over the past decade has forced governments to reassess their levels of engagement with this important economic partner.

East Asian countries have measures in place to balance economic opportunities and national security interests

Lessons from East Asian countries show that economic dependency does not have to translate into an accommodating position towards China. When China shifted from being a manufacturing base for companies from Japan, Taiwan and South Korea to becoming a key market, these countries revised their China policies. East Asian countries have measures in place to balance economic opportunities and national security interests. With China now less of a partner and more of a competitor, clear limits were put in place that defined the scope of cooperation. Although the responses are not identical, many have taken measures to safeguard technology:

- Raising awareness among businesses and academia
- Strict investment regulations for acquisition of high-tech companies
- Review process or regulation of high-tech investments in China
- Revision of legislation and prosecution of acts of passing on trade secrets
- Guidelines and industry cooperation on preventing intentional and unintentional knowledge transfer
- Countermeasures preventing knowledge transfer via recruitment (head hunting)
- Technical cooperation in joint research for high-tech not encouraged by government
- Development of incentives to reduce companies' dependence on Chinese market

Safeguarding key technology is seen as crucial for remaining economically competitive. A rising urgency to respond to a more ambitious China forced the leading industrial nations in Asia to take measures beyond merely voicing concerns or increasing investment-screening mechanisms. Their examples also illustrate that taking active measures to safeguard key interests and know-how does not necessarily result in a breakdown of economic relations.

Europe is slowly waking up to the challenges arising from China's globally expanding state capitalist system. Voices favoring the stronger use of industrial polices and protectionism illustrate how China's industrial policies are kicking off a debate about Europe's strategy for staying at the technological frontier. Fears of losing out in newly emerging industries have sparked calls for national champions and technology autarky in key sectors. Europe can learn from East Asian experiences in formulating its response to "Made in China 2025" and other forceful tools of China's industrial innovation policy.

RECOMMENDATIONS

Improving Europe's innovation system without copying China:

- **Combine joint EU responses with small-group efforts of leading member states to improve Europe's innovation system and better exploit opportunities from current technological changes.** The EU needs to take stock of its structural weaknesses. In order to face a technologically more ambitious China, the EU and member states need to step-up their game to foster innovation, invest in education systems and strengthen the EU's industrial performance. This should be based on market-driven mechanisms.
- **Improve policy support for applied research by private entities.** A better regulatory environment and financial instruments should stimulate research and technology adaptation in Europe. This includes strengthening single market mechanisms, the creation of European standards in emerging technologies and instruments that improve the transmission of academic research results to market.
- **Facilitate greater research collaboration within the EU.** Take steps to improve coordination and collaboration in Europe's innovation landscape, for instance by further strengthening specialized (cross-border) regional innovation clusters.

Doubling-down on the EU's nascent China strategy to promote European economic sovereignty:

- **Reassert core liberal values for a China strategy by defining areas of mutual interest as well as division.** The process initiated by the joint communication on an EU China strategy published in March needs to result in a recalibration of how the EU engages with China by setting a more clearly limited framework for cooperation. While cooperation in areas of overlapping interest is desirable, the EU needs to safeguard and advance core liberal values more forcefully. A violation of defined red lines and lack of progress in critical negotiations needs to result in timely consequences for the EU-China relationship.
- **Prepare for negative (economic) consequences in defense of EU's core interests.** Economic opportunities resulting from China as a trading partner need to be balanced against likely long-term damages resulting from China's persistent hybrid economy, security concerns and an incompatible political system. It should be assumed that Chinese authorities will act smartly in using different forms of economic influence to pursue their interests in the EU-China relationship.
- **Establish an efficient and reliable coordination mechanism to foster greater alignment between Brussels institutions and member states.** Creating a more institutionalized body (commission or task force) to facilitate coordination of China strategies and policies across EU Directorate-Generals and of individual member states might help to further reduce intra-EU divisions.
- **Strengthen cooperation with like-minded countries and leading East Asian economies to advance global fair competition and technology standards in the face of government-driven market distortions and high-tech nationalism.** Any action taken by the EU will benefit from "strength in numbers", i.e., greater alignment with partners to devise international arrangements and rules that help to manage elements of systemic competition in the decades ahead. The EU will need to take the lead in developing plurilateral agreements that effectively tackle government-induced competitive distortions.

Fine-tuning European China strategies to address high-tech competition:

- **Recognize China's persistent top-level push for tech independence.** Detaching the EU from China's innovation ecosystem would undermine Europe's own ability to innovate. While cooperation with China can be of mutual interest, a framework is needed that takes into account China's technological ambitions and progress. Collaboration with a partner that openly strives to replace and compete with Europe's companies requires clearly spelling out conflicts of interest. Building on recent efforts by the Joint Research Council, the EU needs a foresight mechanism to assess future risks to European competitiveness, critical supply-chain dependencies and threats to Europe's (defense) industrial base.
- **Use China's persisting dependence on foreign technology as leverage to promote European interests.** Cooperation in high-tech areas should be made more conditional on meaningful reforms including market opening and strengthening market mechanisms.
- **Initiate steps to limit dependence on critical components from China.** Encourage the adjustment of supply chains for critical components outside China to reduce vulnerability to potential Chinese exports controls (such as with rare earths, battery technology etc.).
- **Strengthen the role and coordination of European business associations in assessing China's high-tech policies and developing responses.** European policy makers need better and more updated information on China's industrial policy practices and technological ambitions. To increase risk awareness and timely responses, this should be accompanied by mechanisms to facilitate information exchanges between companies and industrial bodies across Europe and for reporting possible misconduct and suspicious activities in advanced tech cooperation projects.

Safeguarding research and technological know-how:

- **Review and monitor Sino-European agreements on science and tech cooperation.** EU member states and national institutions have signed various agreements including on joint research and development programs as well as other forms of technological collaboration. A better overview is needed, for instance by creating and updating a consolidated database of relevant cooperation projects on different government levels, universities and research bodies.
- **Define criteria for government-initiated science and technology cooperation.** Supported by an EU-level task force, member states should clearly identify areas in which technological cooperation is or is not encouraged as a guideline for national and local governments, companies, universities, and research institutions.
- **Introduce better safeguards against technology transfers.** European export control regimes and practices need to be beefed-up to make sure that advanced forms of technological cooperation are accompanied by strong measures that safeguard against potential unintended and often intangible technology transfers. The coordination of member state's mechanisms for investment screening, export controls and the review or approval of research collaboration need to be better linked between respective national authorities and aligned across Europe.
- **Require mandatory reporting on cooperation in highly sensitive areas.** Agreements with China in basic research and sensitive areas (such as related to dual-use applications) should require mandatory reporting by the European entity if it is publicly funded.

The MIC25 top-level policy design: the "1+X" framework

"1+X" framework		Date of publication	Policy documents	Releasing institutions
"1"		May 19, 2015	Made in China 2025	State Council
+				
"X" (11 supplementary documents)	2 special action guidelines	July 26, 2016	Guidelines for the Special Action to Develop Service-oriented Manufacturing	MIIT, NDRC, CAE
		August 26, 2016	Guidelines for the Special Action to Promote and Upgrade Equipment Manufacturing Quality Brands	MIIT, AQSIQ, SASTIND
	5 project implementation guidelines	August 19, 2016	Guidelines for the Implementation of the Project to Establish Manufacturing Innovation Centers (2016–2020)	MIIT, NDRC, MOST, MOF
			Guidelines for Implementation of the Strong Industry Foundations Project (2016–2020)	
			Guidelines for the Implementation of the Green Manufacturing Project	
			Guidelines for the Implementation of the Smart Manufacturing Project	
			Guidelines for the High-end Equipment Innovation Project (2016–2020)	
	4 development guidelines	January 07, 2017	Guidelines for the Pharmaceutical Industry Development Plan	MIIT, NDRC, MOST, MOFCOM, NHFPC, CFDA
		January 16, 2017	Guidelines for the Development of the Information Industry	MIIT, NDRC
		January 23, 2017	Guidelines for the New Materials Industry	MIIT, NDRC, MOST, MOF
		February 24, 2017	Guidelines for the Manufacturing Industry Talent Development Plan	MOE, MOHRSS, MIIT

AQSIQ: General Administration of Quality Supervision, Inspection and Quarantine
CAE: Chinese Academy of Engineering
CFDA: China Food and Drug Administration
MIIT: Ministry of Industry and Information Technology
MOF: Ministry of Finance
MOFCOM: Ministry of Commerce
MOHRSS: Ministry of Human Resources and Social Security
MOST: Ministry of Science and Technology
NDRC: National Development and Reform Commission
NHFPC: National Health and Family Planning Commission
SASTIND: State Administration for Science, Technology and Industry for National Defence

Source: MIIT

A selection of national-level state (guiding) funds promoting MIC25

No.	Funds (EN)	Funds (中文)	Estab-lished	Releasing Institution
1	Shipping Industry Investment Fund	船舶产业投资基金	Dec. 2009	Support the development of China's shipping industry
2	China Aviation Industry Investment Fund(officially: Avic Fund of China)	中国航空产业投资基金	Nov. 2010	Support the development of China's aviation industry, especially with regard the aspects of new energy, new materials and innovation
3	Central Government Emerging Industry VC Fund	中央新兴产业创业投资基金	Apr. 2014	Support of strategic emerging industries and innovative SMEs
4	National S&T Achievement Transformation Guiding Fund (officially: "National Fund for Technology Transfer and Commercialization," NFTTC)	国家科技成果转化引导基金	Sep. 2014	Support transformation of S&T achievements, especially in emerging industries
5	National IC Industry Investment Fund ("Big Fund")	国家集成电路产业(投资)基金	Sep. 2014	Support the development of China's national IC industry
6	National SME Development Fund	国家中小企业发展基金	Sep. 2015	Support the development of innovative SMEs, especially in fields such as advanced manufacturing, new energy, new materials, biomedicine, and IT
7	National Advanced Manufacturing Industry Investment Fund	国家先进制造产业投资基金	Jul. 2016	Support the upgarde of traditional manufacturing and the development of advanced manufacturing, especially in emerging industries
8	China Public VC Fund	中国国有资本风险投资基金	Aug. 2016	Support of corporate innovation and China's strategy of innovation-driven development, in general
9	Civil-Military Integration Development Fund	军民融合发展基金	Sep. 2016	Strenghten CMI, especially in aerospace and nuclear technology
10	China Structural Reform Fund	中国国有企业结构调整基金	Sep. 2016	Support reforms in China's SOEs, capital allocation and general assets, especially in fields such as nuclear energy, big data and the Internet of Things
11	China Colleges and Universities Innovation Venture Fund	中国高校双创产业投资基金	Oct. 2016	Support mass entrepreneurship and innovation at Chinese colleges and universities
12	Central Government SOE & Poor Region Industrial Investment Fund	中央企业贫困地区产业投资基金	Oct. 2016	Support of priority industries for development in poverty-stricken regions such as agriculture, manufacturing, electricity, and chemicals
13	National Emerging Industries VC Investment Guiding Fund	国家新兴产业创业投资引导基金	Dec. 2016	Support innovative enterprises in emerging industries
14	China Internet Investment Fund	中国互联网投资基金	Jan. 2017	Support of the Internet+ initiative
15	Central Government SOE Guochang Investment Guiding Fund	中央企业国创投资引导基金	May 2017	Support S&T innovation of central SOEs, especially in emerging industries
16	National Strategic Emerging Industry Development Fund	(国家)战略性新兴产业发展基金	Dec. 2018	Support the development of (clusters of) strategic emerging industries such as IT, high-end equipment, new materials, NEVs, and biopharma

Source: MERICS

State-owned and private enterprises divide the leadership in MIC25 core industries amongst themselves (selection)

Next-generation IT	Ownership	Business area
Huawei	private	network equipment, consumer electronics (-> smartphones)
ZTE	SOE	network equipment provider
Alibaba	private	AI research as well as all kinds of Internet related services
Tencent	private	AI research as well as all kinds of Internet related services
Baidu	private	AI research as well as all kinds of Internet related services
Beijing Bytedance	private	Internet media, smartphone applications, AI research
Sense Time	private	deep learning and AI research, face recognition technology
Cloudwalk	private	AI research, facial recognition technology
Yitu Technology	private	AI research in relation to health care, finance
iFlytek	private	AI, translation systems, voice recognition
Megvii Face++	private	AI, face and body recognition
Cambricon	private	IC, AI chips, semi-conductors
YMTC	SOE	IC / microchips
Horizon Robotics	private	IC / microchips
HiSilicon Technologies	private	IC
Jiangsu Changjiang Electronics Technology	private	IC packaging and testing
Automation and robotics		
Sense Time	private	deep learning and AI research, face recognition technology
DJI	private	intelligent aerial drones, AI research
Ubtech Robotics	private	humanoid robots
Siasun Robot & Automation	private	robots: industrial, mobile, service; intelligent logistics and assembly systems
Aviation and space equipment		
Commercial Aircraft Corporation of China	SOE	large commercial / passenger aircraft
Aviation Industry Corporation of China	SOE	transport, fighter & bomber aircraft; helicopters; gen. Aviation
China Aerospace Science and Technology Corporation	SOE	spacecraft, launch vehicles, strategic & tactical missile systems
Maritime equipment and high-tech ships		
China Shipbuilding Industry Corporation (CSIC)	SOE	shipbuilding, marine engineering
China State Shipbuilding Corporation (CSSC)	SOE	shipbuilding, equipment manufacturing
Dalian Shipbuilding Industry Corporation (part of CSIC)	SOE	shipbulding, energy and offshore equipment
COMEC / GSI (part of CSSC)	SOE	shipbuilding; marine, electrical and mechanical equipment

Source: MERICS

State-owned and private enterprises divide the leadership in MIC25 core industries amongst themselves (selection)

Advanced railway transportation equipment		
China Railway Construction Corporation	SOE	railway construction
China Railway Group (parent: China Railway Engineering)	SOE	infrastructure construction: railways, roads etc.
China Communications Construction Company	SOE	transportation infrastructure: railways, roads, ports etc.
CRRC Corporation	SOE	rolling stock, trains, locomotives
Energy saving and new energy vehicles		
Baidu, Alibaba, Tencent	private	in relation to AD: platform and mobility service
Didi Chuxing	private	platform and mobility service
Pony.ai	private	vehicle construction
WeRide / Jingchi	private	vehicle construction
Horizon Robotics	private	AI chips
Cambricon	private	AI chips
Contemporary Amperex Technology	private	Electric Vehicle Batteries
BYD	private	Electric Vehicle Batteries
OptimumNano	private	Electric Vehicle Batteries
Guoxuan High-Tech	private	Electric Vehicle Batteries
Beijing National Battery Technology	SOE	Electric Vehicle Batteries
NIO	private	Electric Vehicles
Xpeng Motors	private	Electric Vehicles
BAIC Group	SOE	Automotive Industry incl. Electric Vehicles
Geely	private	Automotive Industry incl. Electric Vehicles
Energy equipment		
Hanergy	private	previously hydro power, now solar power
GCL-Poly	private	cogeneration, incineration, wind power
China Three Gorges Corporation	SOE	power generation, hydro-electric power
Goldwind	private	wind power
Jinko Solar	private	solar panels
Guodian Technology and Environment Group	SOE	environmental protection, energy conservation, wind power
Agricultural equipment		
Yito Group	SOE	agricultural machinery
Changfa Agricultural Equipment	SOE	agricultural machinery: tractors, rice transplanters, harvesters
Chery	SOE	automotive, agricultural machinery

Source: MERICS

State-owned and private enterprises divide the leadership in MIC25 core industries amongst themselves (selection)

New materials		
Contemporary Amperex Technology	private	batteries, energy storage
Shanghai Phichem	private	ultraviolet curing materials
Guangdong Dowstone Tech.	private	ceramic ink, metal / enamel / full cast glaze
Jiangsu Nata Opto-electronic Material	SOE	electronic materials, metal organic sources
Jiangsu Jiuwu High-Tech.	SOE	ceramic / organic membranes
Biomedicine & high-performance medical equipment		
Jiangsu Hengrui Medicine	private	innovative medicine, surgical medicine
Shanghai Pharmaceuticals	private	pharmaceuticals
Sinopharm Group	SOE	pharmaceuticals
Wuxi Apptec	private	medical devices, pharmaceuticals
China Resources Pharmaceuticals Group	SOE	chemical drugs, pharmaceutical and healthcare products

Source: MERICS

Change in wording, but no change in meaning

Theme	Gov. Work Report 2015*	MIC25	Gov. Work Report 2016	Gov. Work Report 2017	Gov. Work Report 2018	Gov. Work Report 2019
Manufacturing superpower	Accelerate the transformation from a major manufacturing power to a manufacturing superpower	Turn China into a manufacturing superpower with a world-leading manufacturing industry	Accelerate the establishment of a quality superpower, a manufacturing superpower, and an IPR superpower	Improve the policy system for the establishment of a manufacturing superpower	Speed-up the establishment of a manufacturing superpower	Accelerate the establishment of a manufacturing superpower
Smartification	Persist in [...] the smartification [of the manufacturing industry]	Make the smart manufacturing the major direction to follow	Implement a batch of smart manufacturing demonstration projects	Make the development of smart manufacturing the major direction to follow	Advance smart manufacturing	Expand "Smart+"
Quality	Support the development of strategic emerging industries such as [...] high-end equipment manufacturing	By 2025, substantially upgrade the quality of the manufacturing industry	Promote the upgrade of the manufacturing industry	Promote the forging-ahead of China's manufacturing industry towards the mid- and high-end [segments]	Embark on a quality revolution of China's manufacturing industry	Promote high-quality development of the manufacturing industry
Regionally coordinated development	Refine policies for regionally differentiated development	Implement an overall strategy for national regional development	Promote regionally coordinated development	Optimize the layout of regional development	Make solid progress with the strategy of regionally coordinated development	Promote regionally coordinated development
	March 2015	May 2015	March 2016	March 2017	March 2018	March 2019

* First official mention of MIC25

Sources: State Council, Xinhua

ENDNOTES

1 | United Nations (2014). "World Economic Situation and Prospects 2014." January. https://www.un.org/en/development/desa/policy/wesp/wesp_current/wesp2014.pdf. Accessed: June 27, 2019.

2 | Cherif, Reda and Fuad Hasanov (2019). "The Return of the Policy That Shall Not Be Named: Principles of Industrial Policy." IMF Working Paper No. 19/74. Washington, DC: International Monetary Fund.

3 | Xie, Liangbing **谢良兵** (ed.) and Song, Fuli **宋馥李** (ed.) (2019). "**世界智能制造中心发展趋势报告** (Report on the global smart manufacturing center development trend)." Chinese research institutes (**标准排名城市研究院** and **经济观察报政研院**). May 24. https://www.shangyexinzhi.com/article/details/id-132687/. Accessed: June 27, 2019.

4 | Wang Jianing **王佳宁** (ed.) (2016). "**中共中央 国务院印发《国家创新驱动发展战略纲要》** (The State Council of the CCP Central Committee releases the "Outline of the National Innovation-driven Development Strategy")." Xinhuanet. May 19. http://www.xinhuanet.com/politics/2016-05/19/c_1118898033.htm. Accessed: June 27, 2019.

5 | Holzmann, Anna (2018). "China's battery industry is powering up for global competition." MERICS Blog. October 24. https://www.merics.org/de/blog/chinas-battery-industry-powering-global-competition. Accessed: June 27, 2019.

6 | Total R&D spending in the EU was 320 billion EUR in 2017 (latest available figure). See: Eurostat (2019). "R&D expenditure in the EU increased slightly to 2.07% of GDP in 2017." January 10. https://ec.europa.eu/eurostat/documents/2995521/9483597/9-10012019-AP-EN.pdf/856ce1d3-b8a8-4fa6-bf00-a8ded-6dd1cc1. Accessed: June 27, 2019.

7 | Hao, Janet and Mike Hoffmann (2019). "China's 'intangible investment' continues to underperform." The Conference Board. May. https://www.conference-board.org/publications/publicationdetail.cfm?publicationid=8626. Accessed: June 27, 2019.

8 | The LSG is the decision-making unit within the CCP organizational structure responsible for macro-strategic planning and coordination of China's transformation into a manufacturing superpower. See: Wübbeke, Jost et al. (2016). "Made in China 2025: The making of a high-tech superpower and consequences for industrial countries." MERICS Papers on China, No. 2, p. 17. December 8. https://www.merics.org/sites/default/files/2018-07/MPOC_No.2_MadeinChina2025_web_0.pdf. Accessed: June 27, 2019.

9 | http://www.miit.gov.cn/n973401/n5977672/n5977712/c5980768/content.html (not accessible anymore); http://www.miit.gov.cn/n973401/n5977672/n5977743/c5981894/content.html (not accessible anymore).

10 | Martina, Michael et al. (2018). "Exclusive: Facing U.S. blowback, Beijing softens 'Made in China 2025' message." Reuters. June 25. https://www.reuters.com/article/us-usa-trade-china-madeinchina2025-exclu/exclusive-facing-u-s-blowback-beijing-softens-made-in-china-2025-message-idUSKBN1JL12U. Accessed: June 27, 2019.

11 | Xiao, Qiang **萧强** (ed.) (2018). "**关于中美贸易战等** (Concerning the China-USA Trade War etc.)." China Digital Times. June 29. https://chinadigitaltimes.net/chinese/2018/06/%E3%80%90%E7%9C%9F%E7%90%86%E9%83%A8%E3%80%91%E5%85%B3%E4%BA%8E%E4%B8%AD%E7%BE%8E%E8%B4%B8%E6%98%93%E6%88%98%E7%AD%89/. Accessed: June 27, 2019.

12 | Caixin Global (2018). "Chart of the Day: 'Made in China 2025' Dropped From List of Local Government Priorities." December 12. https://www.caixinglobal.com/2018-12-12/charts-of-the-day-made-in-china-2025-dropped-from-list-of-local-government-priorities-101358524.html. Accessed: June 27, 2019.

13 | Wu, Xiaolang **吴啸浪** (ed.) (2018). "**中央经济工作会议举行 习近平李克强作重要讲话** (The CCP Central Committee Economy Work Conference takes place, Xi Jinping and Li Keqiang make important speeches)." Central government website, news section. December 12. http://www.gov.cn/xinwen/2018-12/21/content_5350934.htm?mc_cid=6d1a8bac0b&mc_eid=39be4d9b38. Accessed: June 27, 2019; Nie, Chenjing **聂晨静** (ed.) (2019). "(**现场实录**) **政府工作报告** ([On-site record] government work report)." Xinhuanet. March 5. http://www.xinhuanet.com/politics/2019lh/2019-03/05/c_1124194454.htm. Accessed: June 27, 2019.

14 | Wei, Lingling and Bob Davis (2018). "China Prepares Policy to Increase Access for Foreign Companies." Wall Street Journal. December 12. https://www.wsj.com/articles/china-is-preparing-to-increase-access-for-foreign-companies-11544622331?tesla=y&mod=djemalertNEWS&ns=prod/accounts-wsj. Accessed: June 27, 2019.

15 | Lo, Kinling (2019). "'Made in China 2025' all talk, no action and a waste of taxpayers' money, says former finance minister Lou Jiwei." South China Morning Post. March 7. https://www.scmp.com/news/china/diplomacy/article/2189046/chinas-tech-strategy-all-talk-no-action-and-waste-taxpayers. Accessed: June 27, 2019; Harada, Issaku (2019). "China ousts reformist official who called Made in China 2025 'waste'." Nikkei Asian Review. April 5. https://asia.nikkei.com/Politics/China-ousts-reformist-official-who-called-Made-in-China-2025-waste. Accessed: June 27, 2019.

16 | Liang, Jun (ed.) (2018). "Xi calls for developing China into world science and technology leader." Renminwang. May 29. http://en.people.cn/n3/2018/0529/c90000-9464968.html. Accessed: June 27, 2019.

17 | Based on a key-word based search (using the Lawinfo China database, http://www.lawinfochina.com/) for policy documents that contain "Made in China 2025 (**中国制造**2025)" in the title or main text and were released at central government level between May 1, 2015 and December 31, 2018.

18 | State Council**国务院印发** (2015). "**国务院关于积极推进"互联网+"行动的指导意见** (State Council Guiding Opinions on actively promoting the "Internet+" Initiative)" July 4. http://www.gov.cn/zhengce/content/2015-07/04/content_10002.htm. Accessed: June 27, 2019.

19 | See e.g. MIIT **工业和信息化部** (2017). "**促进新一代人工智能产业发展三年行动计划** (2018-2020 **年**) (Promote the New Generation Artificial Intelligence Industry Development Three-year Action Plan [2018-2020])." December 14. http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057497/n3057507/c5979554/content.html. Accessed: June 27, 2019; Wang Jianing **王佳宁** (ed.) (2016). "**中共中央 国务院印**

发《国家创新驱动发展战略纲要》 (The State Council of the CCP Central Committee releases the "Outline of the National Innovation-driven Development Strategy")." Xinhuanet. May 19. http://www.xinhuanet.com/politics/2016-05/19/c_1118898033.htm. Accessed: June 27, 2019; Premier Li Keqiang also promoted the integration of MIC25 and the Internet+ Initiative when he introduced the term "Manufacturing industry + Internet" (**中国制造+互联网**) in January 2016. See: Jiao, Fei **焦非** (ed.) (2016). "**制造业与互联网融合发展《意见》政策解读** (Interpretation of the Opinions on the policy on the integrated development of the manufacturing industry and the Internet)." State Council Information Office. May 9. http://www.scio.gov.cn/34473/34515/Document/1476671/1476671.htm. Accessed: June 27, 2019. And Yu, Shihang **于士航** (ed.) (2016). "**让"中国制造+互联网"为"中国制造**2025"**插上羽翼** (Make "Made in China + Internet" part of "Made in China 2025")." Central government website, policy section. January 28. http://www.gov.cn/zhengce/2016-01/28/content_5036901.htm. Accessed: June 27, 2019.

20 | Wübbeke, Jost et al. (2016). "Made in China 2025: The making of a high-tech superpower and consequences for industrial countries". MERICS Papers on China, No. 2, p. 20. December 8. https://www.merics.org/sites/default/files/2018-07/MPOC_No.2_MadeinChina2025_web_0.pdf. Accessed: June 27, 2019; NMSAC **国家制造强国建设战略咨询委员会** and CAE Strategy Advisory Center **中国工程院战略咨询中心** (eds.) (2016). "**《中国制造**2025**》解读——省部级干部专题研讨班报告集** (Interpretations of "Made in China 2025" – Special Seminars Report Collection at Provincial and Cadre Level)." Made in China 2025 series, p. 234. May 20. Beijing: Publishing House of Electronics Industry. http://www.cm2025.org/show-23-101-1.html. Accessed: June 27, 2019.

21 | http://www.miit.gov.cn/n973401/n5977672/n5977743/c5981894/content.html (not accessible anymore); Qin, Shuang **秦爽** (ed.) (2018). "**《中国制造**2025**》政策将一如既往平等适用于内外资企业** (The "Made in China 2025" policy will continue to be applied equally to domestic and foreign companies)." China Economy. March 26. http://www.ce.cn/xwzx/gnsz/gdxw/201803/26/t20180326_28610726.shtml. Accessed: June 27, 2019.

22 | Fang, Yuanzhen **方圆震** (ed.) (2017). "**允许科技人才在高校科研院所和企业兼职** (Allowing science and technology personnel to work part-time in research institutions and enterprises)." State Council Standing Committee. July 19. http://www.gov.cn/premier/2017-07/19/content_5211814.htm. Accessed: June 27, 2019; Hou, Yunlong **侯云龙** (2017). "**这三地多城有望率先入选"中国制造**2025"**示范区** (These three cities are expected to be selected as "Made in China 2025" demonstration zones)." Xinhuanet. December 12. http://www.xinhuanet.com//fortune/2017-12/12/c_1122094377.htm. Accessed: June 27, 2019; Du, Chang **杜畅** (ed.) (2016). "**工信部批复宁波为首个"中国制造**2025"**试点示范城市** (MIIT approves Ningbo as the first "Made in China 2025" pilot demonstration city)." Central government website, news section. August 18. http://www.gov.cn/xinwen/2016-08/18/content_5100482.htm. Accessed: June 27, 2019.

23 | Xie, Liangbing **谢良兵** (ed.) and Song, Fuli **宋馥李** (ed.) (2019). "**世界智能制造中心发展趋势报告** (Report on the global smart manufacturing center development trend)." Chinese research institutes (**标准排名城市研究院** and **经济观察报政研院**). May 24. https://www.shangyexinzhi.com/article/details/id-132687/. Accessed: June 27, 2019.

24 | http://www.miit.gov.cn/n973401/n5977672/n5977743/c5981894/content.html (not accessible anymore); Zhu, Lingqing (2018). "Top-level design of Made in China 2025 completed, ministry says." China Daily. January 31. http://www.chinadaily.com.cn/a/201801/31/WS5a71576aa3106e7dcc138e1a.html. Accessed: June 27, 2019.

25 | MOST **中华人民共和国科学技术部** (2018). "**科技部 财政部关于加强国家重点实验室建设发展的若干意见** (Opinions of the Ministry of Science and Technology and the Ministry of Finance on Strengthening the Establishment and Development of State Key Laboratories)." June 22. http://www.most.gov.cn/mostinfo/xinxifenlei/fgzc/gfxwj/gfxwj2018/201806/t20180625_140289.htm. Accessed: June 27, 2019.

26 | Wübbeke, Jost et al. (2016). "Made in China 2025: The making of a high-tech superpower and consequences for industrial countries." MERICS Papers on China, No. 2, pp. 17-18. December 8. https://www.merics.org/sites/default/files/2018-07/MPOC_No.2_MadeinChina2025_web_0.pdf. Accessed: June 27, 2019.

27 | MIIT**工业和信息化部** (2016). "**制造业创新中心建设工程实施指南**（2016-2020**年**）(Guidelines for the Implementation of the Project to Establish Manufacturing Innovation Centers [2016-2020])." August 19. http://www.miit.gov.cn/n1146295/n1652858/n1652930/n3757016/c5224429/content.html. Accessed: June 27, 2019.

28 | MIIT **工业和信息化部** (2017). "**省级制造业创新中心升级为国家制造业创新中心条件** (Requirements for the upgrade of provincial-level to national-level manufacturing innovation centers)." July 19. http://www.miit.gov.cn/n1146295/n1652858/n1652930/n3757016/c5734581/content.html. Accessed: June 27, 2019.

29 | See e.g. Zhou, Nan **周楠** (ed.) (2016). "**人民银行等八部委印发 关于金融支持工业稳增长调结构增效益的若干意见** (Eight authorities such as the People's Bank of China issue Opinions on financial support for stable industrial growth and structural adjustments in order to increase efficiency)." Central government website, news section. February 16. http://www.gov.cn/xinwen/2016-02/16/content_5041671.htm. Accessed: June 27, 2019; http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057278/n4704593/c5552394/content.html (not accessible anymore).

30 | Liu, Miao **刘淼** (ed.) (2016). "**国开行将为"中国制造**2025"**提供不低于**3000**亿元融资** (China Development Bank will provide no less than 300 billion CNY financing for "Made in China 2025")." Central government website, news section. November 10. http://www.gov.cn/xinwen/2016-11/10/content_5130742.htm. Accessed: June 27, 2019.

31 | Yoko, Kubota (2018). "China Plans $47 Billion Fund to Boost Its Semiconductor Industry." Wall Street Journal. May 6. https://www.wsj.com/articles/china-plans-47-billion-fund-to-boost-its-semiconductor-industry-1525434907. Accessed: June 27, 2019.

32 | MIIT**工业和信息化部** (2017). "2017**年工业转型升级（中国制造**2025**）资金（部门预算）项目指南的通知** (2017 Industrial Transformation and Upgrade [Made in China 2025] Funding [Department Budget] Project Guidelines)." August 21. http://www.miit.gov.cn/n1146295/n1652858/n1652930/n3757016/c5766699/content.html. Accessed: June 27, 2019; MIIT**工业和信息化部** (2018). "**工业和信息化部关于发布**2018**年工业转型升级资金（部门预算）项目指南的通知** (MIIT releases the 2018 Industrial Transformation and Upgrade Funding [Department Budget] Project Guidelines)." August 14. http://www.miit.gov.cn/n1146290/n4388791/c6317176/content.html. Accessed: June 27, 2019.

33 | Guo, Jieyu **郭洁宇** (ed.) (2017). "**中国制造**2025**添百亿专项资金 物联网等**25**项任务入围** (Made in China 2025 receives additional 10 billion in special funds, 25 tasks such as the Internet of Things are shortlisted)." Xianhuanet. October 12. http://www.xinhuanet.com/fortune/2017-10/12/c_1121789033.htm. Accessed: June 27, 2019.

34 | Liu, Lizhen **刘丽靓** (2018). "**万亿国家级引导基金助力新经济发展** (A great number of national guiding funds help the new economy development)." Zhongzhengwang. May 4. http://www.cs.com.cn/xwzx/201805/t20180504_5792251.html. Accessed: June 27, 2019.

35 | MIIT**工业和信息化部** (2016). "**工业和信息化部办公厅关于开展《中国制造**2025**》重大项目库项目征集工作的通知** (Notification on the MIIT General Office launching the project collection work for the "Made in China 2025" Major Project database)." April 1. http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057267/n3057272/c4692134/content.html. Accessed: June 27, 2019.

36 | MIIT**工业和信息化部** (2017). "2017**年度工业企业技术改造升级导向计划正式发布** (Official release of the 2017 plan for industrial enterprise tech transformation and upgrade)." September 13. http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057267/n3057272/c5799256/content.html. Accessed: June 27, 2019.

37 | The China Dashboard (2019). "State-Owned Enterprise Policy Reform." Asia Policy Society Institute. Winter edition. https://chinadashboard.asiasociety.org/winter-2019/page/state-owned-enterprise. Accessed: June 27, 2019.

38 | Qi, Peiyu **祁培育** (ed.) (2019). "**国资国企改革加快推进** (State-owned enterprise reform speeds up and advances)." Central government website, policy section. April 10. http://www.gov.cn/zhengce/2019-04/10/content_5381059.htm. Accessed: June 27, 2019; Zhang, Xiaozhe **张晓哲** (ed.) (2018). "**积极有序推进新时代国有企业混合所有制改革** (Actively and orderly promote the mixed ownership reform of state-owned enterprises in the New Era)." SASAC. November 19. http://www.sasac.gov.cn/n2588020/n2877938/n2879597/n2879599/c9837792/content.html. Accessed: June 27, 2019.

39 | Hanemann, Thilo et al. (2019). "Chinese FDI in Europe: 2018 Trends and Impact of New Screening Policies." MERICS and Rhodium Group. March. https://www.merics.org/sites/default/files/2019-03/190311_MERICS-Rhodium%20Group_COFDI-Update_2019.pdf. Accessed: June 27, 2019.

40 | Fannin, Rebecca (2019). "China Rises To 38% of Global Venture Spending In 2018, Nears US Levels." Forbes. January 14. https://www.forbes.com/sites/rebeccafannin/2019/01/14/china-rises-to-38-of-global-venture-spending-in-2018-nears-us-levels/#2c39f8e45a5c. Accessed: June 27, 2019.

41 | EU Chamber of Commerce in China (2019). "Business Confidence Survey 2019." May. https://www.european-chamber.com.cn/en/publications-business-confidence-survey. Accessed: June 27, 2019.

42 | Hancock, Tom (2019). "Global automakers seek to make China electric vehicle export hub." Financial Times. April 22. https://www.ft.com/content/e2a6ca2a-61a8-11e9-b285-3acd5d43599e. Accessed: June 27, 2019.

43 | In March 2019, Xi Jinping suggested closer Sino-German cooperation in key emerging industries, including AI autonomous driving and new materials. See: Liang, Yu (ed.) (2019). "Xi makes 3-point proposal on China-Germany ties in meeting with Merkel." Xinhuanet. March 27. http://www.xinhuanet.com/english/2019-03/27/c_137925507.htm. Accessed: June 27, 2019.

44 | Wübbeke, Jost et al. (2016). "Made in China 2025: The making of a high-tech superpower and consequences for industrial countries." MERICS Papers on China, No. 2, p. 17. December 8. https://www.merics.org/sites/default/files/2018-07/MPOC_No.2_MadeinChina2025_web_0.pdf. Accessed: June 27, 2019; Liu, Yang **刘杨** (ed.) (2016). "**当《中国制造**2025**》遇上德国《工业**4.0**》** (When "Made in China 2025" meets Germany's "Industry 4.0")." Central government website, news section. June 15. http://www.gov.cn/xinwen/2016-06/15/content_5082309.htm. Accessed: June 27, 2019; NMSAC **国家制造强国建设战略咨询委员会** (2016). "**智能制造** (Smart manufacturing)." Made in China 2025 series, pp. 24 ff., 49, 59 ff. May 20. Beijing: Publishing House of Electronics Industry. http://www.cm2025.org/uploadfile/2016/0520/znzz.pdf. Accessed: June 27, 2019; German Federal Ministry for Economic Affairs and Energy (2018). "Plattform Industrie 4.0: Digital Transformation 'Made in Germany'." March. https://www.bmwi.de/Redaktion/EN/Publikationen/plattform-industrie-4-0-digital-transformation.pdf?__blob=publicationFile&v=8. Accessed: June 27, 2019.

45 | The German government sets the larger framework for public and private cooperation with China. At the federal level, more than 90 cooperation agreements were signed at regular Sino-German government consultation meetings since 2011.

46 | Cheng, Hongyi **程宏毅** and Hua Qin **华秦** (eds.) (2015). "**习近平：关于中共中央关于制定国民经济和社会发展第十三个五年规划的建议的说明** (Xi Jinping: Explanation of the proposal of the Central Committee of the Communist Party of China on formulating the Thirteenth Five-Year Plan for National Economic and Social Development)." CPC news. November 4. http://cpc.people.com.cn/n/2015/1104/c64094-27773638.html. Accessed: June 27, 2019.

47 | See http://www.cgip.gov.cn/en/ for more information on the China-Germany (Shenyang) High-tech Equipment Industrial Park; for direct quote, see: http://govt.chinadaily.com.cn/regional/shenyang/2017-11/28/c_114638.htm (not accessible anymore).

48 | Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) (2018). "Sino-German Cooperation on Industrie 4.0 (**中德工业**4.0**合作**)." Brochure, p. 3. June. https://www.giz.de/en/downloads/giz2018_en_Brosch%C3%BCre_Industrie%204.0%20Kooperation.pdf. Accessed: June 27, 2019.

Contributors

Max J. Zenglein, Head of Program Economic Research. Max J. Zenglein's research focuses on China's macroeconomic development, international trade and industrial policies. He has a particular interest in China's evolving economic system and the economic conditions in Hong Kong, Macau, and Taiwan. Zenglein has over ten years of professional experience working on China-related economic issues. Before joining MERICS he was an economic analyst for the German Chamber of Commerce in Shenzhen and Beijing. He is an economist by training and has studied at the University of New York at Buffalo, the Berlin School of Economics and Law, the University of Hong Kong and the University of Kassel. He received his Ph.D. from the University of Kassel in 2015.

max.zenglein@merics.de

Anna Holzmann, Analyst. Anna Holzmann's research focuses on China's industrial policies, especially with regard to emerging technologies. Prior to joining MERICS, she worked as a research assistant at the Vienna University of Economics and Business, and gained professional experience in Austria's information & communications technology (ICT) industry. Anna Holzmann studied International Business Administration (BSc), Chinese Studies (BA) and East Asian Economy & Society (MA) in Austria, Australia and China. In the course of her studies, she completed a one-year intensive Chinese language and culture program at Zhejiang University in Hangzhou.

anna.holzmann@merics.de

Imprint
MERICS | Mercator Institute for China Studies
Klosterstraße 64, 10179 Berlin, Germany
Tel.: +49 30 3440 999 0
Mail: info@merics.de
www.merics.de

Editors
Claudia Wessling, Head of Publications, MERICS
Gerrit Wiesmann, Freelance Editor

Design
STOCKMAR+WALTER Kommunikationsdesign

Layout and graphics
Alexandra Hinrichs, Graphic Designer, MERICS

Printed in Berlin, Germany

ISSN (Print): 2509-4319
ISSN (Online): 2509-5862

www.merics.org

ISSN (Print): 2509-4319
ISSN (Online): 2509-5862