

Country Profile China

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Präambel:

Wir schreiben im Folgenden in der maskulinen Form, und zwar ausschließlich wegen der einfacheren Lesbarkeit: Wenn beispielsweise von Mitarbeitern die Rede ist, meinen wir selbstredend auch Mitarbeiterinnen.

Empfohlene Zitierweise:

GAUSEMEIER, J.; KLOCKE, F.: Industrie 4.0 – Internationaler Benchmark, Zukunftsoption und Handlungsempfehlungen für die Produktionsforschung. Paderborn, Aachen, 2016

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Summary

China is **all about speed**. **Urgent need for automation** to cope with high levels of **wage inflation drives** government and industry attention to automation. **Capital is not an issue for migration, but time is**: Companies face **rising costs threatening their position**. China wants to **avoid to lag behind technology** in automation and **jump from little automation to the latest available technology**, but **not to wait** for technology which only now is in development. **Industrie 4.0 is still in its infancy in China** and industry is gaining an understanding. **Domestic automation industry is still not developed enough** to fulfill local demand and high quality requirements. In the mid-term, **markets for technology and automation devices will rapidly drive growth** – potentially on a global level.

Highlights



Access to Selling
and Procurement
Markets

A **unique network of suppliers and clusters of competence in selected technologies** has led to the possibility for a very quick set-up of supply chains for new productions.



Business Model

Chinese **companies excel at innovation** to the budget needs and specific requirements of a customer. Companies master **fast-follower** strategies. **Business-focused innovation** by companies is complemented by government-driven technology innovation in select strategic fields.



Business
Environment

High demand for productivity improvements paired with little sunk costs in legacy automation lines and **massive availability of capital** lead to a large expected **demand spike in automation**.

Map



Industrie 4.0 in China

Drivers/ Challenges	<p style="text-align: center;">Drivers</p> <ul style="list-style-type: none"> ▪ Need to automate due to rising wages to avoid losing production to emerging markets (South-East Asia) and re-industrialization (US, EU) ▪ Competitive quality standards for producing mid-tier products for the global market by local companies ▪ Leveraging available competences in ICT for driving production as the most relevant component of the economy ▪ Demographic change means mean age of workers will rise and ergonomic processes are needed 	<p style="text-align: center;">Challenges</p> <ul style="list-style-type: none"> ▪ Lack of knowledge and talent pool in production technology ▪ Young people prefer to work in other fields than production ▪ Weak domestic supplier base of high-end production and automation equipment ▪ Identification of specific business levers feasible to tackle by companies facing existential cost threats
Key Stakeholder	<ul style="list-style-type: none"> ▪ Ministry of Science and Technology (MoST) – Coordinator of China’s high-tech strategy (863 strategy) ▪ Ministry of Industry and Information Technology (MIIT) ▪ Chinese Academy of Engineering (CAE) ▪ China Academy of Information and Communications Technology (CAICT) (attached to MIIT) 	<ul style="list-style-type: none"> ▪ China Integration and Innovation Alliance of Internet and Industry (CIIAII) (led by CAICT) ▪ Companies headquartered in Taiwan driving for automation, e.g. Foxconn – Drivers for automation usage ▪ Huawei Technologies Co., Ltd. – Driver for pushing Internet of Things technologies
Key Approaches	<p>Deep Integration of Informatization and Industrialization (2013-2018) The MIIT-led program aims to develop strategic Internet technologies for driving productivity in manufacturing, leading to the creation of CIIAII. The program also targets the development of standards.</p> <p>Made in China 2025-Strategy Designed as China’s answer to Industrie 4.0, the Chinese government aims to improve productivity in manufacturing to retain market share. The plan, developed by CAE and MIIT, focuses on current needs and future trends. Strategic industries for expedited implementation will be announced.</p>	

Technology (1/2)



Overview

China is very strong in ICT but lags behind in production technology. Basic research in selected key strategic areas of production technology is starting through government strategies. Automation is currently not at a high level throughout local manufacturing, but seen as the key technology to keep a strong production footprint in China despite growing wages. China is actively developing industries requiring higher competence and low-skilled manufacturing is starting to move from China to lower-wage countries. Industrie 4.0 is recognized as a trend and opportunity in China and the Chinese government is eager to leverage technological potentials in an automation strategy. However, domestic actors are unwilling and unable to wait for development of future technologies at this stage and prefer piloting currently available technology and finding business innovations based on current potentials.



Security

While ► security is seen as a key challenge for the long-term development of Industrie 4.0 solutions in China, the current focus is on employing readily available technology which is still focused on networking within a factory or company. The domestic competence level on cyber security is high due to government initiatives and a highly developed mobile devices industry. Competence in the ICT sector is world-class and developing secure solutions would be a possibility for Chinese companies if the market demands them. Access restrictions to high-grade encryption and VPNs are a challenge to international companies desiring to integrate their Chinese operations into their global information networks.



Standards, Migration and Interoperability

Domestic standardization is government-driven, including current activities for standardizing smart manufacturing. Lack of cross-country standardization in smart manufacturing is seen as a challenge for adopting smart manufacturing systems at present. Academies and research institutes are tasked with developing standards and architectures for key strategic areas. Industry has little participation in international standardization. China's presence in international standardization bodies is driven by individual research groups and professors, except for key strategic areas, where government involvement drives a more active role. Standardization is seen as a field for cooperation in Industrie 4.0. Due to the current low level of automation, migration of current systems and ► interoperability between heterogeneous systems is seen less of a challenge.



Sustainability

The need for sustainable growth is clearly seen by government due to currently observable health effects of pollution as well as long-term expected shortages of energy and resources. However, currently other levers such as energy production and mobility are key areas for reducing pollution, rather than energy efficiency in production. China pilots several concepts for smart cities with zero-emission ► ecosystems (Eco-cities), but these are seen as pilot areas for new urban development in the future rather than specific levers for current energy reduction. In these projects energy efficiency is highly valued, but this pilot development will not form a mass market in the near future. Industry is not a current driver for sustainability. The government plans for changing this in the mid-term. The ► Made in China 2025 strategy includes sustainability as a key reason for moving to smart manufacturing.

Technology (2/2)



User friendliness

► **Human-Machine-Interaction (HMI)** systems in Chinese factories **need to take into account** the currently low **competence level in automation** and **high fluctuation rate** of operators. **Simple user interfaces** for automation equipment are seen as a major need. Rising income and skill levels will lead to **greater demand for ergonomic and safe working environments**. **HMI research and development** outside of production **is at a very high level** in China owing to the **consumer electronics** industry, but less used in industrial settings. Main **points of interface between user and machine**, such as the **control units**, are **not locally built at large scale and high quality**. **Industrial design is important**, mainly concerning the optical appeal of machines and systems. Factory **owners take optics into account** when **purchasing machines** as a **clean and modern image of factories helps acquiring talent**. Lean production concepts are starting to be used. **High technology is expected to be complex** ► **ecosystem is demanded** by factory owners for handling configuration and maintenance **through specialized companies**.



Collection and Analysis of Field Data

So far, data is not acquired consistently in most factories. Process and material flow automation is not yet used widely, except in highly developed factories in regional clusters like Shanghai. Thus, there is little data that can be readily collected without the use of complex systems. Current production processes are **mostly manual** and rarely are large amounts of process parameters recorded. ► **Sensors and automation have been a national priority** since the establishment of the »863« national high-tech program in 1983, but have **so far not been deployed widely**. Sensors are mostly bought from Germany and Japan. Sensors in production are **seen as a major driver to automate processes**, including **costly quality inspection processes**. Thus, given **current wage increases**, more **widespread use of sensors in production is likely**. **Data analysis in production** is a **focus** of the government, with **research grants existing**. However, as so far too little data is collected, it is not yet used widely. **Existing automated factories have heterogeneous control systems** and **closed interfaces** are a **challenge to deploying data analytics**.



Material and Information Flow

Factories are able to **rapidly adapt to changing products**, but this **flexibility** is currently largely **dependent on having large pools of extra workers** and manual production processes which increases wage costs. **Industrial IT is still in its infancy**. Information flow is largely handled manually. **Use of ERP systems** is predicted to **rise** in the near future, but so far is **not commonplace in domestic companies**. **International companies are connected to their international systems**, but not all of them use them consistently in local factories and in conjunction with local suppliers. In contrast to material flow systems, **business processes in logistics are highly developed** and optimized for speed, though not necessarily automated in IT systems.

People

 <p>Overview</p>	<p>China has a strong base of production workers and needs to retain jobs in production to employ the masses. Nevertheless, wage growth necessitates productivity improvements per worker. Skill in production technology is scarce and needs to be imported through education abroad. Although production is held in very high esteem socially, other industries are better able to attract local talent. Chinese employees are highly pragmatic and business-oriented, but blue-collar workers are constrained to rigid hierarchies.</p>
 <p>Training and Qualification</p>	<p>Workers are plenty, but talent in automation and production management is short. University education focuses on theory and is not seen as preparing graduates for managerial work in production. Interdisciplinary education is starting but still confined to few universities. To develop a talent pool in production technology and industrial engineering programs to put returning graduates from foreign universities in junior leadership roles are in place. Public academies for training skilled workers exist, but international companies prefer to set up their own training academies, considering the public ones insufficient for meeting their requirements. Productivity is currently rising slower than wages, leading to a need for increased worker productivity through not only technology but also training. However, the use of IT in production is also seen as a way to speed up operator training.</p>
 <p>Importance of » Production«</p>	<p>China's wealth is based on production, but it must work to keep it that way. Production employs millions of Chinese, but large amounts of current manufacturing in China are based on manual-labor. With wages rising at double-digit levels per year, productivity increases are needed to keep China competitive in production. The importance of this matter has top-level government attention, with the ►Made in China 2025 strategy specifically referring to Germany's Industrie 4.0 approach and interpreting it for China. Despite the importance of production to Chinese economy and society, the competence level in cutting edge production technology and production research is low. There is little cooperation and technology transfer between fundamental research universities and industry. Moreover, young talents prefer to work in the ICT or service industries, which seem more advanced as China is moving up the value chain. Smart manufacturing and, as a first step, automation is seen as a way to make production both more competitive and more attractive.</p>
 <p>» Pioneering Spirit«</p>	<p>A nation of pioneers, constrained by hierarchies. Calculated business risk and innovative trade are traditionally highly regarded in Chinese society. However, this pioneering spirit is largely constrained to the personal and entrepreneurial domains. Strict hierarchies in traditional industries (including manufacturing) prevent big-picture-awareness and innovation potentials of individual employees. Loyalty of employees and employers is very low. Consequently fluctuation rates are very high, limiting the potential for building up expertise in employees over the long term. Such expertise is especially needed by the increasing complexity of modern machines and processes Senior production experts are lacking. Generally, specialist experts in a field are held in higher esteem than lateral thinkers and generalists. However interdisciplinary approaches are starting to enter the research sector.</p>

Organization

 Overview	<p>Speed as a form of art. Business innovation capacity and pragmatism of Chinese companies is a major driver for the high flexibility and adaptability of companies to short product lifecycles. Organizations are not adapted to bottom-up innovation and continuous improvement by individual employees, but can be very efficiently redirected from the top. Driving companies to establishing global brands is a government priority, but difficult to achieve since the domestic market seems large enough for many companies. Rule-of-law is still not at global standard and can be intransparent – the central government aims for global transparency standards, but at province and city level rule-of-law can still be uncontrollable. Central government has a strong drive to curb corruption as it is seen as a restraint on innovation.</p>
 Business Model	<p>Innovation to cost and target. Chinese companies excel at designing products for emerging markets and customers demanding high quality with limited functionality and complexity. Focus is on fulfilling needs which were previously too expensive to fulfill. Entrepreneurs also focus on innovative ways to fulfill existing needs. Many needs in the domestic market are still untapped but require ingenious solutions to be addressed in a cost-effective way. Chinese companies have not yet managed to establish global brands, except to the ICT sector. In the B2B market, China has produced disruptive business models in supply chain management, such as Alibaba. Generally, however, innovation is focused on improving cost-efficiency and flexibility rather than driving for disruptive innovation. Intangible business services are not yet appreciated strongly. In contrast, business services for tangible aspects such as projecting, planning and configuring lines are very important, however, and specialized service providers exist.</p>
 Corporate Culture and Flexibility	<p>Agile but tightly controlled. Chinese companies are traditionally very hierarchical, with the exception of the private ICT-sector. An influx of young graduates returning from studying abroad and availability of jobs at multinational companies slowly changes traditional hierarchy perceptions especially in private companies. Many large companies are state-owned, by central, provincial or city governments. Companies are very agile due to excellence in strategy execution. Furthermore, large amounts of workers and little use of flexibility-reducing systems (processes, IT systems) enable swift reaction to changes. This agility is needed in sectors like mobile-phone production with very short product life cycles. Inflexible automation could jeopardize this advantage, though. Strategic market instruments such as joint ventures (JVs) and acquisitions are used for technology transfer from abroad to Chinese companies. Such inorganic measures are promoted by the government and actively used by companies. In strategic industries, JVs need to be used by companies entering the Chinese market. Furthermore, cash-heavy companies acquire select international small companies with access to key technologies.</p>
 Internationality	<p>Made in China versus Made for China. International companies have used China as a production base, but increasingly see it primarily as a market. Domestic companies in the B2C sector focus on the large home market. Government is actively pushing companies to export and build global brands, but so far few have developed. Language skills still impede domestic companies in innovating globally. Selling globally in B2B and component markets is very simple for Chinese companies. Highly developed market platforms for the B2B market (e.g. Alibaba) facilitate match-making between buyers and sellers. Many large Chinese companies are headquartered in Taiwan and conduct operations in the Mainland. International companies can acquire world-wide talent as expatriates, whereas Chinese companies have access to networks of returning foreign-educated Chinese.</p>

Business Environment

 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Overview</p>	<p>Production is very important to China's economy and has top-level government attention. Smart Manufacturing/ Industrie 4.0 are seen as major enablers for productivity growth. Major government stakeholders are ▶<i>MIIT</i> developing the ▶<i>Made in China 2025</i> program together with ▶<i>CAE</i>, and leading the ▶<i>Deep integration of Informatization and Industrialization</i> program and ▶<i>CIIAII</i> platform; and ▶<i>MoST</i> administering the 863 high-tech development program. Many factories are still largely manual, giving potential to implementing automation solutions in greenfield approaches using the newest available paradigms. Government has the capital resources to massively push automation demand through subsidies, incentives and R&D support.</p>
 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Political Will and Restrictions</p>	<p>Government sees the urgent need for automation – and China does not want old technology. Government is pushing the ▶<i>Made in China 2025</i> strategy, designed for 10 years rather than the usual 5, to boost long-term productivity. Automation is seen as an urgent need for implementing soon, and China wants to prevent investment lock-in in soon-obsolete technology. However, the need for action is urgent, and waiting for technology still in development is not an option. To ensure long-term viability of investments, China wants to cooperate to set global standards. Automation is needed to remain productive, but government keeps close tabs on not losing too many workplaces in the process – e.g. factories may only be built to enter a market when employing a minimum number of employees. Political strategic decisions remain stable and dependable over time, so investment can follow them.</p>
 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Access to Capital</p>	<p>Resource abundance in strategic areas. Government attention for a topic can focus vast amounts of resources for development of markets and companies. In the past, such resource spills have frequently led to overcapacities and consolidation to survival of the fittest. State-owned Enterprises furthermore have large amounts of cash at their disposal. Increasingly manufacturing companies are however fighting with lower margins due to higher wages. Even large manufacturing companies are fighting for profitability and survival, and will not have cash ready to heavily invest in capital-expensive needed automation without government support or investment financing.</p>
 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Access to Selling and Procurement Markets</p>	<p>Experts in trade with clusters of supply. Historically, trade has been a strong skill of Chinese companies. Digitalization has long been embraced as a driver for trade and market-matching through the use of platforms. Next to strong access to the global B2B market, China has a massive domestic market. While components of nearly all kinds can be sourced locally, export controls hinder China's development of a sophisticated domestic semiconductors industry. Production and automation devices of high quality are imported from Japan and Germany. Regional clusters with competence in certain technologies and industries have developed, some of them duplicated in different areas of China (e.g. in the Pearl River delta area and in the Yangtze delta area). Cooperation of suppliers within regional clusters is seen as very important for speed and flexibility.</p>