

## Country Profile Japan

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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

**Efficiency and ergonomics are focus. Industrie 4.0** is mostly seen as a possibility to **become more competitive compared to China and Korea** by further **increasing automation** and facing **the challenges of demographic change** by using robotics. Large companies have **highly automated factories with first Industrie 4.0 applications implemented**. Providing these solutions to external customers is already seen as an attractive opportunity and in a few cases already implemented. Nevertheless, often **proprietary solutions for the domestic market do not meet global demands. High competences in the field of automation and emerging markets** like China in the direct neighborhood are **huge opportunities for Japan's automation and IT industries**. Compared to its strength in hardware, Japan's **competences in software are rather low** and not on a global level.

### Highlights



Material and Information Flow

**Very strong** ► **vertical integration between companies** supported by smart technologies like digitalized Kanban systems, the use of smart devices in intra-logistics and a very high rate of automation characterize Japan's competences in material and information flow.



Normative Basis

Japan is **leading in the development and stringent implementation of clear production concepts and processes**. Process-oriented working and thinking deep-rooted in society.



Importance of »Production«

Japan is **proud of its production** and wants to keep it on-shore despite **demographic change and increasing competition** with other Asian countries.

### Map



## Industrie 4.0 in Japan

Drivers/ Challenges	<div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p style="text-align: center; color: #0070C0;"><b>Drivers</b></p> <ul style="list-style-type: none"> <li>▪ <b>Increasing competition with China</b> and Korea demands higher efficiency in production</li> <li>▪ <b>Demographic change</b> increases the demand for automation and ergonomic work places</li> <li>▪ <b>Increasing wages in China</b> open emerging markets for automation technologies</li> </ul> </div> <div style="width: 48%;"> <p style="text-align: center; color: #0070C0;"><b>Challenges</b></p> <ul style="list-style-type: none"> <li>▪ <b>Low level of internationalization</b> and English skills complicates international cooperation</li> <li>▪ <b>Strong focus</b> on the <b>domestic market</b> and development of proprietary solutions for the domestic market do not meet global demands</li> <li>▪ <b>Traditionally low readiness</b> to assume risks hinders the development of radical innovations</li> </ul> </div> </div>
Key Stakeholder	<ul style="list-style-type: none"> <li>▪ <b>Ministry of Economy, Trade and Industry (METI)</b></li> <li>▪ <b>Fanuc</b> – Industrial robotics lead supplier with highly integrated automated solutions</li> <li>▪ <b>Fujitsu</b> – Next-Generation Manufacturing Environment Support Initiative</li> <li>▪ <b>Mitsubishi Electric</b> – Founder of the E-F@ctory-Alliance</li> </ul>
Key Approaches	<p><b>Robot Revolution</b>          Governmental strategy by METI to promote and push Japans competencies in robotics to become the leading innovation hub and leading utilization society for robotics. Part of Japan’s Revitalization Strategy.</p> <p><b>Japans new IT Strategy (2013)</b>          Activities coordinated by the Cabinet Office to become »the world’s most advanced IT Nation«.</p> <p><b>E-F@ctory-Alliance</b>          Factory automation initiative founded by Mitsubishi Electric providing factory automation solutions for all parts of the automation pyramid.</p> <p><b>Control System Security Center (CSSC)</b>          Non-profit association with 26 members from academia and industry. The main objective is to ensure the security of control systems of important infrastructure by various operations including R&amp;D, international standardization, certification, human resource development, promotion, and security verification of each system.</p>

## Technology (1/2)

 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Overview</p>	<p>Japan has <b>one of the most automated industries</b> in the world and especially for <b>industrial hardware the competence level is very high</b>. Particular strengths lie in <b>automation technologies</b>, <b>sensors</b>, and <b>robotics</b>. Japan's robots account for 70 % of the global market and its domestic market has one of the <b>world's highest densities of robots</b> in production. In contrast, the competences in <b>software</b> are rather <b>weak</b>: Both the <b>global competitiveness</b> and the <b>application</b> of modern IT in domestic companies, e.g. <b>cloud computing</b>, are <b>very low</b>. However, Japan developed industrial IT <b>tailored specifically to the domestic market</b> and larger companies actually <b>use proprietary innovative IT-solutions internally</b>. <b>Research</b>, especially for applied sciences, is mainly <b>done by companies</b>. Universities are more focused on basic research. <b>Government funding</b> for research is low.</p>
 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Security</p>	<p><b>Sensitivity</b> for <b>security</b> aspects is <b>very high</b>. <b>Risks</b> in cyber space and cyber-attacks are perceived to be <b>increasing</b>. To meet challenges, a public <b>Cyber Security Strategy</b> was developed. Governmental financed non-profit organizations like the <b>Control System Security Center</b> have the goal to advance research and standardization for cyber security. Few domestic companies are specialized in cyber-security-solutions. Thus, <b>conglomerates</b> have their <b>own security</b> departments and concepts. Due to limited resources, <b>SMEs are using available security systems provided by big U.S. companies</b>. Because of missing technological solutions the focus is still on <b>securing individual components</b>. At the moment, large companies do not see security as a major challenge for Industrie 4.0, because current applications are mostly focused on single factories and thus secured by closed networks. Despite high costs and inefficiencies, <b>companies encapsulate their corporate networks intensively from the internet</b>.</p>
 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Standards, Migration and Interoperability</p>	<p>Japan is <b>well represented in the international standardization community</b>. Nevertheless, the <b>domestic market is dominated by national standards</b>. <b>International standards</b> are adopted for <b>selling to the global market</b> and less applied to the Japanese market. <b>Standardization is mainly done by the Japanese Industrial Standards Committee (JISC)</b>, comprising academia, industry, consumers, and regulators. For Japanese companies, the <b>use of proprietary standards and closed interfaces is widely common</b> and their <b>business models</b> are accordingly designed. Yet, <b>successful examples</b> for the use of open solutions and the according adaption of business models <b>are lacking</b>. The <b>technological level and the automation rate of factories are very high</b>. Thus <b>Industrie 4.0 solutions are normally migrated to existing systems</b>.</p>

## Technology (2/2)



### Sustainability

Japan has limited domestic energy and raw material resources. Nevertheless, **sustainability and energy efficiency are not in the main focus** of Japan's governmental and industrial strategies and approaches for **smart manufacturing**. Due to the accident in Fukushima in 2011, the government shut down all nuclear power plants which **raised the energy costs** and made Japan to one of the largest importers of fossil energy. As a consequence, **the government is promoting energy saving policies**. However, the possibility of **re-commissioning nuclear power plants has been reconsidered** to lower energy costs. **Big manufacturers are active in sustainability research** driven by the positive effect of eco-friendly products on the company image.



### User friendliness

**Usability is an important factor** in Japanese daily life, leading to high demands on industrial **HMs**. **User experience** is mainly designed to be **simple and easy to understand**. Due to the demographic change, especially **the importance of ergonomic HMs and workplaces is increasing**. Innovative user interfaces such as »Brain-Machine Interface« were first developed in Japan and R&D efforts of companies are still high. **HMs of the consumer electronics are widely used in production facilities** (e.g. for maintenance of machines and logistics). Japanese production **employees' educational background is high**. Thus, they are able to **rapidly adapt to new technologies** such as machine tool operation using a smartphone or tablet.



### Collection and Analysis of Field Data

**Sensor technology** is on the **highest level** in Japan. Most leading sensor manufacturers worldwide are Japanese. Japan is one of the biggest **sensor providers for global automation** industry. In contrast, the **competence level in software and analytics is rather low**. Strong focus on hardware is seen as a weakness. For smart manufacturing, large companies are developing proprietary software solutions for their internal use or have to form alliances to develop these software solutions. Software companies are rather small and offer specialized solutions for the domestic market. **Software is tailored to individual customers in the domestic market and difficult to adapt to global market**. Topics such as **Big Data** or **Cloud Computing** are gaining more attention but **do not find large success** yet. The Japanese are referred to as »Slow Adopters of Western Technology« and employees are afraid of losing their know-how and being replaced.



### Material and Information Flow

Japan's industry is one of the **most automated in the world**. Globally used production concepts, such as *lean*, *just in time production*, *Toyota Production System*, *Kanban* and *Kaizen* have been developed in Japan. The World Bank ranks **Japan's logistics performance** as one of the **highest worldwide**. Digitalized Kanban systems using RFID technology, tablet computers in the logistics industry, and autonomous trucks driving in a convoy with as little as four meters apart are just a few examples for **the high competitiveness, flexibility, and innovativeness of Japan's logistics competences**. Solution providers like the **e-F@ctory** alliance are **developing and already offering efficient and fully-integrated automation solutions** for the entire production process. But so far, they are only successful on the domestic market. However, **the digitalization of the information and data flow is still a big challenge**, especially in the automotive industry. Although there are **differences between big companies and SMEs**, the **competence level of SMEs is higher compared to other Asian markets**.

## People

 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Overview</p>	<p><b>Production is centered on the human. Occupational safety</b> of employees is of great importance in Japan. <b>Zero-accident campaigns</b> are supposed to further lower the already very low number of accidents in industry. Japan's <b>society is very process and service oriented</b> and the idea and willingness of <b>continuous improvement is deep-rooted</b> in people minds. This mindset and philosophy has led to <b>several production concepts and methodologies</b> which are <b>used in companies and factories around the world.</b></p>
 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Training and Qualification</p>	<p><b>Japan needs more young engineers.</b> Compared to other industrialized countries, the average working engineer is much older. Thus cross-generational knowledge-transfer is very important. Although the quality of Japanese engineering university courses is considered relatively high, <b>the education is often very theoretical</b> and lacks practical relevance. Studying <b>engineering is less attractive</b> to most Japanese students than e.g. economics and medicine. <b>Knowledge-transfer from university to industry is seen as a weakness</b>, due to little cooperation and conjoint research projects. Furthermore, transfer of new methods and findings by graduates is avoided by older employees due to extreme hierarchical organization structures. <b>Internal education in companies and the concept of lifelong learning</b> is very common. For instance, graduates are supposed to work in the production facilities of the company for a while in order to gain practical knowledge.</p>
 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Importance of » Production«</p>	<p><b>The importance of production to Japanese society is huge.</b> Production accounts for the majority of exports. Despite demographic change, a major objective of the government is to keep the production on-shore. Nevertheless, working in production is not popular. <b>Engineers</b> are often seen as <b>simple »blue collar« workers</b> and receive rather <b>low wages</b>. <b>Japan stands synonymous for high quality</b> and has developed <b>many of the globally popular production and quality management methodologies</b>. Japan's products and production facilities have an excellent reputation both domestically, and on the international market.</p>
 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">» Pioneering Spirit«</p>	<p>Japanese work culture is characterized by a <b>very high loyalty</b> of employees. Working the <b>whole life for just one company is still very common</b>. Job and company have an extremely high value for employees. Accordingly, the <b>mobility</b> of Japanese employees is rather <b>low</b>. <b>The failure acceptance is very low</b> out of tradition and culture. Due to the fear of the <b>»loss of face«</b>, the number of start-ups is <b>very small</b>. <b>Popularity of entrepreneurship is rather low</b> due to hierarchical organization structures and managers who are focused on cost-cutting and less on innovation. <b>Pioneering spirit is not prevalent</b>. However, due to two decades of economic stagnation and an unclear future for many young people, the <b>traditional mindset is already changing</b>.</p>

## Organization

 Overview	<p>Japanese corporate structure is characterized by <b>strong integration along the value chain</b>, also referred to as Keiretsu or corporate groups. In contrast, <b>integration of companies within one industry does not exist</b> due to the strong competition between companies on the domestic market. Collaborations between different companies or between companies and universities is not popular and most research and innovation is done within the companies.</p>
 Business Model	<p><b>Relevance of services has heavily increased</b> in the last years, accounting for more than 70 % of the GDP by now. <b>The Keiretsu system</b>, conglomerates of companies legally independent but financially linked, <b>is prevalent</b>. Due to traditional risk avoidance, <b>Japan has just a small number of start-ups</b>. <b>Most innovation originates at large companies</b>. Japanese production technologies are considered to be high-quality and »<b>Made in Japan</b>« <b>represents a strong global brand</b>.</p>
 Corporate Culture and Flexibility	<p>Companies are characterized by <b>extreme hierarchical structures</b> with <b>high staff loyalty and conformity</b>. The hierarchical level of different employees defines their personal relationship and how they expect others to interact with them. <b>Flexible working models and flexible organization structures are not common</b>. Instead, long hours are expected by companies and <b>work-life-balance is less important</b> than in European countries. Corporate structures in Japan are <b>dominated by the Keiretsu system</b>, consisting of conglomerates of companies which are legally independent but economical strongly dependent.</p>
 Internationality	<p><b>English is still a challenge</b>. The <b>internationalization</b> of Japan and Japanese companies is <b>low</b>. <b>English is not common as a corporate language</b>. Active participation in international committees, e.g. for standardization, is thereby still a challenge. Attempts to increase internationalization such as <b>recruiting international talents exist but the success is still limited</b>. <b>Staff diversity is very low</b> with one of the smallest proportion of international professional and managerial staff worldwide. Japanese <b>universities are also lacking internationality</b>. This problem is recognized and <b>universities try to acquire international top-talent</b>, for example by <b>offering more engineering courses in foreign languages</b>. <b>Supply chains are organized on a national level</b> as material and products »made in Japan« are seen to be of higher quality. Due to the accident in Fukushima and resulting supply bottlenecks, companies <b>try now to internationalize their supply-chains</b>. <b>SMEs are generally not oriented toward the global market</b>.</p>

## Business Environment



### Overview

**Revitalization of the economy** and industry by approaches like the »Robot Revolution« is **on top of the governmental agenda**. A weak Yen facilitates exports and **companies hold large amounts of liquid assets**. Thus, the access to capital should be no problem in principle. The **availability of venture capital is insufficient**, as risky investments are avoided. Due to a long period of economic stagnation since the early 1990s, the **management of Japanese companies is still focused on cost-cutting approaches and measures to increase efficiency**. Emerging markets and the enabling of **innovations are not focused by** management decisions. Japanese manufacturing companies have **modern factories with high robot density**, efficient process design, and automation using advanced ICT support. The automation level is already up to the point of being extremely inflexible in production. Large companies and machine tools providers successfully **integrated first smart manufacturing applications in their plants**. Providing Industrie 4.0 solutions to external customers is also considered.



### Political Will and Restrictions

**To boost Japans economy**, the government implemented the »**Revitalization strategy**«. This strategy presents numerous measures to support the industry including the »Strategic Market Creation Plan« and the »Strategy of Global Outreach«. One approach to implement the Revitalization strategy is the »**Robot Revolution**«, published in 2014, which is seen as an answer to Germanys Industrie 4.0 strategy. The objective of the »Robot Revolution« is to **promote and push Japan's competencies in robotics** to become **the leading innovation hub and leading utilization society for robotics** in the world. Besides the production environment, it focuses on all possible applications for robots. However, **governmental strategies** for smart manufacturing are still in **the planning phase** and specific implementation plans have to be developed. The role of labor unions is growing and the consumer protection system has been reinforced to give consumer organizations more rights. Nevertheless, **labor concerns are not seen as a major restraint** for the implementation of smart manufacturing applications.



### Access to Capital

Due to the economic policies under prime minister Shinzō Abe, also known as »Abenomics«, and the connected measures to increase the inflation rate by a glut of money and low interest, **capital costs are nearly zero**. **Capital resources of Japanese large companies are sufficient**. Having 50% of its market value as cash is not a rarity. **Investment level is quite high but most resources are invested in restructuring and efficiency increasing** measures and less in innovations. The need for capital and the investment level of SMEs is rather low due to the shrinking domestic market. Despite low capital costs, **access to venture-capital for start-ups is still insufficient**.



### Access to Selling and Procurement Markets

The Japanese **market is unique and relatively closed** and often denominated as suffering from »Galapagos Syndrome«. Japanese **industry tends to focus on the domestic market** with specialized technological solutions. **Despite innovative and even superior technologies, they are often not able to address international markets** and become globally successful. A well-known case is the development of cellphones with specialized features which are a big success in Japan but fail to reach the international market. Particularly **Japanese SMEs are extremely focused and dependent on the domestic market**, while large corporates especially from the strong automotive and ICT industry, are globally successful with huge exports e.g. to China and the U.S.A. Japan also has **numerous trade agreements, e.g. with India, and is currently in negotiations with China**. The **importance of international networks is increasing**. Especially after the Fukushima accident, companies **realized risks of national sourcing and implemented an international multi-sourcing-supply-strategy**.