

Country Profile Korea

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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

Korea is bringing smart manufacturing technologies to implementation. » Manufacturing Innovation« in context of **Industrie 4.0** is mainly an **application-oriented approach driven by government**. **Focus** is solely on enabling **SMEs to simply implement smart manufacturing technologies**. Aims are to have a **more efficient and safer production**. Large companies in **semiconductor and display industries** are **high-end in automation**. **Smart manufacturing solutions** are **tested in own factories** before **offering** these solutions to the **global market**. Focus of own development is mainly on **solutions for vertical IT integration**. **Large companies** are **encouraged by state** to **transfer** manufacturing knowledge to **SMEs**. **SMEs** are rather **low** and **heterogeneous** technological equipped, **demanding** for **simple adoption** of **new automation solutions**.

Highlights



Political Will and Restrictions

Application-oriented approach driven by government to transform SME's factories into smart ones, initiated and balanced by all **relevant governmental departments** in **two implementation steps until 2020**.



Collection and Analysis of Field Data

Strong semiconductor and display industries led to a **strong foundation in data acquisition and analysis for process control**, esp. for **predictive process maintenance**, which is regarded to be **above the level** required for **Industrie 4.0**.



Technology

Profound technological basis of large and diversified companies (Chaebols) in **system integration, automation, integrating different IT solutions** in production, and **rapidly adopting high-tech base technology** developed globally.

Map



Industrie 4.0 in Korea

Drivers/ Challenges	<div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p style="text-align: center; color: #0070C0;">Drivers</p> <ul style="list-style-type: none"> ▪ Rising energy costs push the implementation of efficient smart technologies in production facilities ▪ Competitive situation with China and Japan forces the implementation of more cost efficient production systems ▪ Emphasis on safety in production fosters implementing smart technologies in the field of user friendly production facilities </div> <div style="width: 48%;"> <p style="text-align: center; color: #0070C0;">Challenges</p> <ul style="list-style-type: none"> ▪ Labor unions are strong and could prevent the implementation of smart manufacturing technologies due to privacy concerns ▪ Low margins and the competitive situation of SMEs requires strong support by large companies ▪ Lack of attractiveness of SMEs for qualified employees </div> </div>
Key Stakeholder	<ul style="list-style-type: none"> <li style="width: 50%;">▪ Ministry of Trade, Industry and Energy (MoTIE) <li style="width: 50%;">▪ Smart Manufacturing Innovation Center (SMIC at KITECH) <li style="width: 50%;">▪ Ministry of Science, ICT and Future Planning (MSIP) <li style="width: 50%;">▪ Regional Creative Economy Complex Center <li style="width: 50%;">▪ Korea Institute of Industrial Technology (KITECH) <li style="width: 50%;">▪ LG CNS – Smart Factory Solution <li style="width: 50%;">▪ Electronics and Telecommunications Research Institute (ETRI) <li style="width: 50%;">▪ Samsung SDS – Intelligent Manufacturing <li style="width: 50%;">▪ Korean Electronics Technology Institute (KETI) <li style="width: 50%;">▪ Posco ICT – Smart Engineering/ Smart Integration <li style="width: 50%;">▪ Korea Institute of Machinery & Materials (KIMM)
Key Approaches	<p>Manufacturing Industry Innovation 3.0 Strategy (MII 3.0 Strategy) ▶ MoTIE-initiated project to equip SME factories with smart technologies at different technological levels.</p> <p>Connected Smart Factory (CSF) ▶ MSIP-driven project for development of a platform for connected smart factories and testbeds for evaluating connected smart factory technologies.</p> <p>LG CNS Smart Factory Solution Holistic smart factory solution consisting of factory design, standardization and integration planning to continuous improvement of production by smart production facilities.</p> <p>Samsung SDS Intelligent Manufacturing Managing and control of manufacturing plants worldwide as “One Factory” based on automation, analytics and manufacturing execution software solutions with focus on productivity and workers’ safety.</p> <p>Posco ICT Smart Engineering/ Smart Integration Application of industrial Internet of Things (IoT) and Big Data solutions in manufacturing, and integrated management system connecting the company’s individual factories globally (Pospia 3.0).</p> <p>Creative Economy Vitamin Project Regional build-up of Creative Economy Complex Center, each exclusively supported by one conglomerate, to realize sustainable regional growth and cultivate new business sectors by integrating information technology.</p>

Technology (1/2)

 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Overview</p>	<p>Korea is a technology-oriented nation with high performance, especially in the consumer electronics industries. Korean manufacturers fear being driven out of their markets from Chinese competitors. Energy and labor-intensive industries (e.g. ship-building, steel) are likely to lose their market positions. State and companies are transforming labor intensive manufacturing into productivity-based highly automated manufacturing. Korean industry excels at system integration and technology application and rapidly adopts advanced base technologies developed globally (e.g. sensor technology). The major Chaebols (e.g. Samsung, LG) have advanced technologies and know-how in automation and integrating individual processes into a single production system. The Chaebols are furthermore skilled in integrating different IT solutions in production. Their initial focus is on fulfilling their own production system demand, and the demand of their suppliers. After maturing their products, export is aimed for. 28% of GDP is generated by the manufacturing sector and 4% of GDP is invested into R&D, one of the highest in the world. The competition with China and Japan is the driving force for Korea to upgrade technologies used in domestic production</p>
 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Security</p>	<p>Previously, no significant national activities have been conducted in industrial security. Recently, industrial security programs have been established as part of the MIIT 3.0 Strategy. For the implementation of smart manufacturing, industrial security is not currently seen as a main challenge by major companies, as networking in factories will initially be limited in scope to intra-company networks in the defined step one of the MIIT 3.0 Strategy. Domestic IT security-solutions exist, but are not exported due to lack of brand awareness. There is anxiety over losing valuable resources to China or North Korea. The government needs to protect domestic systems from frequent cyber-attacks launched by unknown hackers supposedly from North Korea. The punishment of corporate data thefts is considered too weak.</p>
 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Standards, Migration and Interoperability</p>	<p>Standard development in Korea is mostly market-driven. Relevant and useful international standards are applied. In addition to using existing standards, large companies develop and internationally push own standards in selected strategic fields, especially at the business process level of the automation pyramid. Key companies largely do not participate in international standardization bodies, and if so usually only as an observer. Public international standardization bodies are seen as too slow to react to market demands. MoTIE has developed a maturity model of Smart Factories in 4 different levels. Based on these maturity levels, a certification of Smart Factories is discussed. The maturity model is used to steer implementing Smart Factories in SMEs. The migration of technologies in supported Smart Factory projects is planned to take place in two defined steps.</p>

Technology (2/2)



Sustainability

Sustainability plays a subordinate role compared to the increase in productivity in the ▶MII 3.0 Strategy. Production system manufacturers, however, do emphasize the **high energy efficiency and resulting cost reducing elements** of their production systems. A **lack of natural resources** causes Korea to depend heavily on oil and gas prices, which drives **the reduction of production costs**. In the long term, **Korea is gradually increasing its sustainability effort** due to the rising energy costs. Currently, **environmental regulations are less strict** in comparison to the EU. **The society is becoming more environmentally aware** and is starting to prefer eco-friendly products.



User friendliness

Research activities for ▶HMI devices (esp. virtual and ▶augmented reality and wearable devices) are conducted to boost productivity on the shop floor level as part of the ▶MII 3.0 Strategy. The use of consumer electronic technologies and devices (e.g. tablet PCs) in production settings already takes place. **Knowledge management and structuring of operator knowledge** is seen as a key productivity driver and is actively researched. ▶**Safety** for operating machines is **critical as recent accidents have led to an increased sensibility of society for workplace accidents.** Interests in ergonomics exist, but there is **no research focus on ergonomics.** Smart manufacturing enabling **safer workplaces will attract more skilled young adults to work in the manufacturing sector.** Employees are comparatively **open to technologies and quick-learners.** However, **integration of unions into decision-making is a challenge: Work regulation concerns** including privacy have already led to **rejection of pilot projects** (e.g. smart helmet) by unions.



Collection and Analysis of Field Data

Strong semiconductors and displays industries (esp. Samsung and LG) have led to the development of a strong foundation of knowledge in data acquisition and analysis for process control in Chaebols. The focus is on **predictive process maintenance.** This level of process control knowledge is regarded to be **above the level required for Industrie 4.0** and similar approaches envisioned for other industries. However, industrial ▶**sensor technology is not currently seen as a large market opportunity** by Chaebols. In other industry areas, domestic **sensor technology** is considered **less developed** than production technology and ICT. The manufacturing sector relies mostly on sensor **imports from Japan and Germany.** **High costs of real-time data analysis** and exchange are mentioned as **key challenges for SMEs.** **State funding** and ▶**KITECH** and ▶**ETRI** research is used to **strengthen domestic sensor innovation and application of data analysis in SMEs.** Publicly funded developments are required to produce **open source platforms** to roll out innovation across SMEs. **Unions strongly oppose** the collection of **field data** and are **not proactively involved** in research or **conceptual activities.**



Material and Information Flow

Larger corporations are highly automated using sophisticated technology for ▶intralogistics (e.g. RFID component tracking) and linking of material and information flow. Especially the **Chaebols** are very successful **system integrators**, including in the field of industrial IT. In contrast, **SMEs use crude intralogistics** and have **not yet consistently automated production logistics processes.** Funded research by ▶**ETRI** focuses on developing a **development platform for integrating shop floor and business process** data including simulation and virtualization of processes. Large companies see potential **productivity increases by integrating data of their suppliers** and are developing solutions to do so. A **key challenge** is the **heterogeneity of information management maturities** across value chains **involving SMEs** concerning machinery, processes and logistics information. Exchange of **information flow in real-time** across the value chain is planned only for the **second phase** of the ▶**MII 3.0 Strategy** for SMEs.

People

 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Overview</p>	<p>One main goal of the ►MII 3.0 Strategy is to make SMEs more attractive for employees by equipping the companies with safer and more efficient production systems. The strong emphasis on ►safety in the smart factory concepts is mostly driven by the long neglect of occupational safety in the past. Large companies are able to select talents but the SMEs have difficulties finding appropriate employees. Demographic changes will lead to labor shortage in production-relevant industries in the future. The dependency on foreign temporary low-skilled workers is already increasing, also because of lower salary compared to core staff. Therefore, the public generally welcomes the concept of productivity improvement through automation and digitalization of production to create a labor market for higher educated employees (including shop floor workers and engineers).</p>
 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Training and Qualification</p>	<p>Education level in Korea is high. Korean parents spend the most money per child on education globally. Domestic universities are able to train enough graduates, including in technological degrees. However, for high-skilled graduates the service industry is currently more attractive than working in engineering. Studying abroad, mostly in Japan, China and the U.S, is common. Besides university, there are no public educational programs to qualify young employees. SMEs lack in resources to set up proper own qualification programs: The traineeship system in the industrial sector does not fully meet the requirements of local industry. However, large companies have own training programs and can demand high employee qualification standards since a large number of graduates applies to few large companies. International talents are less attracted to the domestic labor market. Many employees retire early at their mid-50s due to increasing personnel costs after a long period of employment, by indirect pressure from employers. This results in a loss of valuable experience and leads to challenges concerning cross-generational know-how transfer.</p>
 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Importance of » Production«</p>	<p>Korean production industry generates about 30% of the nation's GDP and the service industry is highly linked to the production industry. Korea is an export-oriented nation. Due to the increasing competition with Japan and China, the awareness of the importance of production is even growing in society. However, Korean employees avoid working in the manufacturing sector. Blue collar workers are not well-respected and the so called dirty, dangerous and demeaning jobs (»3D-jobs«) are avoided. The number of fatal accidents is still relatively high. Therefore, one focus of the ►MII 3.0 Strategy is to make jobs in production more attractive by using modern technology and improving ►safety in factories. Regarding general production culture, Korean companies emphasize on developing and producing their goods entirely without outside interference.</p>
 <p style="writing-mode: vertical-rl; transform: rotate(180deg);">» Pioneering Spirit«</p>	<p>Korean work culture is hierarchical. Employers demand obedience from their employees. For most employees the company plays a central role in their life. In general, the loyalty of employees towards the employer is high. The willingness to work long hours or even through holidays is common. Employees are constantly under pressure to deliver visible results. The balance between work and leisure time is lacking. Socializing with colleagues and superiors outside work is highly encouraged by the employers. Due to rather low failure tolerance, pioneering spirit in companies is not very pronounced. In general, society values job security more than pioneering spirit. Labor unions have a powerful position in Korea and sometimes an equal position to the employers. This leads to the danger of preventing the implementation of new production technologies by unions.</p>

Organization

 Overview	<p>The Korean economy is dominated by few large companies (Chaebols), family-oriented conglomerates, which generate a high proportion of the GDP. Organizations are lacking in flexibility, but the management is able to observe and make decisions quickly, as these companies were successful fast followers and reacted agile to market changes in the past. SMEs have limited conditions to develop smart manufacturing systems with their current competence and organizational structure without support by the government or large companies. The Korean intellectual property (IP) and regulation systems are no restraining factor for innovation. While IP is well-protected, some companies criticize that the punishments for IP thefts are often weak. The Korean legal-system supports business and innovation. Regulations are adaptive to technological changes. For example, following concerns that driverless cars cannot be tested in Korea due to regulations, the government created a special test-field zone for companies. Discount fees for individual inventors and SMEs for filing patents exist. The state owned enterprise for supporting and founding regional industrial clusters, KICOX, is seen as highly effective.</p>
 Business Model	<p>Perception of service innovation and business model innovation compared to technological innovations is still low. There is no overall governmental approach to support the development of new business models and service innovation. Large companies are aware of the importance of service innovation and new business models, and have their own service innovation departments. Since industries are mostly end-consumer oriented (e.g. electronic, automotive), companies are more focused on B2C service and business model innovation. However, large companies, which are strong system integrators also see a large potential in offering new B2B-services and developing new business models in the field of smart manufacturing. In contrast, most SMEs – being dependent suppliers on just one big company - have limited need and possibilities to innovate business models or offer new services. The number of spin-offs and start-ups increased. Both SMEs and start-ups, are supported by state agencies, but the majority of them is not competitive enough to enter the international market.</p>
 Corporate Culture and Flexibility	<p>Corporate culture is mostly dominated by hierarchical structures. When a top management decision is made, large companies have the agility and resources to quickly catch up with competitors. Because most of the large companies are diversified, a huge capacity and variety of skills is available. Thus, large companies are capable to combine different technologies quickly and easily (e.g. electronics and manufacturing). Korean industries are mostly known as fast-followers in dynamic industries. Flexible adaptation and short innovation cycles are solely obtained in large companies, driven by the development of high-tech products with short product life cycles (e.g. semiconductors, smartphones). Due to the domestic market penetration and the wide positioning in diverse industries, conglomerates have strong capabilities to apply smart manufacturing in different sectors and across value chains. Conglomerates encourage cross-functional job rotation measures and combining different departments by creating interdisciplinary task forces. Flexible work hours are rarely offered by companies. The dependency of SMEs on large companies limits the freedom of decision and the flexibility in organizational adaption.</p>
 Interoperability	<p>Large companies have successfully penetrated international markets and created international cooperation while the domestic market is still an important basis. Conglomerates often form strategic cooperation and joint-ventures with domestic and international partners. In contrast, SMEs are focused on the domestic supply network because of their dependency on large companies. Diversity in workforce is rather low inside Korean companies. International talents are less attracted by the Korean labor market. There is a low prevalence of English as corporate language, even though employees in customer facing positions have a sufficient level of English skills. Large companies have global R&D centers with foreign talents, who keep headquarters informed about technological and economical changes outside Korea.</p>

Business Environment



Overview

Korean government is offering a business-friendly environment for companies: Investing a set amount of company's profit into research will be honored by receiving tax reductions. The application-oriented **►MII 3.0 Strategy** has launched to create an environment for Korean economy to become **early fast follower** in smart manufacturing. The **most important goal** of the implementation of smart manufacturing technologies is the **reduction of production costs**. Korean manufacturers like to **maintain high quality products** with **lower prices** compared to other competitors. The **start-up scene** is gaining **more attention** by **active support of the state**. Especially **SMEs** wish to **reduce labor usage** in the production lines with the help of **automation**. Through establishment of **►Creative Economy Complexes**, the government creates an environment to **lead and educate SMEs** by large companies (e.g. Samsung and LG). Large companies offer **expert exchanges** and **share knowledge** in the manufacturing sector to **educate SMEs** on **smart manufacturing**.



Political Will and Restrictions

Following the Industrie 4.0 approach in Germany, Korea has introduced its own **►MII 3.0 Strategy**. Currently, a **coordinated planning** and **promotion of Smart Factories** is in progress by two major ministries. **►MoTIE** is in charge of the **►MII 3.0 Strategy**, which is **application-oriented**, and **►MSIP** is running the **project ►CSF** as part of the **►MII 3.0 Strategy**, which is considered **more technology-oriented**. The **ministries' aim** is to **develop and promote a roadmap** for implementation of **smart manufacturing technologies** in Korean factories. The focus of this **government driven approach** is solely on **SMEs**. The **specific aim** is to **apply ICT solutions for manufacturing** in **10.000 smart factories until 2020** in **two implementation steps** (first step: "Entry into Smart Ready"; second step: "Achievement of Smart Advanced") supported by **state agencies**, **research institutes** and **large companies**. **Large companies** are involved as **beacons** and **supporters for the SMEs** in **transforming the manufacturing industry**. **►SMIC at KITECH** supports both **►MoTIE** and **►MSIP** in initiating and advancing R&D projects. Regional **►Creative Economy Complexes** were established to **support the training of SMEs** in their transformation to smart manufacturing.



Access to Capital

Only the few large companies have the necessary financial means to develop and apply smart manufacturing facilities in their production lines. **SMEs** are **highly dependent** on **subventions** offered by the **state** to even apply new technologies in their production. The **public budget** to initiate smart manufacturing is **insufficient** and the **participation** of the **large companies** is **essential** to **drive the projects**. In the early stage of the development, **►venture capital** is **little available**. **Promising start-ups** are **supported** by the government. **One third** of the **total investment (about 240 Mio. Euro)** in the **►MII 3.0 Strategy** will be **carried by the government** and **distributed to the relevant research institutes**, which **coordinate the R&D projects** with the companies. Because the **government** is determined to **continue to invest in manufacturing**, there are other **large public funding** in **production-relevant sectors**. Korea is **attractive for foreign investors** due to **economy's potential for growth** in the following years. However, the **society considers too much foreign investment to be harmful** to their economy. The **heavy focus on R&D of the country** is an attractive factor for investors as well.



Access to Selling and Procurement Markets

Korean large enterprises have **positioned** themselves as **fast technology adopters** over the **global market**. The **domestic companies** have mostly **expanded** their production lines into **China and other Asian countries**, in which a **strong network to selling markets** in diverse areas has been established. In many cases, **SMEs**, **supplying the large companies**, often **move out together into new markets** so that the **value chain of the manufacturing** is mostly **remained untouched**. The **close economic relations to the U.S., Japan, and China** are advantageous. The recent trend of **middle-east countries to build up new productions facilities** is considered to be an **export target of Korean smart factory solutions** in the near future. **Large companies** are in the **comfortable situation** to **develop and test smart manufacturing technologies** in **domestic or global factories**. Especially large companies in the semiconductor and display industries have **very strong competences** in **system integration** as well as **►vertical integration of IT solutions**. If and when these **solutions are proven in own factories**, they are able and willing to **offer turnkey solutions** to **global market** or to **built-up smart factories** »as-a-service«.