

Korea Smart Factory Initiative

Colloquium on Digital Industrial Policy Programme (12 Nov. 2018)

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1. Background of Initiative

- ▶ **Manufacturing is the backbone of the Korean economy**
 - ▶ Share in GDP and employment: (30.4% in 2017, 16.6% as of in June 2018)
 - ▶ The ratio of R&D expenditure to GDP: 4.24% (ranked 2nd in the world)
 - ▶ Higher deployment of industrial robots (531 industrial robots/10,000 workers)

- ▶ **Deepening gap between large corporations (conglomerate) and SMEs**
 - ▶ rate of operating profit, productivity, wages
 - ▶ Industrial accident rate: large (0.36%): SME (0.69%)

1. Background of Initiative

<Table 1> Large Corporations vs SMEs in Manufacturing in 2014 *(share, %)

	Large corporations	SMEs
number of establishments	708 (0.6)	123,661 (99.4)
number of employees	738,258 (22.6)	2,529,673 (77.4)
value added (billion won)	248,073 (48.8)	260,012 (51.2)

Source: Ministry of SMEs and Startups

*establishment with employment ≥ 5

- ▶ Demand for policies to strengthen SMEs to help them to prosper alongside conglomerate
- ▶ Movement of advanced countries with high competitiveness in manufacturing (Germany and Japan)
 - ▶ Promote the adoption and deployment of smart factory among SMEs to enhance the competitiveness of manufacturing sector (flexible production system)

IMD World Digital Competitiveness Ranking: Korea

<Table 2> Korea's Ranking

Overall	Factors	Sub-Factors		
14	Knowledge	Talent	Training & education	Scientific concentration
	11	26	8	7
	Technology	Regulatory framework	Capital	Technological framework
	17	27	44	2
	Future readiness	Adaptive attitude	Business agility	IT integration
17	3	47	20	

Source: IMD World Digital Competitiveness Ranking 2018

*Overall ranking: USA (1), Germany (18), Japan (22), China (30)

IMD World Digital Competitiveness Ranking: Korea

- ▶ **Criteria in which Korea ranked very highly**
 - ▶ Higher education achievement (3)
 - ▶ Total expenditure on R&D (2)
 - ▶ Enforcing contracts (1)
 - ▶ Internet bandwidth speed (1)
 - ▶ E-Government (3)

- ▶ **Criteria in which Korea shows top weakness**
 - ▶ Female researchers (52)
 - ▶ Immigration laws (55)
 - ▶ Development and app. of technology (52)
 - ▶ Banking and financial services (54)
 - ▶ Venture capital (53)

2. Korea Smart Factory Initiative

- ▶ In 2014, Ministry of Trade, Industry, and Energy (MOTIE) launched the Korea Smart Factory Initiative as part of the Manufacturing Industry Innovation 3.0 strategy.
 - ▶ Initial goal: build 10,000 Smart Factory Sites for Korean small business by 2020
 - ▶ Revised goal (2017): increase the number of domestic smart factories operating with the latest digital and analytical technologies to 30,000 by 2025
- ▶ Smart Factory Initiative represents the principal government instrument to assist Korean SME manufactures with funding, technology development, and know-how to adopt digital manufacturing practices
- ▶ In 2015, MOTIE established a public-private partnership Korea Smart Factory Foundation (KSFF)
 - ▶ Role: control tower for smart factory-related projects (dissemination & diffusion, technology planning, standards planning, and building infra)
- ▶ Korea's Smart Factory Standard Research Council also plays an important role
 - ▶ Task: effectively respond to international trends and activities and to undertake efforts to standardize locally developed regulations

Definition of Smart Factory

- ▶ <KSFF> Customized production with minimum costs & time by implementing automation & digitalization, integrating whole process (planning, design → manufacturing → marketing, sales) with IoT, AI, and Big Data technologies.
- ▶ <Deloitte> A flexible system that can self-optimize performance across a broader network, self-adapt to and learn from new conditions in real or near-real time, and autonomously run entire production processes.
 - ▶ The smart factory as defined should not be considered the “end state,” given the rapid pace of technological development
 - ▶ Rather, it represents an ongoing evolution, a continuous journey toward building and maintaining a flexible learning system – rather than the “one and done” factory modernization approach of the past.

Smart Factory Components (KSFF)

- ▶ **Technology Components**
 - ▶ Automation Technology
 - ▶ Production Technology
 - ▶ ICT Technology

- ▶ **Performance Components**
 - ▶ Productivity
 - ▶ Flexibility
 - ▶ Resource Awareness

Levels of Smart Factory and Contents

<Table 3> Levels of Smart Factory

Korea	Germany	Implementation
Basic	Lv.1~Lv.2	Basic logistics info. collection level using barcode and RFID Quality history management through lot-tracking Partial process automation
Intermediate 1	Lv.2~Lv.3	Real-time data collection from the facility and monitoring Real-time info. exchange based on info. management and factory operation
Intermediate 2	Lv.4~Lv.5	Automation of facility control Real-time decision making and direct facility control
Advanced	Lv.5	Intelligent production with self-diagnostics and control using CPS, IoT, and big data Real-time customized service through value chain

Source: MOTIE(2017)

Top Digital Transformation Trends in Manufacturing

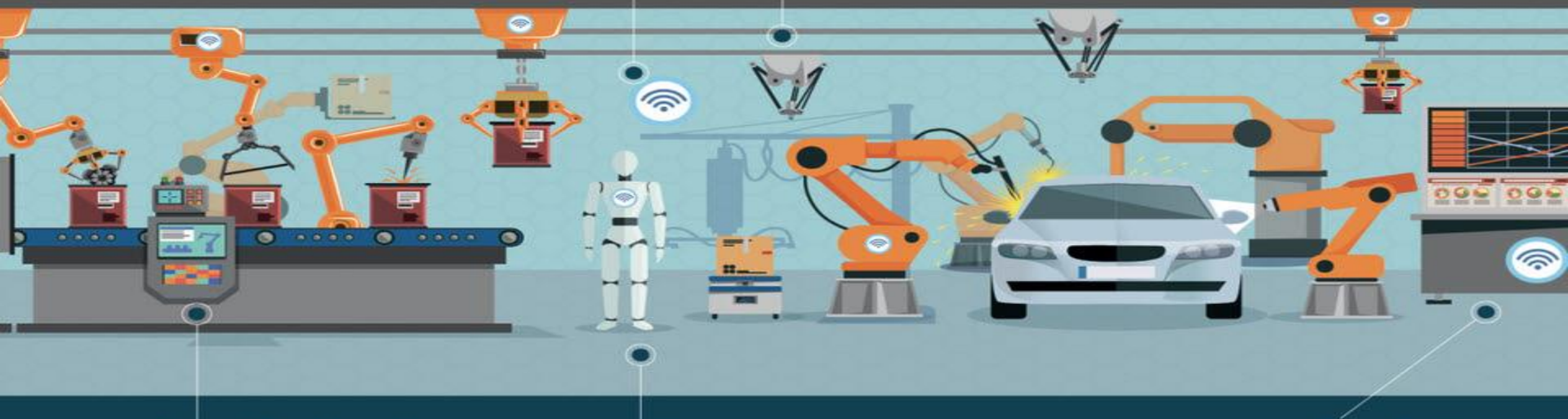
Like the Industrial Revolution impacted manufacturing, digital transformation is now responsible for changing the industry. *Now, manufacturing companies are using technology to move from mass production to customized production, and it's happening at a rapid pace.*

IoT and Industry 4.0

At the center of industrial transformation is IoT, accounting for more than \$178 billion in 2016 and proving critical to providing companies with a competitive edge.

Improved speed and efficiency

Robots and other automated technology are also integral in improving speed and efficiency, allowing manufacturing companies to "optimize production workflows, inventory, Work in Progress, and value chain decisions."



AI and machine learning

Smart factories with integrated IT systems provide relevant data to both sides of the supply chain more easily, increasing production capacity by 20 percent.

Robots

Today, however, robots are capable of mimicking more human traits such as dexterity and memory, which makes them more useful in industries like manufacturing.

Data and analytics

It is predicted that by 2020, there will be 50 times the digital content compared to what exists today.

Current Situation of Korea

- ▶ Except auto sector, penetration rate of smart factory is around 1.5%.

<Table 4> Penetration rate of Smart Factory by manufacturing sector

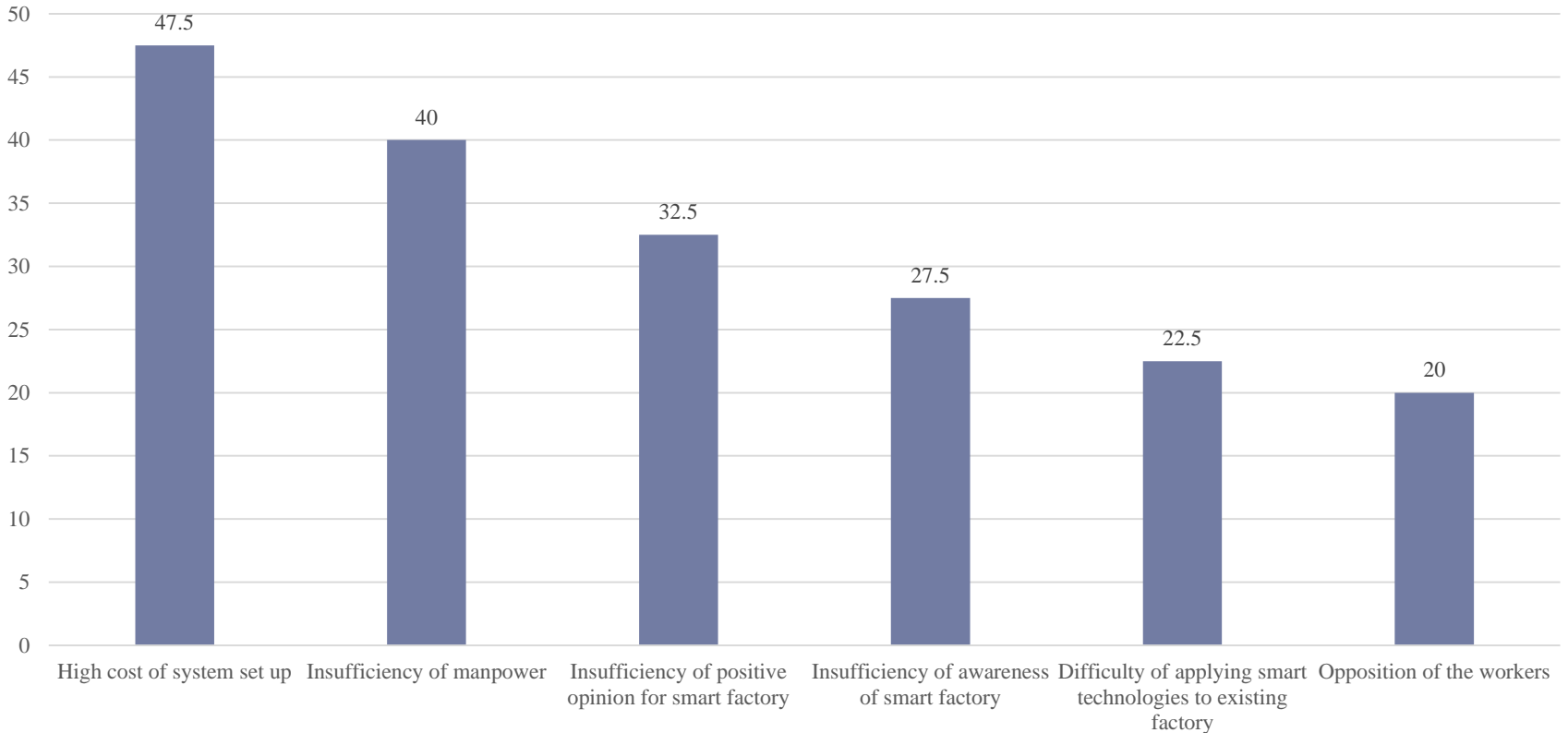
	auto	electronic parts	Machinery /equipment	chemical products	textiles	metal processing	total
penetration rate	9.8	1.9	1.4	1.3	1.0	1.2	1.5

Source: MOTIE(2017)

- ▶ Korea has relatively decent technology in SW such as MES and SCM, but weakness in hardware technology such as sensor and robot
 - ▶ shortage of manpower in the area of HW/SW development

Current Situation of Korea

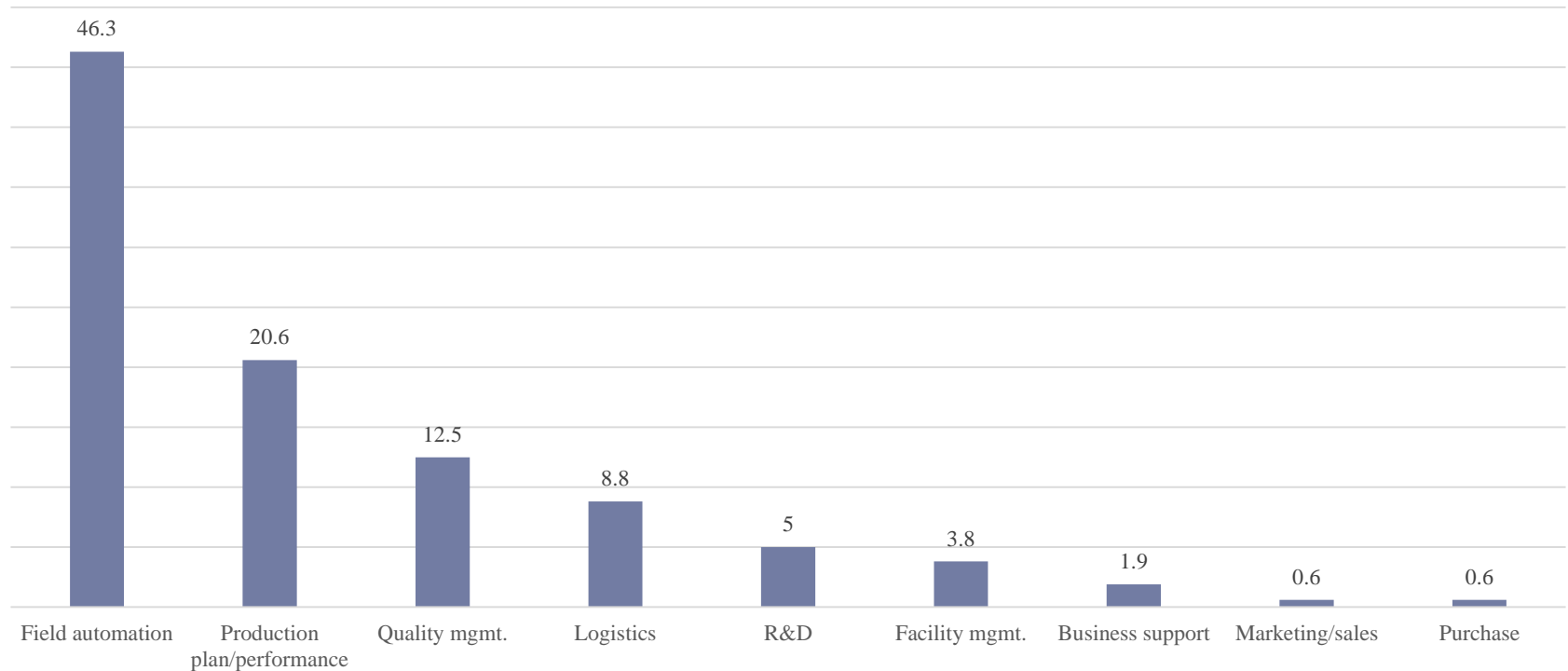
Obstacles to deploying smart factory (% of responding system solution providers)



Source: Lee et al. "Anaysis of Field Conditions and Requirements for Deploying Smart Factory," *Journal of Korean Society of Precision Engineering*, Jan. 2017

Current Situation of Korea

The main purpose of adopting smart factory (% of responding firms which have not adopted it yet)



Source: Lee et al. "Analysis of Field Conditions and Requirements for Deploying Smart Factory," *Journal of Korean Society of Precision Engineering*, Jan. 2017

Current Situation of Korea

<Table 5> The evaluation of Korea' Smart Factory Technology (Relative to the most advanced county: %)

		Relative Level of Technology
Control Network	PLC (Programmable Logic Controller)	80%
	CNC (Computerized Numerical Control)	60%
	Industrial sensor	40%
Solution SW	Manufacturing Execution System (MES)	70%
	Enterprise Resource Planning (ERP)	60%
	Product Lifecycle Management (PLM)	20%
	Supply Chain Management (SCM)	90%
Production	Industrial Robot	40%

Source: MOTIE(2017)

3. Details of Korea Smart Factory Initiative

- ▶ Goal: build 30,000 (on a cumulative basis) Smart Factory Sites for Korean small business by 2025

- ▶ 2017 (5,000) → 2020 (12,000) → 2022 (20,000) → 2025 (30,000)

- ▶ How was the goal set?
 - ▶ Out of 67 thousand SMEs with more than 10 employees, it was estimated that 50 thousand firms hold intermediate technology. Need to disseminate smart factory technology to 60% of them first in stages.

- ▶ How to support SMEs?
 - ▶ Two methods: Government support or Large corporation support.

3. Details of Korea Smart Factory Initiative

<Table 6> Two Methods of Support

	Contents	Portion (%)
Government	Support smart factory technology adoption Funding Method (Gov't: SME=5:5)*	70
Private (Large corporations)	Voluntary support by large companies (as part of Industrial Innovation Movement (2013-2018))	30

* Gov't support amount: 50 million won (44,000 US\$) in the general case, 200 million won (177,000 US\$) in demonstration model

3. Details of Korea Smart Factory Initiative

- ▶ Competition rate for the support program
 - ▶ 1.12:1 (2015), 2.8:1 (2016)
- ▶ Total Amount supported (2014-2017)
 - ▶ Gov't 210 billion won (78.8%), Large companies 57 billion won (21.2%)
- ▶ In 2018, a new support method has been introduced to encourage the role of private sector.
 - ▶ Gov't participates in voluntary supports of large companies
 - ▶ (Funding ratio) Gov't: Large: SME=3:3:4

4. Performance of the support program

- ▶ The performance of the SMEs supported by the program is estimated to be good.
 - ▶ Productivity ↑, product defect rate ↓, production cost ↓, delivery time ↓
 - ▶ Increase of 2.2 employment per supported firm
 - ▶ Decrease of industrial accident rate (0.65 → 0.53 for the firms supported in 2015)

- ▶ It is estimated that private (voluntary?) support performed better than government support.
 - ▶ But large companies' support for their partner SMEs are likely to be mostly one-off as they are government-led movements.
 - ▶ As the Industrial Innovation Movement ended in July 2018, it is likely that voluntary supports by private sector will shrink.

4. Performance of the support program

<Table 7> Comparison of performance by supporters (%)

	Productivity increase	Decrease of defect rate	Cost reduction	Shortening of delivery time
SMEs in partnership with large companies and supported by them	49.5	48.7	26.2	21.4
SMEs supported by Gov't	28.0	44.8	14.0	16.1

Source: Presidential Committee on the 4th Industrial Revolution, "Strategy on the dissemination and sophistication of smart factories", March 2018

4. Performance of the support program

- ▶ The smart factory technology adopted in the support program is mostly basic level.
 - ▶ Only 2.1% of the SMEs adopted Intermediate 2 level technology with which they can control the production process in real-time.

<Table 8> The Level of Technology adopted in the support program

Level	Key Features	Share (%)
Basic	Digitalization of production information, production history management	76.4
Intermediate 1	Collection & analysis of production information in real-time	21.5
Intermediate 2	Control of production process through system	2.1
Advanced	Customized flexible production and intelligent factory	-

Source: Presidential Committee on the 4th Industrial Revolution, “Strategy on the dissemination and sophistication of smart factories”, March 2018

<Difficulties of SMEs which are considering the adoption of smart factory technology>

- ▶ In a survey of Korea Federation of SMEs (Dec. 2016), 83.3% of responding SMEs pointed out lack of funds.
 - ▶ Difficulty with following-up management (57.4%)
 - ▶ Lack of personnel to operate smart factory (35.7%)

5. New Strategy on Smart Factory Initiative

- ▶ Korean government announced a new strategy on the dissemination and sophistication of smart factory in March 2018.

- ▶ **Shift of Focus**
 - ▶ From individual SMEs to SME group in industrial complex or in the same industry
 - ▶ Expansion of support by private sector (large companies) (Increase the share of private sector from 30% in 2018 to 50% in 2022)

- ▶ **Upgrading the level of smart factory**
 - ▶ Enlarge sensor and robot utilization
 - ▶ Expand cloud-based smart factory and the use of big data
 - ▶ Preferential support for R&D on areas needed to localize and upgrade smart factory technology in Korea (i.e. element technology)

- ▶ **Strengthen job conversion training and enhancing expertise**
 - ▶ Training of 50, 000 operating personnel by 2022 (upskill SME employees)
 - ▶ Expansion of graduate curriculum related to smart factory technology

6. Implications from Korean experiences

<Fancy “smart” image vs SME reality>

- ▶ The smart factory technology adopted in the support program in Korea is mostly basic level. Considering the unfavorable situation of SMEs, it is important to set the target level appropriately.
 - ▶ Some experts advise not to overemphasize the ICT technology aspect of smart factory.
 - ▶ Need to recognize the importance of production (or operation) technology automation technology.

<Encourage private sector support>

- ▶ In Korea, it was estimated that voluntary support by private sector performed better than government support. In Korea, one of the key economic policy agenda is to encourage mutual (shared) growth between large corporations and SMEs.
 - ▶ It is desirable to create an environment to facilitate (voluntary) close cooperation between large corporations and SMEs
 - ▶ Invisible hand vs invisible pressure from the government
 - ▶ Important to create a win-win situation

<Be sustainable>

- ▶ Support program should not be one-off event. It is important to follow up after the project ends.
 - ▶ Identify and address difficulties facing SMEs

Case Study: SME IT (ERP) support project (2001-2003)

- ▶ Goal: support 30,000 SMEs

One follow-up study shows;

- ▶ Not utilize IT system after setting up: 46.1%
- ▶ Not having IT maintenance contract: 54.6%
- ▶ Facing IT system bottleneck, abandoned the system: 52.9%

<Train manpower for smart factory operation>

- ▶ It is not easy for SMEs to secure manpower for smart factory operation. It is necessary for the government to run a program for the conversion of jobs of SMEs.
 - ▶ Overcome employee's passive attitude toward the adoption of new technology