Korea Smart Factory Policies and Practices for SMEs

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Smart Manufacturing Innovation Center, KPC
I. Introduction to Smart Factory
II. Korea Smart Factory Policies
III. Korea Smart Factory Practices for SMEs
Introduction to Smart Factory

1. Background
2. Concept of Smart Factory
The term "Industry 4.0", shortened to I4.0 or simply I4, originates from a project in the high-tech strategy of the German government, which promotes the computerization of manufacturing. Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, has published a book entitled “The Fourth Industrial Revolution” in which he describes how this fourth revolution is fundamentally different from the previous three, which were characterized mainly by advances in technology.

After the global economic crisis, manufacturing is becoming more important globally. Strategies are being promoted in many countries to enhance the competitiveness of their manufacturing industries.

**High-tech Strategy**
- Projects for the future "Industrie 4.0" and "Smart Services World"

**Industry Revival Plan**
- Restructuring Industry structure
- Increasing R&D investment on design & production technology
  *つながる工場"(connected factory), "Monozukuri"

**High Value Manufacturing Strategy**
- Support to increase the value of all manufacturing processes
- Support SMEs through "HVM Catapult Center"

**Mfg. Innovation 3.0 & Smart Factory**
- Smart Factory Initiatives
- Smart Factory R&D Roadmap
- Factory Digitalization and Automation

**Manufacturing Renaissance**
- Formation of a "National Network for Manufacturing Innovation"
- Research Center "Digital Manufacturing and Design Innovation"

**Manufacturing 2025**
- Focus on IT integration in industrial processes
- Energy efficiency legislation
1. Background | 2) National Innovation Strategies

- Understanding of Industry 4.0
  - Industry 4.0 is a broad term that encompasses different perspectives, industries, corporate functions, technologies and fields.
  - This study analyses the opportunities and challenges of international cooperation in the field of Industry 4.0.
  - It is based on more than 150 interviews and discussions with experts from Germany, China, Japan, South Korea, the UK and the US.

The most significant economic opportunities of Industry 4.0

- Businesses in particular are not simply introducing and adapting to Industry 4.0 for the sake of it - they are doing so because of the economic opportunities that it provides.
- The experts from all of the countries saw production optimisation as one of the main economic benefits.

South Korea’s economy has risen steadily in global manufacturing, ranked 11th in 1990, 8th in 2000 and 7th in 2010. South Korea’s manufacturing share of GDP is 28% ranked in the world’s 2nd place.

* Source: McKinsey Global Institute, 2012
New productivity innovation strategies are required in the age of I4.0.

**New productivity innovation strategies**

1. Creating New Value
   - Smart Product (IoT, AI)
2. Increasing Operational Efficiency
   - New Business Model (Servitization)
   - Smart Production (Data-driven process)
Industry 4.0 fosters what has been called a "smart factory". Within modular structured smart factories, cyber-physical systems monitor physical processes, create a virtual copy of the physical world and make decentralized decisions.

* Source: DFKI (German Research Center for Artificial Intelligence)
2. Concept of Smart Factory | 2) Definition of SMLC

- Smart Manufacturing is the ability to solve existing and future problems via an open infrastructure that allows solutions to be implemented at the speed of business while creating advantaged value.

* Source: SMLC (Smart Manufacturing Leadership Coalition)
Korea Smart Factory Policies

1. Introduction of KOSF
2. Key Features
3. Main Projects
4. Expected Effects
1. Introduction of KOSF

- Purpose of establishment
  - To promote the spread of smart factories to strengthen international competitiveness of Korea manufacturing industry
  - To promote the software solution industry of smart factories for Korea smart factory development
  - To create high quality job for smart factories

- Main Functions

<table>
<thead>
<tr>
<th>Diffusion</th>
<th>Research &amp; Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Diffusion of smart factories for SMEs</td>
<td>• Development of smart factory solutions and key technologies</td>
</tr>
<tr>
<td>• Promotion : Expo, Survey, Best practices</td>
<td>• Representative smart factory</td>
</tr>
<tr>
<td></td>
<td>• Demo smart factory (testbed)</td>
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</table>

<table>
<thead>
<tr>
<th>Standard &amp; Certification</th>
<th>Education &amp; Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Establishment of standards related to smart factories</td>
<td>• Establishment of smart factory department in graduate school</td>
</tr>
<tr>
<td>• Certification of smart factory maturity level</td>
<td>• Training for CEOs, employees, s/w engineers and consultants</td>
</tr>
</tbody>
</table>
KOSF was established as a public-private joint foundation to support and control the Korea smart factory policies in June 2015.
2. Key Features | 1) Definition of Smart Factory

- An intelligent factory for customized smart productions by integrating whole manufacturing process based on **ICT**
  * It is different from production automation through unmanned factory

![Diagram showing key features of Smart Factory](image_url)
2. Key Features | 1) Definition of Smart Factory

- **Scope of support projects for SMEs**
  - The smart factory includes all manufacturing related processes:
    1. from product development to mass production,
    2. from demand forecasting and customer orders to finished product shipment,
    3. vertically including all areas of field automation, control automation and application system.

**Business Process**
- Product Planning/Design/Development
- Production Planning & manufacturing
- Sales and Distribution

**ICT based System**
- Product Lifecycle Management
- Supply Chain Management
- Enterprise Resource Planning
- Manufacturing Execution & Operation
- Device sensing/Actuating/Controlling

**Key Features**
- **Product Lifecycle Management**
  - Production Order
  - Master Data
  - Master Data Engineering Info'
  - Engineering Info'

**Supply Chain Management**
- Order, Forecast
- Progress

**Enterprise Resource Planning**
- Plan, Schedule
- Progress, History

**Manufacturing Execution & Operation**
- Work-order Control
- Real-time Data

**Device sensing/Actuating/Controlling**
- Customers
- Suppliers

➢ The smart factory includes all manufacturing related processes:
   1. from product development to mass production,
   2. from demand forecasting and customer orders to finished product shipment,
   3. vertically including all areas of field automation, control automation and application system.
2. Key Features | 2) Phased Approach

- Step-by-step 5-level approach from the basic level to the advanced level
  - Basic level ~ 2nd level: use current technologies
  - Smart level: use smart factory technologies developed with IoT and CPS

IoT: Internet of Things
CPS: Cyber Physical System
## 2. Key Features | 2) Phased Approach

- We define 4 levels of the Smart Factory by the ICT system and automation levels.

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced</td>
<td>• IoT &amp; CPS based Intelligent and Flexible Manufacturing System.</td>
<td>Future Factory Technology</td>
</tr>
<tr>
<td>Intermediate-2</td>
<td>• All working machinery are fully automated by controllers.</td>
<td>Current Factory Technology</td>
</tr>
<tr>
<td></td>
<td>• The Controllers communicate at real-time with ICT System such as CAD/CAM.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• At every event, material and machine communicate each other and ICT system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>control intelligently at real-time.</td>
<td></td>
</tr>
<tr>
<td>Intermediate-1</td>
<td>• All working machinery sense status and send current parameter values</td>
<td></td>
</tr>
<tr>
<td></td>
<td>at every event to ICT system.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ICT system can monitor and identify the problems, and make decision</td>
<td></td>
</tr>
<tr>
<td></td>
<td>at real-time by the parameter values.</td>
<td></td>
</tr>
<tr>
<td>Basic</td>
<td>• Material and process flow are traced at real-time by ICT System</td>
<td></td>
</tr>
<tr>
<td>ICT Not-used</td>
<td>• All kind of works are done by manual labor, EXCEL, MS-Word</td>
<td></td>
</tr>
</tbody>
</table>
2. Key Features | 3) Strengthening Competitiveness

- Demand Industry Perspective

- LSIS: a leading company in the power system and automation sectors
- KAI: Korea Aerospace Industries, LTD
2. Key Features | 3) Strengthening Competitiveness

- Supply Industry Perspective
  - Technological competitiveness of domestic enterprises is 20-90 percent in developed countries as measured by item level.
  - It expects average annual growth of 11.2% to $2.4 billion level of the domestic market (1.5% of the global market).
    * The world market is based on $155.2 billion in 2012 and has grown into a $246 billion in 2018 (Markets & Markets)
3. Main Projects | 1) Smart Factory Diffusion

- Overview

Support SMEs and hidden champions to adopt Smart Factory to enhance manufacturing competitiveness

**Objective**

- 2015 ~ '20 (6 years)
- Target: Provide a total of 10 thousand Smart Factories (2015 YTD 1,240 factories)

**Term**

ICT converged Smart Factory propagation project (MOTIE), Regional investment promotion subsidy project (MOTIE, municipalities), Production site digitalization project (SMBA)

**Current Status**

- Gov't
  - Industry innovation campaign, Support suppliers of conglomerates and community based businesses via Creative Economy Innovation Center

**Projects as of 2015**

<table>
<thead>
<tr>
<th>Classification</th>
<th>2014</th>
<th>2015</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MOTIE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF adoption by industry type</td>
<td>-</td>
<td>303</td>
<td>303</td>
</tr>
<tr>
<td>Regional investment promotion subsidy</td>
<td>-</td>
<td>193</td>
<td>193</td>
</tr>
<tr>
<td>Specialized local project (KIAT)</td>
<td>-</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td><strong>SMBA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production site digitalization project</td>
<td>144</td>
<td>187</td>
<td>281</td>
</tr>
<tr>
<td><strong>Private</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry innovation</td>
<td>133</td>
<td>139</td>
<td>272</td>
</tr>
<tr>
<td>Creative Economy Innovation Center</td>
<td>-</td>
<td>167</td>
<td>167</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>277</td>
<td>963</td>
<td>1,240</td>
</tr>
</tbody>
</table>
3. Main Projects | 1) Smart Factory Diffusion

- Results and Achievements
  - 5,003 SMEs completed the introduction of smart factory by the end of 2017.
  - They experienced 45% quality improvement, productivity improvement by 45%, delivery time reduction by 16% and cost reduction by 15%.

- Results of Diffusion projects ( # of enterprises)

- Effects of Smart Factory

  - Delivery Time Reduction: 16%
  - Cost Reduction: 15%
  - Quality Improvement: 45%
  - Productivity Improvement: 30%

* Aggregated by the end of 2017

* Average of 2800 companies completed by the end of 2017
3. Main Projects | 2) R&D - Representative smart factory

- SMEs need a model house showing what a smart factory is in real site

**Propose a reference smart factory model for main industry fields**

- **Factory tour is necessary to show what is smart factory**
  - Started factory tour for root industry in 2015
  - Apply advanced manufacturing technologies to real operating factory site

- **Provide opportunities for SMEs to see high-level smart factories that they can approach**
  - Large companies’ technical level is high enough but it is not easy to benchmark for SMEs
  - Presenting smart factory leading model considering reality
3. Main Projects | 2) R&D - Demo smart factory

Show the Future of Manufacturing (Lighthouse Project)

- Establishment of a smart factory to facilitate domestic manufacturing industry
- Provide interoperability and usage plan considering international and industrial standards (de-facto)
  → IEC/ISO, IEEE, KS (Korea Standard)...

A reference model by integrating {enable} manufacturing technologies

- Developed a testbed that combines 9 {enable} technologies for smart manufacturing

BIG DATA  IIoT  CPS/ Digital Twin  CLOUD COMPUTING  VR/AR
5G WIRELESS  Smart Machine  3D Printing  AI

1. POC(Proof of Concept)  2. Certification  3. Training for Skilled Technicians
3. Main Projects | 3) Standard & Certification

- Building the foundation for an autonomous proliferation by private companies
- Building standard and certification system of smart factory
  - (Standard) Enhancement on compatibility between SW and HW at Smart Factory and Establishment of a strategy and a Standard Road-map in order for corresponding to international standard
- (Certification) Developing on assessment model for certification, establishing a framework, and pushing the pilot test applied to certification model

### Standardization procedures

- 1. Selecting and finding areas that need to standardize
- 2. Standard survey by each field
- 3. Selecting area in response to priority

- Agreement on common standards
  - (Standards in scrambling area)
- New standards development
  - (Standard non-existent in area)

### Excepted effects in case of introducing certification

- Suggestion of methodology for the implementation of SMEs for Smart Factory
- To spread the consensus of "Trusted company in case of acquisition of Smart Factory certification" in order to create an atmosphere to the spread of a voluntary Smart Factory
3. Main Projects | 4) Education & Training

- SMEs need a model house showing what a smart factory is in real site

**HRD Program for Smart-Factory Expert**

**Subject**

1. Mechanical Engineering · Industrial Engineering · Computer Engineering Major (4-year) Graduates (Full-time)
   Smart Factory Operation Design Graduate students who want to improve their R & D ability through specialist graduate education and acquire expert knowledge of smart factory factor technology and to engage in smart factory supplier and smart factory introduction company after graduation.

2. Manufacturing-related workers (incumbent)
   A company that is trying to lead future technology in smart factory operation and design by integrating field experience and theoretical content.

KOSF R&R: Smart factory operation / training, curriculum development, student selection / management, mentoring, recruitment of participating companies and finding out industrial demand.
4. Expected Effects

- Improved smart level of manufacturing companies → Ability to increase productivity and added value
  - Enhanced the smart level of SMEs beyond "IT-based production management"

- Promoting related to industry: Sensor, automation machine
  - Prospect of Smart Factory domestic industrial scale (Markets & Markets, hundred million dollars): 40(‘17) → 56(‘20)

<table>
<thead>
<tr>
<th>The main core product technology level (compared to developed countries)</th>
<th>Smart factory domestic industrial scale (hundred million dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60%(‘14) → 70%(‘17) → 80%(‘20)</td>
<td>24(‘14) → 40(‘17) → 56(‘20)</td>
</tr>
</tbody>
</table>

- Improvement of the working environment and job creation related to high value-added
Korea Smart Factory Practices for SMEs

1. Cases of Smart Factory Transformation
2. Smart Solution Providers behind the Scene
3. Education & Training
4. Smart Factory Consulting
1. Cases of Smart Factory Transformation

- SAEHAN VACUUM HEAT TREATMENT Co.

Saehan Vacuum Heat Treatment Co (http://heattreatment.co.kr):
1. First year saving of electricity cost exceeded initial investment
2. Reduction of defects by 67%
1. Cases of Smart Factory Transformation

- FRONTEC

Revenue 4% up, Productivity 7% up, Reduced defect 80%, New jobs 45

Frontec, Inc. (http://e-frontec.co.kr/)
1. Cases of Smart Factory Transformation

- **Supplier Smart Factory Program (Construction Machinery Industry)**

1. **Digital connectivity**
   - 1-1. Master Data

2. **Automated production**
   - 2-1. Production Facility
   - 2-2. Fool Proof

3. **Data-driven optimization**
   - 3-1. RTMS & Simulation
   - 3-2. Quality Data
   - 3-3. Predictive Maintenance

4. **Visible shop floor**
   - 4-1. Real-time Process Monitoring
   - 4-2. Real-time Quality Check
   - 4-3. KPI Dashboard
1. Cases of Smart Factory Transformation

- Piston Manufacturing Company
  - Medium-sized automotive piston producing company
  - Ranked 1st in Korea market share (4th in the world)

Implementation of Integrated Smart Factory

**Before**
- Connected
- Mass production system for specific product
- Real-time monitoring system for separate manufacturing process
- Control automation for casting and processing

**After**
- Optimized
- Mass customization system for multi-product
- Digital synchronization of Actual factory and virtual factory using IoT and CPS
- Intelligent control automation based on big data

Productivity 43% increased
Defective rate 74% decreased
2. Smart Solution Providers behind the Scene

- MES Solution Provider: ACS

MES Solution (DABOM - MES)

- It integrates 4M (Man, Machine, Material, Method) information of production resources with M2M technology of wired and wireless sensor.
- Applies Web service standard MES application technology to enable real-time central management of multiple plants scattered around the global.

References

Automotive parts

[List of automotive parts]

Electrical/electronic parts

[List of electrical/electronic parts]

Logistics/others

[List of logistics and others]
2. Smart Solution Providers behind the Scene

- IoT Solution Provider: Ulala Lab

Facilities

Data Analysis

Management (Dashboard)

Before

After 3 months

15 ~ 30 thousands / month

18% → 8%

✓ (USD) 27 ~ 54 thousands per month
✓ (USD) 12 ~ 24 thousands per month
3. Education & Training

- HRD Program for Smart Factory Expert

Subject

1. Mechanical Engineering · Industrial Engineering · Computer Engineering Major (4-year) Graduates (Full-time)
   Smart Factory Operation Design Graduate students who want to improve their R & D ability through specialist graduate education and acquire expert knowledge of smart factory factor technology and to engage in smart factory supplier and smart factory introduction company after graduation.

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KOSF R&R: Smart factory operation / training, curriculum development, student selection / management, mentoring, recruitment of participating companies and finding out industrial demand.
4. Smart Factory Consulting

- Examples of smart factory consulting

Education & Benchmarking

Smart Level Assessment

Roadmap

Education

• Smart Factory Standard (KS X 9001-3)

Assessment Model

Main Strategies

BP Benchmarking

Assessment Result Review

Roadmap

- 1
- 2
- 3
Thank You

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