ECLAC / Santiago de Chile / 14 May 2019

Korea Smart Factory Policies and Practices for SMEs

- 14 May 2019 -

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KOREA PRODUCTIVITY CENTER

KOREA SMART FACTORY FOUNDATION

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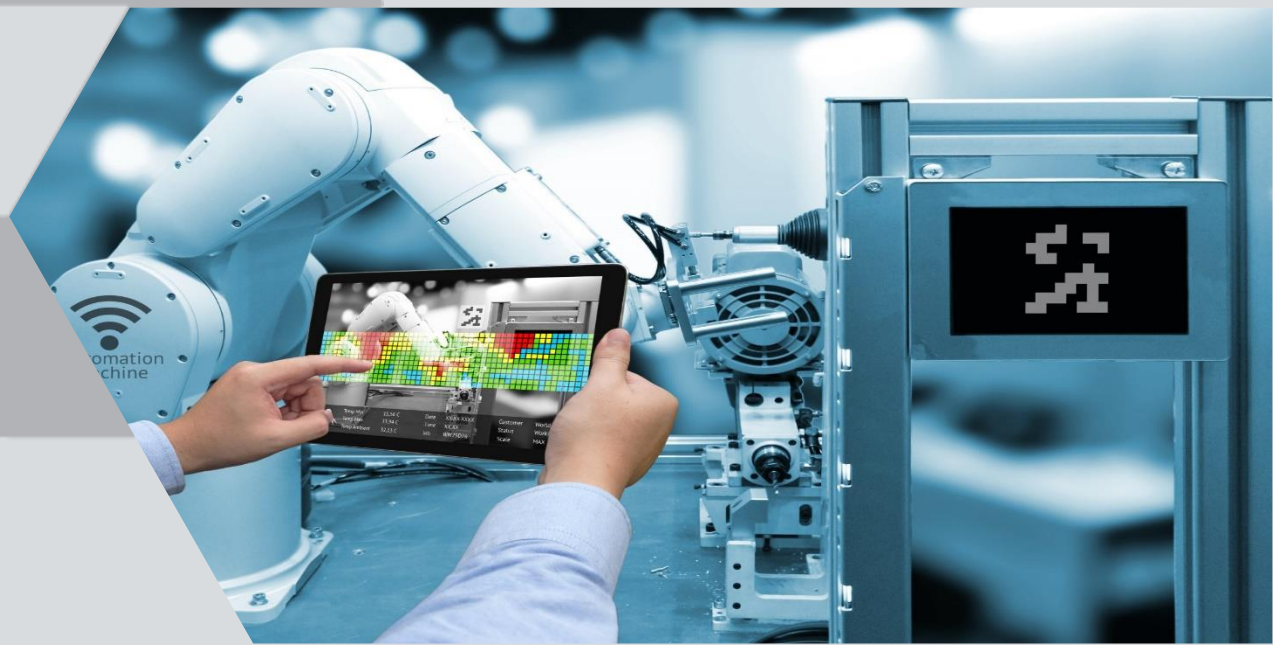

Ⅰ Introduction to Smart Factory

1. Background
2. Concept of Smart Factory

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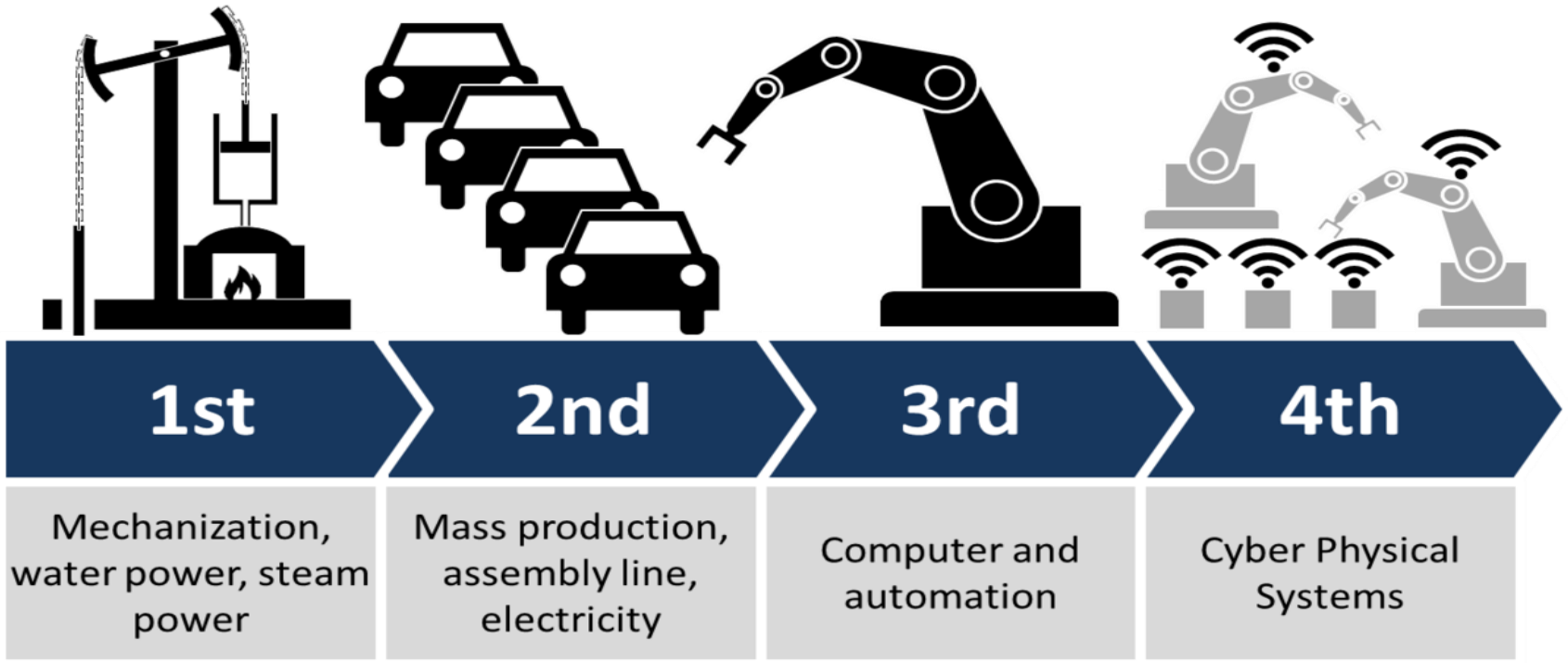
1. Background | 1) The Fourth Industrial Revolution

- 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.



* Source: Wikipedia

1. Background | 2) National Mfg. Innovation Strategies

- ❑ 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"

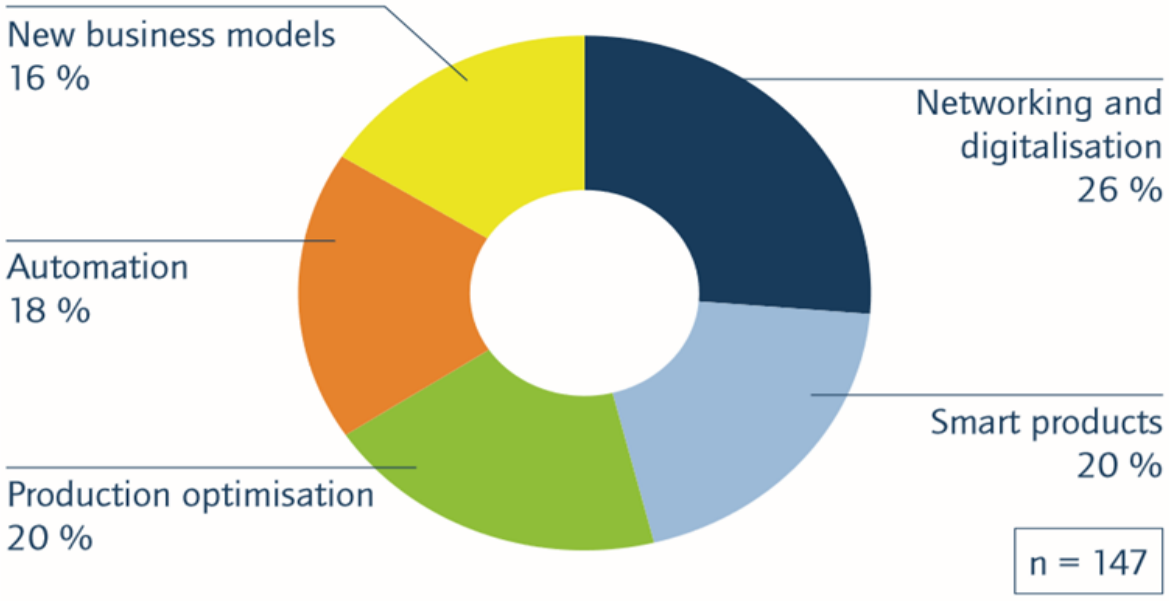
Manufacturing 2025

- 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.

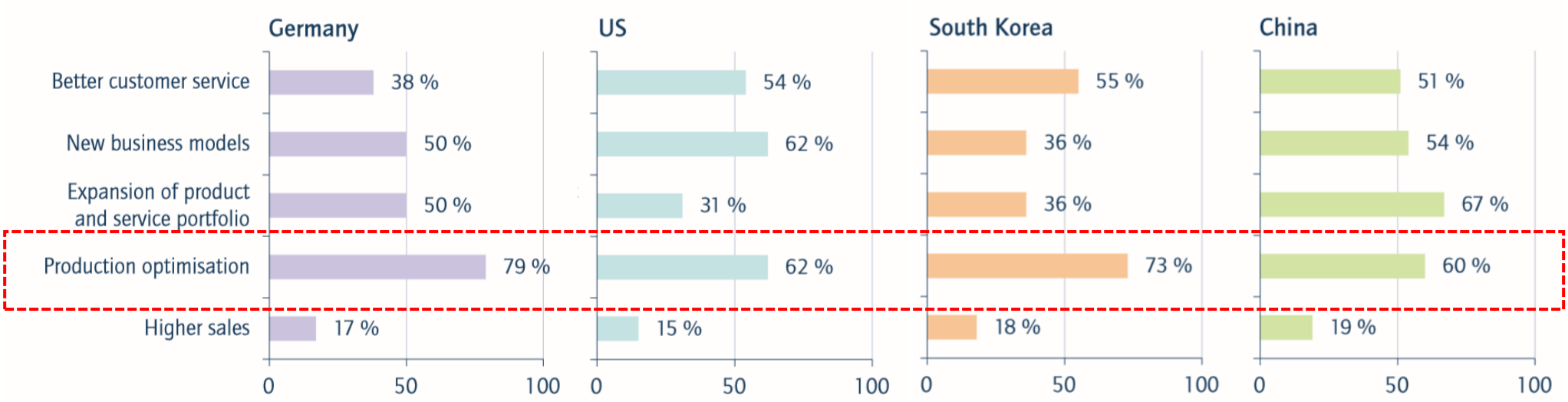


* Source: ACATECH, "Industrie 4.0 in a Global Context", 2016

1. Background | 2) National Innovation Strategies

❑ 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.



n = 148, multiple responses allowed

* Source: ACATECH, "Industrie 4.0 in a Global Context", 2016

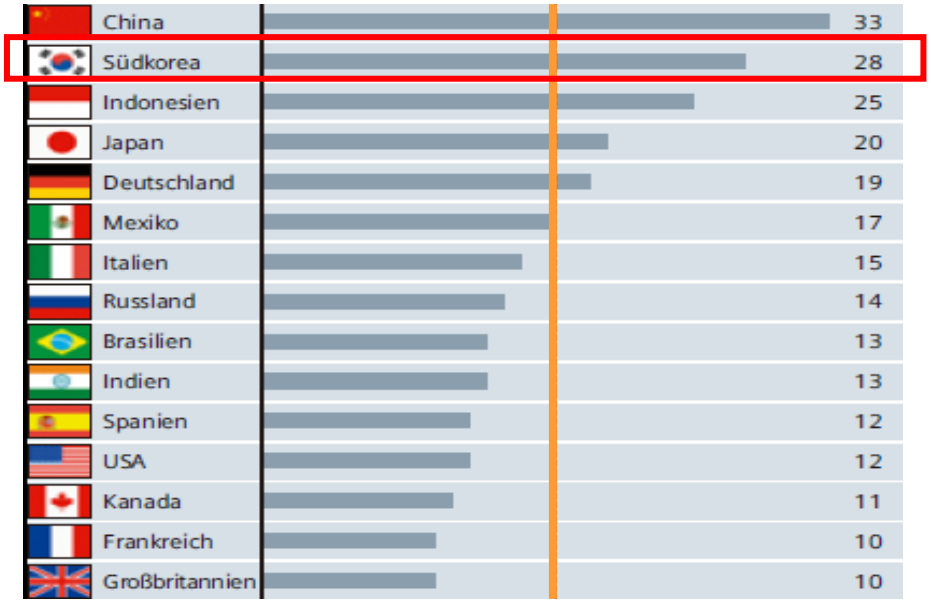
1. Background | 3) Ranking by Mfg. share of GDP in percent

- 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.

❖ Ranking by share of manufacturing gross value added

	1980	1990	2000	2010
1	USA	USA	USA	USA
2	Deutschland	Japan	Japan	China
3	Japan	Deutschland	Deutschland	Japan
4	Großbritannien	Italien	China	Deutschland
5	Frankreich	Großbritannien	Großbritannien	Italien
6	Italien	Frankreich	Italien	Brasilien
7	China	China	Frankreich	Südkorea
8	Brasilien	Brasilien	Südkorea	Frankreich
9	Spanien	Spanien	Kanada	Großbritannien
10	Kanada	Kanada	Mexiko	Indien
11	Mexiko	Südkorea	Spanien	Russland
12	Australien	Mexiko	Brasilien	Mexiko
13	Niederlande	Türkei	Taiwan	Indonesien
14	Argentinien	Indien	Indien	Spanien
15	Indien	Taiwan	Türkei	Kanada

❖ Manufacturing share of GDP in percent



* Source: McKinsey Global Institute, 2012

1. Background | 4) New productivity innovation strategies

❑ New productivity innovation strategies are required in the age of I4.0

New productivity innovation strategies

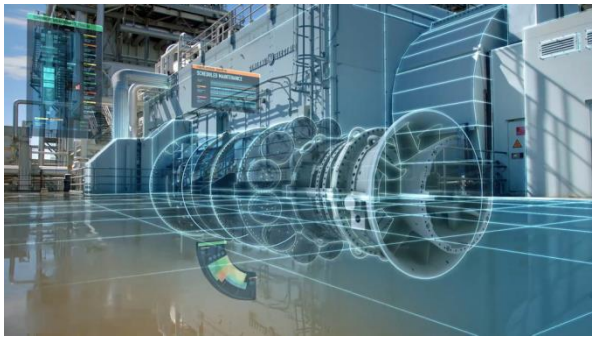
Creating New Value

Increasing Operational Efficiency

Smart Product (IoT, AI)

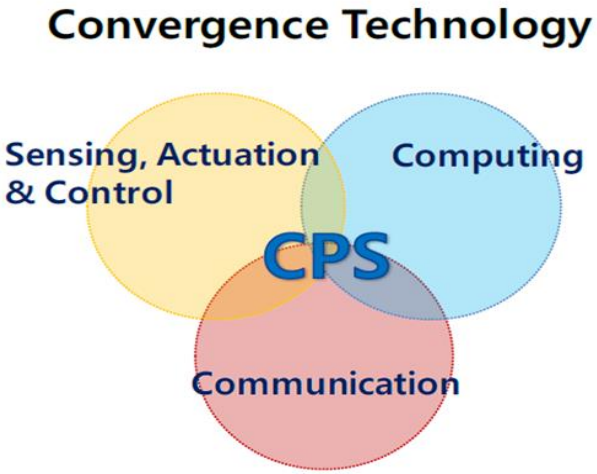
New Business Model (Servitization)

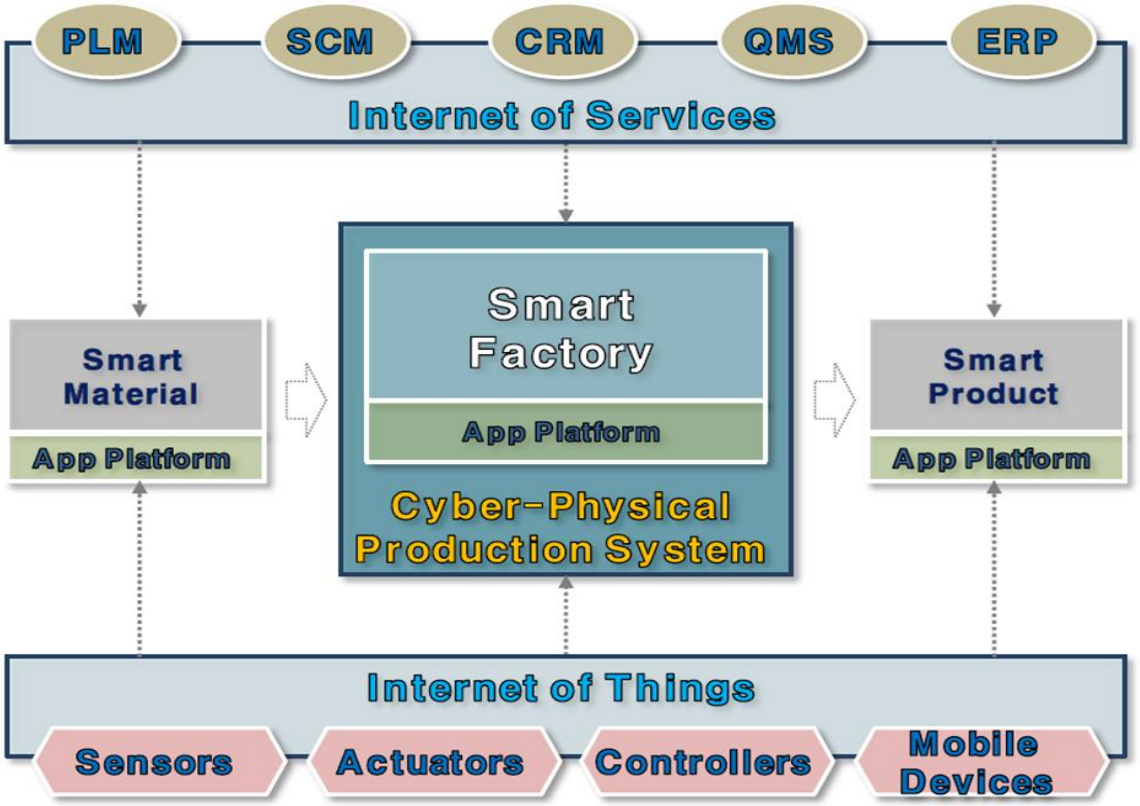
Smart Production (Dater driven process)



2. Concept of Smart Factory | 1) Definition of DFKI

- 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.



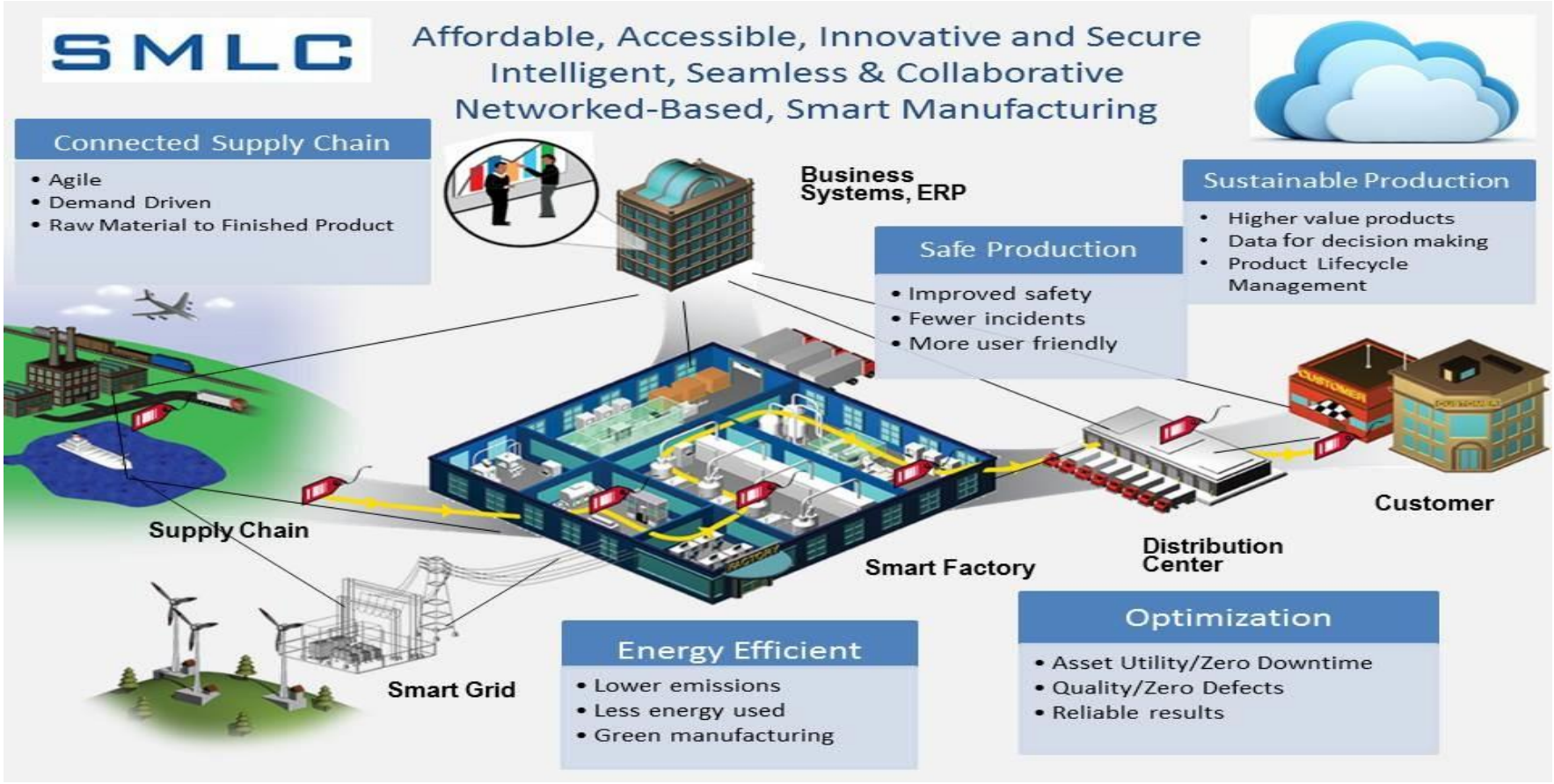


* Source: DFKI (German Research Center for Artificial Intelligence)

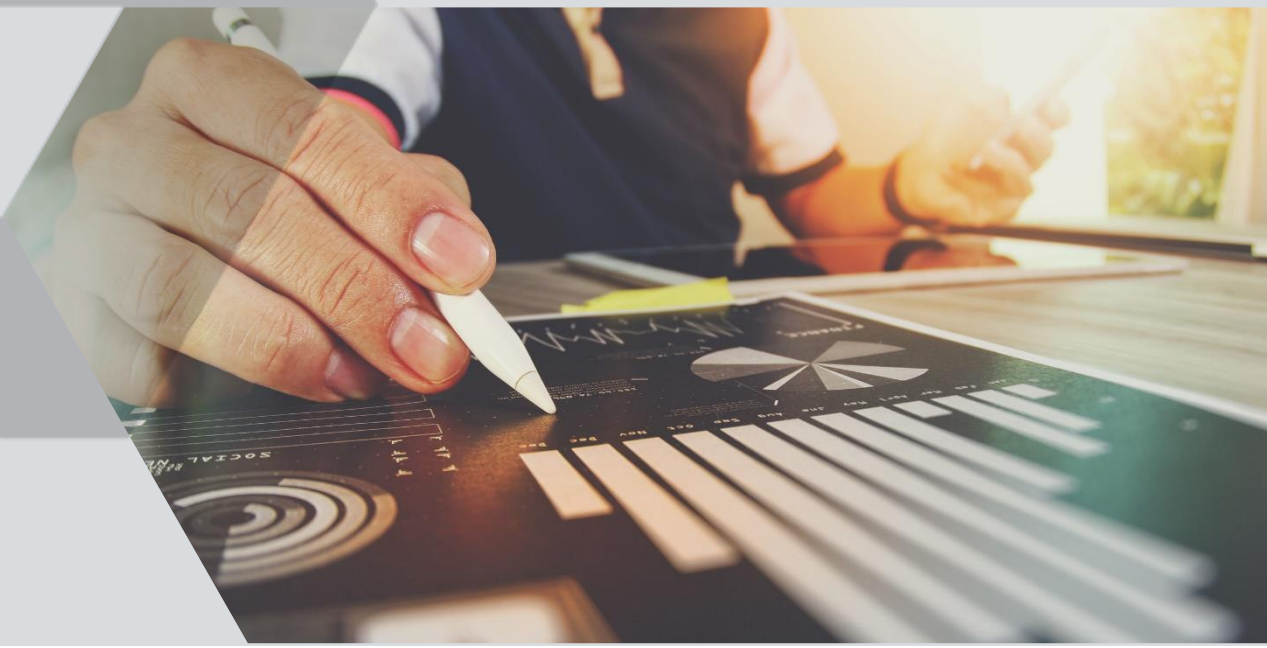
PLM : Product Lifecycle Management
SCM : Supply Chain Management
CRM : Customer Relationship Management
QMS : Quality Management System
ERP : Enterprise Resource Planning

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)



Ⅱ | Korea Smart Factory Policies

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

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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

Diffusion

- Diffusion of smart factories for SMEs
- Promotion : Expo, Survey, Best practices

Research & Development

- Development of smart factory solutions and key technologies
- Representative smart factory
- Demo smart factory (testbed)

Standard & Certification

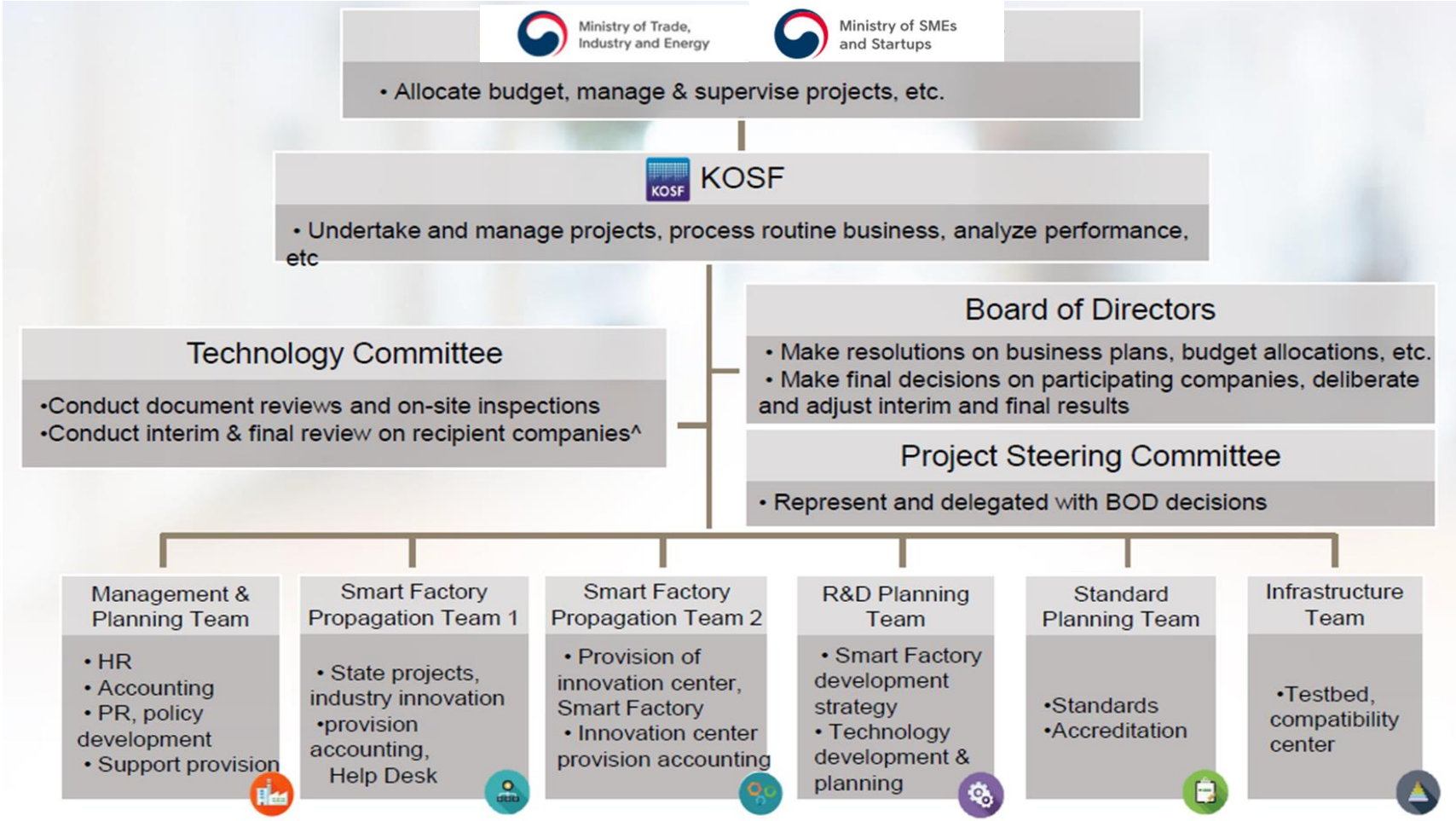
- Establishment of standards related to smart factories
- Certification of smart factory maturity level

Education & Training

- Establishment of smart factory department in graduate school
- Training for CEOs, employees, s/w engineers and consultants

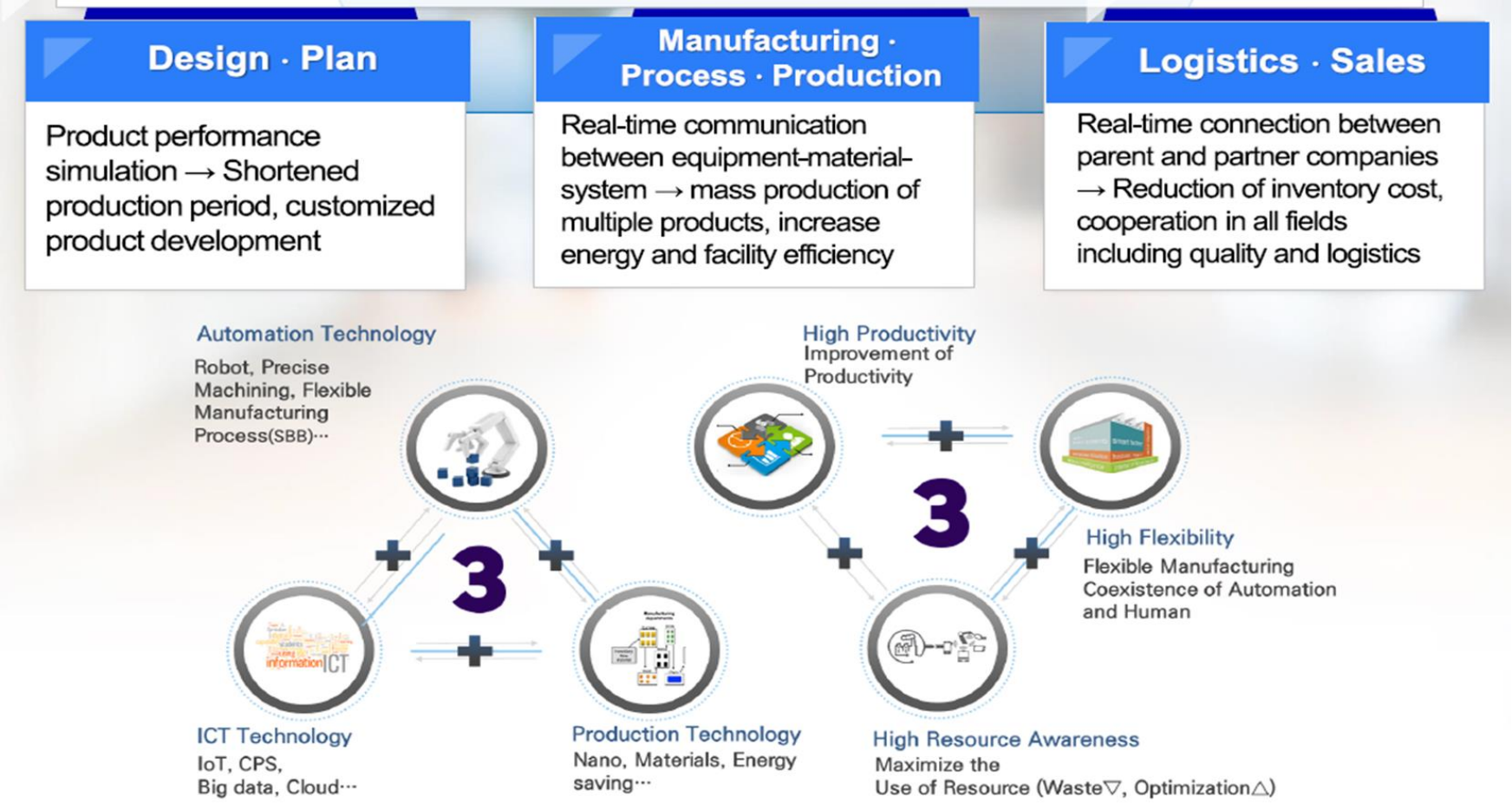
1. Introduction of KOSF

❑ KOSF wad 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



2. Key Features | 1) Definition of Smart Factory

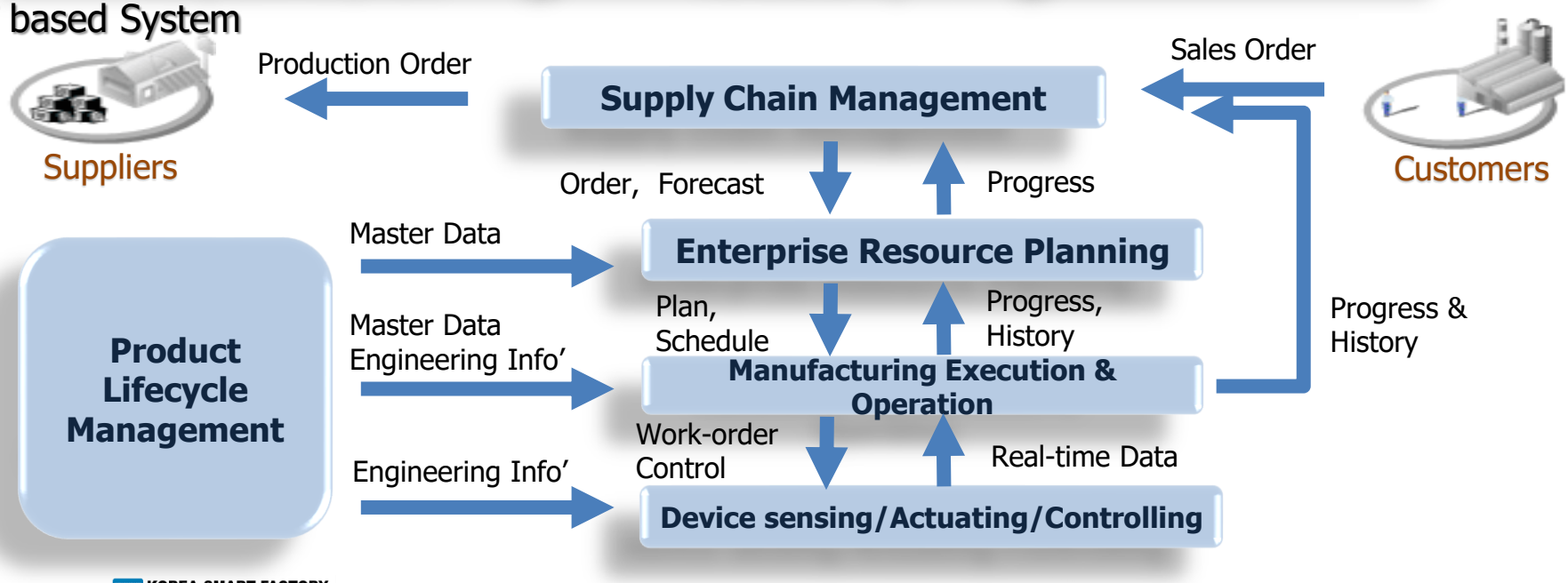
❑ Scope of support projects for SMEs

➢ 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

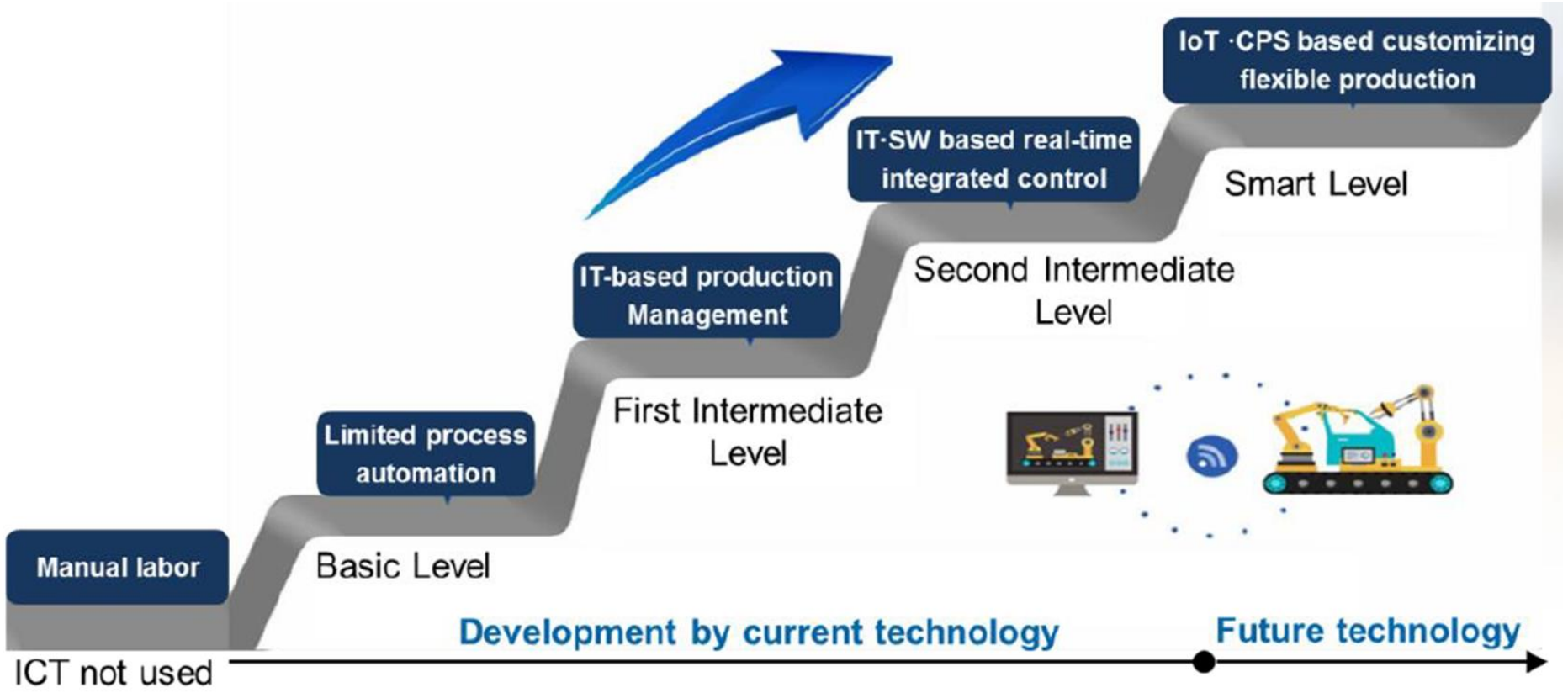
ICT based System



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

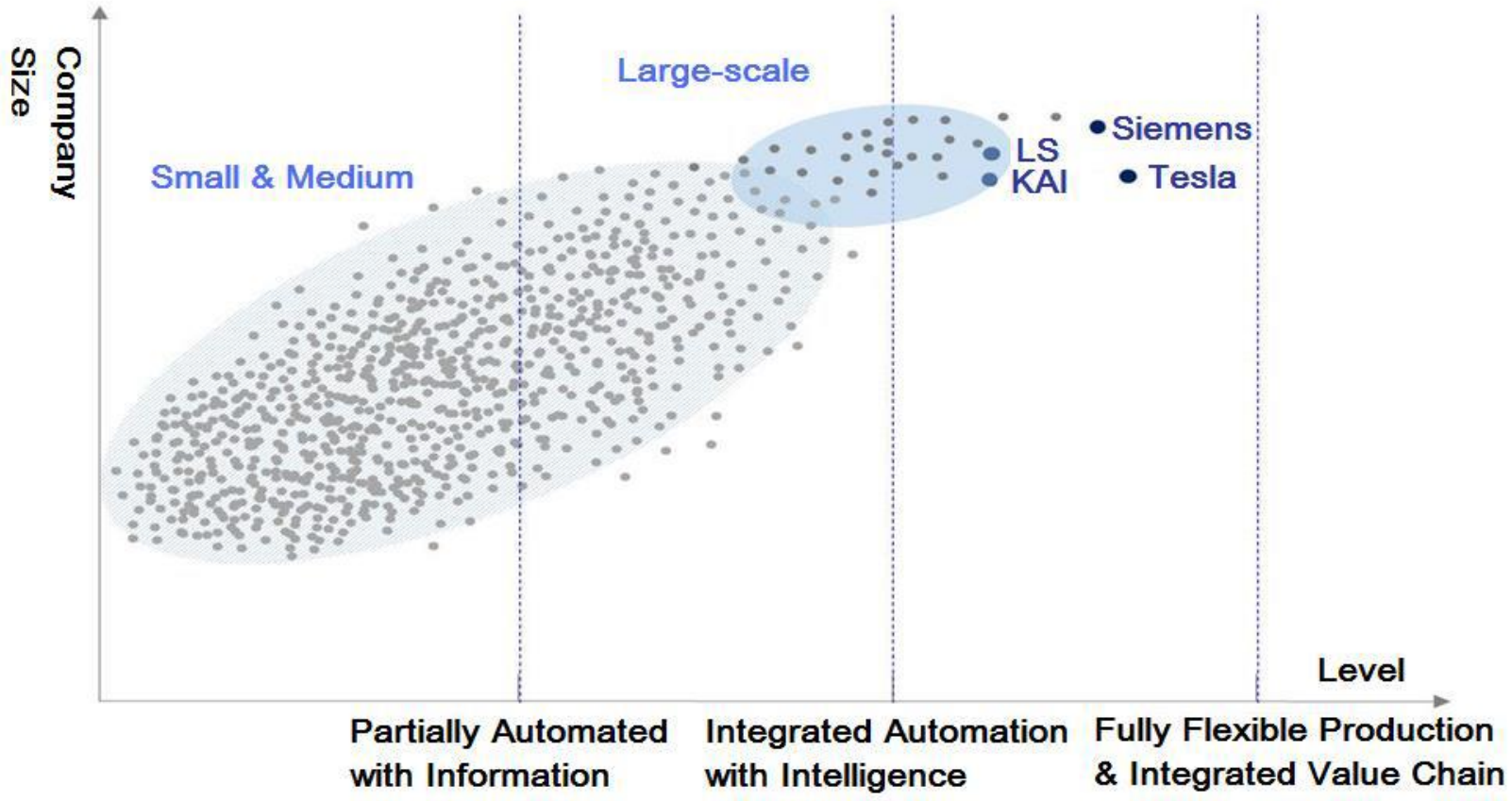
2. Key Features | 2) Phased Approach

❑ We defines 4 levels of the Smart Factory by the ICT system and automation levels.

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

2. Key Features | 3) Strengthening Competitiveness

❑ Demand Industry Perspective

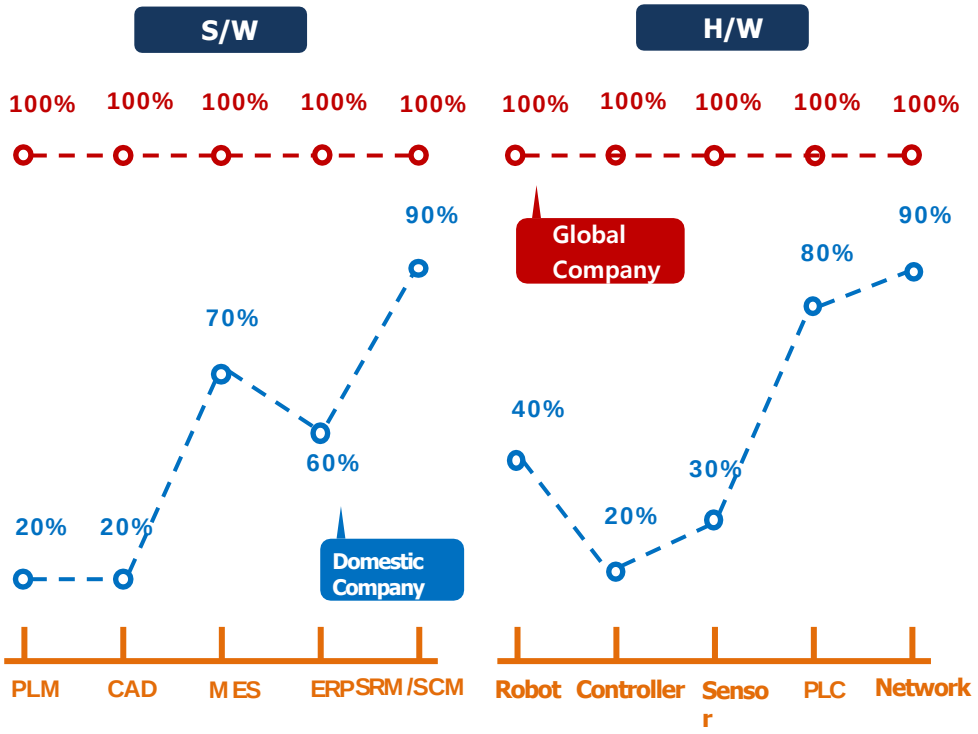


LSIS : a leading company in the power system and automation sectors
KAI : Korea Aerospace Industries, LTD

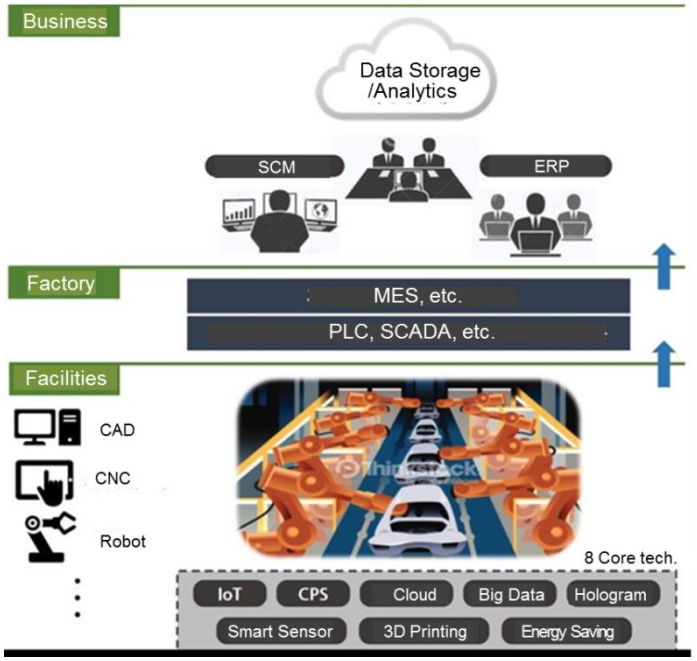
2. Key Features | 3) Strengthening Competitiveness

❑ 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)



<Smart Factory Industrial Concept>



3. Main Projects | 1) Smart Factory Diffusion

❑ Overview

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

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

Current Status

- **Gov't** ICT converged Smart Factory propagation project(MOTIE), Regional investment promotion subsidy project(MOTIE, municipalities), Production site digitalization project(SMBA)
- **Private** Industry innovation campaign, Support suppliers of conglomerates and community based businesses via Creative Economy Innovation Center

Projects as of 2015

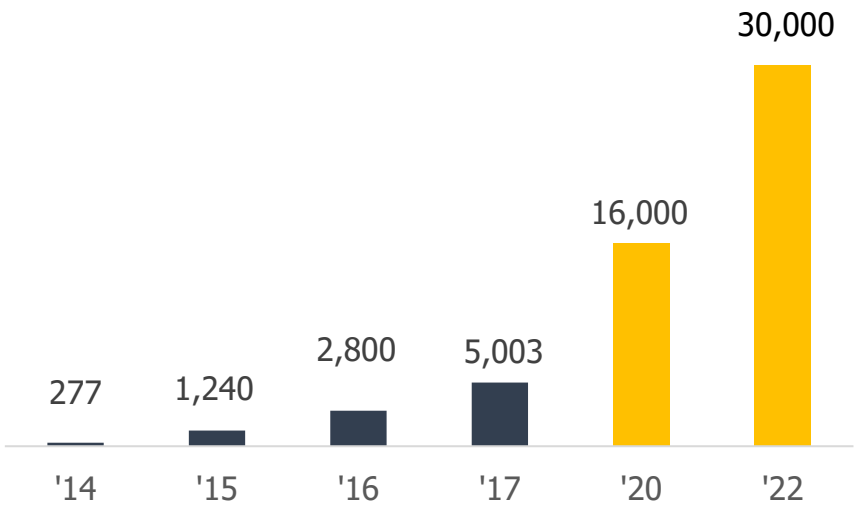
Classification		2014	2015	Total
MOTIE	SF adoption by industry type	-	303	303
	Regional investment promotion subsidy	-	193	193
	Specialized local project(KIAT)	-	24	24
SMBA	Production site digitalization project	144	137	281
Private	Industry innovation	133	139	272
	Creative Economy Innovation Center	-	167	167
	Total	277	963	1,240

3. Main Projects | 1) Smart Factory Diffusion

❑ Results and Achievements

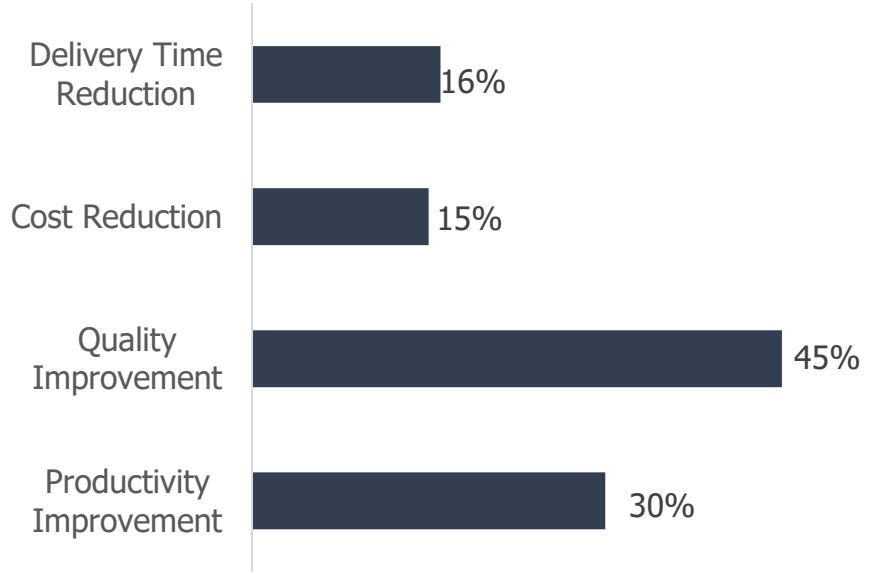
- 5,003 SMEs completed the introduction of smart factory by the end of 2017.
- They experienced 45% quality improvement, productivity improvement by 45%, delivery time reduction by 16% and cost reduction by 15%.

❖ Results of Diffusion projects (# of enterprises)



* Aggregated by the end of 2017

❖ Effects of Smart Factory



* 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

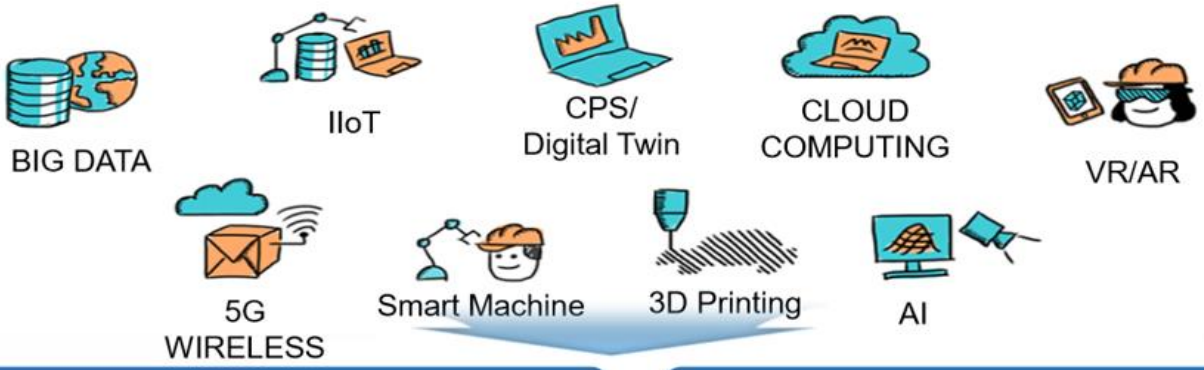
3. Main Projects | 2) R&D - Demo smart factory

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



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

Standardization procedures

Standard Survey

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)

➢ (Certification) Developing on assessment model for certification, establishing a framework, and pushing the pilot test applied to certification model

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

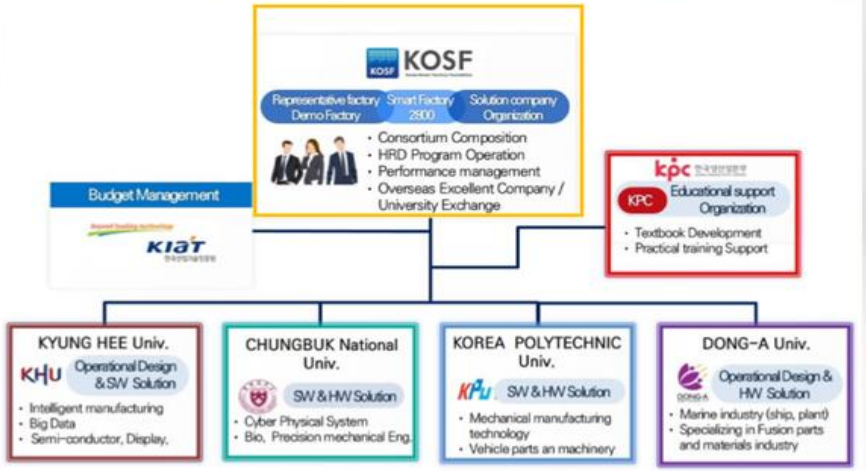
HRD Program for Smart-Factory Expert

S	M	A	R	T
Special Knowledge	Market Driven	Agile Methodology	Resource Utilization	Technology Reference

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.

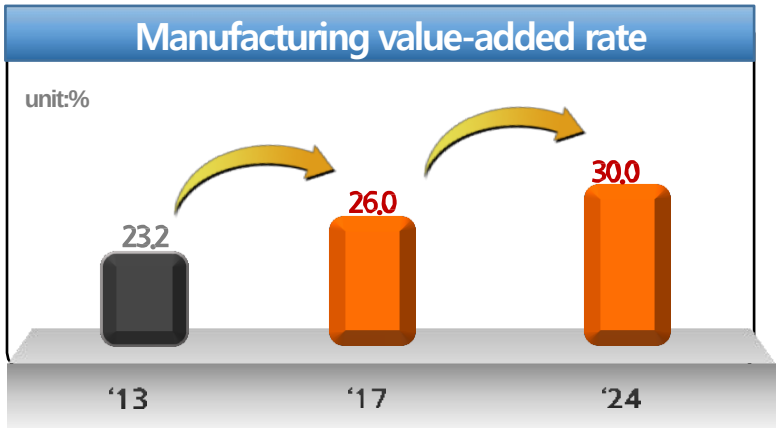


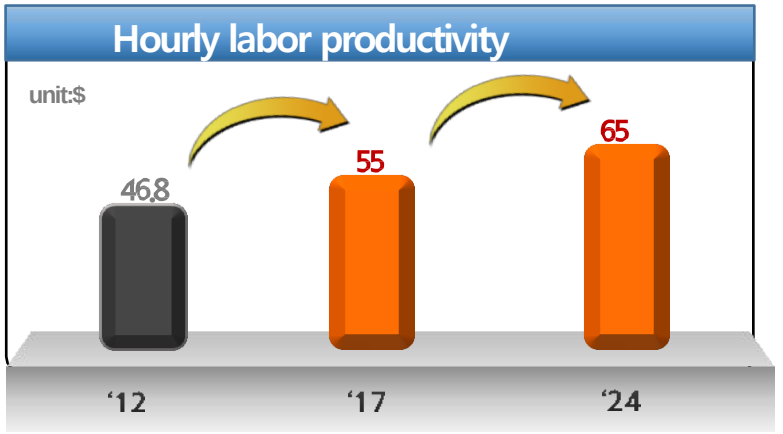
KOSF R&R: Smart factory operation / training, curriculum development, student selection / management, mentoring, recruitment of participating companies and finding out industrial demand

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"



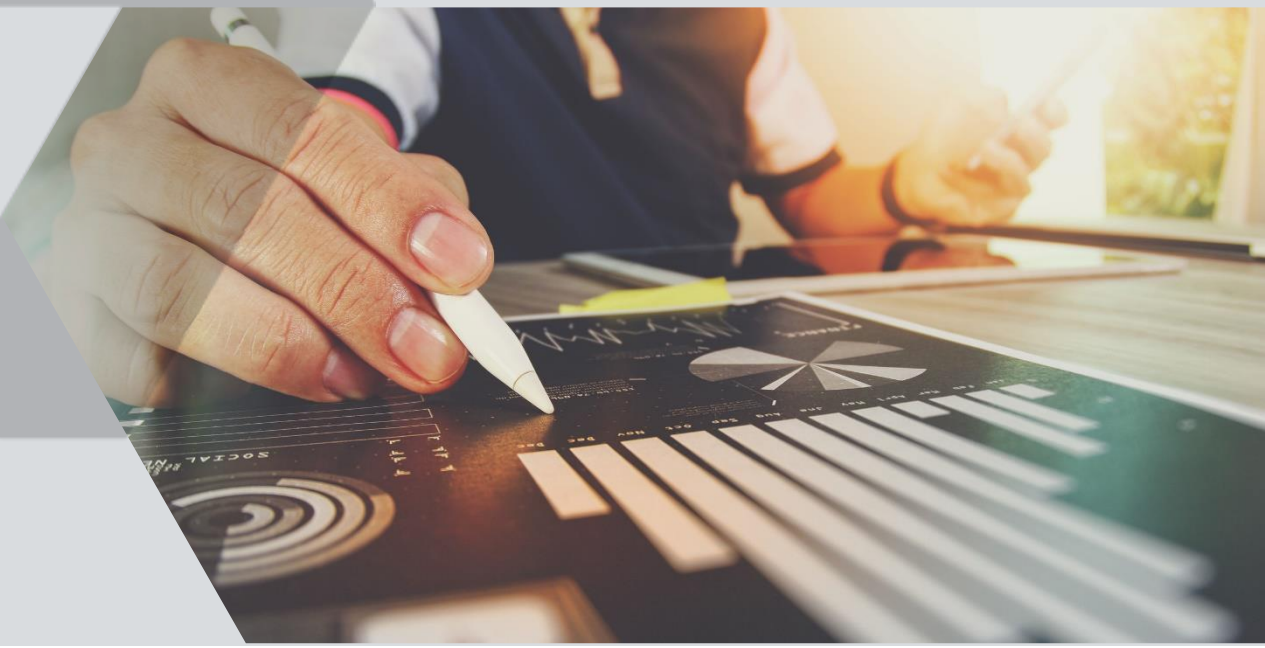


❑ Promoting related to industry : Sensor, automation machine

➢ Prospect of Smart Factory domestic industrial-scale(Markets&Markets, hundred million dollars): 40('17)->56('20)

The main core product technology level (compared to developed countries)	Smart factory domestic industrial scale (hundred million dollars)
60%('14)→70%('17)→80%('20)	24('14)→40('17)→56('20)

❑ Improvement of the working environment and job creation related to high value-added



Ⅲ | 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

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1. Cases of Smart Factory Transformation

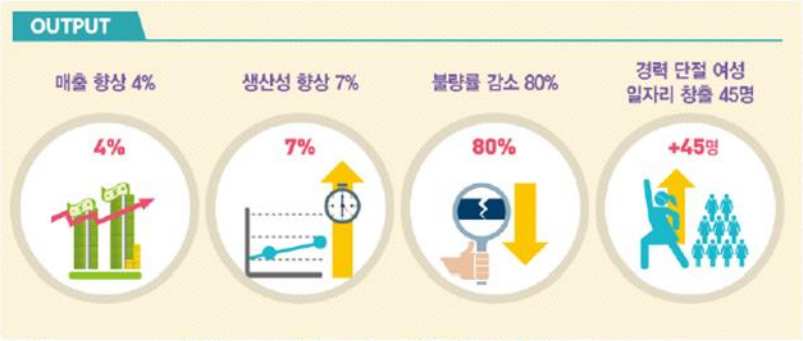
❑ SAEHAN VACUUM HEAT TREATMENT Co.

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

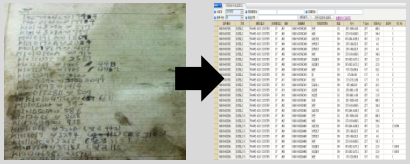
Frontec, Inc.
(http://e-frontec.co.kr/)

1. Cases of Smart Factory Transformation

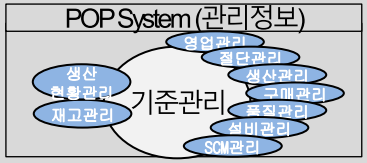
❑ Supplier Smart Factory Program (Construction Machinery Industry)

① Digital connectivity

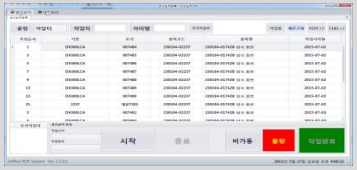
1-1. Master Data



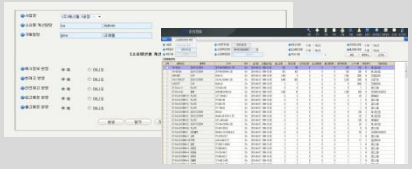
1-2. Production Information



1-3. Production Order



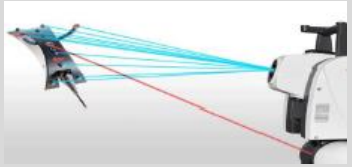
1-4. Purchase Order



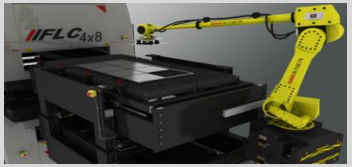
② Automated production

2-1. Production Facility

2-2. Fool Proof

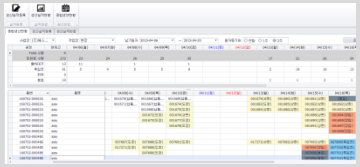


2-3. Factory Logistics



③ Data-driven optimization

3-1. RTMS & Simulation



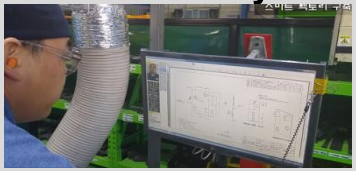
3-2. Quality Data

3-3. Predictive Maintenance

④ Visible shop floor

4-1. Real-time Process Monitoring

4-2. Real-time Quality Check



4-3. KPI Dashboard

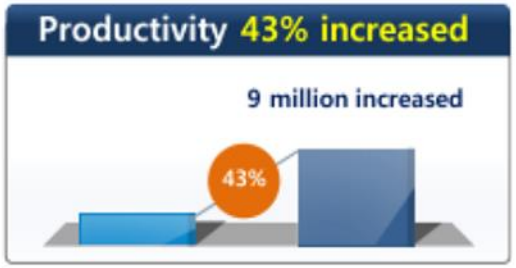
1. Cases of Smart Factory Transformation

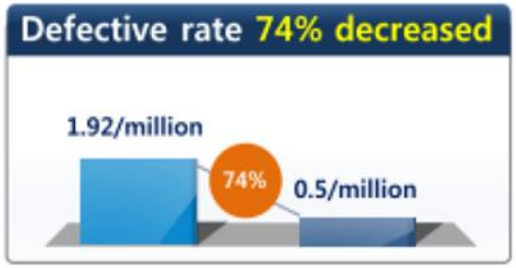
❑ Piston Manufacturing Company

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

Implementation of Integrated Smart Factory
➡ Flexible production, IoT · CPS, Big data, A.I.

구분	Before	After
Level	■ Connected	■ Optimized
Autom ation	■ Mass production system for specific product	■ Mass customization system for multi-product
Digitaliza tion	■ Real-time monitoring system for separate manufacturing process ■ Control automation for casting and processi	■ Digital synchronization of Actual factory and virtual factory using IoT and CPS ■ Intelligent control automation based on big data





< MES >

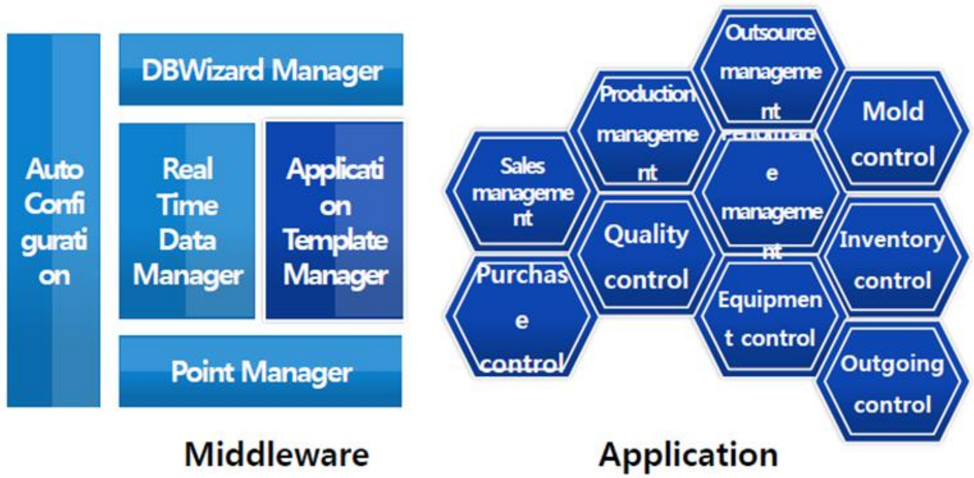
< CPS >

2. Smart Solution Providers behind the Scene

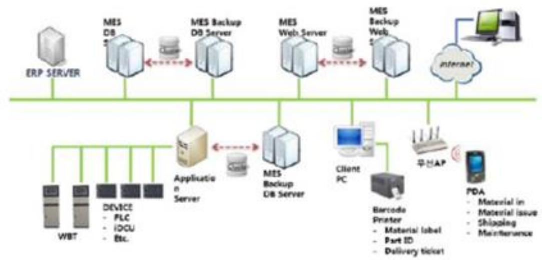
❑ MES Solution Provider : ACS

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.



MES Configuration



References

Automotive parts

Electrical/electronic parts

Logistics/others

2. Smart Solution Providers behind the Scene

❑ IoT Solution Provider : Ulala Lab

Facilities

Data Analysis

Management (Dashboard)

15 ~ 30 thousands / month ↓

18% → **8%**

✓ (USD) 27 ~ 54 thousands per month

✓ (USD) 12 ~ 24 thousands per month

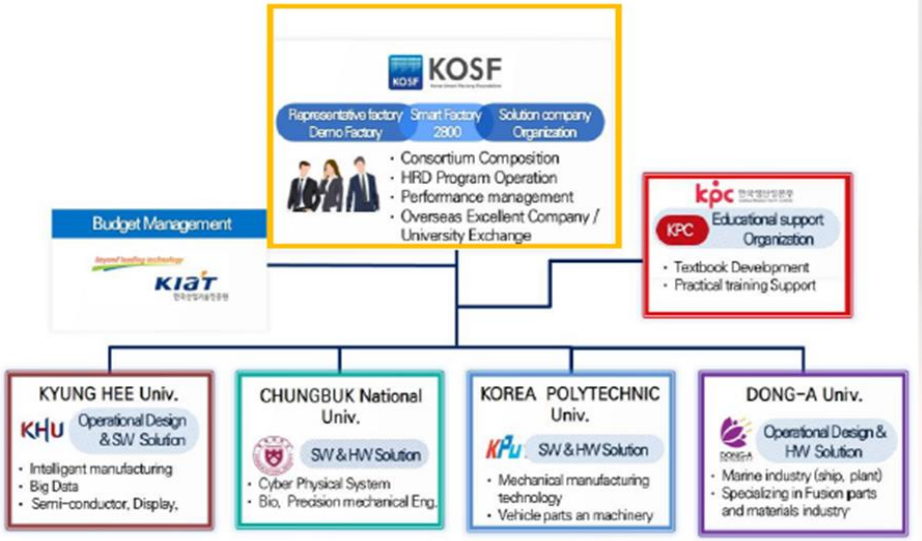
3. Education & Training

❑ 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

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. Smart Factory Consulting

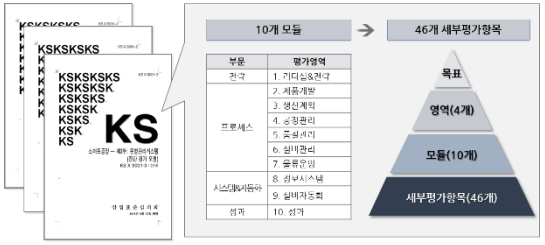
❑ Examples of smart factory consulting

Education & Benchmarking → Smart Level Assessment → Roadmap

Education

Assessment Model

- Smart Factory Standard (KS X 9001-3)



Main Strategies

1 염색 업종 스마트공장 모델 제시 (Model Factory)
- 염색 업종 스마트공장 단계별 구축 지원을 위한 모델 공장 구축
- 스마트 수준별 표준 개선과제 도출 및 추진사례 개발

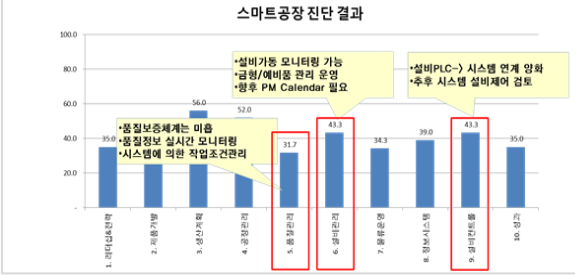
2 염색 시제품 제작 스마트 서비스 제공 (Test Bed)
- 품질, 원가, 납기 개선을 통한 더 우수한 시제품 서비스 제공
- 시제품 개발 전과정의 노하우를 기업에게 제공하는 Total Service 개발

3 염색공정 전문인력 양성을 위한 러닝 팩토리 (Learning Factory)
- 염색공정에 특화된 파일럿 플랜트 기반 학습형 플랫폼 제공
- 실습시나리오 및 기능별 교육프로그램 개발

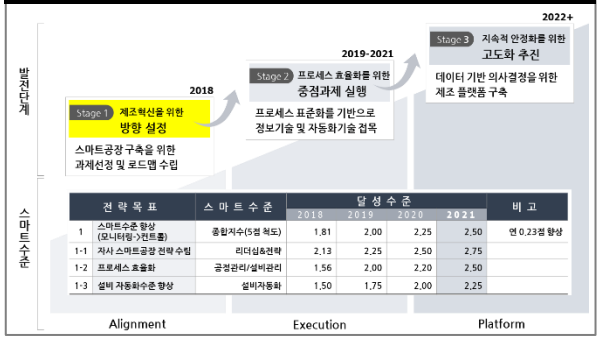
BP Benchmarking

Assessment Result Review

[세부 평가점수] 주물업의 가장 중요한 공정관리 – 품질관리 – 설비관리 분야에서 매우 탁월한 시스템 운영과 성과를 보여주고 있음



Roadmap



전략목표		스마트수준	달성수준 2018	2019	2020	2021	비고
1	스마트수준 향상 (모니터링->컨트롤)	종합지수(5점 척도)	1.81	2.00	2.25	2.50	연 0.23점 향상
1-1	자사 스마트공장 전략 수립	리더십&전략	2.13	2.25	2.50	2.75	
1-2	프로세스 효율화	공정관리/설비관리	1.56	2.00	2.20	2.50	
1-3	설비 자동화수준 향상	설비자동화	1.50	1.75	2.00	2.25	

Thank You

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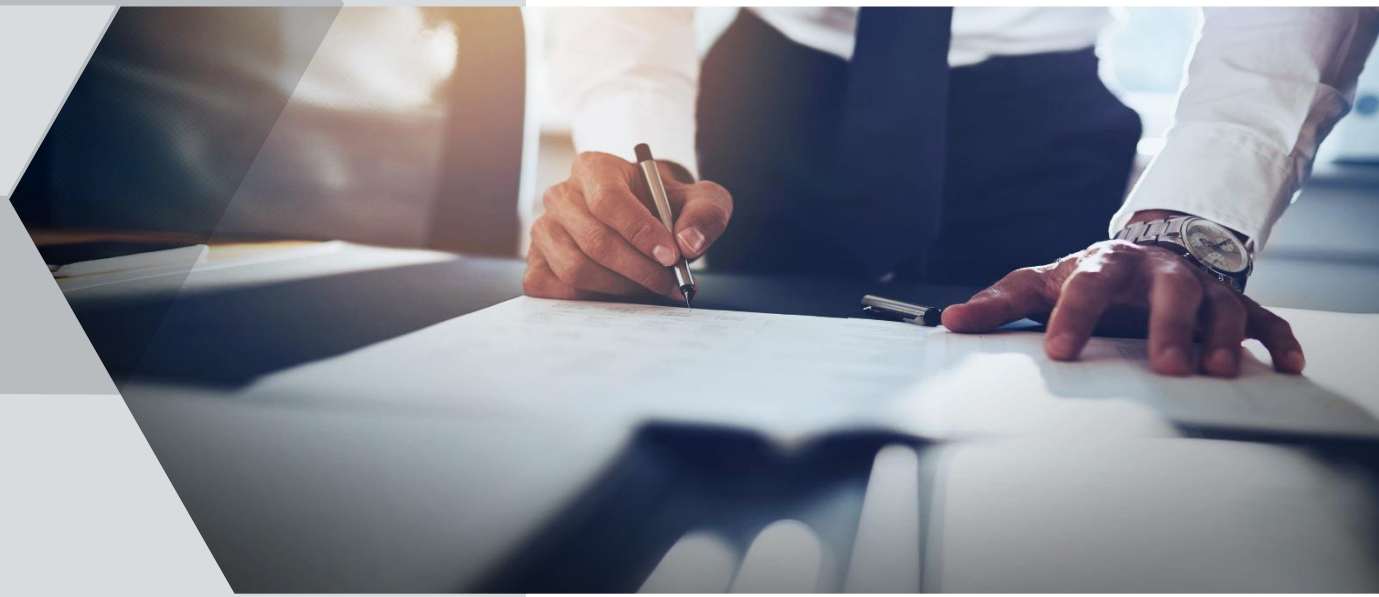
KPC



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