

# Innovating re-education in an age of digital transformation

## focusing on future skills needs

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# 0. Abstract

As the digital transformation of smart manufacturing, smart farm, smart farming, smart tourism, and smart welfare is discussed as a key topic in convergence innovation, it is required to prepare a proper HRD policy.

At this time, it is important to recognize and reflect the specific contents of skill change by industry and occupation.

It is necessary to have a HRD policy appropriate for each of the occupations with distinguishing the different skills change of Information analysis occupation, engineer, technician, manual worker and other occupations.

# 1. Digital Transformation focusing on Smart Manufacturing

Innovative reorganization of the entire industrial value chain due to intelligent technologies.

It covers not only planning, design, production, distribution, and sales but also logistics and distribution.

## Digital Transformation

- Industry 4.0
- Smart Factory
- Smart Manufacturing
- Digital Transformation

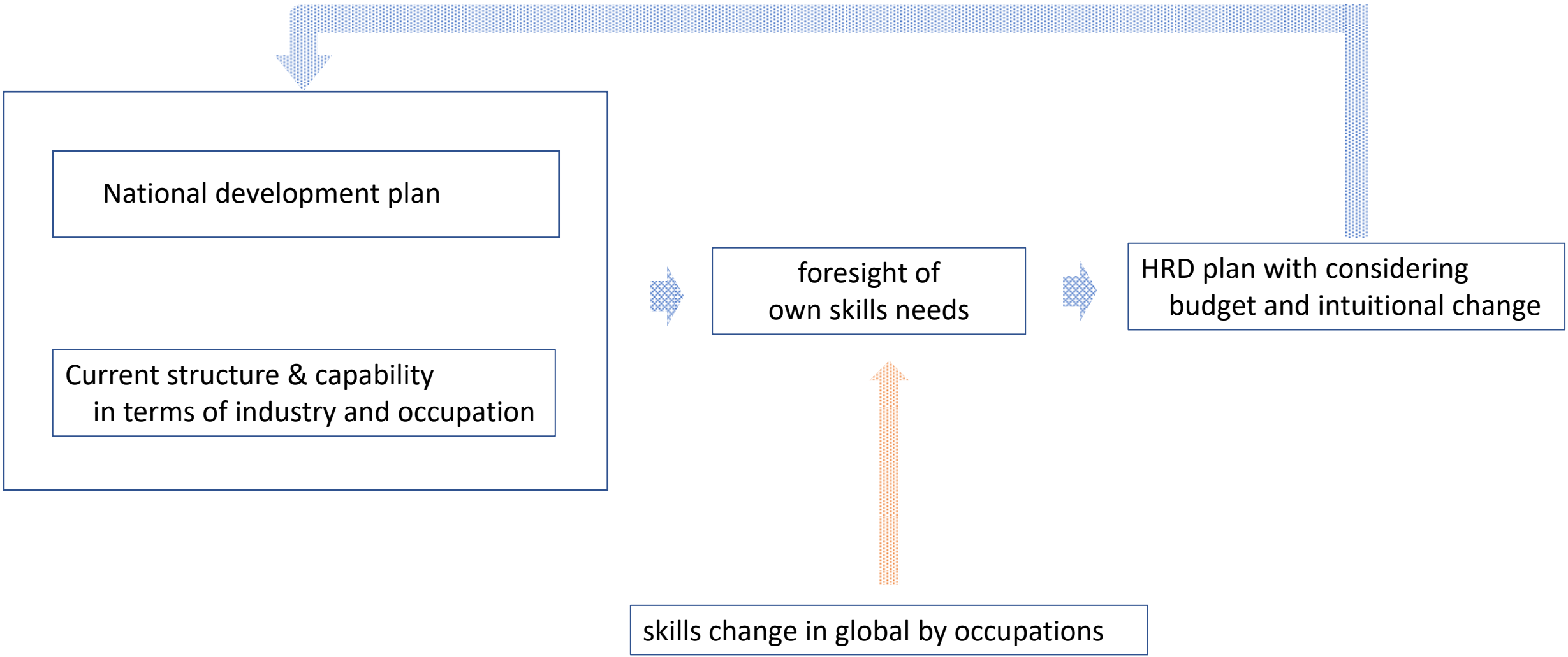
### Automation:

- MES(Manufacturing Execution System)
- ERP(Enterprise Resource Planning)
- PLM(Product Life cycle Management)
- SCM(Supply Chain Management)
- FEMS(Factory Energy Management System)

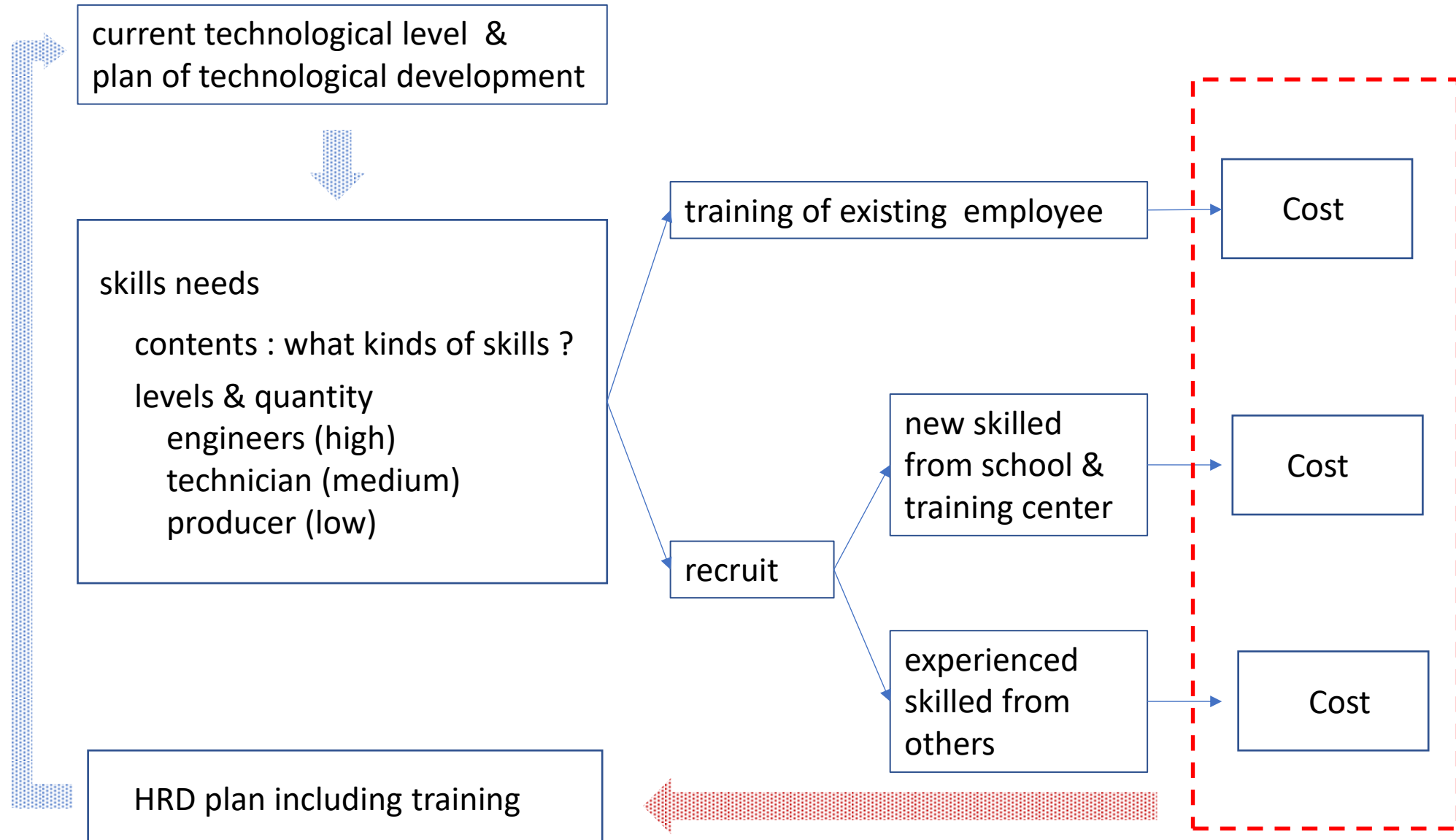
### Smart (Intelligence):

- IoT (Intent of Thing)
- Industrial Internet
- Big Data
- AI

# 2. Logic of HRD plan



## 2. Logic of HRD plan



### 3. Change in skills level required

On O\*Net (US Occupational information), 854 jobs in 2010 vs. 968 jobs in 2019

- 64 dropped out
- 790 maintained
- 178 newly appeared



information technology  
green energy  
medical demand

Occupation*	Total	newly appeared (%)		Newly appeared Job
Management Occ.	56	26	46%	Quality Control Systems Managers, Aqua-cultural Managers, etc.
Business and Financial Operations Occ	50	17	34%	Logistics Analysts), Risk Management Specialists, etc.
Computer and Mathematical Occ. (Information Occ.)	33	26	79%	Computer and Information Research Scientists, Database Architects, etc.
Architecture and Engineering (Engineer)	70	22	31%	Fuel Cell Engineers, Non-Destructive Testing Specialists, etc.
Life, Physical and Social Science Occ.	60	8	13%	Bioinformatics Scientists, etc.
Healthcare Practitioners and Technical Occ.	86	32	37%	Sports Medicine Physicians, Art Therapists, etc.
Construction and Extraction Occ.	61	4	7%	Solar Photovoltaic Installers, etc.
Installation, Maintenance, and Repair Occ. (Technician)	54	4	7%	Wind Turbine Service Technicians, etc.
Production Occ. (Producer)	111	8	7%	Recycling and Reclamation Workers, etc.
Transportation and Material Moving Occ.	53	3	6%	Recycling Coordinators, etc.
Total	968	178	18%	

\* Omitted occupations: Healthcare Support; Protective Service Occupations; Food Preparation and Serving Related; Building/Grounds Cleaning and Maintenance; Personal Care and Service; Sales and Related; Office and Administrative Support; Farming, Fishing and Forestry.

### 3. Change in skills level required

Changes in skills are derived by new jobs rather than by the changes in existing jobs

	2010 vs. 2019		existing jobs vs. new jobs	
	2010 (790)	2019 (790)	Existing job (790)	New job (178)
Basic skills (R, W, Math, Sci)	2.91	2.92	2.92	3.37 ***
Learning Skills	3.15	3.17	3.17	3.58 ***
Social Skill	2.85	2.83	2.83	3.21 ***
Problem Solving Skill	3.06	3.07	3.07	3.50 ***
Functional Skills	1.35	1.33	1.33	1.49 *
Analytic Skills	2.67	2.72	2.72	3.31 ***
Management Skills	2.06	2.05	2.05	2.48 ***

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.'

# 3. Change in skills level required

Engineer : skills level of new job does not seem to be higher than existing job

Producer : skills level of new job seems to be higher than existing job,  
 particularly in social skill, basic skills, learning skills, problem solving skills, analytical skills

## Changes of skills in manufacturing related occupations

	Engineer		Technician		Producer	
	Existing job	New job	Existing job	New job	Existing job	New job
	(48)	(22)	(50)	(4)	(103)	(8)
Basic skills (R, W, Math, Sci)	3.82	3.79	2.52	2.63	2.28	2.58*
Learning Skills	3.68	3.65	2.85	2.88	2.62	2.90*
Social Skill	3.03	3.02	2.54	2.35	2.21	2.59**
Problem Solving Skill	3.79	3.77	2.97	2.97	2.59	2.86*
Functional Skills	2.09	2.40.	2.49	2.71	1.87	2.18.
Analytic Skills	3.54	3.54	2.62	2.72	2.13	2.50*
Management Skills	2.58	2.60	1.92	1.95	1.66	1.86

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.'



### 3. Change in skills level required

Computer and Mathematical Occupation (Information Occupation)

similar to engineer, skills level of new job does not seem to be higher than existing job

In general, the level of management skill in new job is higher than existing jobs.

#### Changes of skills in other major occupations regarding new job appeared

	Management		Business and Financial Operations		Computer and Mathematical	
	Existing job (33)	New job (17)	Existing job (30)	New job (26)	Existing job (7)	New job (26)
Basic skills (R, W, Math, Sci)	3.30	3.31	3.47	3.41	4.33	3.42 ***
Learning Skills	3.48	3.6	3.82	3.90	4.03	3.61 **
Social Skill	3.17	3.29	3.54	3.70	2.65	3.07 *
Problem Solving Skill	3.38	3.54	3.73	3.67	4.28	3.76 ***
Functional Skills	0.75	0.94	1.40	0.96	1.15	1.90 **
Analytic Skills	3.29	3.46	3.64	3.66	3.82	3.63
Management Skills	2.35	2.71	3.33	3.61	2.03	2.38

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.'

# 4. Employment and Shortage in Korea

## Current employment and shortage rate in Manufacturing occupations

		2014	2015	2016	2017	2018	2019
Engineer	shortage rate	1.88%	1.91%	1.92%	1.83%	1.97%	1.50%
	employment	443,733	472,156	496,620	531,747	540,698	559,735
Technician	shortage rate	2.21%	2.32%	2.88%	2.61%	2.24%	2.16%
	employment	301,579	309,742	311,379	335,148	337,426	336,363
Producer	shortage rate	2.23%	2.07%	2.23%	2.27%	2.05%	1.20%
	employment	1,915,236	1,976,683	2,084,491	2,141,228	2,143,972	2,101,630

- Anticipated change from the ONET trend is the lack of engineer.
- But change of employment has not yet arrived.
  - Occupational classification is too broad and still not allow detail structure of change.
    - ➡ new classification arrived (KECO 2018)
  - Smart manufacturing is early stage in overall
    - ➡ preparation is needed

# 4. Employment and Shortage in Korea

## Current employment and shortage rate in IT occupations

		2014	2015	2016	2017	2018	2019
Computer and Communication Engineer	shortage rate	2.35%	2.86%	1.34%	1.18%	1.49%	1.42%
	employment	22,846	19,281	22,546	21,937	23,219	25,221
System Designer	shortage rate	2.46%	1.78%	3.54%	1.84%	2.87%	2.81%
	employment	23,029	24,275	28,225	28,817	28,679	29,270
Software Developer	shortage rate	3.88%	3.39%	3.85%	3.90%	3.44%	3.68%
	employment	127,128	121,880	139,987	141,940	141,110	142,908
Web expert	shortage rate	6.11%	4.01%	3.54%	3.31%	3.93%	3.27%
	employment	21,287	22,859	22,817	23,958	28,908	30,601
Database & System Operator	shortage rate	1.64%	1.75%	1.99%	1.39%	2.61%	1.99%
	employment	69,682	80,178	75,647	87,621	85,732	93,276
Communication technician	shortage rate	2.44%	1.55%	1.88%	1.54%	1.49%	1.53%
	employment	2,786	60,858	61,032	65,720	70,257	67,890

The shortage rates of software developer and web experts are relatively high. There is also a high shortage of system designer.

→ Core of Smart manufacturing.

## 5. Implications derived from O\*NET

- For engineer and information occupation, the levels of skill of newly emerging jobs are not higher than those of existing jobs in the same occupation. While new jobs are emerging very quickly in engineer and information occupation, it is suggested that not only the new workforce but also the active transition of existing experts can be useful.

Emerging Issues: ReEducation and ReTraining of Engineer and Information occupations  
keeping domain knowledge + new skills (DATA literacy etc.)

- For technician, change to skills level of new jobs is generally higher than that of existing jobs, but it should be noted that the appearance of new jobs is limited.
- For producer, the skill levels due to the emergence of new jobs are overall increased. Here the importance of social skills and basic skills should not be disregarded.

Emerging Issues: Social skills, Basic skills, Learning skills are getting more important in lower skilled

- Skills change in America is anticipated to be emerged though new jobs, mainly.
- In General, management skills and analytical skills should be emphasized more.