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 **

A Study on Improving to Examine of P·E Qualification

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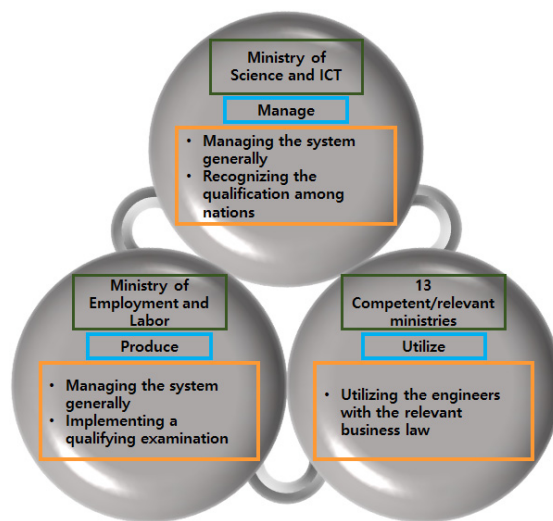
Abstract

The domestic professional engineer qualification system has been changed after the enactment of the law in 1963. However, the domestic professional engineers have been unaccepted and unrecognized internationally. In addition, the domestic professional engineer system is operated in accordance with the individual laws of each ministry, but the official qualification examination is conducted by the Human Resource Development Service of Korea. Thus, the domestic professional engineer system has many problems in system itself and operating. In this research, we compare the domestic qualification system with the systems of other foreign countries, and propose how to improve the qualification system. This study limits the scope to the qualification examination for P·E. We suggest 3 ways to improve the qualification examination; (1) The structure of the qualifications, (2) The testing method, and (3) The unification of the qualification system and operation.

Keywords : Qualification, PE(Professional Engineer), NCS(National Competency Standards)

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[Figure 1] Management System of National Qualification[5]

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<Table 1> Qualifications of Professional Engineer

Plant Control	Architectural Execution	Textile	Weather Forecaster
Packing	Landscape Architecture	Clothing	Energy Mineral Resource Management
Quality Control	Urban Planning	Generation Transmission and Distribution	Mining Hazard Prevention and Reclamation
Product Design	Transportation	Electronic Application	Explosives and blasting
Road & Airports	Die and Mould	Building Electrical Facilities	Radiation Management
Harbor Coastal Engineering	Machine	Electric Railway	Atomic Power Generation
Ocean	Construction Equipment	Railroad Signal Apparatus	Fire Protection
Water Supply Sewage	Industrial Machinery Facility	Electronic Application	Machine Safety
Geology and Geotechnics	Air-conditioning Refrigerating Machinery	Industry measurement control	Electric Safety
Railway	Transportation Vehicles	Information Management	Construction Safety
Civil Engineering Quality Testing	Railroad Rolling Stock	Computer System Application	Chemical Safety
Civil Engineering Agricultural Fishery	Shipbuilding	Information Communication	Gas
Civil Engineering Structures	Aircraft Body	Fisheries Processing	Industrial Hygiene Management
Soil Mechanics Foundation	Aero-Motor	Food Stuff	Nondestructive Testing
Civil Engineering Execution	Metal Working	Water Pollution Control	Agricultural Chemistry
Water Resources Development	Metal Material	Air Pollution Control	Protected Cultivation
Cadastral Surveying	Metallurgy	Wastes Treatment	Seeds
Surveying Geo-Spatial Information	Welding	Noise and Vibration	Livestock
Architectural Structures	Surface Treatment	Soil Environment	Forestry
Construction Quality Testing	Ceramic	Ergonomics	Aquaculture
Building Mechanical Facilities	Chemical Industry	Nature Environmental Management	Fishery

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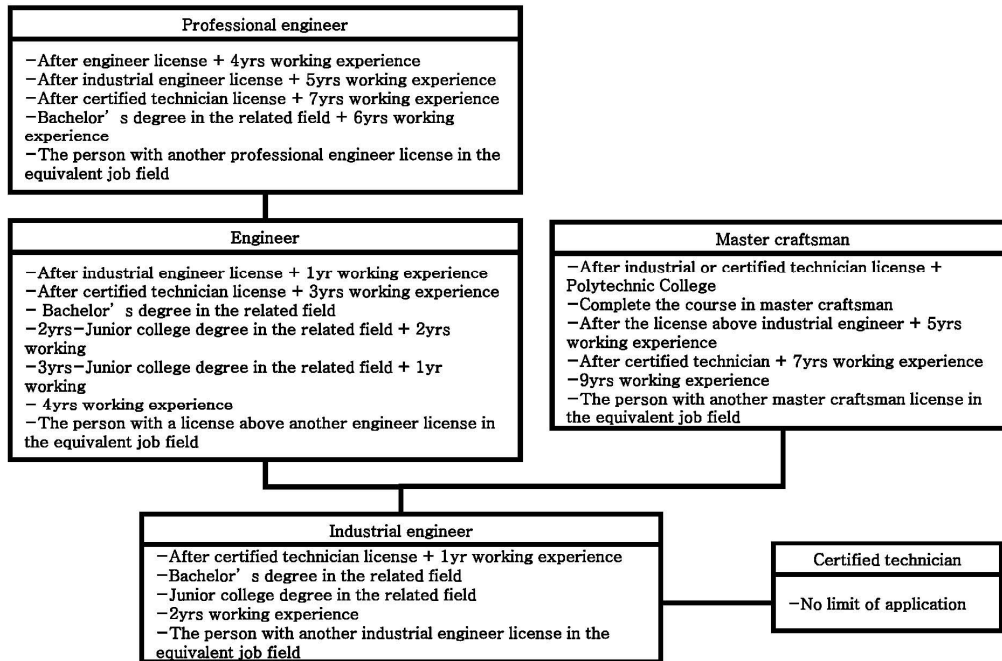
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[Figure 2] Q-net National technique license level and qualification for examination[5]

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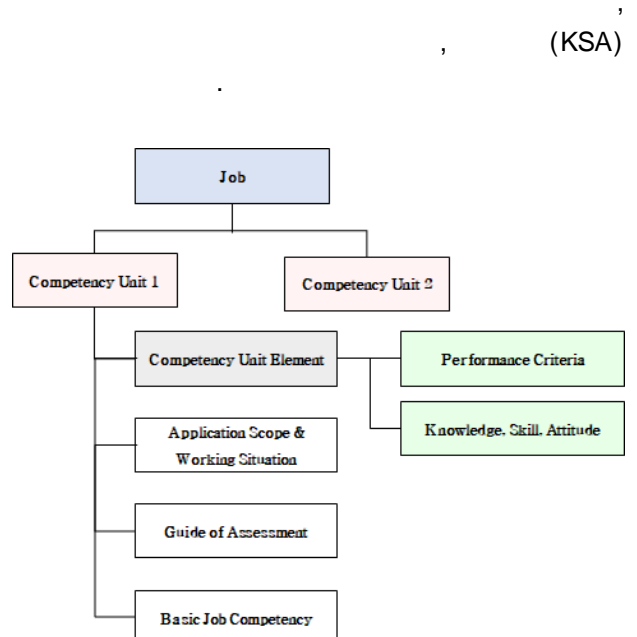
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 NCS <Table 3> [6].

<Table 3> Classification System of NCS[6]

Classification	Subordinate Capabilities
Large Category	- The similar function area
Medium Category	- The similar function area within the large category - The similar industry within the large category - The independent labor market or the similar career path within the large category - The area having the sector council for the industry within the medium category
Small Category	- The similar function area within the medium category - The area having the sector council for the industry within the small category
Detail Category	- The similar function area within the small category - The typical job within the Korean Employment Classification of Occupations

NCS [Figure 3]



[Figure 3] Competency unit Structure in NCS

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 <Table 4> [6].

<Table 4> NCS Level[6]

Level	Section	Detail
8	Definition	1. The capable level abling to create a new theory ussing the highest degree of theory and knowledge in the relevant, to perform extensive technical tasks with the highest -skilled, and having the authority and accountability overall organization and tasks
	Knowledge technology	2. The capable level abling to create a new theory ussing the highest degree of theory and knowledge in the relevant
		3. The capable level abling to perform extensive technical tasks with the highest -skilled
	Capability	4. The capable level having the authority and accountability regarding overall organization and tasks
	Working Experience	5. The achievable level after working at level 7 for 2 -4 years
7	Definition	6. The capable level abling to use the spcialized theory and knowledge in the relevant, to perform extensive tasks with the high -skilled, and to require responsibility and accountability to the result by others
	Knowledge technology	7. The capable level abling to use the spcialized theory and knowledge in the relevant and to use the theory and knowledge in the analogous fields
		8. The capable level abling to perform extensive tasks with the high -skilled
	Capability	9. The level requiring responsibility and accountability to the result by others
	Working Experience	10. The achievable level after working at level 6 for 2 -4 years
6	Definition	11. The capable level abling to freely use theory and knowledge in the relevant within independent authority, to perform various tasks with general skill, and to deliver knowledge and know -how in the relevant to others
	Knowledge technology	12. The capable level abling to freely use theory and knowledge in the relevant
		13. The capable level abling to perform various tasks with the general skilled
	Capability	14. The level requiring responsibility and accountability to the result by others
15. The capable level abling to perform within independant authority		
	Working Experience	16. The achievable level after working at level 5 for 1 -3 years
5	Definition	17. The capable level abling to perform very complicated and unusual tasks within comprehensive authority using theory and knowledge in the relevant and to delver the knowledge in the relevant to others
	Knowledge technology	18. The capable level abling to freely use theory and knowledge in the relevant
		19. The capable level abling to perform very complicated and unusual tasks
	Capability	20. The capable level abling to deliver the knowledge in the relevant to others
21. The capable level abling to perform very complicated and unusual tasks		
	Working Experience	22. The achievable level after working at level 4 for 1 -3 years
4	Definition	23. The capable level abling to perform various and complex tasks within general authority using restrictive theory and knowledge in the relevant
	Knowledge technology	24. The capable level abling to use restrictive theory and knowledge in the relevant
		25. The capable level abling to perform various and complex and tasks
	Capability	26. The capable level abling to perform within general authority
	Working Experience	27. The achievable level after working at level 3 for 1 -4 years
3	Definition	28. The capable level abling to perform tasks with a certain degree within limited authority using basic theory and general knowledge in the relevant
	Knowledge technology	29. The capable level abling to use basic theory and general knowledge in the relevant
		30. The capable level abling to perform tasks with a certain degree
	Capability	31. The capable level abling to perform within limited authority
	Working Experience	32. Theachievablelevelafterworkingatlevel2 for 1 -3 years

Level	Section	Detail
2	Definition	33. The capable level abling to perform rputin and proceduralised tasks using general knowledge in the relevant
	Knowledge technology	34. The capable level abling to use general knowledge in the relevant
		35. The capable level abling to perform routine and proceduralized tasks
	Capability	36. The capable level abling to perform with general direction and supervision
	Working Experience	37. The achievable level after working at level 1 for 6 - 12 months
1	Definition	38. The capable level abling to perform a simple and repetitive task using basic general knowledge such as understanding letters and simple caluation
	Knowledge technology	39. The capable level abling to use basic knowledge of calculating and understanding letter
		40. The capability level abling to perform simple and repetitive tasks
Capability	41. The capable level abling to perfoeme tasks with detail direction and stric supervision	

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<Table 5> A Example of P · E Qualifications with NCS & Qualification System

NCS Classification Structure			Qualification Classification		Qualification	
Medium Category	Small Category	Detail Category	Qualification Large Category	Qualification Medium Category	Engineer	
1. Planning	1. Management Planning	01. Management Planning	02Management/ Accounting/ Office	021 Management		
		02. Management Assessment				
2.Administraition/ HumanResource	1. Administration	01. Administration			023 Office Work	
		02. Asset Management				
3.Finance/ Accounting	1. Finance	01. Budget				
		02. Capital				
	2. Accounting	01. Accounting Audit		022 Accounting		
		02. Tax				
4.Production/ QualityControl	1. Production Management	01. Purchasing			024 Production Management	Packaging
		02. Material Management				Factory Management
		03. Process Management				
		04. SCM				
	2. Quality Control	01. QM/QC Management		Quality Control		
		3. Supply Chain Management	01. Supply Chain Management			
02. Import and export Management						
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<Table 6> A Standard for an Qualification P·E Examination

Main	Details
1. Quality Planning and Design	1. Quality Planning(Vision, Policy, Establishing and developing a strategy)
	2. Quality Design(QFD, System, Parameter, Tolerance Planning)
	3. Developing and Quality Assurance System(Product Planning, Design, Material Production, Product Inspection, Sales and Marketing Step)
	4. Quality Management Model
	5. Quality Safety Management
	6. Customer Management(Customer Management Planning, Performance Evaluation, Customer Satisfaction Survey, etc.)
2. Quality Management Operation	1. Selecting Quality Characteristics(Origin, Upper Class, Middle Class, Lower Class characteristics)
	2. Measurement System Analysis(Uncertainty, Discrimination, R&R, Stability, Linearity)
	3. Sample Design (General Inspection Practice, Sampling Method and Sample Inspection)
	4. Quality Management Application Technique (QC & New QC 7 Tools Using Method)
	5. Control Chart Utilizing & Process Capability Index(Coefficient, Control Chart for Variables, Multivariate Control Chart, Control Chart Interpretation)
	6. Quality Information Management
	7. Service Quality Management
3. Statistic Quality Control	1. Probability and Probability distribution (Normal, Lognormal, Gamma, Triangular, Uniform, Weibull Distribution), (Statistic Distribution : t, Chi Square, F, Hypergeometric, Binomial, Poisson Distribution)
	2. Stochastic estimation (Statistics : Z, t, X ² , F test & estimation) (Enumerated Data : Defect Rate, The quantity of the defect, Range, Contingency table test)
	3. Regression analysis(ANOVA, Correlation analysis, Multi - regression analysis)
	4. Applied stochastic analysis(Multivariate analysis, Conjoint analysis, Non - parametric statistics)
	5. Experiments design(Principle of experiments, 1 - way & 2 - way factorial design, Factorial experiment, Orthogonal experiment, Split - plot design, Confounding, Fractional factorial design, Response surface methodology, etc.)
	6. Quality Engineering(SN ratio & loss function, design and analysis of static and dynamic characteristics)
4. Quality Cost & Industry Standardization	1. Quality Cost Management
	2. General Standardization(Necessity, Purpose & Effects, Standardization within the company)
	3. Using Industry Standard (Numerical Closure, Standard Number, Package, System, etc.)
	4. Quality Certification System (ISO, KS, Single PPM, APQP, etc.)
5. Reliability Design & Analysis	1. General Reliability
	2. Reliability Measurement & Test
	3. Interpreting a failure mode and Forecasting reliability
	4. Reliability Analysis(RAMSControl, FMEA, FTA, Reliability Management, System Reliability)
6. Quality Improvement	1. Value Engineering
	2. 6 Sigma, LEAN
	3. TPM(Total Productive Maintenance)
	4. Quality Management Innovation Activity

<Table 7> A Standard for QM/QC

Order	Category Number	Capability unit	Level
1	0204020101_14v1	Establishing quality strategy	6
2	0204020102_14v1	Managing quality information	4
3	0204020103_14v1	Managing service quality	5
4	0204020104_14v1	Standardization within a company	4
5	0204020105_14v1	Managing quality cost	6
6	0204020106_14v1	Managing design quality	5
7	0204020107_16v2	Managing process quality	4
8	0204020108_14v1	Managing quality inspection	4
9	0204020109_14v1	Managing suppliers' quality	4
10	0204020110_16v2	Establishing quality assurance structure	5
11	0204020111_14v1	Managing reliability	5
12	0204020112_14v1	Managing safety quality	6
13	0204020113_16v2	Quality Management Innovation Activity	4
14	0204020114_16v2	Consistent Improvement Activity	3
15	0204020115_14v1	Managing quality in site	3
16	0204020116_16v1	Managing quality management system certification	5

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<Table 8>

<Table 8> The Demands of Knowledge & Skill of Quality Strategy

Knowledge	1	General Management Knowledge(Finance, Marketing, Quality Management Policy)
	2	Quality Control Method & New Quality Control Methods
	3	Understanding quality assurance activity
	4	Basic knowledge in purchasing & production management(Ordering method, Establishing production plan & schedule management)
	5	Knowledge in product safety and hazardous material regulation
	6	Management environment analysis techniques such as SWOT ,3C ,BCG matrix,PERT-CPM, etc.
Technology	1	Capability to analyze management environment
	2	Capability to analyze quality information and forecast methods
	3	Capability to systematically develop the purpose
	4	Capability to diagnose developing the purpose
	5	Capability to evaluating the goal achievement
	6	Capability to analysis data
	7	Capability to judge management items and checklist
	8	Capability to file a monitoring report

<Table 9>

<Table 9> The Demands of Knowledge & Skill of Quality Cost

Knowledge	1	Classified items regarding quality cost and COPQ
	2	Standard of computation about quality cost and COPQ
	3	Basic knowledge in prime cost
Technology	1	Capability to draw and compute quality cost and COPQ
	2	Capability to establish and analyze quality cost and COPQ standard
	3	Capability to classify cost account code
	4	Capability to develop improvement activity
	5	Capability to judge the suitability of computation standard

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<Table 10> The Demands of Knowledge & Skill of Safety Quality Management

Knowledge	1	Law regarding Safety System(Product Liability Act, Product Safety Act, Safety Management Act for each)
	2	Knowledge in Product Safety
	3	Knowledge in Product Liability Prevention
	4	Knowledge in the method of Pre-Safety Quality Design(Robust Design)
	5	Knowledge in Product Liability Defence
	6	Knowledge in Product Liability Insurance
	7	Standard regarding risk management
	8	Knowledge in operating Safety and Health Management System
	9	Understanding the method to set a safety quality index
	10	Understanding data regarding safety quality
	11	Understanding the method to collect the data regarding safety quality
	12	Understanding the method to analyze safety physically and chemically
	13	Knowledge in operating Safety and Health Management System
	14	Understanding robust design and analysis method in design step
	15	Understanding FMECA/FTA
	16	Understanding the pre-risk analysis
	17	Understanding the system risk analysis
	18	Understanding sub-system risk analysis

Technology	1	Technology of systemizing safety quality
	2	Pre-Safety Quality Design(Robust Design) and Analysis technology
	3	Technology regarding safety requirement for each
	4	Technology of writing a manual for quick reaction regarding production liability
	5	Capability to utilize the method to set the safety quality index
	6	Capability to analyze and estimate safety quality
	7	Capability to collect safety quality data
	8	Technology regarding robust design and analysis method in design step
	9	Understanding to write FMECA/FTA
	10	Capability for pre-risk analysis
	11	Capability to utilize hardware and software regarding safety quality

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<Table 11> NCS Items on the 122nd P·E Exam

Main items for test	Standard Capability Unit	Level
1. Quality Planning and Design	Establishing quality strategy	6
	Service quality control	5
	Quality information management	4
2. Quality Control Management	Standardization within a company	4
	Quality Management Innovation Activity	4
3. Statistic Quality Control	Managing quality management system certification	5
	Managing quality cost	6
4. Quality Cost and Industry Standardization	Managing design quality	5
	Managing process quality	4
	Managing quality inspection	4
6. Quality Innovation	Managing suppliers' quality	4
	Establishing quality assurance structure	5
5. Reliability Design and Analysis	Managing reliability	5
	Managing safety quality	6

<Table 11>

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<Table 12> Applying Criteria for the P·E Examination

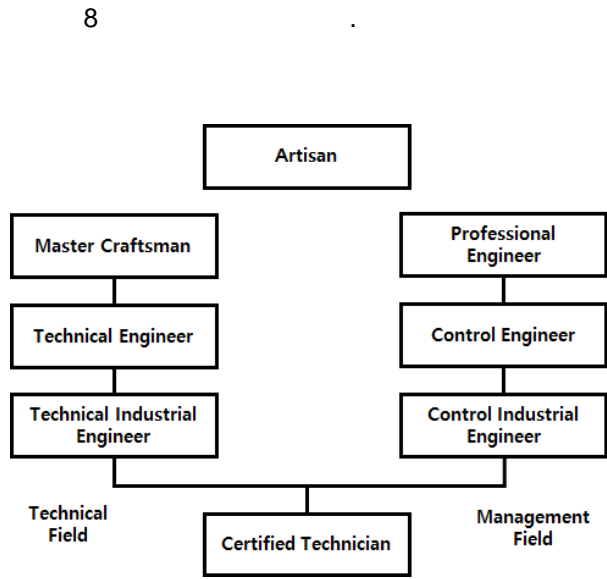
A person who falls under any of the following:	
1. A person who have a job experience at the job field, where the person applies, for more than 4 years after achieving an engineer qualification. The job filed includes the similar job fields determined by Ministry of Employment and Labor Law and is called the same or similar job field in the rest	
2. A person who have a job experience at the same or similar job field, where the person applies, for more than 5 years after achieving an industrial engineer qualification	
3. A person who have a job experience at the same or similar job field, where the person applies, for more than 7 years after achieving a certified technician qualification	
4. A person who have a job experience at the same or similar job field, where the person applies, for more than 6years after achieving a bachelor degree in related major where the person applies. The major is determined by the minister of Employment and Labor and is called the related major in the rest.	
5. A person who achieve other kind of professional engineer qualifications in the same or similar job field	
6. A person who have a job experience at the same or similar job field, where the person applies, for more than 7years after achieving in the related major at 3yrs - junior college	
7. A person who have a job experience at the same or similar job field, where the person applies, for more than 8years after achieving in the related major at 2yrs - junior college	
8. A person who have a job experience at the same or similar job field, where the person applies, for more than 6years after completing an engineer level - technical training program for each field of national technique qualification in the training organization determined by Ministry of Employment and Labor Law	
9. A person who have a job experience at the same or similar job field, where the person applies, for more than 8years after completing an industrial engineer level - technical training program for each field of national technique qualification in the training organization determined by Ministry of Employment and Labor Law	
10. A person who have a job experience at the same or similar job field, where the person applies, for more than 9years	
11. A person achieving the qualification required for the same field from foreign countries	

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<Table 13> Change of Students by Higher Education

Year	Candidates	Junior College	University	Open University	Graduate School
1999	795,998	306,802	319,278	49,648	84,273
2000	819,779	318,135	321,399	47,387	94,079
2001	839,516	322,687	327,031	50,949	99,562
2002	819,052	311,304	320,534	47,175	102,784
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2009	791,025	242,525	347,750	34,157	120,088
2010	817,225	249,144	358,511	31,240	126,958
2011	832,631	249,693	361,686	31,619	126,872
2012	817,142	238,952	372,941	28,822	126,116
2013	788,994	227,707	365,515	29,576	126,860
2014	791,242	221,750	363,655	25,406	127,757
2015	774,611	214,466	355,772	21,730	129,201
2016	756,527	208,808	348,393	18,301	126,972
2017	735,581	200,021	343,076	16,835	122,920
2018	734,291	198,110	342,841	16,463	123,705
2019	733,517	197,897	343,248	14,689	123,922
2020	726,981	188,533	342,699	13,161	127,057

[Figure 4]



[Figure 4] A Sample Model for Qualification System

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[Figure 4]

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Job Classification	Technical Field		Equivalence criteria(Complement between education and working experience)		ManagementField	
	Application Criteria	Qualification	Management→ Technique	Technique→ Management	Qualification	Application Criteria
Occupation				<ul style="list-style-type: none"> 4yrs-working experience as a Master Craftsman + a bachelor degree 	Professional Engineer	<ul style="list-style-type: none"> Professional Management Engineer + 4yrs working experience in the relative job field
	<ul style="list-style-type: none"> Technical Engineer + 3yrs-working experience in the same job field Technical Industrial Engineer + 7yrs-working experience in the same job field 	Master Craftsman	<ul style="list-style-type: none"> Professional Management Engineer + 2yrs-working experience in the same job field Management Engineer + 4yrs-working experience in the same job field Management Industrial Engineer + 7yrs-working experience in the same job field 	<ul style="list-style-type: none"> Master Craftsman + a Master degree Technical Engineer + a Bachelor degree 2yrs-working experience as a technical engineer in the same job field + a junior college degree 10yrs-woring experience as a certified technician + a junior college degree 	Professional Management Engineer	<ul style="list-style-type: none"> A bachelor degree + 3yrs-working experience in the same job field Management Engineer + 2yrs-working experience in the same job field Management Industrial Engineer + 6yrs-working experience in the same job field
	<ul style="list-style-type: none"> Technical Industrial Engineer + 4yrs-working experience in the same job field Certified technician + 6yrs-working experience in the same job field 	Technical Engineer	<ul style="list-style-type: none"> Management Industrial Engineer + 2yrs-working experience in the same job field 	<ul style="list-style-type: none"> Technical industrial engineer + a junior college degree 	Management Engineer	<ul style="list-style-type: none"> A bachelor degree(or graduand) A junior college degree + 2yrs-working experience Management Industrial Engineer + 1yr-working experience in the same job field
Job	<ul style="list-style-type: none"> Certified technician + 1yr-working experience in the same job field 	Technical Industrial Engineer	<ul style="list-style-type: none"> A high school diploma + 2yrs-working experience in the same job field 		Management Industrial Engineer	<ul style="list-style-type: none"> A junior college degree in the relevant major
			<ul style="list-style-type: none"> No limit of application to a certified technician 			

[Figure 5] A Suggest for New Two System

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<Table 14>

<Table 14> A Summary of Improvement for PE Examination
 Test Method

Section	The present	Improvement	
Level	Professional Engineer	Management Engineer Engineer	
Application Criteria	Qualification Level	Management Engineer	Regulation of Qualification Level System 4yrs-work experience in the same job field after achieving a management engineering qualification
	System Regulation	Engineer	
Test Method	Written Test(Discriptive)	Management Engineer	Written Test(5-Choice, short answer)
	→ Interview	Engineer	Documentation Review, Interview
Test Guidelines	The current	Management Engineer	3 subjects based on NCS (Common, Aptitude, Major)
		Engineer	Interview for work field

※ Organizing a committee pool, Unanimous consent

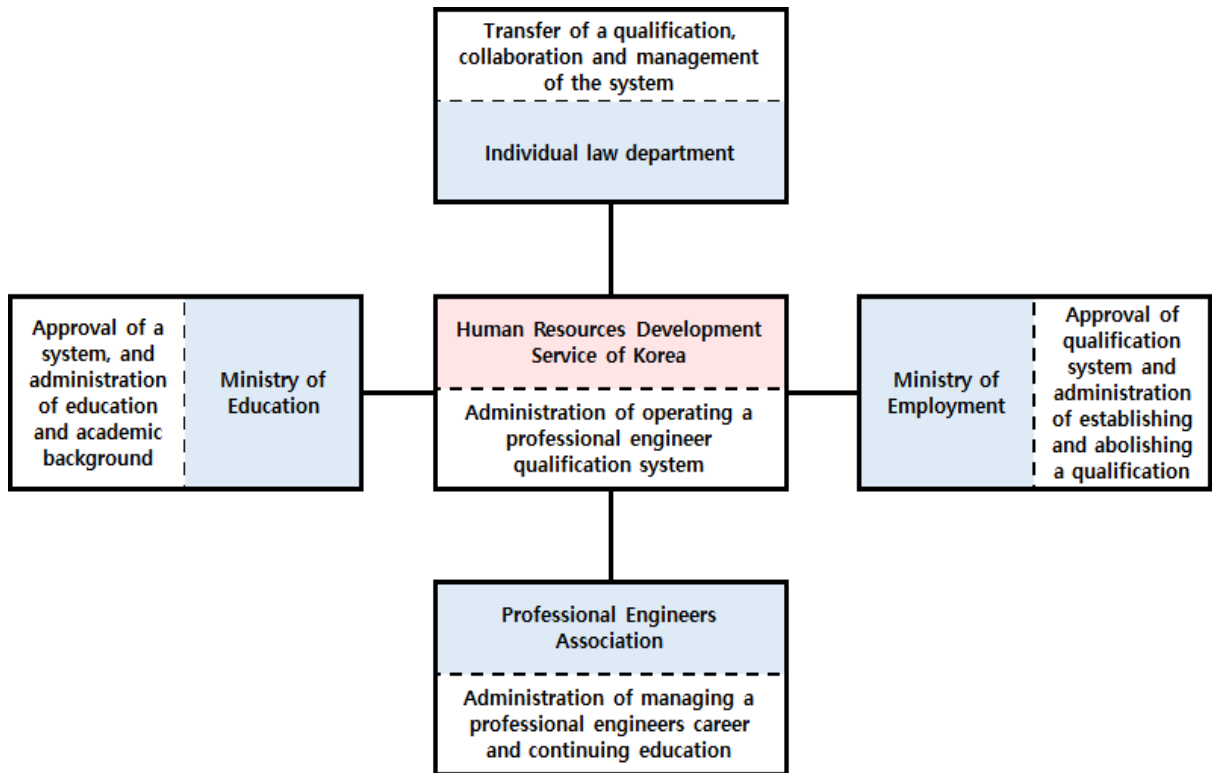
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[Figure 6] New Management System of National Qualification

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