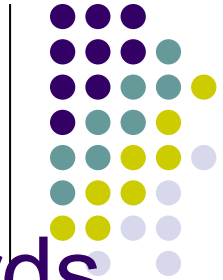

Embedded Technology Skill Standards and the Effects

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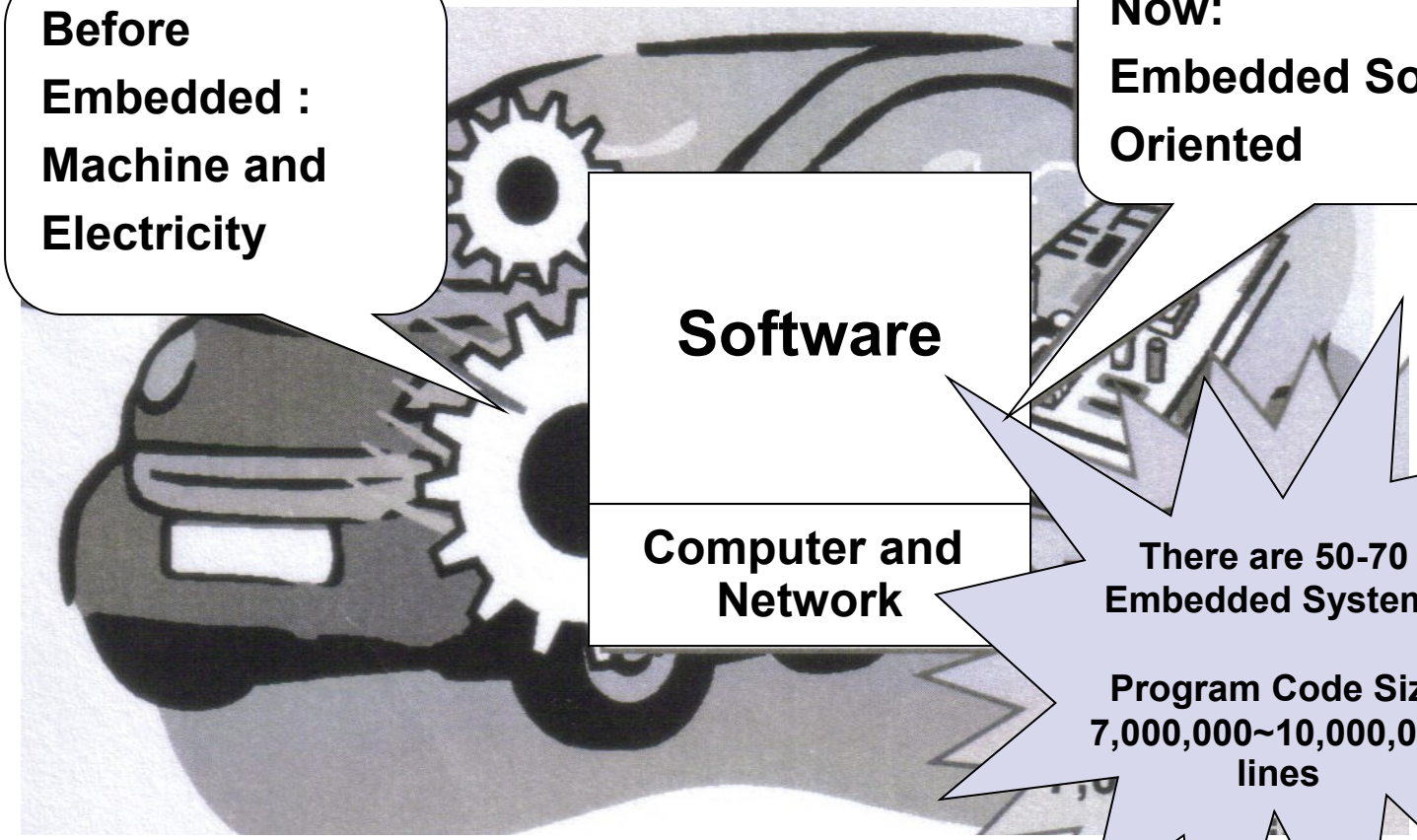
05/2021

Thank to Prof. Ohara

Functions of a Product

Innovation



Before
Embedded :
Machine and
Electricity

Now:
Embedded Software
Oriented

Software

Computer and Network

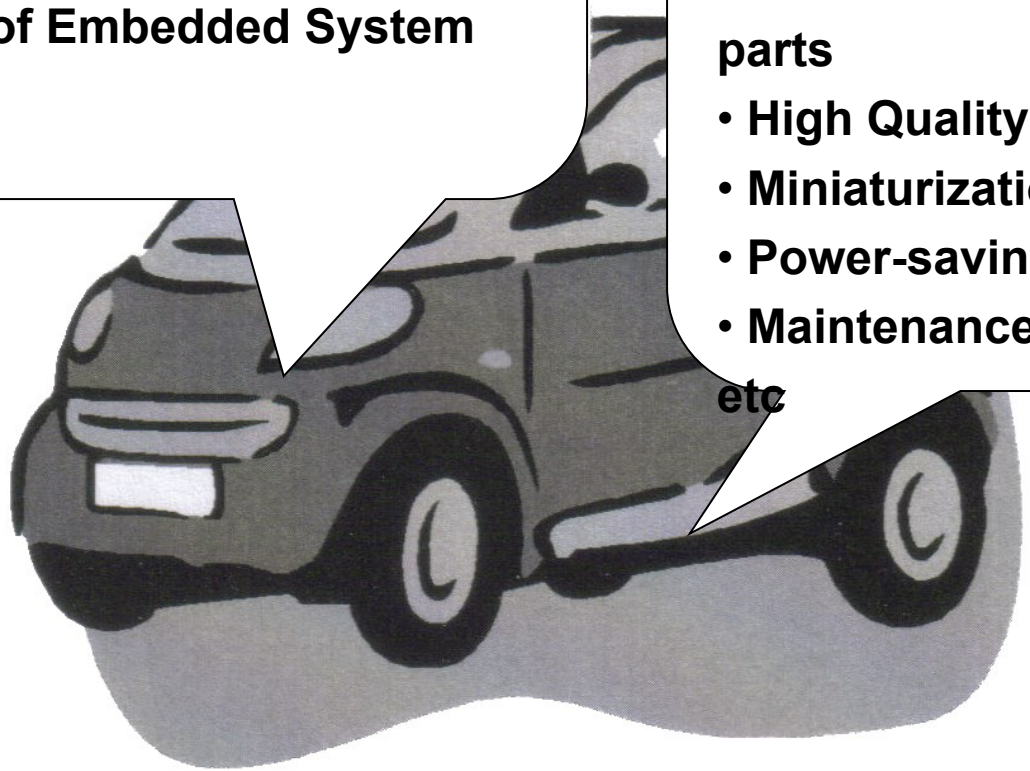
There are 50-70
Embedded Systems

Program Code Size
7,000,000~10,000,000
lines

Why Embedded ?

Embedded System :
The computing system which realizes a function of a product

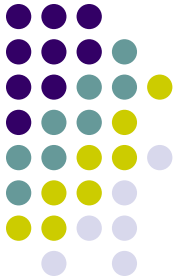
Embedded Software :
Element of Embedded System



Effects :
- **Reduce the number of Machine and Electric parts**
- **High Quality**
- **Miniaturization**
- **Power-saving**
- **Maintenance**

etc

Innovation by Embedded Technology



The effects by Embedded software
- Reduce the number of devices in the product
- Make the high quality, high Performance ,etc.

Reduce the number of the elements
This will make reduce the production process importance

Effects

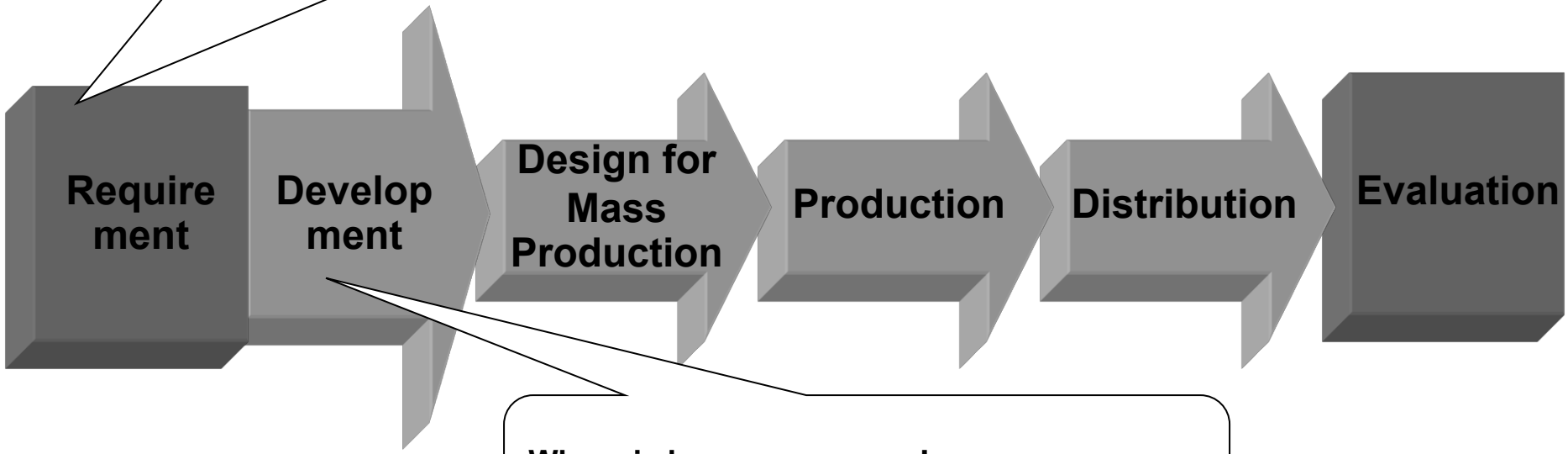
Require ment → Develop ment → Design for Mass Production → Production → Distribution → Evaluation

Effects

Increase the importance of development process : there are no human resource for embedded technologies

Innovation by Embedded Technology

So many Application Fields:
Industrial/OA Machine/Industry FA, Computer/ Peripheral, AV Appliance, Communication Terminal Unit, Home Electronics, Transport/Construction Machinery, etc.

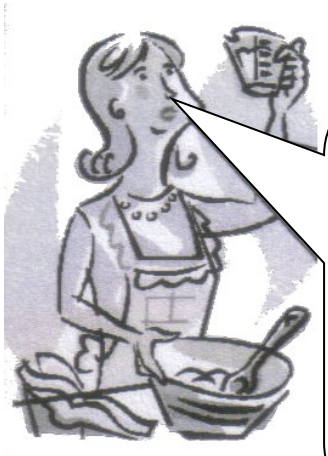


Where is human resource !
How to make or take the human resource?

Technology (Knowledge) and skill

Recipe is Technology (=Knowledge)

Tool is Technology (=knowledge)



- Have any knowledge for recognize
- But no skill for tasting, smell check

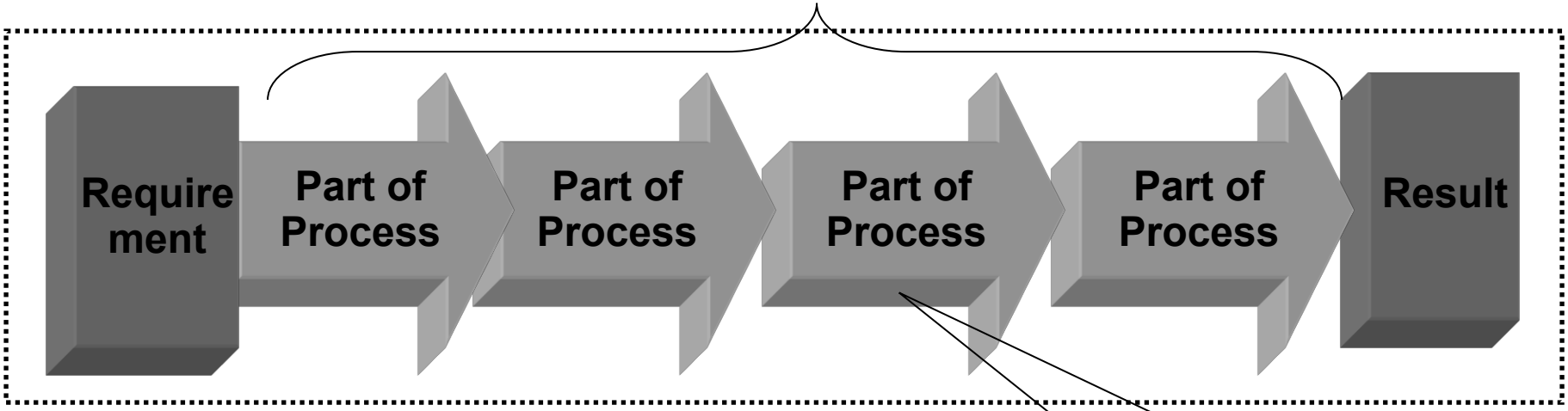
<Can not make the cooking>

Recognize the recipe
And have the skill

<Can make cooking>

Relation of Technology any skill

Technology : Technology is a knowledge. So we can transfer each technologies from/to for each other by formal communication methods. Technology will realize the requirements in the necessary conditions that includes economical conditions



Process:
- **Functional and Data processing process in each requirements.**
- **The design process and the production process of each requirements.**

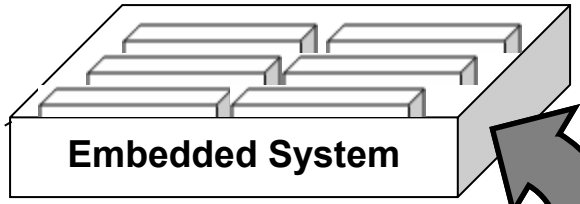
Skill : Depend on Personal Experience. The main ability is actions (how to do, how to can) in the part of process

Skill Criteria : Skill Categories (2)

Technological Elements

- Communication
- Storage
- Information processing
- Sensing and Control
- Multimedia
- Platform
- User Interface
- ...

Technology Elements used in product developments



Product Development

Development Technology

Analyze → Design → Implement → Test

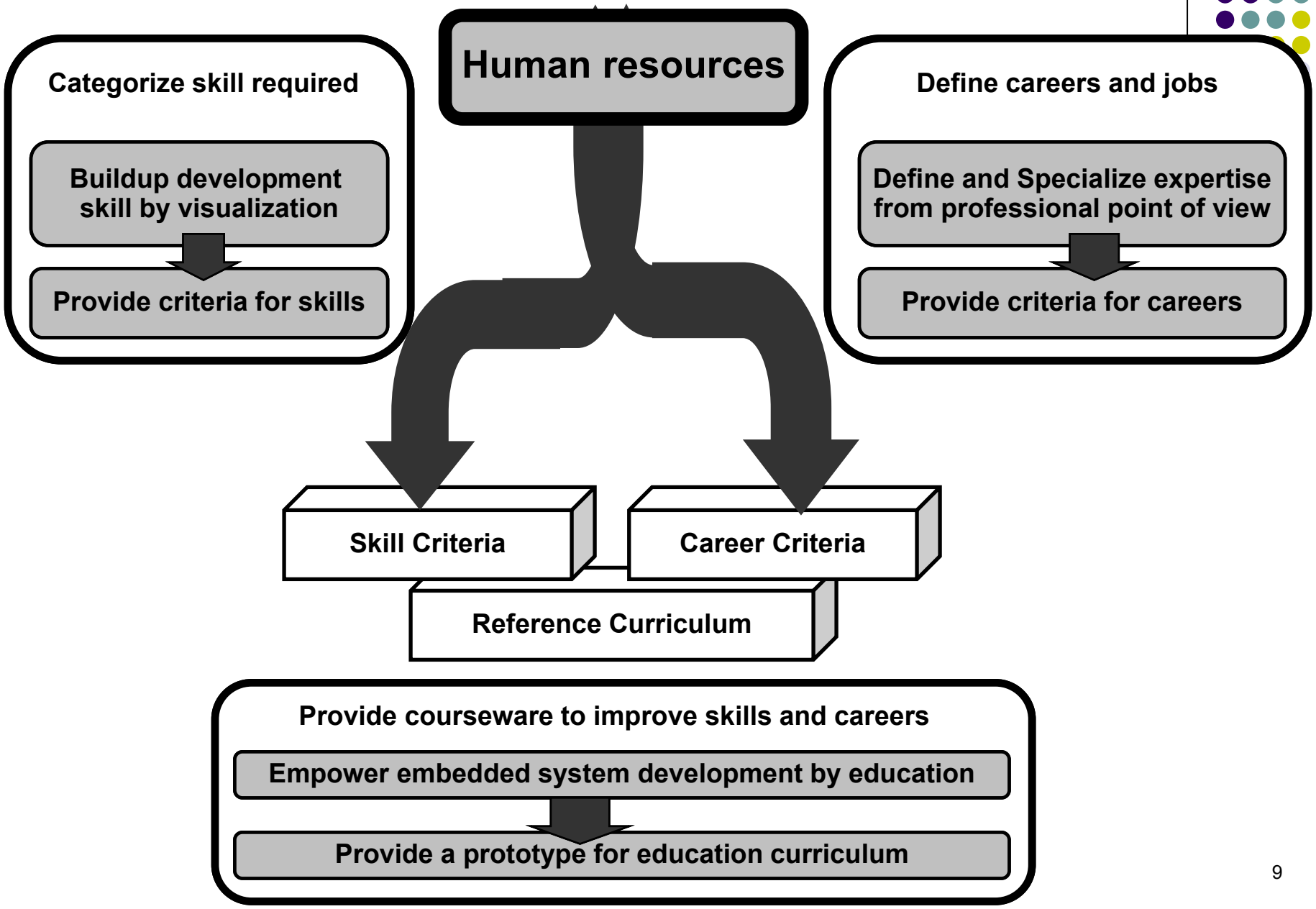
Develop components with Development Technology

Management Technology

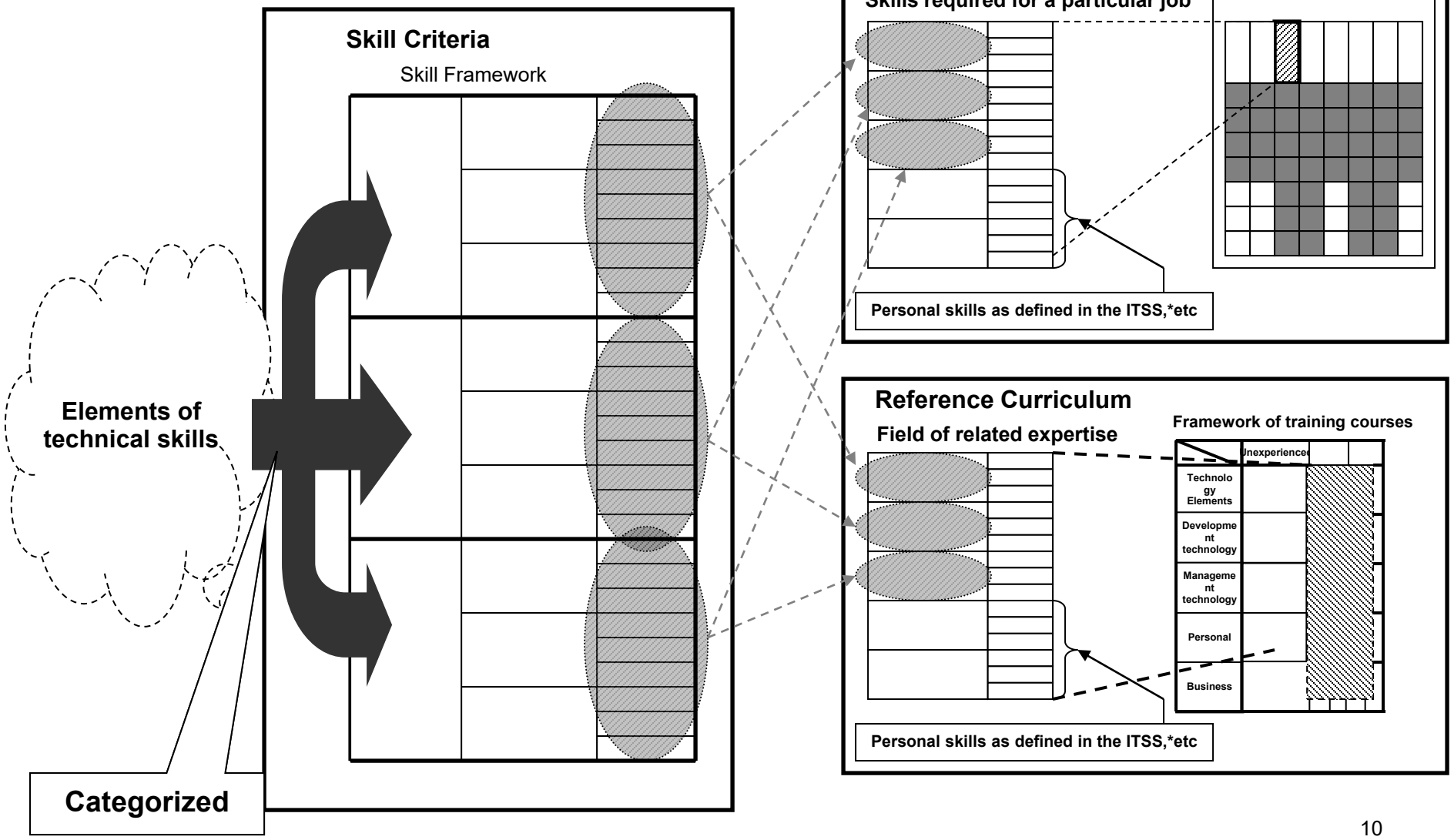
Project Management | Process Management

Manage product development process with Management Technology

Objectives of the Skill Standards

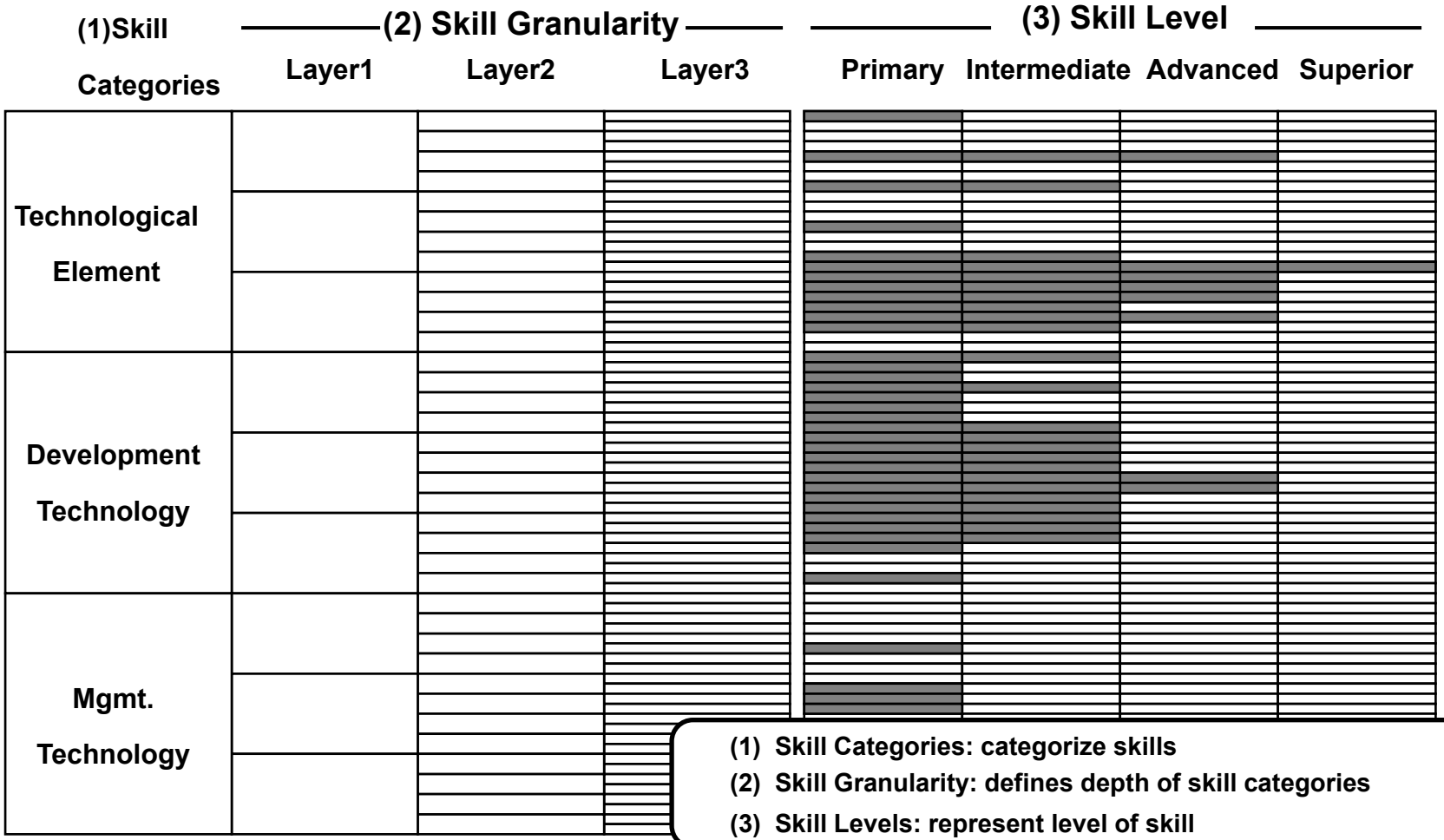


Structure of the Skill Standards

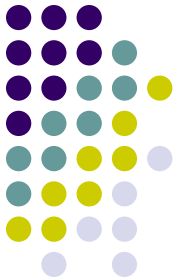


Skill Criteria: Skill Framework

Technological knowledge for skill Granularity

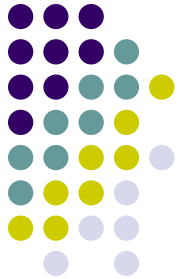


Technological Elements Skill Category (excerpts)



Layer 1		Layer 2		description
1	communication	1	Wired communication	WAN LAN, etc.
		2	Wireless communication	For public and private use
		3	Broadcasting	Digital and analog broadcasting technology
		4	Internet	For transparent data transmission and application
2	Information Processing	1	Input	Data, voice, etc.
		2	Security	Encryption, copyright, etc.
		3	Data Processing	Compression, database, etc.
		4	Output	Markup language, document viewer, etc.
		1	Audio	Data compression and decompression
		2	Audio	decompression

Development Technology Skill Category (excerpts)

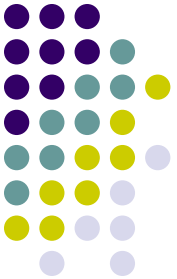


Layer 1		Layer 2		description
1	Systems Requirements Analysis	1	Capturing Requirements	Interviews, marketing survey, etc.
		2	Systems Analysis and Requirements Definition	Modeling analysis, and requirements development
		3	Review of Requirement	Methods of review and inspection, etc.
2	Process Design	1	Allocation of functions and performance between hardware and software	Performance estimation, FMEA, FTA, software cost estimates, IPR, etc.
		2	Feasibility evaluation and design review	Methods of review and inspection, etc.
3	Software Requirements Analysis	1	Definition of requirements for software	Modeling methods, analysis methods, requirements definition, etc.
		2	Evaluation and review of	Method of review and inspection, etc.

Management Technology Skill Category (excerpts)

Layer 1		Layer 2		description
1	Project Management	1	Integrated Management	WBS, EVM, conferencing, review methodology, etc.
		2	Scope Management	WBS, change management, etc.
		3	Time Management	PART, Gant Chart, Estimation methods, etc.
		4	Cost Management	ROI, ROE, Estimates, EVM, etc.
		5	Quality Management	Inspection, error analysis, statistics, trends analysis, etc.
		6	Team Management	Team building, OBS, etc.
		7	Communications Management	Methods of information sharing, etc.
		8	Risk Management	Risk analysis, decision tree analysis, risk categorization, etc.
		9		

Definition of the Skill levels



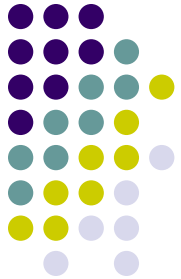
Level 1 (Primary) :
Can do jobs with guidance of the seniors

Level 2 (Intermediate) :
Can do by themselves

Level 3 (Advanced) :
Supervise the process

Level 4 (Superior) :
Organize experiences and find/develop original methods

Skill Requirements



- Requisites to certify the possession of a specific skill when being tested is called “Skill Requirements”

Technological Element Skill Category

- Can make something : make functions aaa by analyzing requirements, constraints, examples, etc.
  - aaa : Technological Elements
- Can use something : implement functions that use aaa by analyzing requirements, constrains, examples, etc.
  - aaa : Technological Elements

Development/Management Skill Category

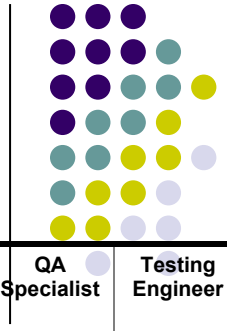
- Can do xxx using yyy
  - xxx : jobs, management items
    yyy : Development/Management Technology (methods,tool,etc.)

Relation of the Technological Elements and Development Technology (Example)

Development Technology	Technological Element: Communication	Information procession	Multimedia	Sensing and Control	Platform
Analyze				●	
Design	○			●	◎
Implement		○	△	○	
Test			◎	◎	

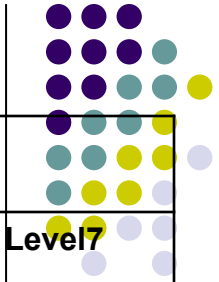
△ Primary ○ Intermediate ◎ Advanced ● Superior

Career Framework



Career	Product Manager	Project Manager	Domain Specialist	Systems Architect		Software Engineer		Bridge Engineer	Support Engineer		QA Specialist	Testing Engineer
Specialties	Embedded Systems	Embedded Software Development	Embedded Software Technologies(1)	Embedded Applications	Embedded Platform	Embedded Applications	Embedded Platform	Embedded Systems Development	Embedded Systems Development Environment	Development Process	Embedded Software Development	Embedded Systems Development
High	Level7											
	Level6											
	Level5											
Mid.	Level4											
	Level3											
Entry	Level2											
	Level1											

Definition of Career Levels

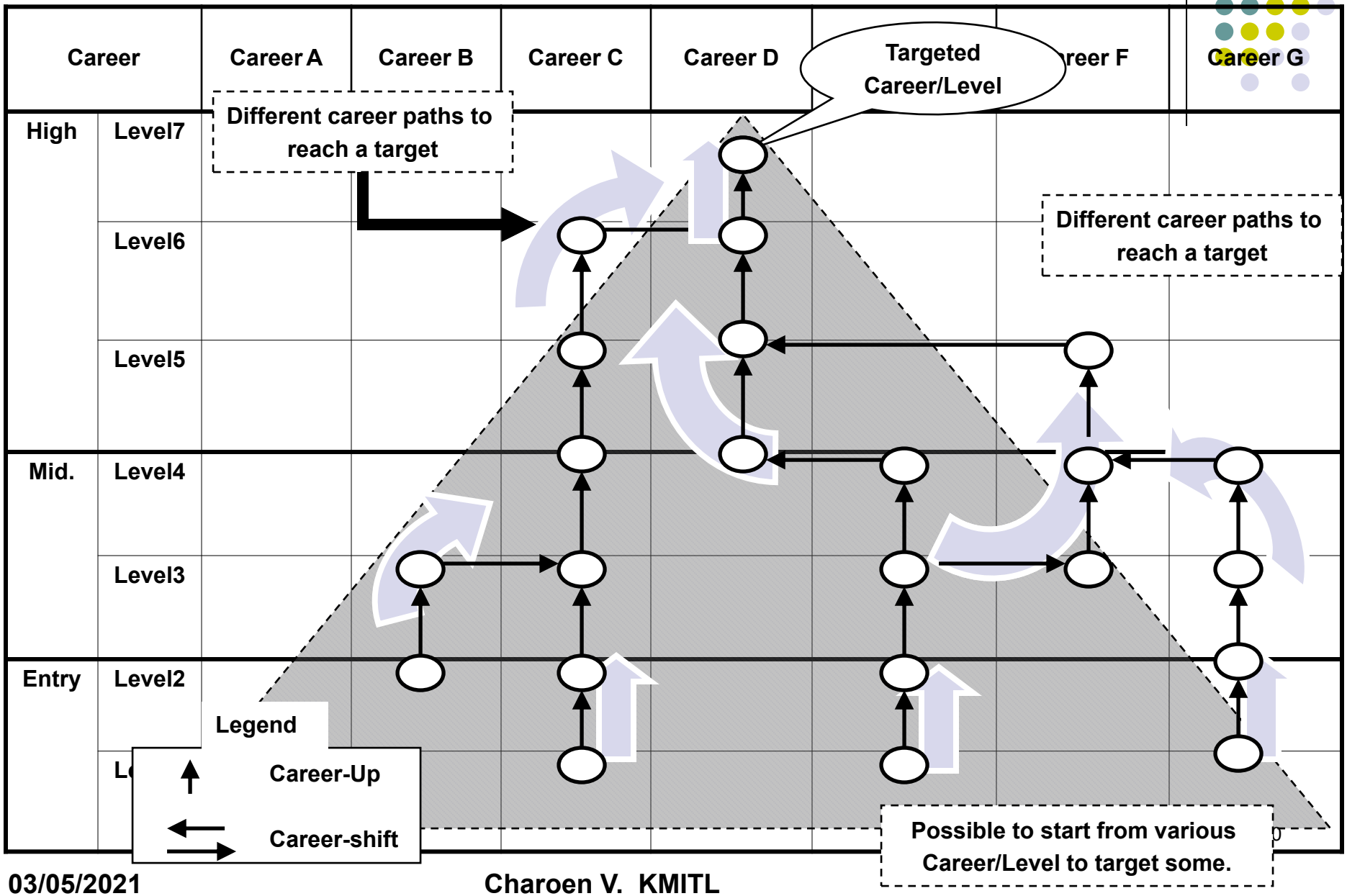


Entry Level		Mid Level		High Level		
Level1	Level2	Level3	Level4	Level5	Level6	Level7
Find problems and solutions with the guidance of the seniors		Find problems and solution in the projects		Lend technologies, methodologies, and business		Lend a company and/or an industry by developing technologies &standards
						Lead the market
					Recognized in the market	
				Lend a company		
			Organize experiences into knowledge to be applicable in the projects and staff education.			
		Can do every job by themselves.				
	Can do some jobs by themselves.					
Can do with Guidance.						

Perform Required Jobs (role)

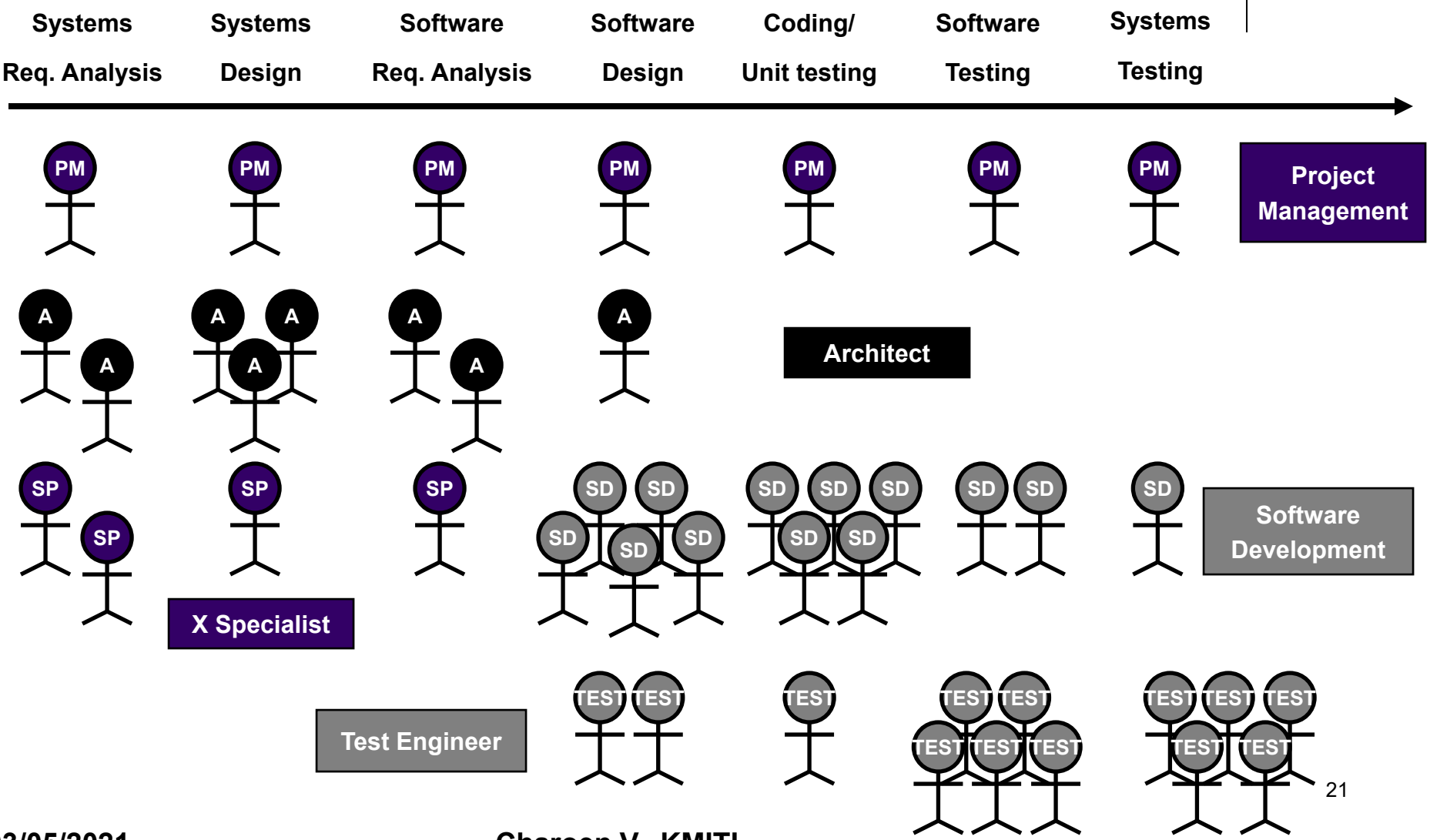
Contribute to create value

Career Paths



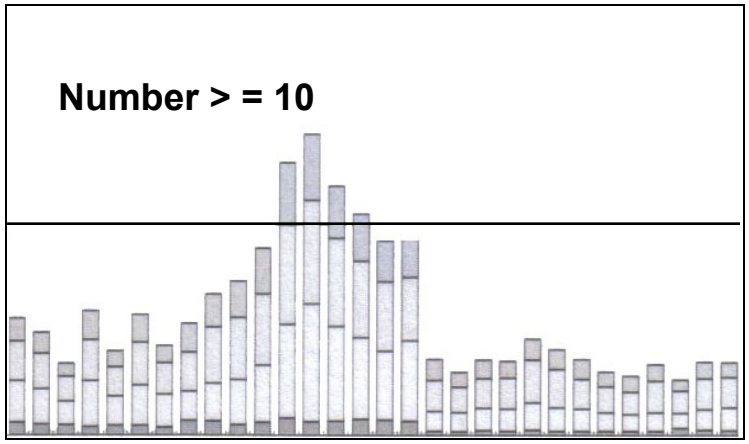
Allocate Human Resources Optimized for the Process

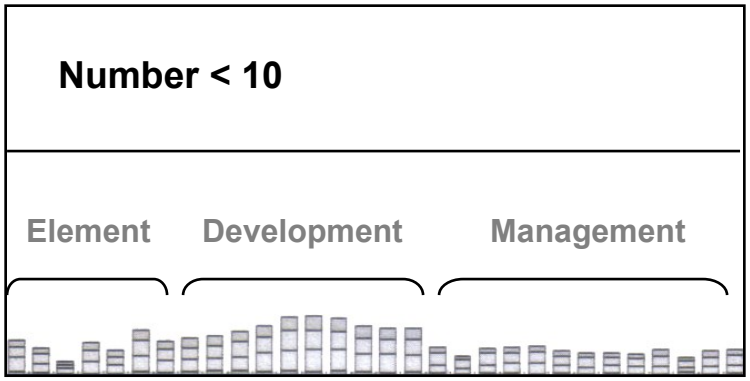
Employment of human resources



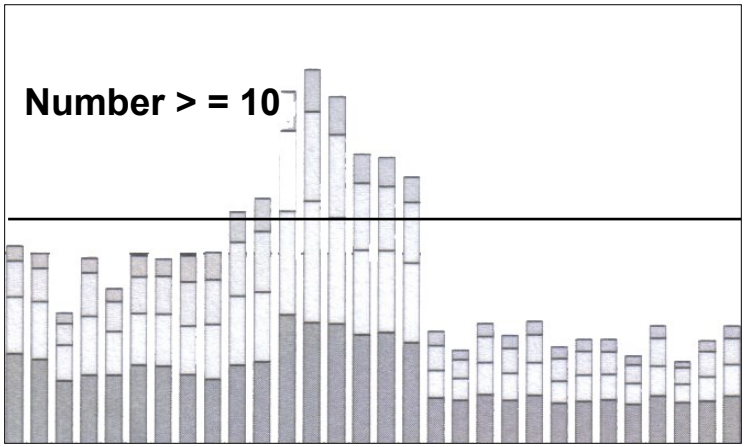
Statistics of Human Resource Allocation of 500 projects

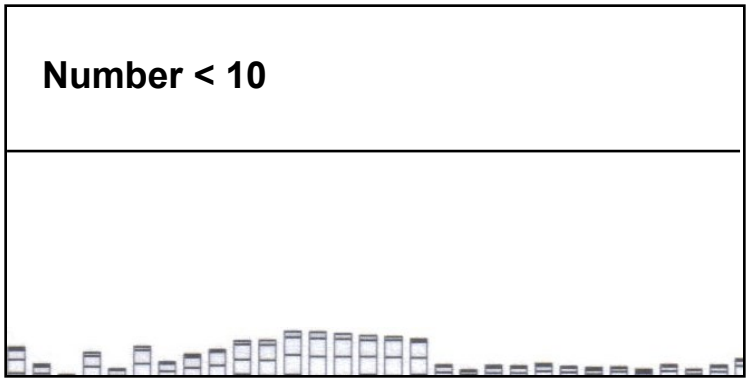
Skill level 1
20%-





Skill level 1
20%+





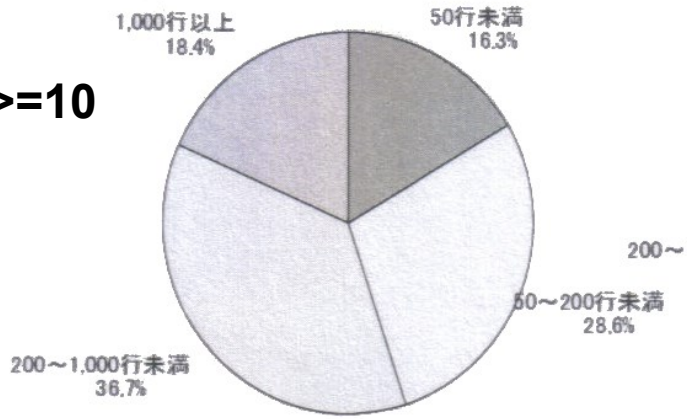
The average of the new lines per week and one person

Skill level 1
20%-

Average

376

Number >=10

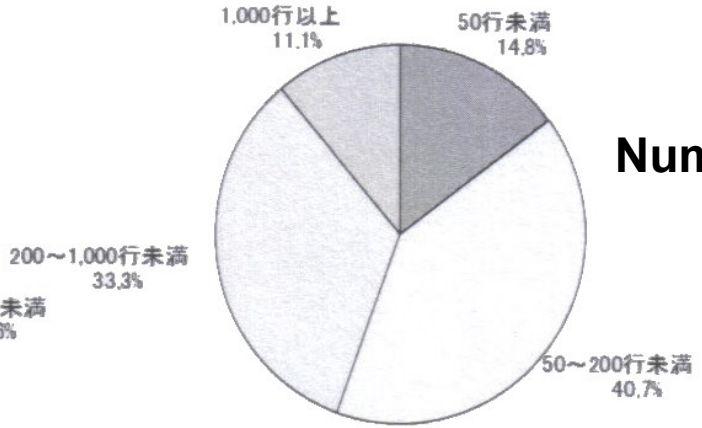


Skill level 1
20%+

Average

191

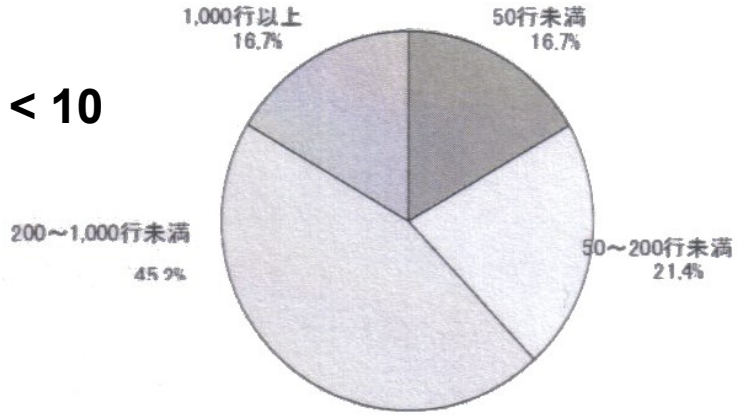
Number >=10



Average

254

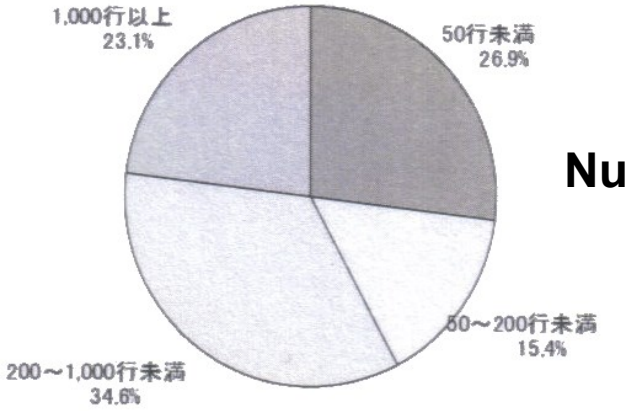
Number < 10



Average

303

Number < 10



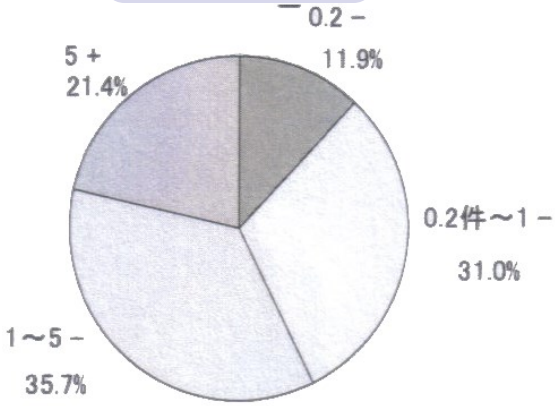
The average of bugs per 1000 lines

Skill level 1
20%-

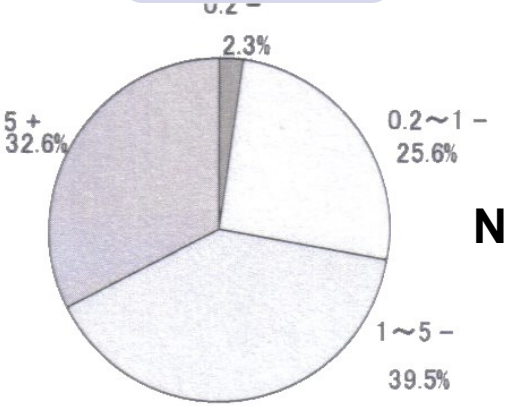
Average

0.52

Number >=10



Skill level 1
20%+



Average

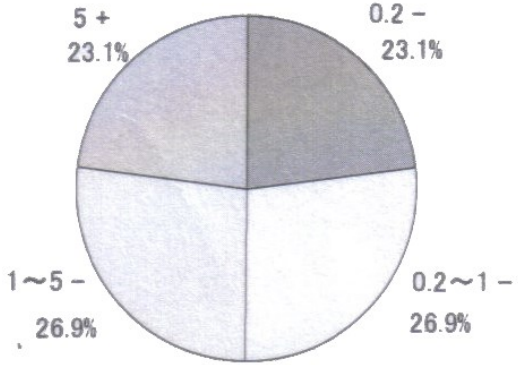
2.22

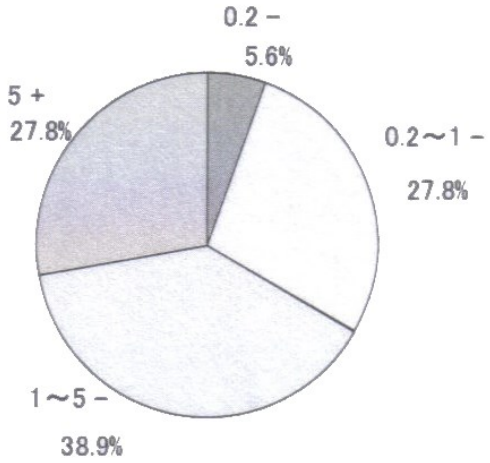
Number >=10

Average

0.86

Number < 10





Average

1.01

Number < 10

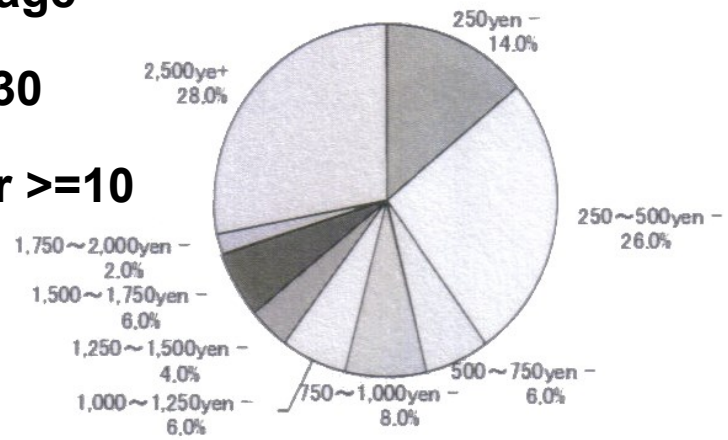
Cost average per new one line (Yen)

Skill level 1
20%-

Average

2,130

Number >=10

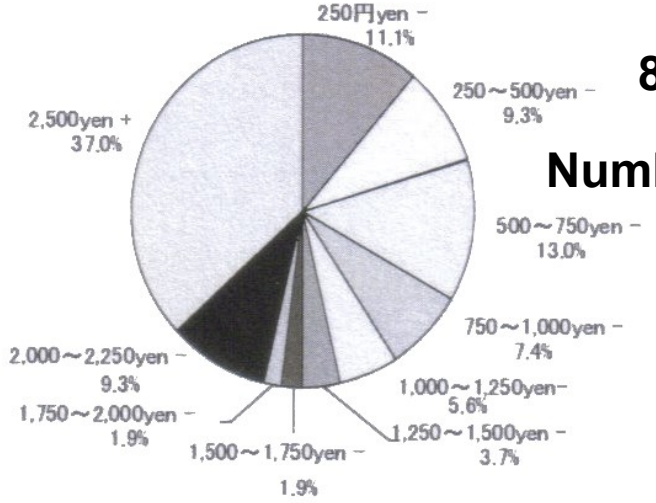


Skill level 1
20%+

Average

8,340

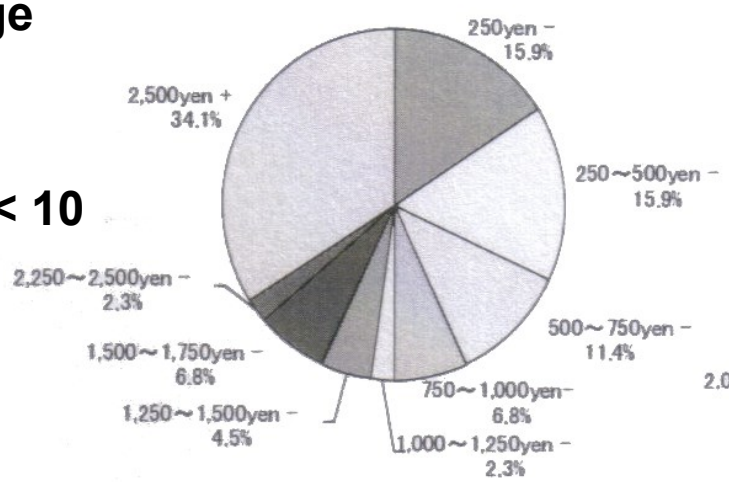
Number >=10



Average

4,930

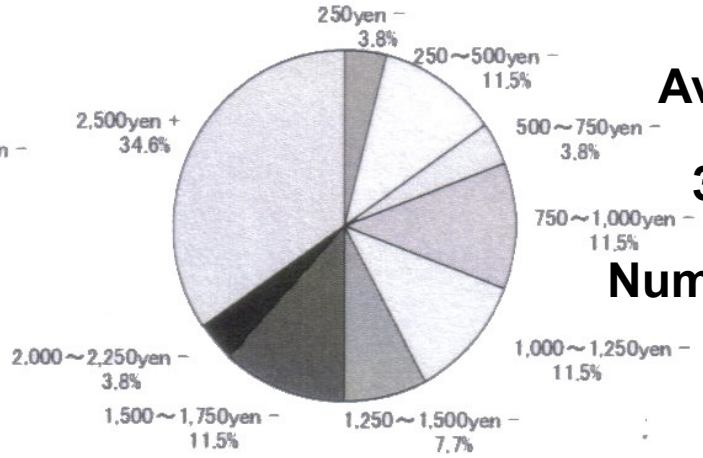
Number < 10



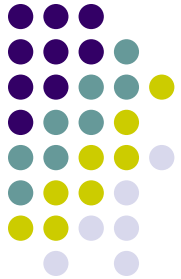
Average

3,030

Number < 10



Conclusion



- What is the Embedded System and Technology
- Innovation by Embedded Technology
- Embedded Skills Standard
- Effects by Embedded Skills Standards