

Embedded Technology Skill Standards

ETSS

Implementation Promoters' Guide

Software Engineering Center, Information-Technology Promotion Agency, Japan (Author and Editor)

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Introduction

This Guide targets people who implement Embedded Technology Skill Standards (ETSS) within companies and/or organizations (ETSS implementation promoters; described in details in this Guide), and provides information relevant to ETSS in order to help them to understand the approach and action toward the implementation of ETSS.

Embedded Technology Skill Standards (ETSS) is designed to be guidelines for “human resource development” and the “effective use of human resources” in order to reinforce embedded software development capabilities. Please refer to the separate guidelines “New Edition - Embedded Technology Skill Standards - ETSS Overview” for details of ETSS.

How This Guide is Organized

This Guide consists of following parts:

Part 1	Description of ETSS and Implementation Promoters	Describes the roles and other details of ETSS and implementation promoters.
Part 2	Operations Involved in Implementing ETSS	Describes actual operations in each activity of implementation processes.
Part 3	References	Contains explanations of terminology and provides format examples.
Part 4	Practice Questions	Contains practice questions to confirm achievement level as implementation promoters.



Table of Contents

Introduction	iii
How This Guide is Organized	v
Part 1 Description of ETSS and Implementation Promoters	1
1.1 ETSS Overview	2
Skills Specification Basics	3
1.2 Effects of ETSS Implementation	14
Extensive Use by Individuals	14
Extensive Use by Managers / Leaders.....	15
Extensive Use by Executives.....	18
1.3 ETSS Implementation Promoters	20
1.4 ETSS Implementation Process	21
1.5 ETSS Implementation Promoter Level	23
1.6 Implementation Promoter Accreditation System	24
1.7 Implementation Process	25
Part 2 Operations Involved in Implementing ETSS	27
2.1 ETSS Implementation Promoter Responsibilities and Task Scope	28
2.2 Details	30
ETSS Implementation Consensus by Departments	
Implementing ETSS (Consensus Document)	30
Creation of Explanatory Materials for Executives	33
ETSS Promotion Organization Establishment	34

ETSS Implementation Plan Details	35
Promotion Team Implementation Training	36
Inclusion of Department Technologies in ETSS Framework	37
Advice on Quantifying Skill Level Assessment	51
Skill Diagnosis Sheet Creation	53
Skill Diagnosis Implementation Approval	58
Skill Diagnosis Briefing	58
Performance of Skill Diagnosis	64
Skill Diagnosis Tabulation	64
Analysis and Evaluation of Skill Diagnosis Results	70
Part 3 References	81
3.1 Glossary of Terms	82
Skill, Technology, Career	82
Education Program	87
3.2 FAQ	90
3.3 Format Examples	91
Operation List	91
Operations Staff Allocation	94
Operation Planning	96
3.4 Skills Specification / Skill Diagnosis Sheet	98
Part 4 Practice Questions	111
Practice 1 Skill Item Selection	112
Practice 1 Worksheet for Question 1	113
Practice 1 Worksheet (1)-1 for Question 2	114
Practice 1 Worksheet (1)-2 for Question 2	115
Practice 1 Worksheet (2)-1 for Question 2	116

Practice 1	Worksheet (2)-2 for Question 2	117
Practice 1	Worksheet (3) for Question 2	118
Reference	Examples of Technological Skill Items	119
Practice 2	Skill Diagnosis	120
Practice 2	Worksheet for Question 1	121
Practice 2	Worksheet for Question 2	122
Practice 2	Worksheet for Question 3	124
Practice 3	Existing Job Category Mapping	125
Practice 3	Worksheet for Question 1	126
Practice 3	Worksheet for Question 2	127

Part **1**

Description of ETSS and Implementation Promoters

1.1	ETSS Overview	2
1.2	Effects of ETSS Implementation	14
1.3	ETSS Implementation Promoters	20
1.4	ETSS Implementation Process	21
1.5	ETSS Implementation Promoter Level	23
1.6	Implementation Promoter Accreditation System	24
1.7	Implementation Process	25



1.1 ETSS Overview

The Embedded Technology Skill Standards (hereafter referred to as ETSS) were formulated in May of 2005 by the Ministry of Economy, Trade and Industry’s Embedded Software Development Capability Promotion Committee. ETSS is composed of a “skills specification,” a “career specification,” and an “education and training specification.”

The purpose of these components is to serve as guidelines for human resource development and human resources utilization in the field of embedded software development. The “skills specification” serves as a framework for systematically organizing embedded software development technologies. The “career specification” defines embedded software development related job categories. The “education and training specification” serves as a guide to embedded software development field human resource development.

The relationships among the components are established based on the skills specification skill items in order to provide overall consistency.

ETSS 1.1.1 Skills Specification Basics

“Figure 1: Embedded software development related technologies” shows the conceptual approach used in organizing the necessary technologies related to the embedded software development that is the target of ETSS.

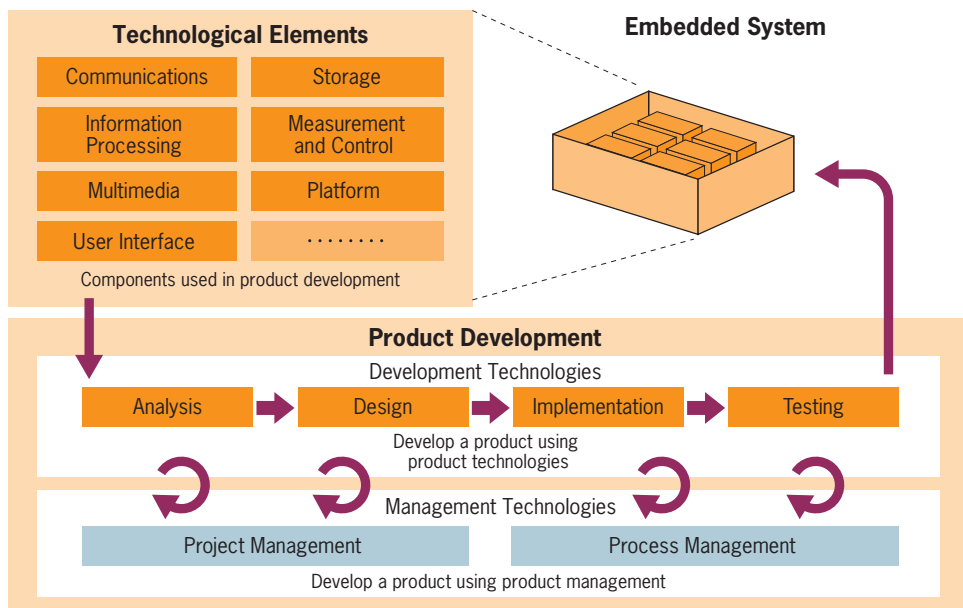


Figure 1: Embedded software development related technologies

The word “technologies,” used in a general sense, is vague, and this vagueness makes further discussion and organization difficult. As Figure 1 shows, according to ETSS, there are three general categories of technologies necessary for embedded software development.

Technological Elements: Technological items built into embedded systems in order to realize system functions. These are referred to as “technological elements.”

Development Technologies: Technologies used during development in order to implement individual technological elements into embedded systems. These are referred to as “development technologies.”

Management Technologies: Technological items used to make embedded system development smooth and precise. These are referred to as “management technologies.”

Categories like “technological elements,” “development technologies,” and “management technologies” are positioned as the starting point of skill categorization and organization. These categories are called skill categories.

Next, let’s look at the elements that make up skill categories. Which technological items are necessary for the product you are trying to develop? For example, if the product must communicate with other products, “communications” will be required as a technological element item. Furthermore, as a means to implement communication, a certain standard will be required.

In actual development scenes, this standard is decided in advance. In other words, developers do not develop “communications,” but instead develop functions which conform with a given standard. It is difficult to perform systematic categorization and organization with individual technologies placed at the top of the categorization and organization hierarchy. Instead, a more inclusive concept is placed above them, and a hierarchy is formed.

The “framework” created by this approach is the skills specification. “Figure 2: Skills framework” shows the ETSS framework.

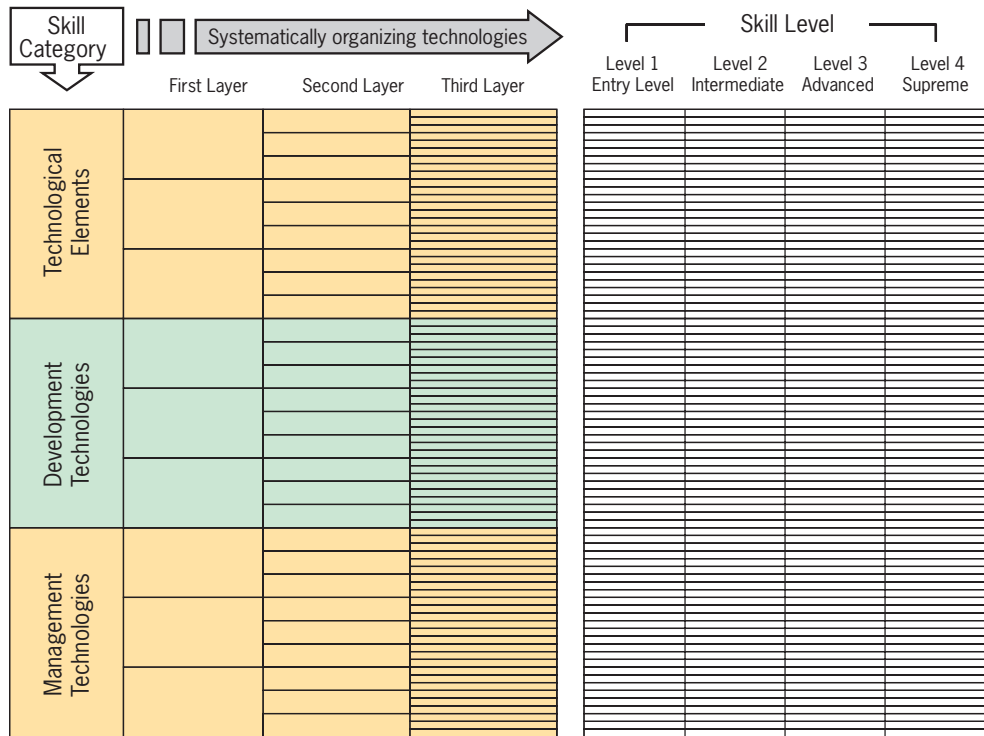


Figure 2: Skills framework

“Figure 3: Technological elements categories” and “Figure 4: Technological elements category examples” show examples of technological elements categorization and organization.

First Layer		Second Layer		Description
1	Communications	1	Wired	Wired communications technologies, such as WAN, LAN, etc.
		2	Wireless	Wireless communications technologies, such as telecommunications and general business wireless technology
		3	Broadcast	Broadcasting technologies, such as digital broadcasting and analog broadcasting
		4	Internet	Internet communication technologies, such as transparent data transfer and applications
2	Information Processing	1	Information Input	Information input technologies, such as data input and voice input
		2	Security	Security technologies, such as encryption and copyright protection
		3	Data Processing	Data processing technologies, such as compression and databases
		4	Information Output	Information output technologies, such as markup language and document viewers
3	Multimedia	1	Voice	Voice processing technologies, such as data processing, voice compression and voice decompression
		2	Still Image	Still image processing technologies, such as data processing, compression and decompression
		3	Moving Image	Moving image processing technologies, such as data processing, compression and decompression
		4	Integration	Integrated processing technologies, including voice and moving images
4	User Interface	1	Human Interface Input	Human interface input device control technologies, such as buttons and coordinate input
		2	Human Interface Output	Human interface output device control technologies, such as visual and voice output
5	Storage	1	Media	Storage media technologies, such as removable storage and memory
		2	Interface	Storage interface technologies, such as removable storage and continuously connected storage interfaces
		3	File System	File system technologies, such as ISO and native OS file systems
6	Measurement and Control	1	Physical and Chemical Input	Physical and chemical input technologies, such as electrical, pressure, and light input technologies
		2	Measurement and Control Processing	Measurement and control technologies, such as coordinate & movement processing, and signal processing
		3	Physical and Chemical Output	Physical and chemical output technologies, such as actuator, light, and heat output technologies
7	Platform	1	Processor	Processor technologies, such as CPUs and GPUs
		2	Basic Software	Basic software technologies, such as kernels and booting
		3	Support Function	Support function technologies, such as data recording and acquisition

Figure 3: Technological elements categories

Name				Skill Items
Department				
Skill Granularity				
First Layer	Second Layer	Third Layer		
Communications	Wired Communications	PAN (Personal Area Network)	CAN	
			TCP/IP	
			USB	
			IEEE 1394	
			IEEE 488	
			VXI	
			RS-232C	
	RS485			
	Wireless Communications	Short Range Communications	Bluetooth	
			IrDA	
		RFID		
	Long Range Communications	IEEE 802		
		CDMA		
	Internet	Transparent Data Transfer	VoIP	
			PPP/PPPoE	
			TCP	
			UDP	
			SOAP	
			IP	
			ARP	
			ICMP	
			Application Processing	DHCP
				DNS
WINS				
HTTP				
FTP				
SMTP				
SNTP				
SNMP				
POP				
IMAP				
Telnet				
SMB				
Samba				
LRP				
WebServer				
WebApplicationServer				
Socket				
UPnP				
NDIS				
Winsock				
COM				

Figure 4: Technological elements category examples

“Figure 4: Technological elements category examples” provides definitions up to the third layer, and also provides examples of detailed technological items (standards) as skill items. Detailed technological items beyond the third layer fall outside the scope of general explanation, so ETSS provides only up to the second layer, as shown in “Figure 3: Technological element categories.” Definitions for the third layer and beyond should be created by the development organization for the product being developed based on an understanding of the ETSS framework.

Skill Levels

In ETSS, skill refers to the capability to perform tasks, and can be expressed in the form “is capable of doing X.” Merely possessing a certain knowledge is not sufficient to be called a skill.

ETSS expresses the capability to carry out tasks (potential) for each technological item in terms of four skill levels.

ETSS skill levels 1 (entry level) to 3 (advanced) are defined in terms of task performance capabilities related to established technologies. In addition, ETSS defines a supreme skill level, skill level 4, in order to evaluate technological innovation promotion capabilities.

◆ Level 4: Supreme	Capable of developing new technologies
◆ Level 3: Advanced	Capable of analyzing and improving tasks
◆ Level 2: Intermediate	Capable of performing tasks on one’s own
◆ Level 1: Entry level	Capable of performing tasks with support

Career Specification

The “career specification” defines job category names and roles related to embedded software development in order to realize human resource development and human resource utilization.

The career specification contains the primary job categories and fields of specialty related to embedded system development software development, and the skills demanded of each. The career specification is intended to function as shared, cross-industry terminology for job

categories and specialty fields.

It uses a common framework (career framework) and describes individual job categories and specialty fields.

It defines a career framework which can be used across industries in order to describe embedded software development related job categories and specialty fields.

The ETSS career framework is composed of the following elements (refer to “Figure 5: Career framework”):

- ◆ Job category / specialty field segment
- ◆ Career level definition
- ◆ Matching between job category / specialty field and skill
- ◆ Job category / specialty field responsibility

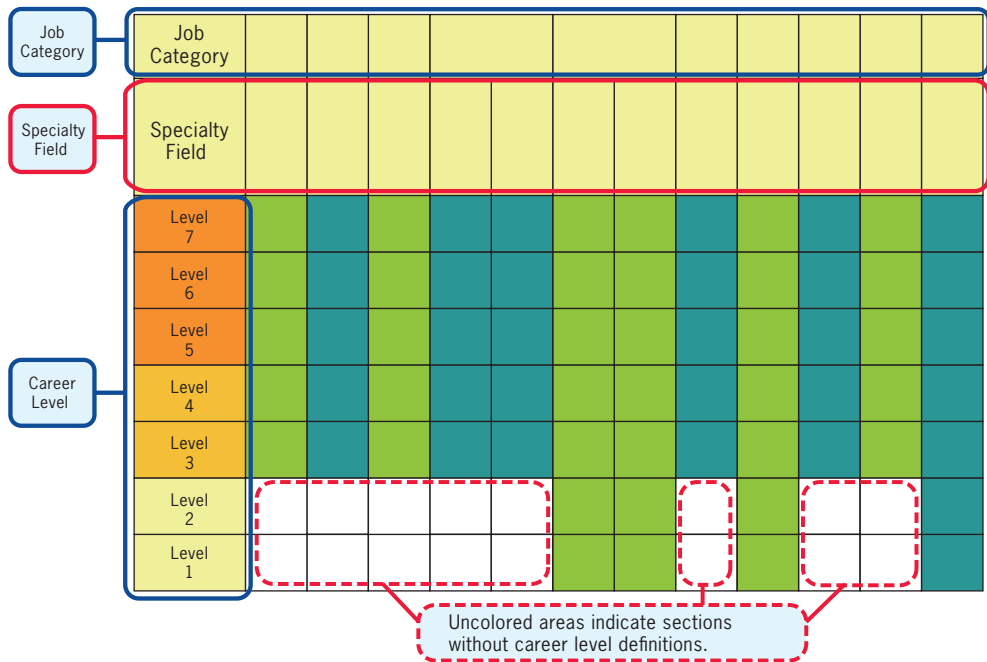


Figure 5: Career framework

ETSS provides job categories / specialty fields and career levels, as shown in “Figure 6: Job categories / specialty fields and career levels.”

Job Category	Product Manager	Project Manager	Domain Specialist	System Architect		Software Engineer		Bridge SE	Development Environment Engineer	Development Processes Improvement Specialist	QA Specialist	Test Engineer
Specialty Field	Embedded System	Embedded Software Development	Embedded-Related Technologies	Embedded Application Development	Embedded Platform Development	Embedded Application Development	Embedded Platform Development	Embedded Software Development	Embedded Software Development	Embedded Software Development	Embedded Software Development	Embedded System Development
Level 7												
Level 6												
Level 5												
Level 4												
Level 3												
Level 2												
Level 1												

Figure 6: Job categories / specialty fields and career levels

A 7-level approach is used for careers, based on the degree to which an individual creates business or professional value in their job category / specialty field (“Figure 7: Career level definitions”). It is important to note that the definitions are different from those of skill levels.

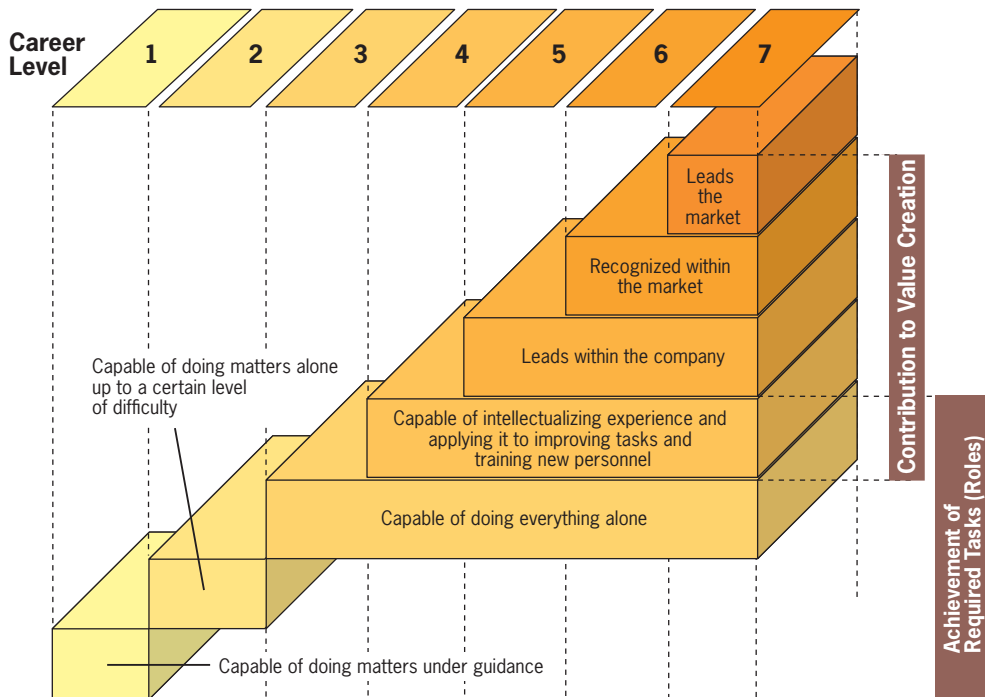


Figure 7: Career level definitions

Education and Training Specification

The ETSS education and training specification is composed of the “education program framework” and education programs, etc., based on it.

The education program framework defined by the ETSS education and training specification clarifies the structure of education methods used to realize human resource development, such as improving the skills and career of engineers involved in embedded system development.

Human resource development is implemented in the ETSS education program framework as described below.

- ◆ Quantitatively visualizing the “entry” point and “exit” point of the education program for human resource development using the skills specification and career specification of ETSS

Entry point: A human resource model who is the targets (participants) of education program training

Exit point: A human resource model who is the objectives (to-be model) of education program training

- ◆ Analyzing the quantified educational targets and educational objectives, and determining what disparity exists between them
- ◆ Arranging the courses in the appropriate order to fill in the gaps (disparity) between the educational targets and the educational objectives

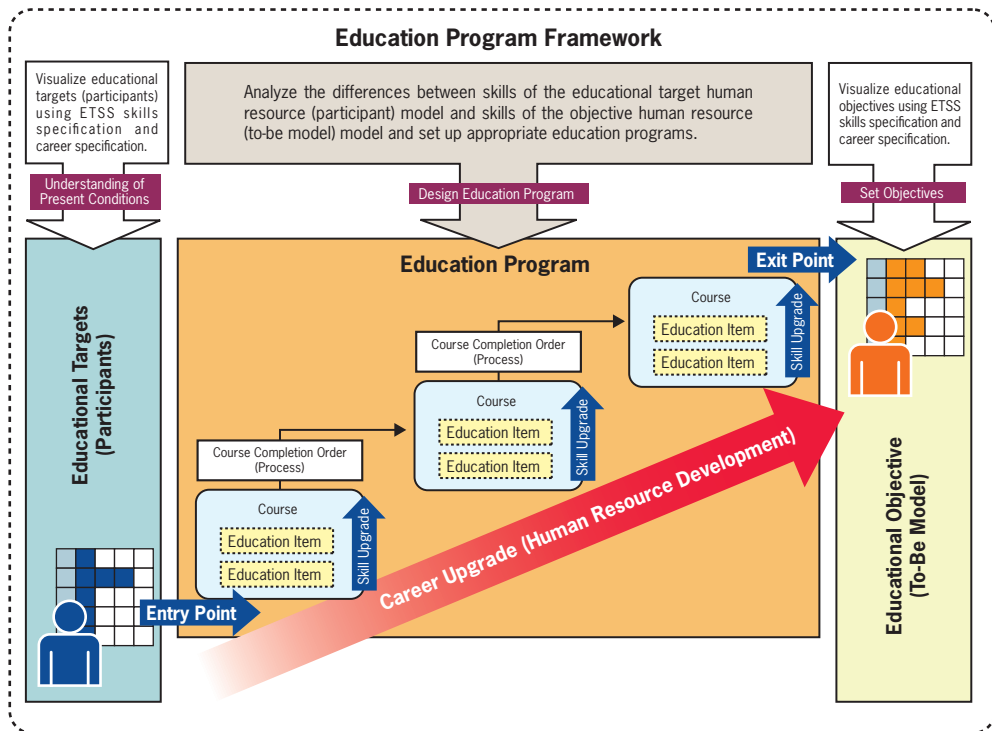


Figure 8: Education program framework

As described above, ETSS uses the skills specification as a foundation, and expands upon it with the career specification and the education and training specification (“Figure 9: Relationship between the skills specification and career specification / education and training specification”).

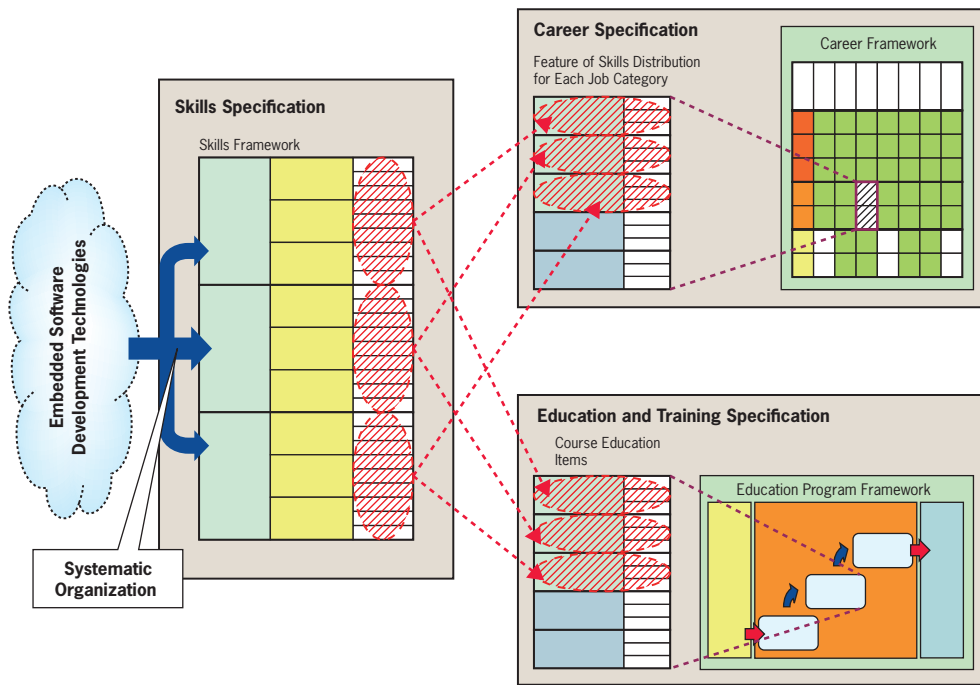


Figure 9: Relationship between the skills specification and career specification / education and training specification

1.2 Effects of ETSS Implementation

Extensive use of ETSS can be effective in the following situations.



1.2.1 Extensive Use by Individuals

◆ Recognition of Ones Strengths and Weaknesses as an Engineer

- The skills specification can be used to measure the embedded software development skills of individual engineers, making it possible to visualize skill level distribution.
- The skill level distribution can be used to objectively and quantitatively recognize the strengths and weaknesses of the engineer (refer to “Figure 10: Individual utilization: visualizing an engineer’s development skill”).

◆ Detailed Career Path Checking

- Engineers who have undergone skill measurement can compare their own skill level distribution against the skills related to the job category / specialty field career levels defined in the career specification in order to confirm the appropriateness of their present job category / specialty field career level.
- They can also get a detailed view of what sort of career path they should take, and how they can improve themselves, in order to reach their target job category career level.

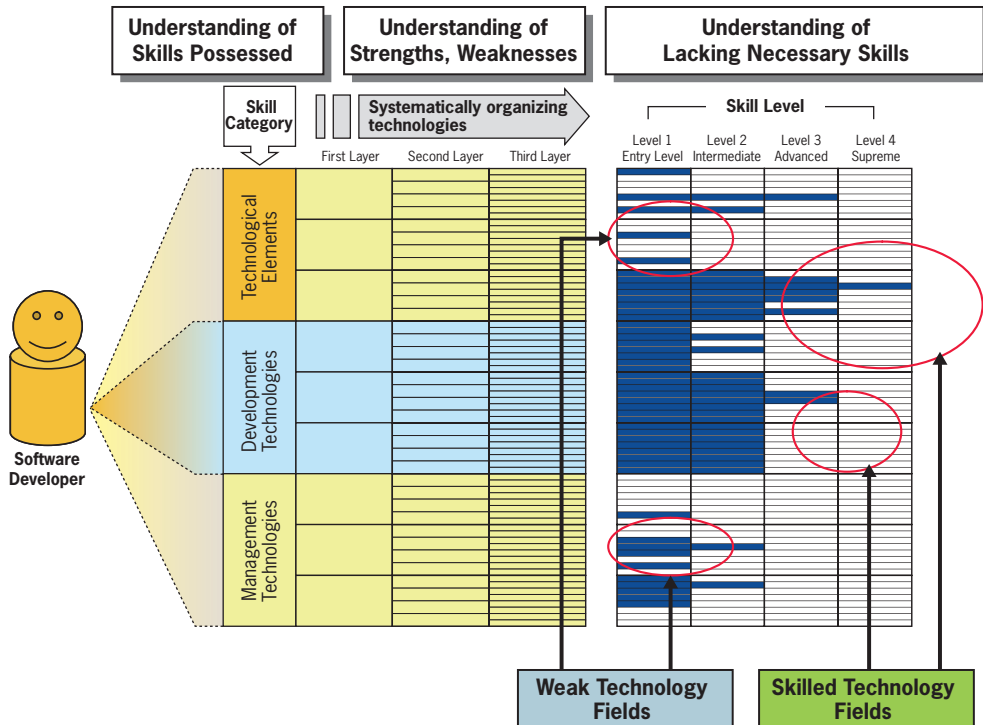


Figure 10: Individual utilization: visualizing an engineer's development skill



1.2.2 Extensive Use by Managers / Leaders

◆ Project Organization Optimization

The distribution of skill levels needed for the development target product, and the distribution of skill levels of the engineers who are planned to carry out the development work, can be used to optimize development project structure formation.

At the appropriate times, teams can be formed in accordance with the skills distribution necessary for each development process, contributing further optimization.

◆ Analysis of Skill Related Development Risk

Risk analysis of development project risks caused by lack of necessary skills can be performed by comparing the distribution of skill levels needed for the development target product and the skills distribution of the development team.

It can also be used as a guideline for effective risk hedge planning, through quantitative visualization of the areas in which skills are lacking, and itemizing the skills needed of new members.

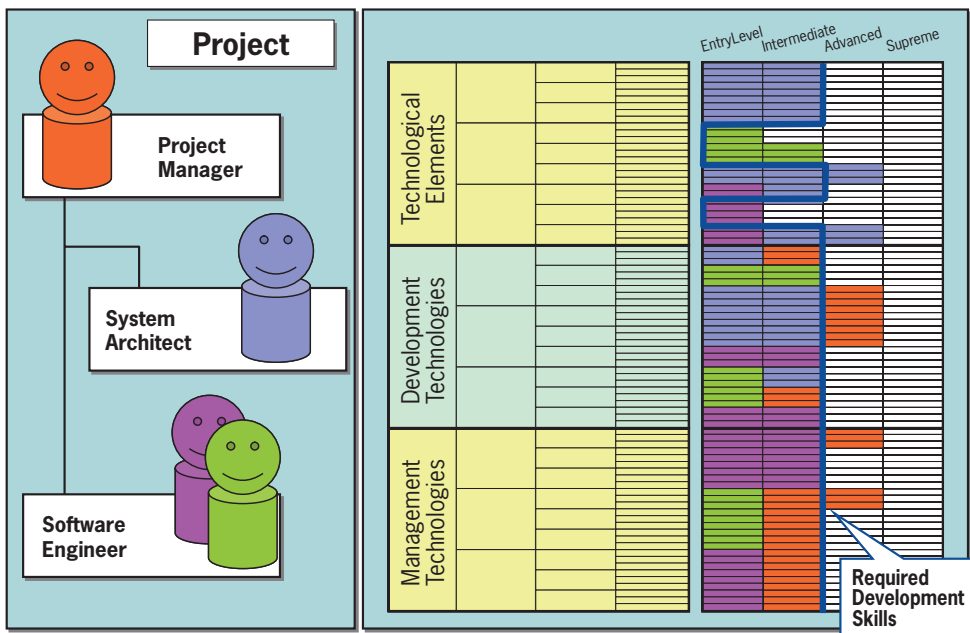


Figure 11: Project utilization: visualizing project development strength (skills are sufficient)

Figures 11 and 12 are visualized examples of required skills being sufficient or insufficient for projects. Figure 13 is an example of placement of members with skill-backed job categories within individual development processes.

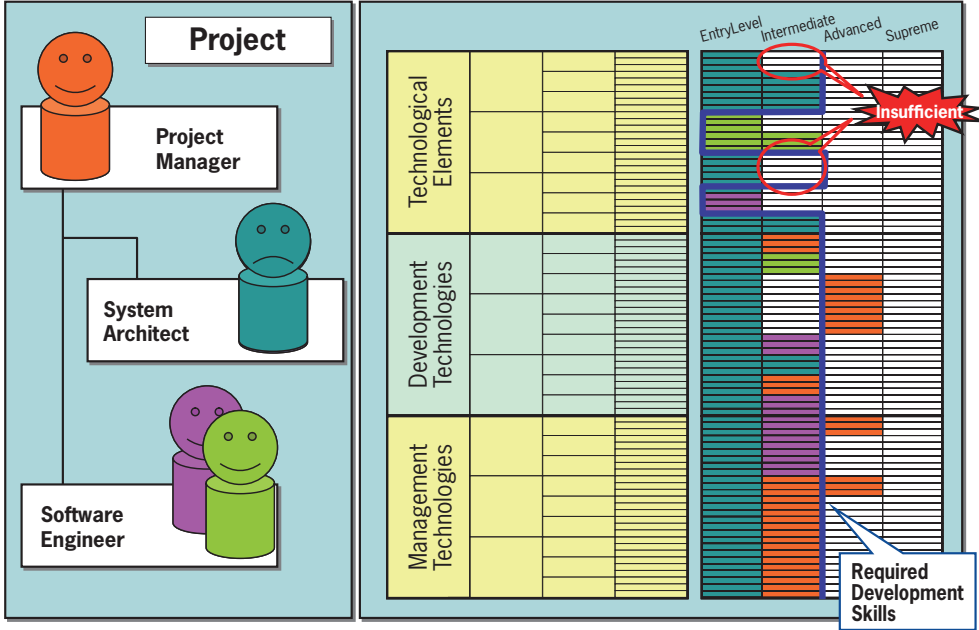


Figure 12: Project utilization: visualizing project development strength (skills are insufficient)

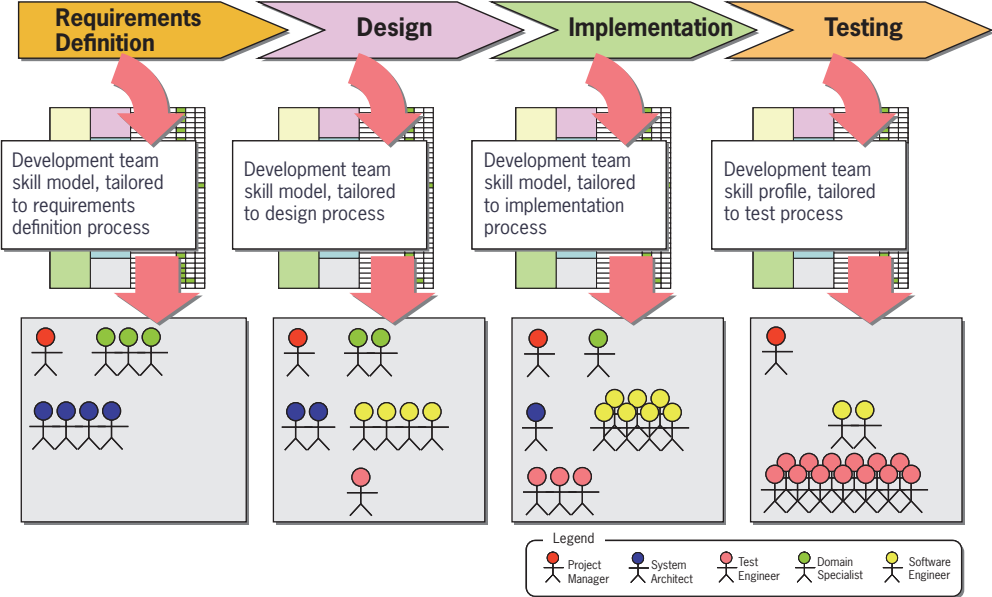


Figure 13: Project utilization: placement of human resources suited to development processes



Extensive Use by Executives

◆ Human Resource Strategy Creation and Evaluation

By measuring the skills of company human resources, and integrating them in an organization, the company's embedded software development related strengths and weaknesses can be visualized.

Industry and technology trends can be compared with company skill measurement results, enabling quantitative consideration of human resource strategies aimed at shoring up weaknesses.

The formulated human resource strategies can be used as specific guidelines during human resource hiring and education.

◆ Education Program Development and Procurement

Organizations providing education services can develop highly effective education programs targeted at the skills and careers demanded by customers.

Companies requiring human resource development can select education programs optimally suited to their objectives.

It can also be used to perform objective measurement of level to which the education results of the education program meet their objectives (skill level improvement, etc.). This feedback can be used to improve the quality of the education program.

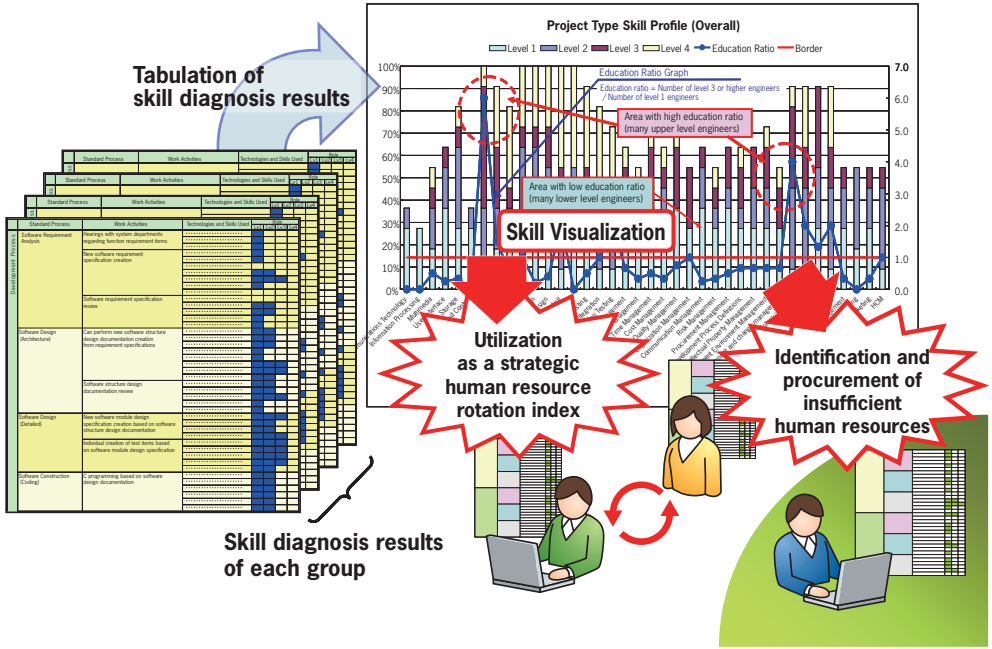


Figure 14: Expected results (top management perspective)

1.3 ETSS Implementation Promoters

People whose role is to utilize an ETSS conformant approach in company's and organization's human resource management activities are positioned as "ETSS implementation promoters." ETSS implementation promoters must have an understanding of the ETSS "skills specification," "career specification," and "education and training specification."

Normally, the term "human resource management" includes a wide range of fields. ETSS uses, as the foundation for these:

- ◆ Skills Specification: Systematic organization of embedded software development skills
- ◆ Career Specification: Defines job categories / specialty fields related to embedded software development
- ◆ Education and Training Specification: Defines the structure and organization of education and training used to realize embedded software development related human resource development

This guide provides explanations based on skill definitions and skill diagnosis (situational understanding of current situation from a human resource management perspective).

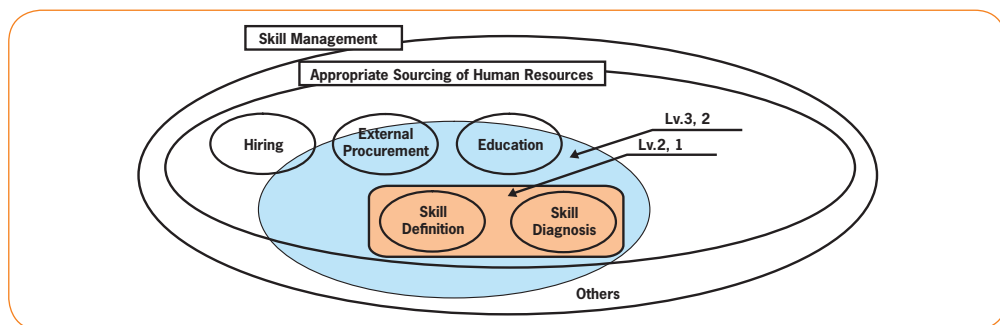


Figure 15: ETSS implementation promoter scope

1.4 ETSS Implementation Process

Management cycle PDCA use is necessary for the implementation of human resource management.

“Figure 16: Human resource management cycle utilizing ETSS” shows an example of the human resource management cycle.

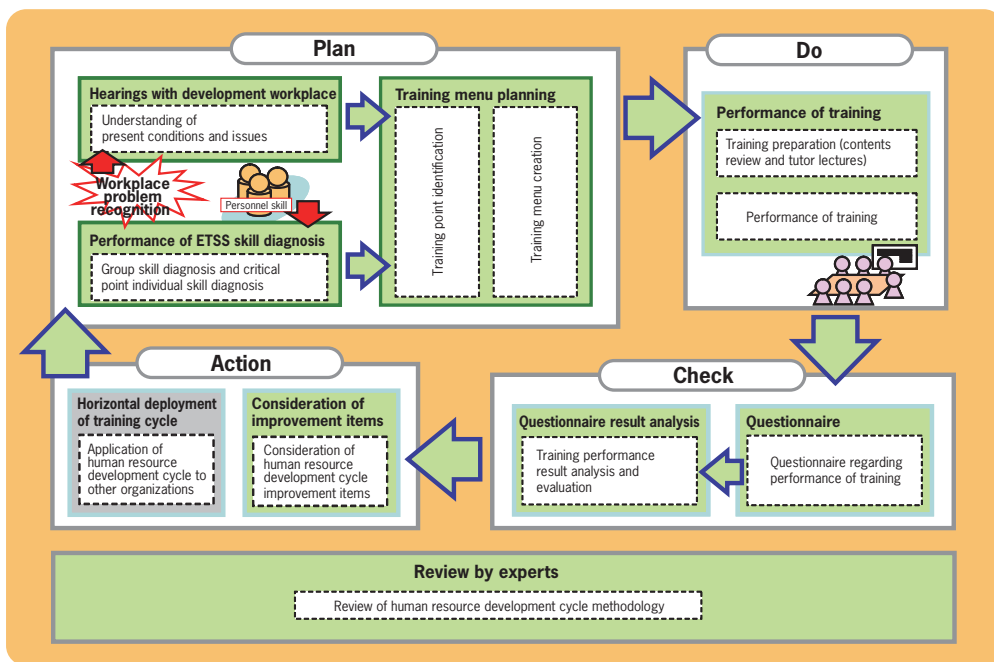


Figure 16: Human resource management cycle utilizing ETSS

This guide provides explanations of the implementation of skill diagnosis, the overall base and starting point of PDCA activities.

“Figure 17: ETSS implementation promoter task scope” shows a list of implementation processes. Part 2 provides further details.

Number	ETSS Implementation Promoter Tasks	Level 1	Level 2
1	ETSS implementation consensus by departments implementing ETSS (consensus document)	-	A
2	Creation of explanatory materials for the management Basic framework (objectives and implementation results), schedule, volume, budget, consensus documents for departments implementing ETSS	B	A
3	ETSS promotion organization startup	-	A
4	ETSS implementation plan details	B	A
5	Promotion team implementation training	B	A
6	Inclusion of department technologies in ETSS framework	B	A
7	Creation of skill evaluation description for individual technologies	B	A
8	Creation of skill diagnosis sheets (observance of personal information protection from this point on)	A	A
9	Skill diagnosis implementation approval (department heads)	-	A
10	Performance of skill diagnosis briefings	A	A
11	Performance of skill diagnosis	A	A
12	Collection of skill diagnosis results	A	A
13	Analysis and evaluation of skill diagnosis results	B	A
14	Reporting of diagnosis results to diagnosis subject members and department heads	-	A
15	Creation of result materials for executives	B	A
16	Creation of ETSS implementation promotion manual	B	A

A: Can take a primary role in activities

B: Activities based on directions and oversight of higher-ranking personnel

Figure 17: ETSS implementation promoter task scope

1.5 ETSS Implementation Promoter Level

As has been explained, performing ETSS implementation work requires implementation promoters, who take a primary role in implementation activities. However, performing skill diagnosis for a large number of people requires a significant amount of time and effort. As such, some personnel must be trained to a level sufficient to assist the implementation promoters, based on the level of the work in question. As such, the following levels have been defined for ETSS implementation promoters:

- Level 1: Assists ETSS implementation promoter level 2 personnel, who manage ETSS implementation activities.
Performs work as directed and supervised by level 2 personnel.
- Level 2: Capable of assuming responsibility for actual ETSS implementation activities.
- Level 3: Capable of deploying ETSS implementation activities as a consultant outside the company.

- The ETSS implementation promoter system (tentative title) is divided into three levels, depending on the skills, knowledge, and experience needed to perform implementation promotion tasks.
- Scopes of implementation promotion tasks that can be performed vary by grade level.

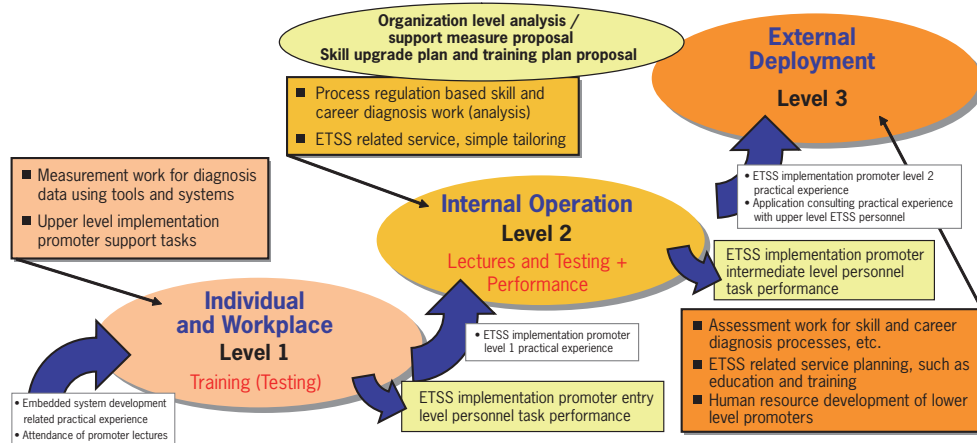


Figure 18: ETSS Implementation promoter levels




1.6 Implementation Promoter Accreditation System

As of November 2008, an accreditation system for the ETSS implementation promoter levels described above has been under consideration.

Its objective would be the promulgation of quality Embedded Technology Skill Standards (ETSS). Accreditation would be performed for each individual level explained above.

- Improvement of status and motivation of ETSS implementation promoters through certification accreditation
- Educating people who understand and promote ETSS as certified implementation promoters



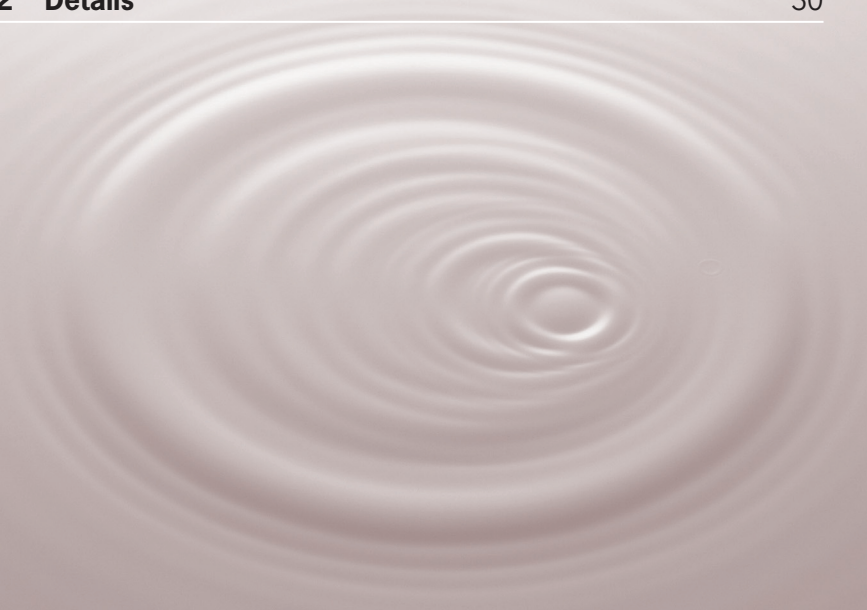
1.7 Implementation Process

The implementation process refers to the activities which are necessary for ETSS implementation. It is the result of organizing the know-how obtained from ETSS deliberation and demonstration testing by companies and organizations, and can be used as a typical example. Part 2 explains the contents of the actual operations involved in the implementation process.

Part **2**

Operations Involved in Implementing ETSS

2.1	ETSS Implementation Promoter Responsibilities and Task Scope	28
2.2	Details	30



2.1 ETSS Implementation Promoter Responsibilities and Task Scope

Before explaining the operations involved in implementing ETSS, this guide will establish the ETSS implementation scope, and define the levels and responsibilities of implementers.

“Figure 18: ETSS implementation promoter levels” shows the scope of ETSS implementation covered in this guide, as well as the levels of implementers.

- The ETSS implementation promoter system (tentative title) is divided into three levels, depending on the skills, knowledge, and experience needed to perform implementation promotion tasks.
- Scopes of implementation promotion tasks that can be performed vary by grade level.

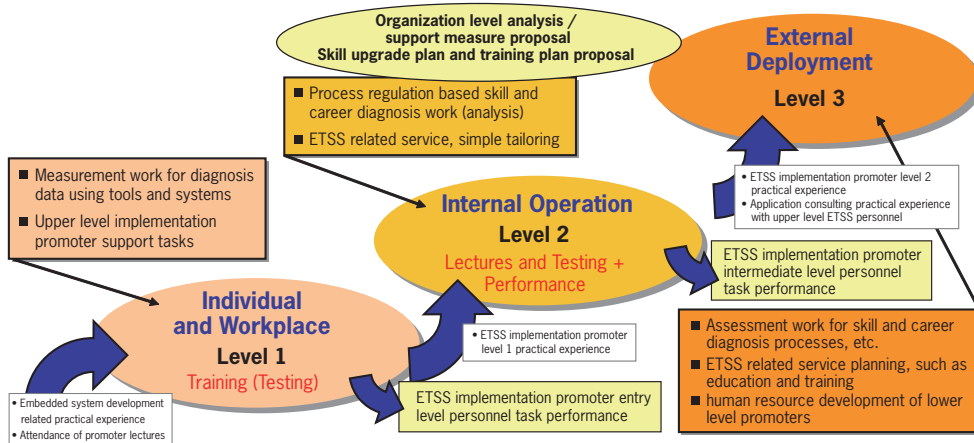


Figure 18: ETSS implementation promoter levels

Detailed explanations for each are provided later.

Top level organization decision making with regard to implementing ETSS is required before beginning the ETSS implementation process. In some cases, this may include sounding out the motivation for implementing ETSS. ETSS implementation promoters (level 2) then indicate the feasibility of ETSS implementation, and begin the groundwork for implementation, such as negotiations with organizations which will undergo skill diagnosis.

Number	ETSS Implementation Promoter Tasks	Level 1	Level 2
1	ETSS implementation consensus by departments implementing ETSS (consensus document)	-	A
2	Creation of explanatory materials for executives Basic framework (objectives and implementation results), schedule, volume, budget, consensus documents for departments implementing ETSS	B	A
3	ETSS promotion organization establishment	-	A
4	ETSS implementation plan details	B	A
5	Promotion team implementation training	B	A
6	Inclusion of department technologies in ETSS framework	B	A
7	Creation of skill evaluation description for individual technologies	B	A
8	Creation of skill diagnosis sheets (observance of personal information protection from this point on)	A	A
9	Skill diagnosis implementation approval (department heads)	-	A
10	Performance of skill diagnosis briefings	A	A
11	Performance of skill diagnosis	A	A
12	Collection of skill diagnosis results	A	A
13	Analysis and evaluation of skill diagnosis results	B	A
14	Reporting of diagnosis results to diagnosis subject members and department heads	-	A
15	Creation of result materials for executives	B	A
16	Creation of ETSS implementation promotion manual	B	A

A: Capable of taking primary role in activities

B: Activities based on directions and oversight of higher-ranking personnel

Figure 19: Implementation process and implementation promoters

2.2 Details



ETSS Implementation Consensus by Departments Implementing ETSS (Consensus Document)

Performing skill diagnosis places a certain amount of burden on the development organization that is the target of the skill diagnosis.

In addition to informing the organization of the objectives and effect of implementation, the ETSS implementation promoter must also inform them of what kind of work will be performed, and how long it will take, and then work together to create an implementation schedule in advance.

Specific steps include:

1. The participation of people conversant in all technologies needed by the target organization in defining skills
2. Explaining and educating subject members of skill diagnosis of all necessary items
3. Performance of skill diagnosis (skill diagnosis sheet distribution, individual entry, collection)
4. Review of skill diagnosis result report
5. Feedback of skill diagnosis results to organization and individuals

The ETSS implementation promoter must put together the above contents into a consensus document, receive the authorization of the person(s) responsible for the organization, and reflect it in explanatory materials for top-level personnel.

Figure 20 shows a sample consensus document.

Target Organization		Date
		Superior Person
		ETSS Implementation Promoter
ETSS Implementation Objectives		
Participants in Skill Definition		
Rough Schedule		
Special Notes		

Figure 20: Sample consensus document

ETSS implementation promoters must first clarify the objectives of ETSS implementation.

The intentions of executives must be organized along ETSS lines, and in some cases it may be necessary to provide examples of the benefits of ETSS implementation (see Part 1) in order to obtain consensus.

Organization of ETSS Implementation Effects

Skill Organization

► Organization of skills possessed

The skills which are currently possessed can be visualized by organizing them with the skills framework.

► Organization of skills which will be necessary in the future (or which are currently insufficient)

Determine which skills will be necessary in the future based on the company or organization's future business vision. These can be visualized by organizing them with the skills framework.

► Understanding skill levels

An understanding of the skill levels of individuals can be gained through skill diagnosis. By aggregating product development unit organization, business division, company-wide, or individual skill levels, strengths and weaknesses can be visualized.

► Utilization in project administration

ETSS implementation can be used in the establishment of targets for allocating necessary skill levels for individual development project processes, assisting in the assignment of existing members for whom skill level measurement has been performed. If the current members are insufficient, human resources can be procured based on needed skill levels.

► Education, training

ETSS implementation clarifies skill objectives for individuals, serving as motivation for individual study, attending training, undergoing certification testing, etc.

Organization training objectives can also be clarified, enabling the creation of detailed training plans.



2.2.2 Creation of Explanatory Materials for Executives

ETSS implementation promoters create specific implementation plans as directed by executives.

Based on the information agreed upon through coordination with the organization (the ETSS implementation consensus document), explanatory materials are created for executives, and an implementation decision is made.

Figure 21 shows an example of explanatory materials for executives.

Executive Briefing Document	
Date	
ETSS Implementation Objectives	
Effects of ETSS Implementation	
Target Organization	
Schedule	
Budget	
Special Notes	

Figure 21: Executive briefing document

ETSS 2.2.3 ETSS Promotion Organization Establishment

Personnel are needed who are both quantitatively and qualitatively capable of creating skill diagnosis sheets, performing skill diagnosis, collecting and tabulating skill diagnosis results, and producing reports.

Organization Member Candidates

1. Organization leader: Implementation promoter level 2 or higher. Dependant on executive approval.
2. Operation members: Implementation promoter level 1 or higher. The number of members must be coordinated based on the volume of work, time allotted, etc.
3. Members capable of defining skills for the target organization: Generally, members from the target organization capable of explaining the technologies and skills involved in their respective departments are needed.
4. Members as determined by organization's approach: Managers, education and human resources departments, budget-related departments, system departments, technology management. Level 3 or level 2 implementation promoters from other organizations.

ETSS Implementation Stakeholders

Clarify the stakeholders to explain promotion organization. If there are no stakeholders in the implementation promotion organization, contact and meeting methods and the like will need to be made clear (contact points, matters that require communication, regular and ad hoc meetings, frequency, etc.).

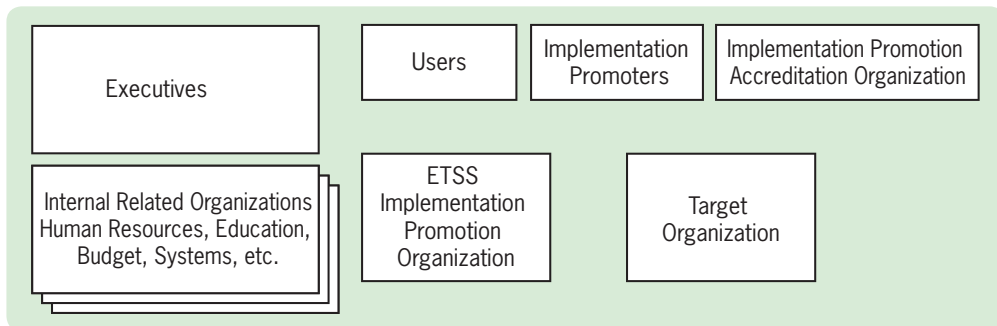


Figure 22: ETSS implementation stakeholders

ETSS
2.2.4 ETSS Implementation Plan Details

As with other projects, a detailed plan must be established for performing implementation. Optimally, management components, such as those described in the “Embedded System Development Management Reference [Plan Edition]” (ESMR) (November 2006, Shoelisha), should be taken into consideration.

Figure 23 shows a sample implementation schedule.

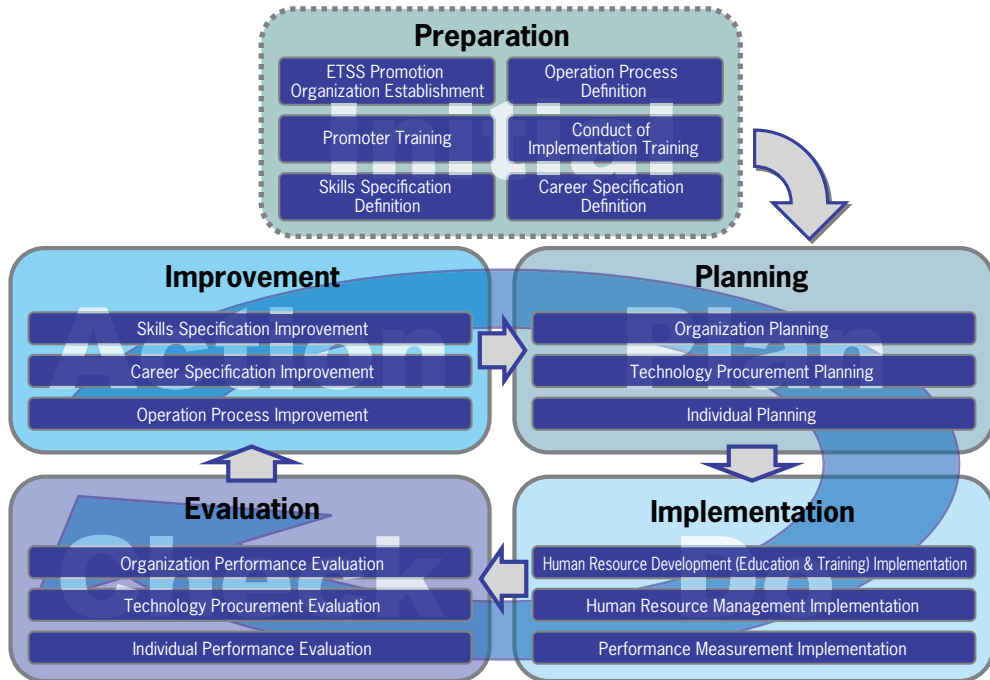


Figure 23: Sample implementation schedule

“Figure 24: Schedule overview” shows a sample schedule overview for use by a large number of related personnel.

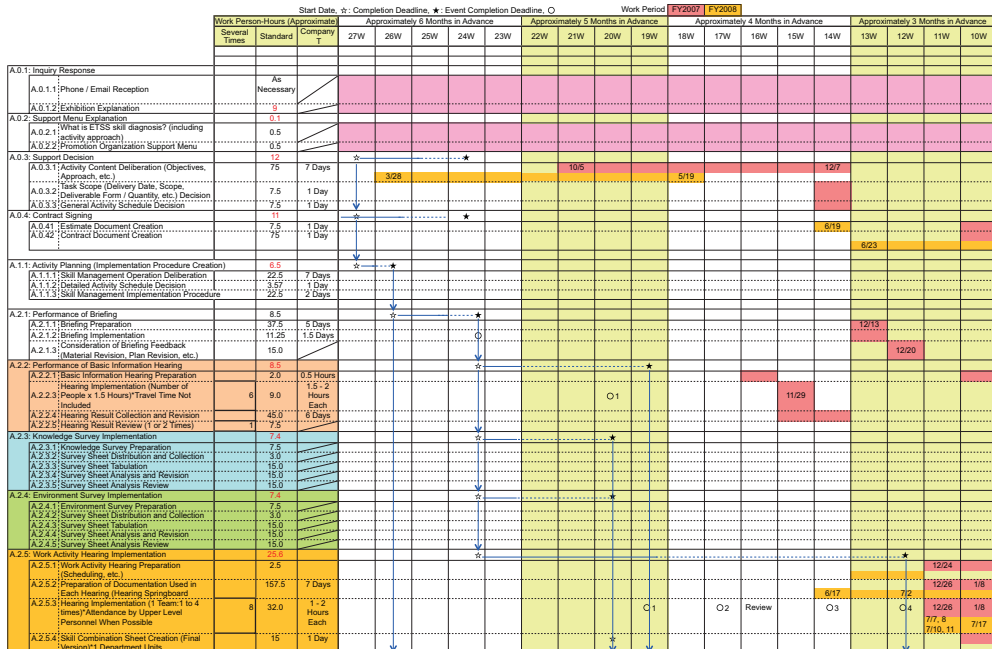


Figure 24: Schedule overview

ETSS 2.2.5 Promotion Team Implementation Training

Implementation promotion team members must share knowledge concerning ETSS and ETSS implementation. Members should first read through ETSS standard documentation. The “Embedded Technology Skill Standards ETSS Overview [2008 Edition]” (May 2008, Shoehisha) provides standard documentation as well as explanations, making it easy for beginners to understand ETSS.

Next, a forum for group education, including lessons on the actualities of implementation, should be established. The contents should consist of explanations of implementation work,

using this guide as a reference. The instructor should be an ETSS implementation promoter of level 2 or higher.

ETSS
2.2.6 Inclusion of Department Technologies in ETSS Framework

ETSS is a framework. Skill standards and definitions appropriate to the organization must be established based on an understanding of skill categories and skill granularity.

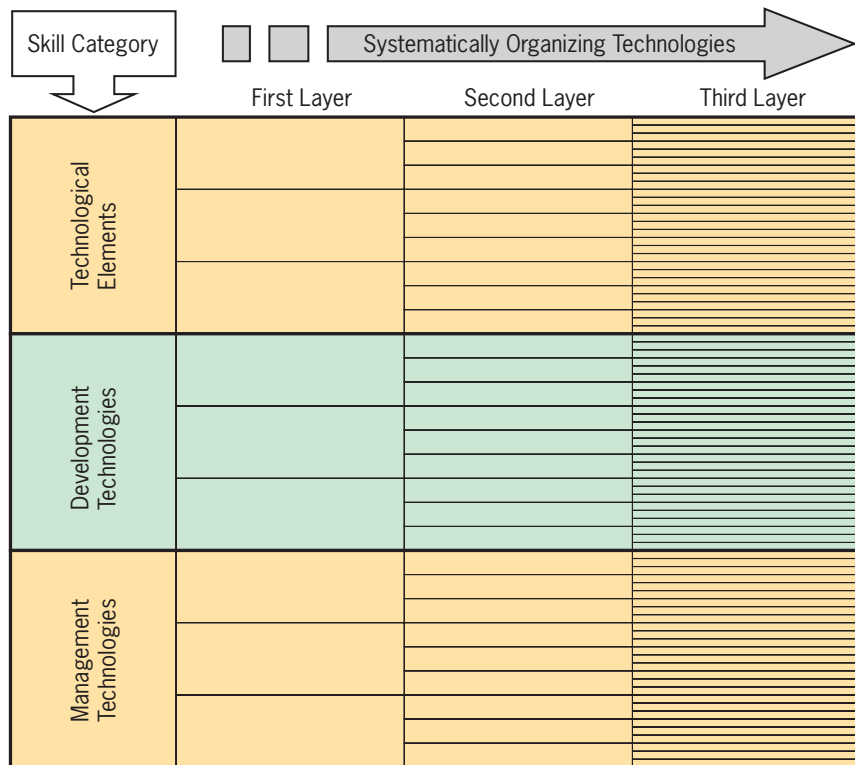


Figure 25: Skills framework

Technological Element Skill Category

The technological element skill category defines elements that achieve their functionality once embedded in a system. This category systematically organizes various technological elements including as algorithms, logic, components and standards. Realization of the functionality of these elements can be based on either hardware or software.

The first layer of technological element skill category is defined as follows:

- (1) Communications: Element related to communications
- (2) Information Processing: Element primarily related to hardware independent data processing
- (3) Multimedia: Element related to voice, still image, and moving image processing
- (4) User Interface: Element related to control of devices used by people
- (5) Storage: Element related to storage system control and processing
- (6) Measurement and Control: Element related to external device related to measurement and control
- (7) Platform: Element related to the infrastructure for application realization

Image of the correlation between the first layer items ((1) through (7)) in the technological element skill category and the second layer in the items is shown in “Figure 26: Technological element skill category overview and correlations.”

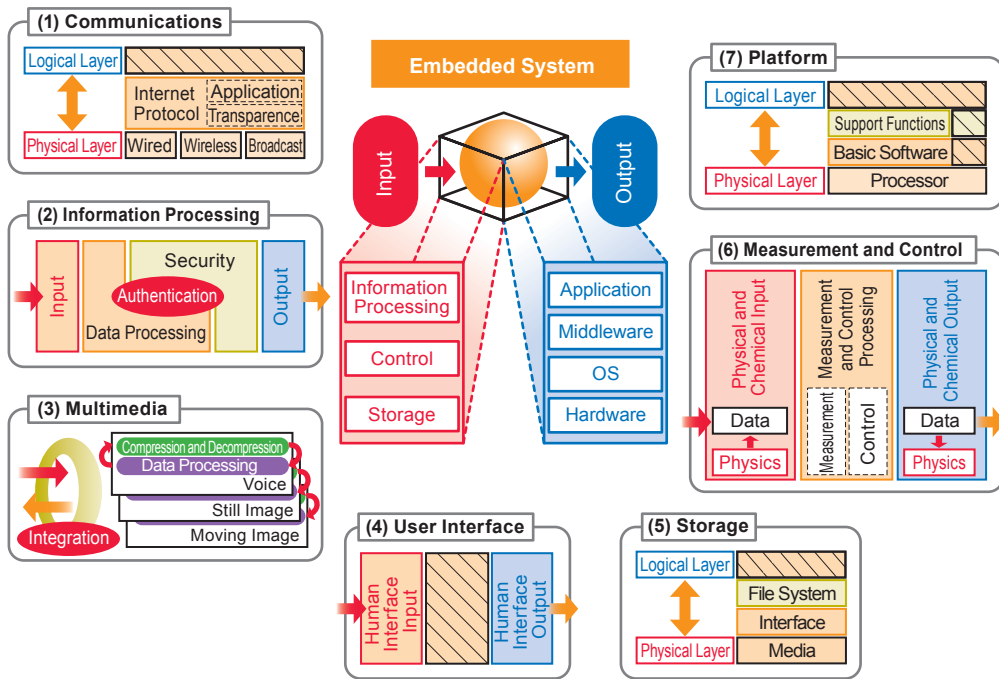


Figure 26: Technological element skill category overview and correlations

“Figure 27: Skill item deployment example (technological element skill categories)” shows a selection of technological element skill categories used in the skills specification, and an example of skill item deployment.

First Layer	Second Layer	Description
1 Communications	1 Wired	Wired communication technologies, such as WAN, LAN, etc.
	2 Wireless	Wireless communications technologies, such as telecommunications and general business wireless technology
	3 Broadcast	Broadcasting technologies, such as digital broadcasting and analog broadcasting
	4 Internet	Internet technologies, such as transparent data transfer and applications
2 Information Processing	1 Information Input	Information input, such as data input and voice input
	2 Security	Security technologies, such as encryption and copyright protection
	3 Data Processing	Data processing technologies, such as compression and databases
	4 Information Output	Information output technologies, such as markup language and document viewers
3 Multimedia	1 Voice	Voice processing technologies, such as data processing, voice compression and voice decompression
	2 Still Image	Still image processing technologies, such as data processing, compression and decompression

Roll-Out

First Layer	Second Layer	Third Layer	Skill Items	Skill Level	
				Can Produce	Can Utilize
1 Communications	4 Internet	1 Transparent Data Transfer	1 PPP		
			2 IP		
			3 ICMP		
			4 ARP		
			5 TCP		
			6 UDP		
		2 Application Processing	1 HTTP		
			2 SMTP		
			3 Telnet		
			4 FTP		
			5 SIP		
			6 DNS		
			7 POP		
			8 DHCP		
9 SNMP					

Skill Assessment Criteria (Examples)

- **Skills that can produce**
FTP can be performed using the required specifications, conditions, features, case examples, information, etc.
- **Skills that can utilize**
Functions using FTP can be achieved by using required specifications, conditions, features, case examples, information, etc.

Figure 27: Skill item deployment example (technological element skill categories)

Development Technology Skill Category

The development technology skill category organizes technologies and skills used in embedded system development. For example, the category consists of programming technologies, debugging technologies and testing technologies. This category organizes a series of development skills starting from the analysis of requirements associated with embedded system development to design, implementation and testing.

The first layer of the development technology skill category defines 10 items as follows:

- | | |
|----------------------------------|--------------------------------|
| • System requirements analysis | • System architecture design |
| • Software requirements analysis | • Software architecture design |
| • Detailed software design | • Software coding and testing |
| • Software integration | • Software qualification test |
| • System integration | • System qualification test |

The skill items of the first layer shown above use development processes specified in JIS X 0160 (Software Life Cycle Process). The second layer assigns relevant tasks (management technologies excluded) from the skills specification defined for technical engineers (embedded system) and software development engineers of the Information Technology Engineers Examination. Defining the development skills per individual task enables visualization of development technology skills associated with embedded software development.

An excerpt from the development technology skill category of the skills specification and an example of the roll-out of skill items are shown in “Figure 28: Development technology skills category skill item deployment example.”

First Layer		Second Layer		Description
1	System Requirements Analysis	1	Requirements Acquisition and Adjustment	Interviewing methods, marketing methods, etc.
		2	System Analysis and Requirements Definition	Modeling methods, analysis methods, requirements definition, etc.
		3	Review of System Analysis and Requirements Definition	Review methods, inspection methods, etc.
2	System Architecture Design	1	Hardware and Software Function and Performance	Performance estimation, FMEA, FTA, software estimation methods, intellectual property rights, etc.
		2	Assignment Decision	Review methods, inspection methods, etc.
3	Software Requirements Analysis	1	Software Requirements Analysis Definition	Modeling methods, analysis methods, requirements definition, etc.
		2	Software Requirements Evaluation and Review	Review methods, inspection methods, etc.

Roll-Out

First Layer		Second Layer		Skill Items	Skill Level	
1	System Requirements Analysis	1	Requirements Acquisition and Adjustment	1	Business Judgment	
				2	Interview Methods	
				3	Consulting Methods	
				4	Market Research	
				5	Positioning	
				6	Presentation	
				7	Requirements Definition Document	
				8	Concept Sheet	
		∴	∴			
		2	System Analysis and Requirements Definition	1	Modeling Methods	
				2	Analysis Methods	
				3	Requirements Definition	
				∴	∴	
				∴	∴	
∴	∴					

Skill Assessment Criteria (Examples)
 By using modeling methods, not just customer requirements but also system requirements can be analyzed.

Figure 28: Development technology skills category skill item deployment example

Management Technology Skill Category

An excerpt from the development technology skill category of the skills specification and an example of the roll-out of skill items are shown in “Figure 28: Development technology skills category skill item deployment example.” The management technology skill category organizes management technologies and skills used to proceed embedded system development smoothly. This category organizes the “project management” knowledge items already defined as job categories within the Skill Standards for IT Professionals and the support processes defined in JIS X0160.

This category also organizes skills associated with management tasks of embedded software development from development project planning to configuration management and change management. The following 2 items are defined in the first layer of the management technology skill category:

- Project management
- Development process management

The management technology skill category is targeted at management associated with embedded software development projects.

However, it is not applicable to the management of organizations (line management) that do not contain elements specific to embedded software.

An excerpt from the management technology skill category of the skills specification and an example of the roll-out of skill items are shown in “Figure 29: Skill item deployment example (management technology skill categories).”

First Layer	Second Layer	Description
1	1	Integration Management WBS, EVM, conference management methodologies, review methods, etc.
	2	Scope Management WBS, Change Management, etc.
	3	Time Management PERT, Gantt chart, estimation techniques, etc.
	4	Cost Management ROI, ROE, estimation techniques, EVM, etc.
	5	Quality Management Audit, failure analysis, statistical methods, trend analysis, etc.
	6	Organization Management Team building, OBS, etc.
	7	Communication Management Information distribution methods and others
	8	Risk Management Risk analysis, decision tree analysis, risk rating, etc.
	9	Procurement Management Planning, procurement destination selection, contracts, performance management, etc.
	1	Development Process Definitions System development process definitions, review planning, etc.

Roll-Out

First Layer	Second Layer	Third Layer	Skill Items	
1	3	1	1	WBS
			2	Organization Knowledge
			3	Deliverables Review
			4	Project Plan Document
		2	1	PDM Method
			2	ADM Method
			3	Activity List, Project Network Diagrams and Templates
			4	Analogous Estimating Methods
		3	1	
			2	
			3	
			4	

Skill Assessment Criteria (Examples)
Schedules can be created using the ADM (Arrow Diagramming Method).

Figure 29: Skill item deployment example (management technology skill categories)

Skill Granularity

Skills are arranged (detailed, embodied) in layers within each skill category.

As an aim, the skill categories contain 1 to 4 layers. The “technology name” is set to appear in the lowest layer as the specific skill. This technology name shall be considered as a skill

item. When categorizing skills, if a specific technology name to be considered as a skill item does not appear, the skill category is further divided into five or more layers, if necessary.

Technology name indicates the technological item name widely accepted as a representation of the skill. This includes, for example, the standardized methods, methods commercialized in the market, and methods publicized through documents.

The skills specification provides only the systematic framework of skills, and does not present and disclose specific technology names. This is because, as a standard, the skills specification may restrict the progress and expansion of technology by limiting the scope to specific technologies.

Adding Skill Items and Categories

Skill categories and skill items can be added as necessary. This is because the framework is such that if necessary, the user can add skill categories and skill items thus enabling the creation of the skills specification that fit actual situations. Industrial groups and companies of the application domain can add skill items specific to their domain making it possible to apply characteristic highly practical skills specification.

Keeping the added specific skill items private and undisclosed to the public makes it possible to secure competitiveness and conceal proprietary technologies.

On the contrary, by disclosing the skill items to the public, one can expect to secure human resources and promote improvement in skills by specifying the skills required for the corresponding application domain and companies.

* Based on considerations of skill level comparisons of people and organizations within industries, human resource hiring, procurement, and the like, skill category and skill granularity standardization are desirable.

“Figure 30: Technological element skill categories” shows examples of ETSS Skill Standards. Please refer to it when adding specific skill categories, or defining items for each layer.

Technological Element Skill Categories

First Layer		Second Layer		Description
1	Communications	1	Wired	Wired communications technologies, such as WAN, LAN, etc.
		2	Wireless	Wireless communications technologies, such as telecommunications and general business wireless technology
		3	Broadcast	Broadcasting technologies, such as digital broadcasting and analog broadcasting
		4	Internet	Internet communication technologies, such as transparent data transfer and applications
2	Information Processing	1	Information Input	Information input technologies, such as data input and voice input
		2	Security	Security technologies, such as encryption and copyright protection
		3	Data Processing	Data processing technologies, such as compression and databases
		4	Information Output	Information output technologies, such as markup language and document viewers
3	Multimedia	1	Voice	Voice processing technologies, such as data processing, voice compression and voice decompression
		2	Still Image	Still image processing technologies, such as data processing, compression and decompression
		3	Moving Image	Moving image processing technologies, such as data processing, compression and decompression
		4	Integration	Integrated processing technologies, including voice and moving images
4	User Interface	1	Human Interface Input	Human interface input device control technologies, such as buttons and coordinate input
		2	Human Interface Output	Human interface output device control technologies, such as visual and voice output
5	Storage	1	Media	Storage media technologies, such as removable storage and memory
		2	Interface	Storage interface technologies, such as removable storage and continuously connected storage interfaces
		3	File System	File system technologies, such as ISO file and OS's native file systems
6	Measurement and Control	1	Physical and Chemical Input	Physical and chemical input technologies, such as electrical, pressure, and light input technologies
		2	Measurement and Control Processing	Measurement and control technologies, such as coordinate & movement processing, and signal processing
		3	Physical and Chemical Output	Physical and chemical output technologies, such as actuator, light, and heat output technologies
7	Platform	1	Processor	Processor technologies, such as CPUs and GPUs
		2	Basic Software	Basic software technologies, such as kernels and booting
		3	Support Function	Support function technologies, such as data recording and acquisition

Figure 30: Technological element skill categories

Embedded Software Development Related Skill Categories

The following shows skill categories, up to second layer, defined for skills specification.

Development Technology Skill Categories

First Layer		Second Layer		Description
1	System Requirements Analysis	1	Requirements acquisition and adjustment	Interviewing methods, marketing methods, etc.
		2	System analysis and requirements definition	Modeling methods, analysis methods, requirements definition, etc.
		3	Review of system analysis and requirements definition	Review methods, inspection methods, etc.
2	System Architecture Design	1	Hardware and software function and performance assignment decision	System function related and non-function related design, design methods, performance estimation, system scale estimation, hardware and software role assignment, etc.
		2	Implementability verification and design review	Review methods, inspection methods, etc.
3	Software Requirements Analysis	1	Software requirements definition	Modeling methods, analysis methods, requirements definition, etc.
		2	Software requirements evaluation and review	Review methods, inspection methods, etc.
4	Software Architecture Design	1	Software structure determination	Performance estimation, reliability design, fault tolerant technologies, software estimation methods, intellectual property rights, reuse, etc.
		2	Software structure design review	Review methods, inspection methods, etc.
5	Detailed Software Design	1	Detailed software design	Design methods, design tools, real-time performance design, etc.
		2	Detailed software design review	Review methods, inspection methods, etc.
6	Software Coding and Testing	1	Program creation and identification of program testing items	Programming methods, programming tools and environments, test design methods, coverage measurement methods, simulations, etc.
		2	Code review and program test item design review	Review and inspection methods, static analysis tools, dynamic analysis tools, etc.
		3	Program test implementation	Drivers and stubs, test tools, regression tests, etc.
7	Software Integration	1	Software integration test specification design	Test design methods, coverage measurement methods, simulations, emulation, hardware environments, etc.
		2	Software integration test implementation	Test tools, ICE, monitors, logic analyzers, oscilloscopes, regression tests, etc.
8	Software Qualification Test	1	Software qualification test preparation and review	Review methods, inspection methods, acceptance tests, etc.
		2	Software qualification test implementation	Test tools, ICE, monitors, logic analyzers, oscilloscopes, regression tests, etc.
9	System Integration	1	Test item selection, test procedure determination and review	Review methods, inspection methods, etc.
		2	System integration test implementation	Test tools, ICE, monitors, logic analyzers, oscilloscopes, regression tests, etc.
10	System Qualification Test	1	System qualification test preparation and review	Review methods, inspection methods, acceptance tests, etc.
		2	System qualification test implementation	Test tools, regression tests, etc.

Figure 31: Development technology skill categories

Management Technology Skill Categories

First Layer	Second Layer	Description
1 Project Management	1 Integration Management	WBS, EVM, conference management methodologies, review and inspection methods, etc.
	2 Scope Management	WBS, change management, etc.
	3 Time Management	PERT, Gantt charts, estimate methods, etc.
	4 Cost Management	ROI, ROE, estimate methods, EVM, etc.
	5 Quality Management	Inspection, fault analysis statistical methods, trend analysis, etc.
	6 Organization Management	Team building, OBS, etc.
	7 Communication Management	Information distribution methods, etc.
	8 Risk Management	Risk analysis, decision tree analysis, risk levels, etc.
	9 Procurement Management	Planning, procurement source selection, contracts, performance management, etc.
2 Development Process Management	1 Development Process Definitions	System development process definitions , review settings, etc.
	2 Intellectual Property Management	Related regulations, management systems, etc.
	3 Development Environment Management	Development environment planning, design, construction, operation management, etc.
	4 Configuration Management and Change Management	Identification, control, recording, inspection, etc.

Figure 32: Management technology skill categories

Skills Specification Description Range

The technologies defined in the skills specification are expected to be used in common throughout embedded software. The skills specification does not include technologies specific to individual companies or application domains.

Specific technological skills such as this must be standardized by individual companies and application domain organizations and groups, which must also consider how specific skills are to be handled. This can be kept confidential, to avoid possible decreases in competitiveness due to technological skill drain. Conversely, technological skills can be disclosed to the public in order for companies to acquire human resources with the skills they need, and in order that they can be reflected in this skills specification as skills common to embedded software.

Creation of Skill Evaluation Description for Individual Technologies

Performing a skill diagnosis requires some sort of guide to use in determining how well one has achieved each defined skill. It is desirable to express clearly in sentence format as an

evaluation description on the skill diagnosis sheet.

“Figure 33: Technological element evaluation description sample” shows examples of technological element evaluation descriptions. “Figure 34: Development technologies evaluation description sample” shows examples of development technology evaluation descriptions.

* The skill definitions provided on the skill diagnosis sheet need only include the particular skills used or needed. Even if a technology is defined merely because it is used within the industry, if there is no-one who can evaluate the skill level, it is as the same that technology not exist.

Name:				Skill Item	Skill Item Evaluation Level		Evaluation Description
Department:					Can Produce	Can Utilize	
Skill Granularity			(1 - 4)		(1 - 4)		
First Layer	Second Layer	Third Layer					
Communications	Wired Communications	PAN (Personal Area Network)	CAN			Capable of creating CAN compliant communications programs.	
			TCP/IP			Capable of creating communications programs using TCP/IP functions.	
			USB			Capable of creating serial communications programs using USB functions.	
			IEEE 1394			Capable of creating serial communications programs using IEEE1394 functions.	
			IEEE 488			Capable of creating parallel communications programs using IEEE488 functions.	
			VXI			Capable of creating parallel communications programs using VXI functions.	
			RS-232C			Capable of creating communications programs using RS-232C functions.	
			RS485			Capable of creating communications programs using RS485 functions.	
	Wireless Communications	Short Range Communications	Bluetooth			Capable of creating communications programs using Bluetooth profile functions.	
			IrDA			Capable of creating communications programs using IrDA stack functions.	
			RFID			Capable of creating communications programs using RFID functions.	
			IEEE 802			Capable of creating IEEE802.11a/b/g compliant wireless communications programs.	
		Long Range Communications	CDMA			Capable of creating CDMA compliant call control programs.	

Figure 33: Technological element evaluation description sample

Name:					Skill Self-Evaluation Level	Evaluation Description
Department:						
Skill Granularity						
First Layer		Second Layer	Third Layer	(1 - 4)		
Basic Design	Requirements Analysis	Software Requirements Analysis	Software Requirements Identification	-		Capable of identifying software requirements based on user requirements.
			Software Requirements Analysis and Specification Creation	Requirements Modeling Methods		Capable of analyzing and express function requirements (Use Cases, etc.).
				Specification Creation		Capable of creating function specifications. Capable of creating operating specifications.
			Specification Review	-		Capable of performing specification review.
	Architecture Design	Software Architecture Design	Top Level Software Structure Design	Structuring Methods		Capable of performing design using structuring methods (DFD, CFD, etc.).
				Object-Oriented		Capable of creating XX analysis models.
				Design Patterns		Capable of using design patterns in architecture development.
				Basic Design		Capable of performing basic design and creating software basic specifications.
				Scale Estimation		Capable of estimating development scale (lines of code and person-hours) based on the basic design.
			Software Structure Analysis and Evaluation	Architecture Analysis and Evaluation		Capable of performing architecture evaluation.
				HW Prototype Function and Capability Evaluation		Capable of creating test programs of HW prototype function and capability
			Basic Design Review	-		Capable of performing basic design reviews

Figure 34: Development technologies evaluation description sample



2.2.7 Advice on Quantifying Skill Level Assessment

ETSS skill diagnosis is done using skill levels as responses. ETSS defines the skill levels as below:

◆ Level 4: Supreme	Capable of developing new technologies
◆ Level 3: Advanced	Capable of analyzing and improving tasks
◆ Level 2: Intermediate	Capable of performing tasks on one's own
◆ Level 1: Entry	Capable of performing tasks with support

However, there is always the possibility of lack of uniformity due to subjective level assessments and differing interpretations of the evaluation descriptions. In order to avoid skill level assessments from differing from person to person, there needs to be a quantitative assessment system, and a method whereby level determination is automatic.

Below is some advice on skill level assessment quantification, based on actual past ETSS implementation experience.

In the skill requirements column, define necessary skills with a wide span of skill levels. Skill level assessment will automatically follow from those results. Let us use “Basic Software” of “Platform” from the technological elements as an example. If “RTOS” is used as the third layer, the skill requirements column must include clearly defined skills needed by levels 1 and 2.

	Skill Requirements	Level 1	Level 2
RTOS	Capable of using RTOS service for communication and synchronization between tasks.	X	X
	Capable of using shared resources.	X	X
	Capable of performing system configuration.		X

Figure 35: Skill level quantification

As you can see, for “RTOS”, the subject skill level cannot be level 2 unless they can perform system configuration.



2.2.8 Skill Diagnosis Sheet Creation

Once creation of the skill standard (skill definition) and evaluation description is completed, next create the skill diagnosis sheet used in actual skill diagnosis.

Skill diagnosis means filling skill levels on the skill diagnosis sheet. The skill diagnosis sheet can be paper-based or electronic, but as (in either form) skill diagnosis sheets will contain information that can identify individuals, such as their names, as well as their individual skills, they are just “personal information.” Consideration must be given to handling them in compliance with the organization’s personal information management regulations.

- * Generally, during the skill definition process, once general skill categories and granularity approaches are finalized, the form of the skill diagnosis sheet will become apparent. Further discussion and final skill diagnosis sheet creation may be easy by using the resulting temporary skill diagnosis sheet.

Skill Diagnosis Sheet Example

*** Please read through this sheet thoroughly before performing skill diagnosis.**

[Important] This skill diagnosis sheet is for use by software developers.

Persons primarily involved in tool development should use the skill diagnosis sheet for tool developers.

• Technological Element Skill Diagnosis

Please refer to the example below, and enter a skill level between 1 and 4 in the “input” column.
(If you do not possess the relevant skill, leave it blank)

Third Layer	Item	Skill Levels					Skill Level Assessment Basis and Reason
		Input	Lv1	Lv2	Lv3	Lv4	
1	PAN	1	2				I have experience in voice output control functions using IC2 interfaces. I was responsible for the entire process, from design to integration testing.
		2	RS-232C	3			I have over 5 years of combined development work experience using RS-232C.
		3	RS422/485/530	2			I have experience with HDLC protocol design using RS422.
		4	USB	1			I have attended outside training. I do not have practical experience.
		5	IEEE1394	1			I am personally interested and am gathering information (purchasing books on the subject, etc.)
		6	IEEE1284				
		7	GPiB(IEEE488)				
		8	SCSI				

Enter the basis for your skill level assessment

Write what level of technological skill (knowledge) you have acquired, and how you are using it (technology-related work experience, examinations, qualifications, attendance of training and lessons, etc.)

Skill level graph display (automatic)

Light color if only the skill level has been entered.
Dark color if the “Skill Level Assessment Basis and Reason” column has been filled out.

Enter your skill level in each technology on a scale of 1 to 4

Level 4 (Supreme): Capable of developing new technologies
Level 3 (Advanced): Capable of analyzing and improving tasks
Level 2 (Intermediate): Capable of performing tasks on one’s own
Level 1 (Entry): Capable of performing tasks with support

• Development Technology, Management Technology, and Personal Skill Diagnosis

Please refer to the example below, read the “Evaluation Description” for each item, and enter a skill level between 1 and 4 in the “Input” column.
(If you do not possess the relevant skill, leave it blank)

Second Layer	Item	Skill Levels					Skill Level Assessment Basis / Reason	Evaluation Description
		Input	Lv1	Lv2	Lv3	Lv4		
1	Integration Management	1					Creation of analogical inference estimation based cost plan charts and human resource procurement plan charts as directed by leader.	I can use project planning methods (cost and schedule plans, etc.) to create project plans.
		2					Experience in project plan chart based project management operations. In the event of risks or failures, decisions made after consultation with superior.	I use my leadership, communication, and negotiating skills in implementing project plans while maintaining a positive relationship with stakeholders.
		2					Practical experience with project change management in accordance with regulations.	I can determine the scope of impact (schedule, cost, risk, quality, personnel allocation) from performance measurement results, and perform change management accordingly.
2	Scope Management	1				Attended EVM method based final cost analysis training.	I can use cost/benefit analysis to write a quantitative scope for project objectives (costs, schedule, quality, etc.).	
		2				Experience in creating project completion report materials based on internal project completion standards. Performed confirmation review based on completion report materials.	I can create development plans, and define project objectives, necessary tasks, and required deliverables. I can compare work results to defined project scopes to verify effective completion, and receive completion standard approval.	

Skill level graph display (automatic)

Light color if only the skill level has been entered. Dark color if the “Skill Level Assessment Basis / Reason” column has been filled out.

Enter the basis for your skill level assessment.

Technology-related work experience, tests, certifications, attendance of training and lessons, etc.

Technological Elements (Can Utilize)

First Layer	Second Layer	Skill Level				Skill Level Assessment Basis and Reason	Evaluation Description
		Input	Lv1	Lv2	Lv3/Lv4		
1	1	Wired					Capable of utilizing CAN-compliant communications programs
							Capable of utilizing communications programs using TCP/IP functions
	2	Wireless					Capable of utilizing serial communications programs using USB functions
							Capable of utilizing communications programs using Bluetooth profile functions
3	Broadcast					Capable of utilizing CDMA-compliant call control programs	
						Capable of utilizing communications programs using IrDA stack functions	
4	Internet					Capable of utilizing channel selection programs for analog terrestrial broadcasting	
						Capable of utilizing programs that obtain location information using the GPS	

Technological Elements (Can Produce)

First Layer	Second Layer	Skill Level				Skill Level Assessment Basis and Reason	Evaluation Description	
		Input	Lv1	Lv2	Lv3/Lv4			
2	1	Communications	1	Wired				Capable of creating CAN-compliant communications programs
			2	Wireless				Capable of creating communications programs using TCP/IP functions
			3	Broadcast				Capable of creating serial communications programs using USB functions
			4	Internet				Capable of creating communications programs using Bluetooth profile functions
3	2	Information Processing	1	Information Input				Capable of creating CDMA-compliant call control programs
			2	Security				Capable of creating communications programs using IrDA stack functions
			3	Data Processing				Capable of creating channel selection programs for analog terrestrial broadcasting
			4	Information Output				Capable of creating programs that obtain location information using the GPS
4	3	Multimedia	1	Voice				Capable of creating communications programs using VoIP functions
			2	Still Image				Capable of creating communications programs using PPP/PPPoE functions
			3	Moving Image				Capable of developing applications for the functions using a mouse
			4	Integration				Capable of developing applications for the functions using a keyboard
5	4	User Interface	1	Human Interface Input				Capable of creating programs using the DTCP protocol
			2	Human Interface Output				Capable of creating DRM-compliant programs
			3	File System				Capable of creating AES-compliant programs
			4	Support Function				Capable of developing applications for the functions using RDB
6	5	Measurement and Control	1	Physical and Chemical Input				Capable of developing applications for the functions using ODBC
			2	Measurement and Control Processing				Capable of developing applications for the functions using CDDB
			3	Physical and Chemical Output				Capable of developing applications for the functions using the window system (2D and 3D) for embedded systems
			4	Support Function				Capable of developing applications for the functions using AWT
7	6	Platform	1	Processor				Capable of creating programs using AAC functions
			2	Basic Software				Capable of creating programs using MP3 functions
			3	Support Function				Capable of creating programs using ADPCM functions
			4	Support Function				Capable of creating programs using JPEG functions

Development Technologies

First Layer	Second Layer	Skill Level				Skill Level Assessment Basis and Reason	Evaluation Description	
		Input	Lv1	Lv2	Lv3			Lv4
1	System Requirements Analysis	1 Requirements Acquisition and Adjustment						Capable of determining customer requirements and creating system requirement specifications by using interview methods
								Capable of determining the information necessary for design, and creating system requirements specifications by understanding product specifications, operation specifications, control specifications, and the like
							Capable of clarifying pertinent customer requirements, and creating embedded product planning documentation by using marketing methods	
		2 System Analysis and Requirements Definition						Capable of performing requirement condition analysis, and creating system requirements definition documentation in order to realize the requirements by using concept modeling
								Capable of resolving task timeline problems, and performing system analysis by using timing charts
								Capable of explaining overall system states and event handling using state transition tables
		3 Review of System Analysis and Requirements Definition						Capable of understanding system requirements
								Capable of understanding inspection implementation procedures, and performing as a system requirements specification review moderator
								Capable of understanding hardware functions, and determining software based control items by using function diagrams
2	System Architecture Design	1 Hardware and Software Function and Capability Assignment Decision						Capable of designing software based control items and control order by using hardware manuals, etc.
								Capable of creating block diagrams including hardware and software functionality assignments
	2 Implementability Verification and Design Review						Capable of verifying, comprehending and understanding device design to be realized by using requirement specifications	
							Capable of verifying implementability by using benchmarks	
3	Software Requirements Analysis	1 Software Requirements Analysis Definition						Capable of performing verification of the implementability of required efficiency by understanding hardware and software efficiency
								Capable of deciding which real-time OS to use, and organizing customer software requirements into specifications
	2 Software Requirements Evaluation and Review						Capable of selecting the appropriate methods to be used in the development model during software development	
							Capable of explaining overall system states and event handling by using state transition tables	
4	Software Architecture Design	1 Software Structure Determination						Capable of evaluating requirements by using design reviews
								Capable of evaluating requirements by using walkthroughs
	2 Software Structure Design Review						Capable of deciding on the software block structure needed to realize requirement functions	
							Capable of creating detailed class diagrams and sequence diagrams based on class diagrams and collaboration diagrams	
5	Detailed Software Design	1 Detailed Software Design						Capable of deciding software structure, taking computer architecture into account
								Capable of performing walkthroughs, and confirming software design validity
	2 Detailed Software Design Review						Capable of performing program quality confirmation by checking integration levels and removing unnecessary relationships between modules	
							Capable of performing detailed software design by using software design methods best suited to the development project	
6	Software Coding and Testing	1 Program Creation and Identification of Program Testing Items						Capable of deciding on priorities for individual tasks in order to guarantee real-time operability required by the system by understanding task state transitions and priorities
								Capable of performing detailed software design that matches the characteristics of the real-time OS being used
	2 Code Review and Program Test Item Design Review						Capable of confirming detailed software design validity by performing design review	
							Capable of confirming detailed software design validity by performing walkthroughs	
7	Software Integration	1 Software Integration Test Specification Design						Capable of creating coding tools optimally suited to the development project
								Capable of selecting compiling options best suited to the development system
	2 Software Integration Test Implementation						Capable of using development languages such as C, C++, etc. to code function groups such as modules	
							Capable of designing individual test items by understanding white box and black box testing	
8	Software Qualification Test	1 Software Integration Test Implementation						Capable of creating single test environments
								Capable of checking software quality by using static and dynamic analysis tools
	2 Software Qualification Test Preparation and Review						Capable of checking software quality by using static and dynamic analysis tools	
							Capable of quantifying path coverage by using coverage tools, etc.	
9	System Integration	1 Software Qualification Test Implementation						Capable of deciding software integration test approaches
								Capable of creating stubs and drivers necessary for software integration testing
	2 System Integration Test Implementation						Capable of creating test procedures, factoring in processing speed, and performing data volume design	
							Capable of determining the completion of software integration testing by using reliability growth curves	
10	System Qualification Test	1 System Qualification Test Preparation and Review						Capable of evaluating whether correction results are correct by performing regression testing
								Capable of identifying program bugs, and confirming whether bugs exist in the correction results by using ICE
	2 System Qualification Test Implementation						Capable of creating test input condition specifications based on input / output specifications	
							Capable of planning effective test implementation orders	
10	System Qualification Test	1 System Qualification Test Implementation						Capable of confirming that no items have been overlooked during testing by walkthroughs
								Capable of creating test environments for the equipment, etc., being used
	2 System Qualification Test Implementation						Capable of testing functions based on input / output specifications by using actual units	
							Capable of organizing test results, and evaluating the results of software qualification confirmation	
10	System Qualification Test	1 System Qualification Test Implementation						Capable of creating test items in accordance with quality properties defined in system design documentation
								Capable of evaluating test contents with a clear categorization of functions realized via hardware and software
	2 System Qualification Test Implementation						Capable of preparing test environments	
							Capable of performing tests in accordance with quality properties defined in system design documentation	
10	System Qualification Test	1 System Qualification Test Implementation						Capable of testing functions based on input / output specifications by using actual units
								Capable of testing functions based on input / output specifications by using actual units
	2 System Qualification Test Implementation						Capable of creating test items which satisfy quality properties based on system requirements specifications	
							Capable of establishing review plans, and selecting optimal review timing and members	
10	System Qualification Test	1 System Qualification Test Implementation						Capable of performing tests in accordance with quality properties required for the system
								Capable of performing operation and failure handling tests by following operation procedures and failure procedures based on reliability quality properties
	2 System Qualification Test Implementation						Capable of performing operation and failure handling tests by following operation procedures and failure procedures based on reliability quality properties	
							Capable of creating evaluation reports based on test implementation results	

Management Technologies

First Layer	Second Layer	Skill Level				Skill Level Assessment Basis and	Evaluation Description
		Input	Lv1	Lv2	Lv3		
1	Project Management	1					Capable of creating project plans by using project planning methods (cost and schedule plans, etc.) Capable of performing project plans while maintaining a positive relationship with stakeholders by using leadership, communication, and negotiating skills in implementing
		2					Capable of performing change management by determining the effect range (schedule, cost, risk, quality, personnel allocation) from performance measurement results accordingly Capable of writing a quantitative scope for project objectives (costs, schedule, quality, etc.) by using cost/benefit analysis
	3	Scope Management					Capable of defining project objectives, necessary tasks, and required deliverables by creating development plans Capable of verifying effective completion by comparing work results to defined project scopes, and receiving completion standard approval
		Time Management					Capable of creating project and network diagrams which establish work order by using activity list based conditional branch diagram methods Capable of estimate the amount of time required by using analogical inference estimation based on actual values from similar previous activities
	4	Cost Management					Capable of performing schedule changes within schedule management by creating schedule change management rules, and using them Capable of performing resource cost estimates using initial project stage analogical inference estimation based on WBS and necessary resources
		Quality Management					Capable of performing cost management by measuring performance in accordance with established performance reporting rules Capable of performing cost change management procedures such as adjusting cost estimates or updating budgets by establishing additional plans needed for changes or problem corrections
	6	Organization Management					Capable of creating quality plans with clear quality standards and operation standards for the project based on cost/benefit analysis Understands OMS based quality properties, and is capable of performing quality evaluation
		Communication Management					Capable of performing project execution result analysis and monitor conformance with required quality standards. If the standards are not being met, the subject can perform quality improvements Capable of creating project organization diagrams by using organization structure standards
	7	Risk Management					Capable of performing personnel procurement using personnel negotiation Capable of creating team education plans, based on a solid understanding of individual skills, and performing team education conformant with those plans
Procurement Management						Capable of performing stakeholder analysis and creating requirement oriented communication management plans Capable of performing performance review, and creating and distributing performance reports	
2	Process Management	1					Capable of creating project completion procedures which serve as public project records by using project reports Capable of establishing risk management plans
		2					Capable of performing risk identification (identifying risks and their effects) by using schematic methods, such as characteristic factor diagrams Capable of performing risk monitoring and management by regular project risk review and revision
		3					Capable of selecting procurement sources in accordance with internal standards Capable of selecting order suppliers by performing order negotiations, including receiving inspection condition confirmation
		4					Capable of selecting proper development methods based on internal development method selection standards Capable of establishing optimal development models based on internal development model standards
3	Development Environment Management	1					Capable of establishing review processes based on internal design review establishment standards Capable of performing appropriate patent requests based on patent right application procedures
		2					Understands copyright law and can apply intellectual property right related regulations Capable of confirming that there are no breaches of patent rights or copyright
4	Configuration Management and Change Management	1					Capable of proposing development tool environment preparation plans and establishing development environment preparation plans Capable of performing development tasks analysis and selecting optimal development environments
		2					Capable of performing development environment evaluation and development environment management Capable of performing development processes change management in accordance with processes change management rules
							Understands configuration management operation regulations, and capable of performing configuration management in accordance with operation regulations Capable of performing configuration management using configuration management tools

Part 2

Operations Involved in Implementing ETSS

Human Skills*

First Layer	Second Layer	Skill Level				Skill Level Assessment Basis and Reason	Evaluation Description
		Input	Lv1	Lv2	Lv3		
1	Social Skills	1					To speak, listen, write, etc.
		2					Questions, investigation, statements, etc.
		3					Capability development, time management, motivation, etc.
		4					Observation, ideas, problem-solving, analysis, logical reasoning, etc.
2	Business Skills	1					Analysis, strategy, assessment, etc.
		2					Financial analysis, accounting, etc.
		3					Analysis, market investigation, strategies, etc.
		4					Personnel strategies, personnel management, capability development, etc.

* Human skills are not defined by the ETSS skills specification. Define them individually as needed.

ETSS

2.2.9 Skill Diagnosis Implementation Approval

Once the ETSS promotion organization has been inaugurated, the ETSS implementation schedule has been established, and skill definitions and skill diagnosis sheets have been created, implementation (skill diagnosis) approval is needed from executives. The executives will gain the consent of the individual stakeholders involved in ETSS implementation, and notify the target organization and members.

The executives must also take appropriate budgetary measures.

ETSS

2.2.10 Skill Diagnosis Briefing

What to Explain

Before skill diagnosis is performed, an explanation must be provided to the subject members of the skill diagnosis. This is because the degree to which subject members understand the skill diagnosis, and their motivation, greatly affect the precision of the diagnosis results.

At the skill diagnosis briefing, pay extra attention to the explanation of the following items.

Skill Diagnosis Motivation

- The objectives of the skill diagnosis (organization's development capability enhancement and external technical appeal, etc.)
 - * Link to "2.2.1 ETSS Implementation Consensus by Departments Implementing ETSS (Consensus Document)" - "ETSS implementation consensus document" - "ETSS Implementation Objectives."
- How the skill diagnosis results will be used (human resources education specifications,

effective expert human resource utilization, etc.)

- What skill diagnosis will improve (development efficiency improvement: overtime work reduction, performance improvements through technical appeal: salary raises, promotions, etc.)

Skill Diagnosis Methodology

- Skill level evaluation approach
- Skill categories (technological elements, development technologies, management technologies, other skills)
- How to fill out skill diagnosis sheets
- How to use skill diagnosis tools (when using tools)

Skill Diagnosis Operation Related Explanations

- Skill diagnosis performance schedule
- Skill diagnosis sheet distribution and collection method
- Skill diagnosis inquiry contact point

In addition to the above, if there are any effective items for improving the understanding or motivating the subject members of the skill diagnosis, add them as desired. If there are any items which do not require explanation due to individual organization circumstances, omit them after due consideration by the promotion organization.

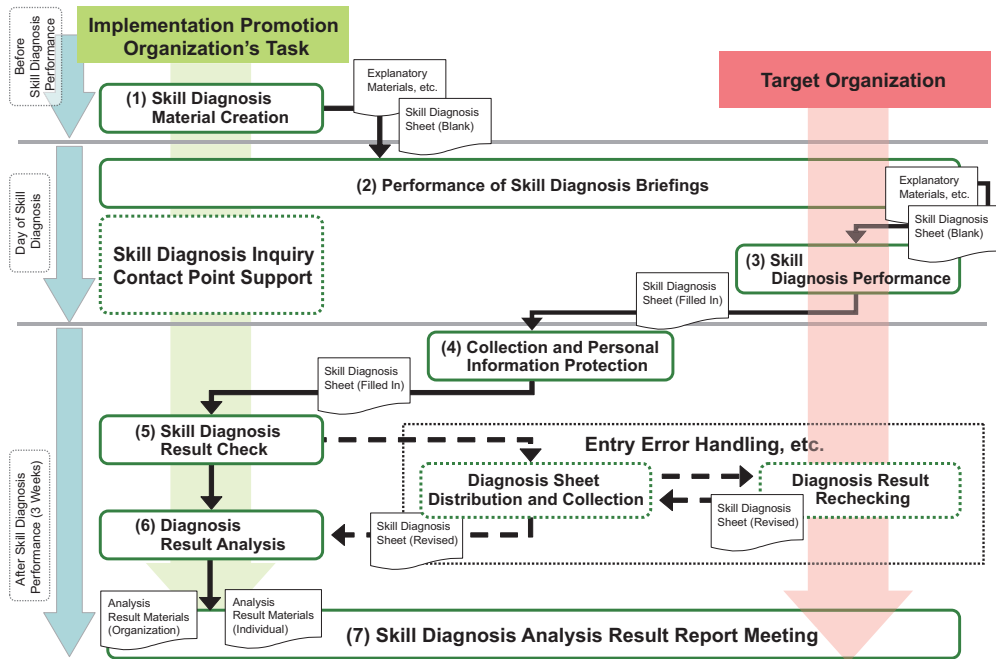


Figure 36: Example of skill diagnosis implementation flow for use in briefing

Selecting Personnel Who Provide Explanation

Someone who can provide appropriate explanations of the items listed in the previous section must be selected for the skill diagnosis briefing.

For example, for the “skill diagnosis motivation” described in the preceding section, a direct explanation from an executive or leader of the organization can be very effective in conveying the importance of the skill diagnosis. For “skill diagnosis methodology” and “skill diagnosis operation related explanations,” someone who is well versed in all skill diagnosis implementation activities, such as the leader of the promotion organization, is an appropriate choice.

Skill Diagnosis Briefing Material Creation and Distribution

Creating and distributing “skill diagnosis briefing materials” can be effective in increasing comprehension during the briefing, and can also serve as reference materials during actual skill diagnosis performance. “Skill diagnosis briefing materials” can be made to reflect the briefing contents described earlier.

Below is an example of how skill diagnosis briefing materials can be structured.

Skill Diagnosis Briefing Material Example Structure

► Objectives of skill diagnosis

Ultimate objectives and implementation policy

► Expected effects

Improvements that will result from performing the skill diagnosis (explanation from perspectives of organization, managers and individuals, etc.)

► Activity overview

Skill diagnosis activity organizational framework and contents (what activities will be performed), implementation schedule

► How to fill out skill diagnosis sheets

Notes regarding filling out of skill diagnosis sheets, and how to use tools

*** Please read through this sheet thoroughly before performing skill diagnosis.**

Please refer to the example below, and enter a skill level between 1 and 4 in the “input” column.
(If you do not possess the relevant skill, leave it blank)

Third Layer	Item	Skill Levels					Skill Level Assessment Basis and Reason	
		Input	Lv1	Lv2	Lv3	Lv4		
1	PAN	1	2				I have experience in voice output control functions using IC2 interfaces. I was responsible for the entire process, from design to integration testing.	
		2	3				I have over 5 years of combined development work experience using RS232C.	
		3	2				I have experience with HDLC protocol design using RS422.	
		4	1				I have attended outside training. I do not have practical experience.	
		5	1				I am personally interested, and am gathering information (purchasing books on the subject, etc.)	
		6						
		7						
		8						

Enter the basis for your skill level assessment

Write what level of technological skill (knowledge) you have acquired, and how you are using it (technology-related work experience, examinations, qualifications, attendance of training and lessons, etc.)

Skill level graph display (automatic)

Light color if only the skill level has been entered. Dark color if the “Skill Level Assessment Basis and Reason” column has been filled out.

Enter your skill level in each technology on a scale of 1 to 4

Level 4 (Supreme): Capable of developing new technologies
 Level 3 (Advanced): Capable of analyzing and improving tasks
 Level 2 (Intermediate): Capable of performing tasks on one’s own
 Level 1 (Entry): Capable of performing tasks with support

Figure 37: How to fill out skill diagnosis sheets

► **Skill level evaluation approach**

ETSS level evaluation essentials (assessment of potential, absolute value assessment, “half-fledged,” “full-fledged,” “high performance,” etc.)

A table, like the one shown below, comparing evaluation levels, can be used to increase comprehension.

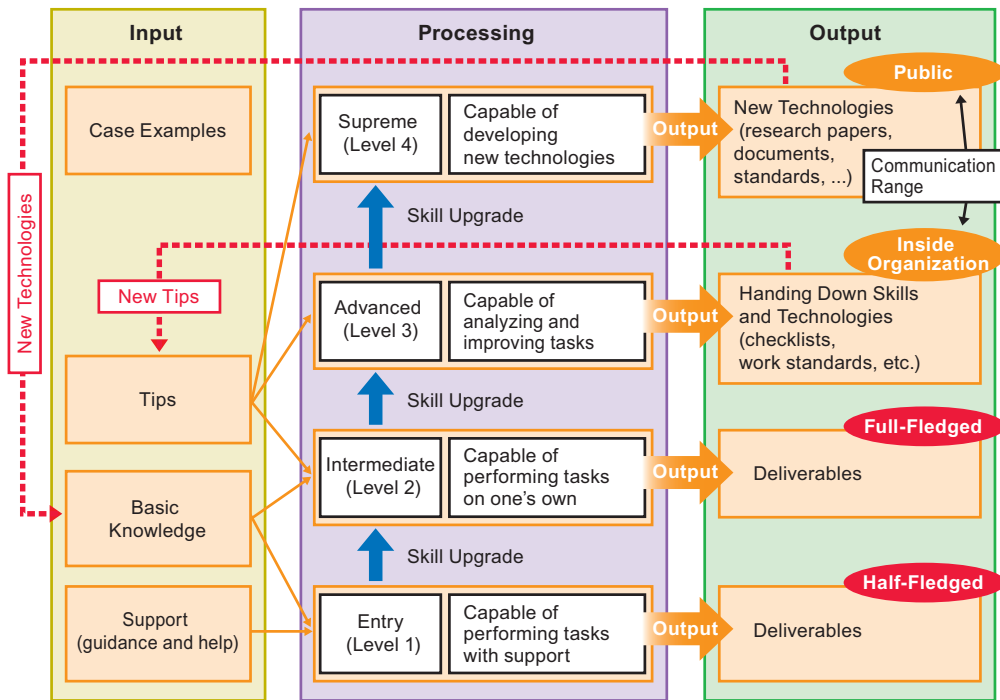


Figure 38: Skill level briefing material example

► Reference materials

Glossary, ETSS overview, links

Q&A

It is recommended to set aside time at the end of the briefing for questions and answers regarding ETSS contents and activities. By providing and sharing immediate responses to questions with an audience of evaluation subject members, understanding of the methods used in skill diagnosis, and its objectives, can be improved, resulting in greater diagnosis precision and smooth operation.

Questions can be written down and organized to be used as feedback in order to improve future explanations and briefing materials.

ETSS 2.2.11 Performance of Skill Diagnosis

The skill diagnosis implementation period (skill diagnosis sheet distribution and collection) is performed after considering the working circumstances of the subject members, and should be of sufficient length. Announce and distribute the skill diagnosis sheets at a pre-announced period.

(Skill Diagnosis is not an examination, so there is no need for subject members to gather together and answer. Allow the skill diagnosis sheets to be filled in appropriately taking into account the feasibility for the evaluation subject members and impact on their work.)

Promotion organization members must be ready to respond to a variety of inquiries during the implementation period.

Keep in mind, during skill diagnosis sheet collection, that the material contained therein is personal information, and must be handled accordingly. Members charged with collecting skill diagnosis sheets must have the rights necessary to handle personal information, and the concordant responsibilities.

ETSS 2.2.12 Skill Diagnosis Tabulation

In order to improve skill diagnosis precision, subjective level, and objectivity, completed diagnosis sheets received from individuals need to be confirmed. Department leaders do this with the assistance of implementation promoters.

- Has anything been skipped?
- From the checker's perspective, are skill levels too high or too low?

Skill level assessments have an extremely large effect on the reliability of diagnosis results.

The subjective sense of levels must be shared by evaluation subject members, department leaders, and implementation promotion organization members. Refer to “Figure 39: Skill level evaluation.”

■ Skill Level Evaluation Index

- In order to perform skill level evaluation objectively, refer to the indices provided in the table below to assign levels.
- There is no need to prepare and supply all assessment proof.

However, please use confirmable materials (work history, lecture attendance history, accreditation documentation, approval of superiors and coworkers, etc.) as proof.

Skill Level	ETSS Level Assessment		Assessment Basis Reference Guideline	Assessment Basis		
		Example of Expected Output		Specialist Evaluation	Work Experience	Experience
Level 4 (Supreme)	Capable of developing new technologies	<ul style="list-style-type: none"> New technologies (essays, books, standards, patents, etc.) 	Has confirmable experience Proposed technologies have been used in actual development Has written technical essays and/or submitted patents Has received objective evaluation by a specialist	X	-	X
Level 3 (Advanced)	Capable of analyzing and improving tasks	<ul style="list-style-type: none"> Work deliverables Passing on of skills Explanation of technologies 	Has confirmable work experience Practical experience records Capable of performing technical support and training for lower level engineers Capable of creating procedures (manuals, guides) regarding unwritten technologies	-	X	X
Level 2 (Intermediate)	Capable of performing tasks on one's own	<ul style="list-style-type: none"> Work deliverables 	Has confirmable work experience Practical experience records Capable of performing tasks of related technologies on their own	-	X	X
Level 1 (Entry)	Capable of performing tasks with support	<ul style="list-style-type: none"> Work deliverables 	Has confirmable experience Education and training experience Related technology test results Practical experience records Has technically related work experience	-	-	X
Level 0	(No experience)	-	Not experienced or has no confirmable experience	-	-	-

Figure 39: Skill level evaluation

Example of Skill Diagnosis Performance

First Layer	Second Layer	Skill Level					Skill Level Assessment Basis and Reason	Evaluation Description	
		Input	Lv1	Lv2	Lv3	Lv4			
1	Requirements Acquisition and Adjustment	1	2					Capable of determining customer requirements and creating system requirement specifications by using interview methods	
			3					Product planning Capable of determining the information necessary for design, and creating system requirements specifications by understanding product specifications, operation specifications, control specifications, and the like	
			2					Product planning Capable of clarifying pertinent customer requirements, and creating embedded product planning documentation by using marketing methods	
	2	System Analysis and Requirements Definition	2						Capable of performing requirement condition analysis, and creating system requirements definition documentation in order to realize the requirements by using concept modeling
				3					STB, etc. system design, including hardware and software Capable of resolving task timeline problems, and performing system analysis by using timing charts
				3					STB, etc. system design, including hardware and software Capable of explaining overall system states and event handling using state transition tables
				3					Capable of understanding system requirements
	3	Review of System Analysis and Requirements Definition	3						Capable of understanding inspection implementation procedures, and performing as a system requirements specification review moderator
	2	System Architecture Design	1	3					STB, etc. software system design Capable of understanding hardware functions, and determining software based control items by using function diagrams
3								STB, etc. software system design and detail design Capable of designing software based control items and control order by using hardware manuals, etc.	
3								STB, etc. system design, including hardware and software Capable of creating block diagrams including hardware and software functionality assignments	
2		Implementability Verification and Design Review	2	3					STB, etc. system verification, including hardware and software Capable of verifying, comprehending and understanding device design to be realized by using requirement specifications
				3					STB, etc. system verification, including hardware and software Capable of verifying implementability by using benchmarks
				3					STB, etc. system verification, including hardware and software Capable of performing verification of the implementability of required efficiency by understanding hardware and software efficiency
				3					STB, etc. system verification, including hardware and software Capable of deciding which real-time OS to use, and organizing customer software requirements into specifications
3	Software Requirements Analysis	1	3					STB, etc. system verification, including hardware and software Capable of selecting the appropriate methods to be used in the development model during software development	
			3					STB, etc. system verification, including hardware and software Capable of explaining overall system states and event handling by using state transition tables	
			3					STB, etc. system verification, including hardware and software Capable of evaluating requirements by using design review	
	2	Software Requirements Evaluation and Review	2	3					STB, etc. system verification, including hardware and software Capable of evaluating requirements by using walkthroughs
2									
4	Software Architecture Design	1	3					STB, etc. software system design Capable of deciding on the software block structure needed to realize requirement functions	
			3					STB, etc. software system design Capable of creating detailed class diagrams and sequence diagrams based on class diagrams and collaboration diagrams	
			3					STB, etc. software system design Capable of deciding software structure, taking computer architecture into account	
	2	Software Structure Design Review	2	2					Capable of performing walkthroughs, and confirming software design validity
				3					STB, etc. software development Capable of performing program quality confirmation by checking integration levels and removing unnecessary relationships between modules
5	Detailed Software Design	1	3					STB, etc. software system design and detail design Capable of performing detailed software design by using software design methods best suited to the development project	
			3					STB, etc. software system design and detail design Capable of deciding on priorities for individual tasks in order to guarantee real-time operability required by the system by understanding task state transitions and priorities	
			3					STB, etc. software system design and detail design Capable of performing detailed software design that matches the characteristics of the real-time OS being used	
	2	Detailed Software Design Review	2	3					STB, etc. software system design and detail design Capable of confirming detailed software design validity by performing design review
				2					Capable of confirming detailed software design validity by performing walkthroughs

First Layer	Second Layer	Skill Level					Skill Level Assessment Basis and Reason	Evaluation Description
		Input	Lv1	Lv2	Lv3	Lv4		
6	Software Coding and Testing	1 Program Creation and Identification of Program Testing Items	2					Capable of creating coding tools optimally suited to the development project
			3				STB, etc. software design implementation	Capable of selecting compiling options best suited to the development system
			3				STB, etc. software design implementation	Capable of using development languages such as C, C++, etc. to code function groups such as modules
	2 Code Review and Program Test Item Design Review	3				STB, etc. software design implementation	Capable of designing individual test items by understanding white box and black box testing	
		3 Program Test Implementation	3				STB, etc. software design implementation	Capable of creating single test environments
			2					Capable of checking software quality by using static and dynamic analysis tools
7	Software Integration	1 Software Integration Test Specification Design	3				STB, etc. software design implementation	Capable of deciding software integration test approaches
			3				STB, etc. software design implementation	Capable of creating stubs and drivers necessary for software integration testing
			3				STB, etc. software design implementation	Capable of creating test procedures, factoring in processing speed, and performing data volume design
	2 Software Qualification Test Preparation and Review	2					Capable of determining the completion of software integration testing by using reliability growth curves	
		3				STB, etc. software design implementation	Capable of evaluating whether correction results are correct by performing regression testing	
		3				STB, etc. software design implementation	Capable of identifying program bugs, and confirming whether bugs exist in the correction results by using ICE	
8	Software Qualification Test	1 Software qualification test preparation and review	2					Capable of creating test input condition specifications based on input / output specifications
			2					Capable of planning effective test implementation orders
			2					Capable of confirming that no items have been overlooked during testing by walkthroughs
	2 Software Qualification Test Implementation	2					Capable of creating test environments for the equipment, etc., being used	
		2					Capable of testing functions based on input / output specifications by using actual units	
		2					Capable of organizing test results, and evaluating the results of software qualification confirmation	
9	System Integration	1 Test Item Selection, Test Procedure Determination and Review	2					Capable of creating test items in accordance with quality properties defined in system design documentation
			2					Capable of evaluating test contents with a clear categorization of functions realized via hardware and software
			2					Capable of preparing test environments
	2 System Integration Test Implementation	2					Capable of performing tests in accordance with quality properties defined in system design documentation	
2						Capable of testing functions based on input / output specifications by using actual units		
10	System Qualification Test	1 System Qualification Test Preparation and Review	2					Capable of creating test items which satisfy quality properties based on system requirements specifications
			2					Capable of establishing review plans, and selecting optimal review timing and members
	2 System Qualification Test Implementation	2					Capable of performing tests in accordance with quality properties required for the system	
		2					Capable of performing operation and failure handling tests by following operation procedures and failure procedures based on reliability quality properties	
		2					Capable of creating evaluation reports based on test implementation results	

Development Technologies

First Layer	Second Layer	Skill Level					Skill Level Assessment Basis and Reason	Evaluation Description	
		Input	Lv1	Lv2	Lv3	Lv4			
1	1	Integration Management	2					Leader of internal product development project composed of up to 10 members	Capable of creating project plans by using project planning methods (cost and schedule plans, etc.).
									Capable of performing project plans while maintaining a positive relationship with stakeholders by using leadership, communication, and negotiating skills in implementing.
	2	Scope Management	2					Leader of internal product development project composed of up to 10 members	Capable of performing change management by determining the effect range (schedule, cost, risk, quality, personnel allocation) from performance measurement results accordingly.
									Capable of writing a quantitative scope for project objectives (costs, schedule, quality, etc.) by using cost/benefit analysis.
	3	Time Management	2					Leader of internal product development project composed of up to 10 members	Capable of defining project objectives, necessary tasks, and required deliverables by creating development plans.
									Capable of verifying effective completion by comparing work results to defined project scopes, and receiving completion standard approval.
	4	Cost Management	2					Leader of internal product development project composed of up to 10 members	Capable of creating project and network diagrams which establish work order by using activity list based conditional branch diagram methods
									Capable of estimate the amount of time required by using analogical inference estimation based on actual values from similar previous activities
	5	Quality Management	2					Leader of internal product development project composed of up to 10 members	Capable of performing schedule changes within schedule management by creating schedule change management rules, and using them
									Capable of performing resource cost estimates using initial project stage analogical inference estimation based on WBS and necessary resources
	6	Organization Management							Capable of performing cost management by measuring performance in accordance with established performance reporting rules
									Capable of performing cost change management procedures such as adjusting cost estimates or updating budgets by formulating additional plans needed for changes or problem corrections
	7	Communication Management							Capable of creating quality plans with clear quality standards and operation standards for the project based on cost/benefit analysis
									Understands QMS based quality properties, and is capable of performing quality evaluation
	8	Risk Management							Capable of performing project execution result analysis and monitor conformance with required quality standards. If the standards are not being met, the subject can perform quality improvements.
									Capable of creating project organization diagrams by using organization structure standards
	9	Procurement Management							Capable of performing personnel procurement using personnel negotiation
									Capable of creating team education plans, based on a solid understanding of individual skills, and performing team education conformant with those plans
								Capable of performing stakeholder analysis and creating requirement oriented communication management plans	
								Capable of performing performance review, and creating and distributing performance reports	
								Capable of creating project completion procedures which serve as public project records by using project reports	
								Capable of formulating risk management plans	
								Capable of performing risk identification (identifying risks and their effects) by using schematic methods, such as characteristic factor diagrams	
								Capable of performing risk monitoring and management by regular project risk review and revision	
							Capable of selecting procurement sources in accordance with internal standards		
							Capable of selecting order suppliers by performing order negotiations, including receiving inspection condition confirmation		
							Capable of entering into contracts with suppliers based on systematic procurement inspection review by resolving unresolved contractual issues		

First Layer	Second Layer	Skill Level					Skill Level Assessment Basis and Reason	Evaluation Description
		Input	Lv1	Lv2	Lv3	Lv4		
2	Process Management	1 Development Process Definitions						Capable of selecting proper development methods based on internal development method selection standards
								Capable of establishing optimal development models based on internal development model standards
							Capable of establishing review processes based on internal design review establishment standards	
							Capable of performing appropriate patent requests based on patent right application procedures	
	2 Intellectual Property Management							Understands copyright law and can apply intellectual property right related regulations
								Capable of confirming that there are no breaches of patent rights or copyright
	3 Development Environment Management							Capable of proposing development tool environment preparation plans and formulating development environment preparation plans
								Capable of performing development tasks analysis and selecting optimal development environments
								Capable of performing development environment evaluation and development environment management
								Capable of performing development processes change management in accordance with processes change management rules
	4 Configuration Management and Change Management							Understands configuration management operation regulations, and capable of performing configuration management in accordance with operation regulations
								Capable of performing configuration management using configuration management tools

Management Technologies

First Layer	Second Layer	Skill Level					Skill Level Assessment Basis and Reason	Evaluation Description
		Input	Lv1	Lv2	Lv3	Lv4		
1	Social Skills	1 Communication	2					To speak, listen, write, etc.
		2 Negotiation	1					Questions, investigation, statements, etc.
		3 Leadership	1					Capability development, time management, motivation, etc.
		4 Problem-Solving	3					Observation, ideas, problem-solving, analysis, logical reasoning, etc.
2	Business Skills	1 Management						Analysis, strategy, assessment, etc.
		2 Accounting						Financial analysis, accounting, etc.
		3 Marketing						Analysis, market investigation, strategies, etc.
		4 HCM (Human Capital Management)						Personnel strategies, personnel management, capability development, etc.

Human Skills

ETSS 2.2.13 Analysis and Evaluation of Skill Diagnosis Results

ETSS does not merely consist of assigning levels for job category to skills, but instead looks from the perspective of distributions of individual technological items.

It is important to be able to see skill distributions in analysis and evaluation results.

Visualizing collected data based on the objectives of self-diagnosis results is effective.

Examples of graphs created according to objectives are presented below.

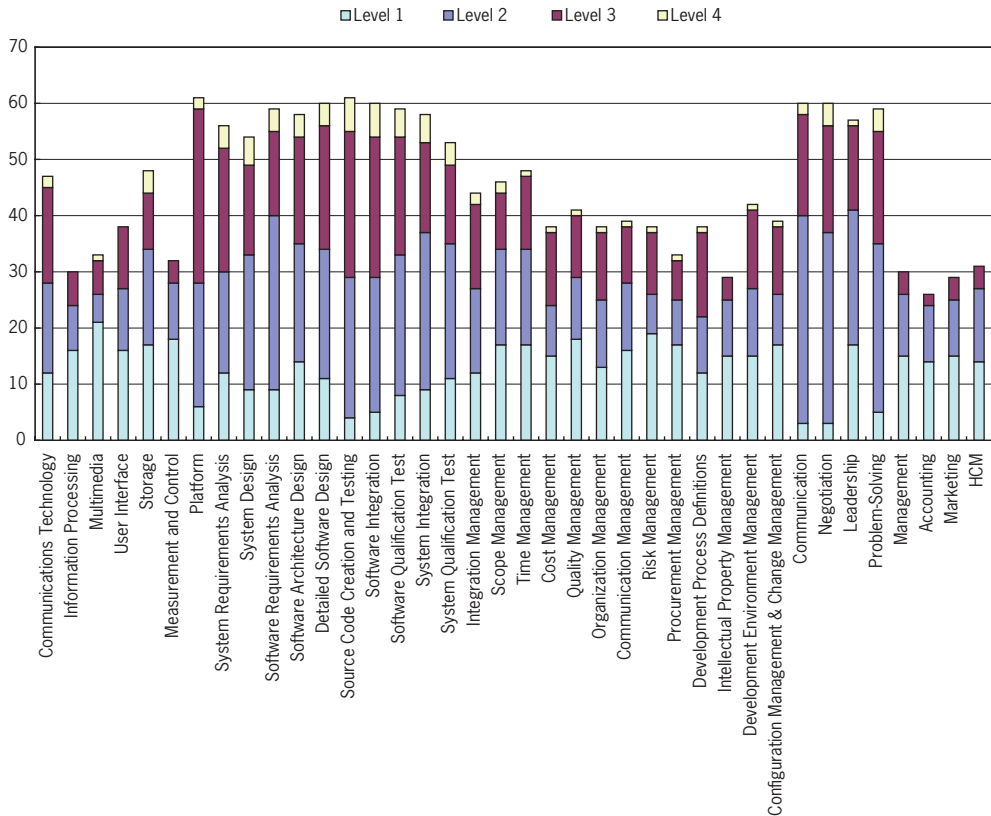


Figure 40: Project skill profile (overall)

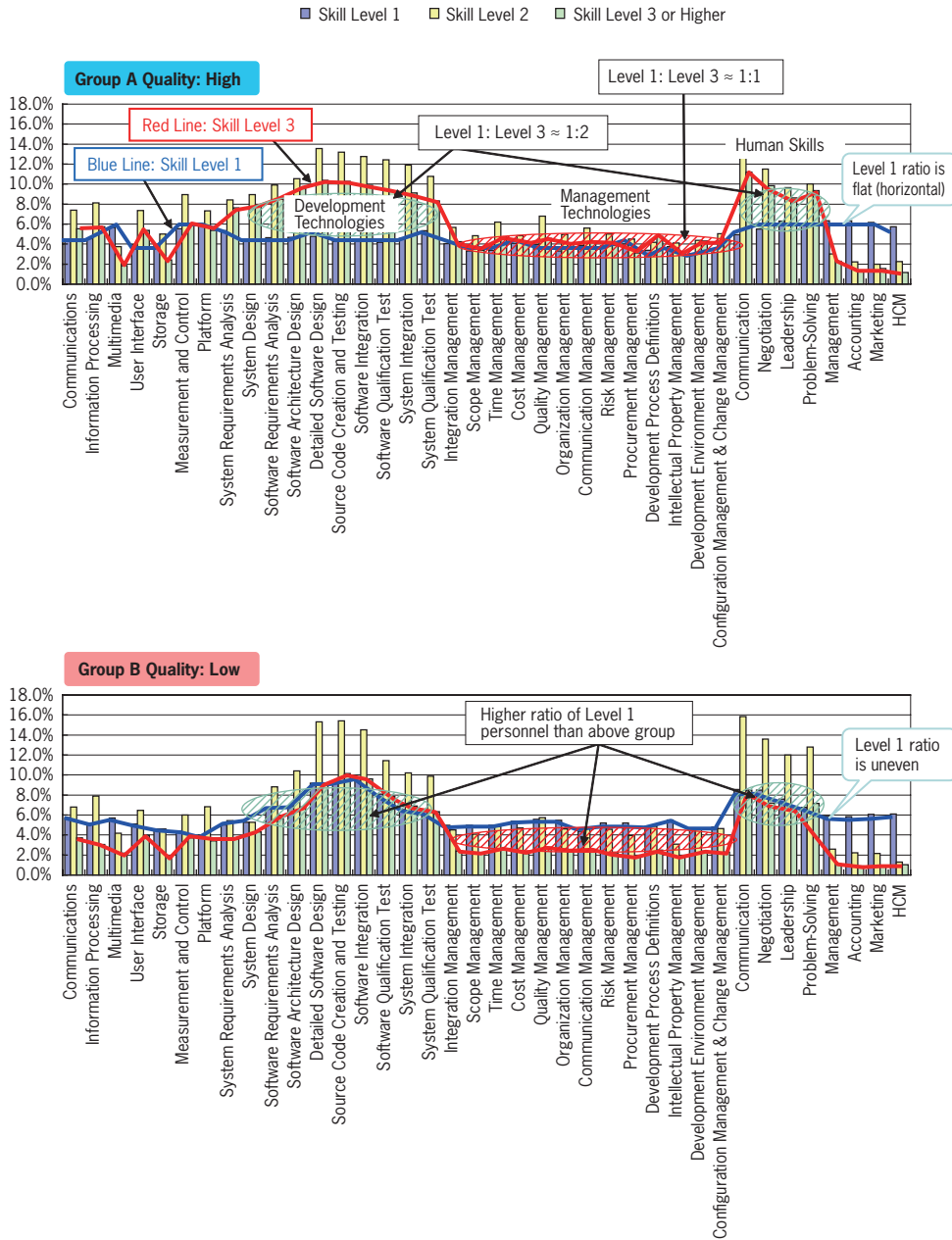


Figure 41: Quality (number of defects / new lines)

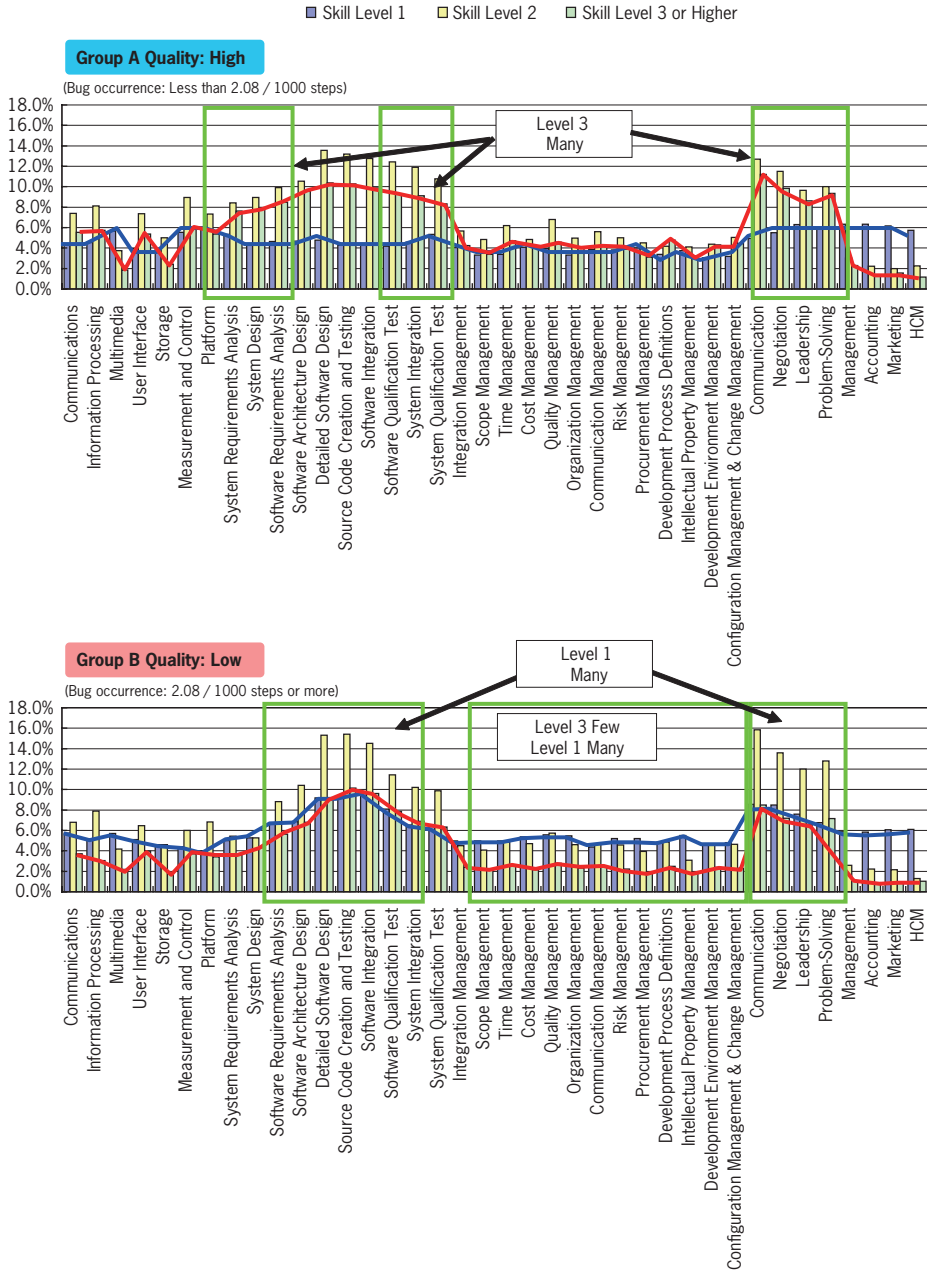


Figure 42: Quality (number of defects / new lines)

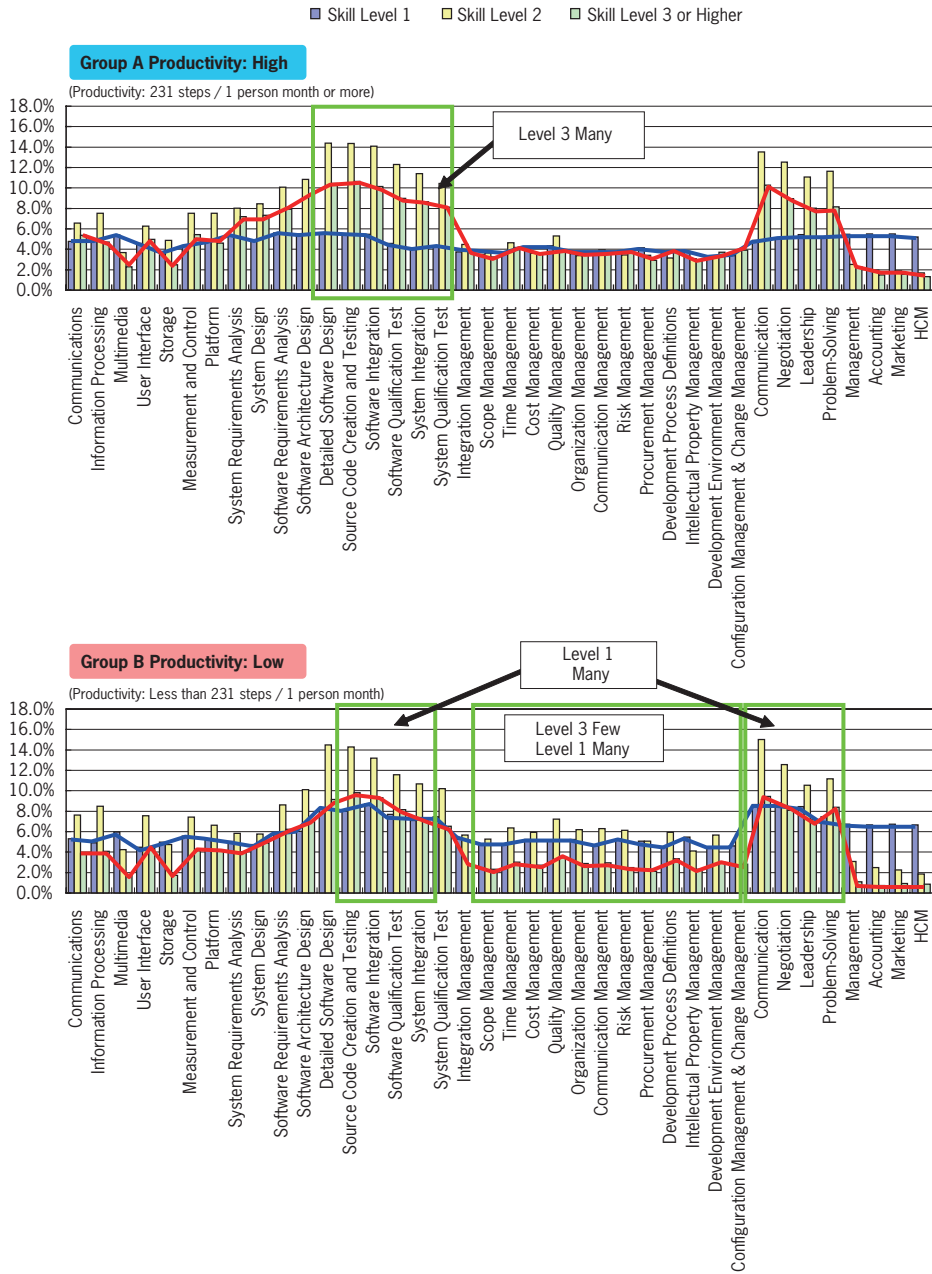


Figure 43: Productivity (number of new lines / total person-hours)

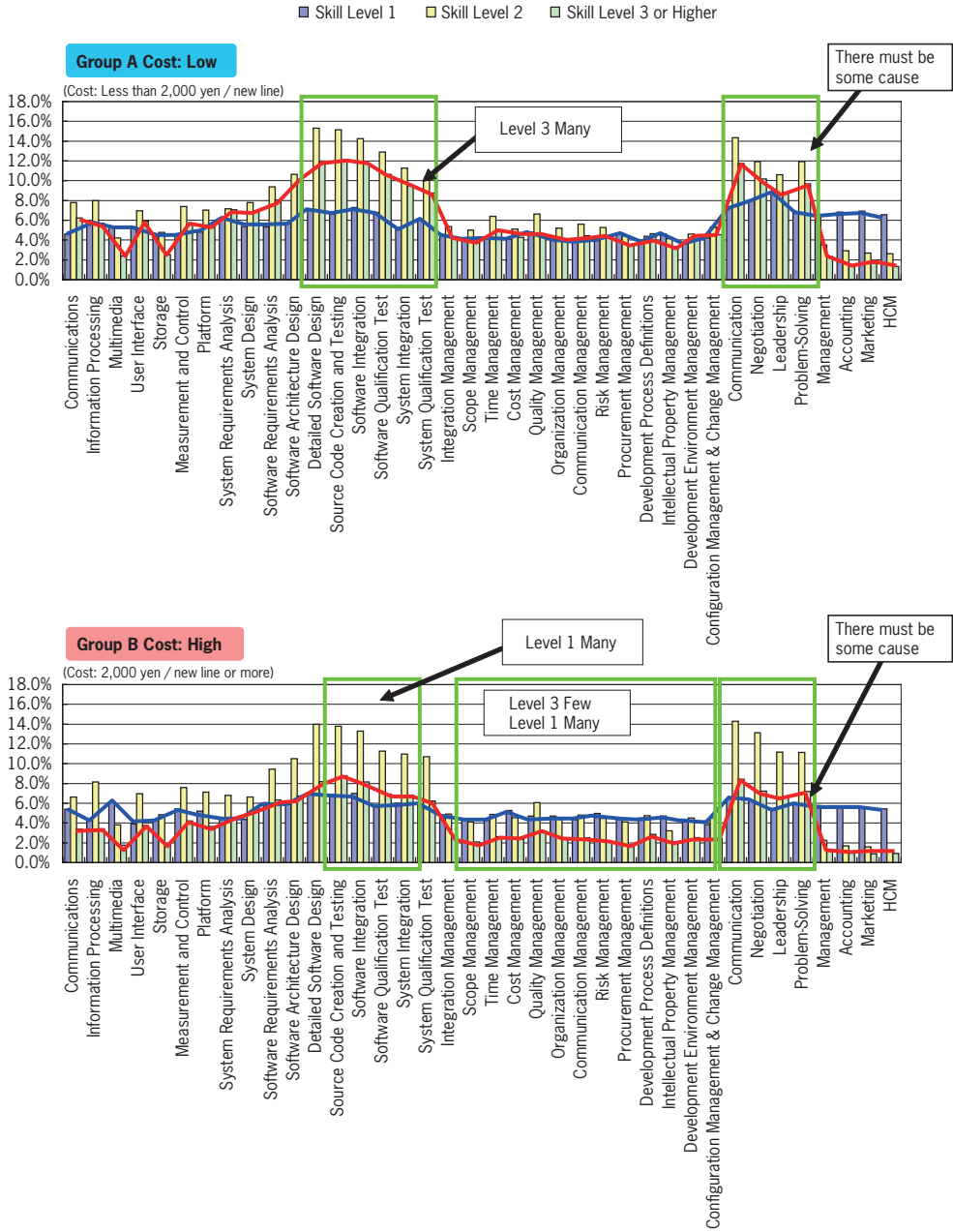


Figure 44: Costs (total costs / new lines)

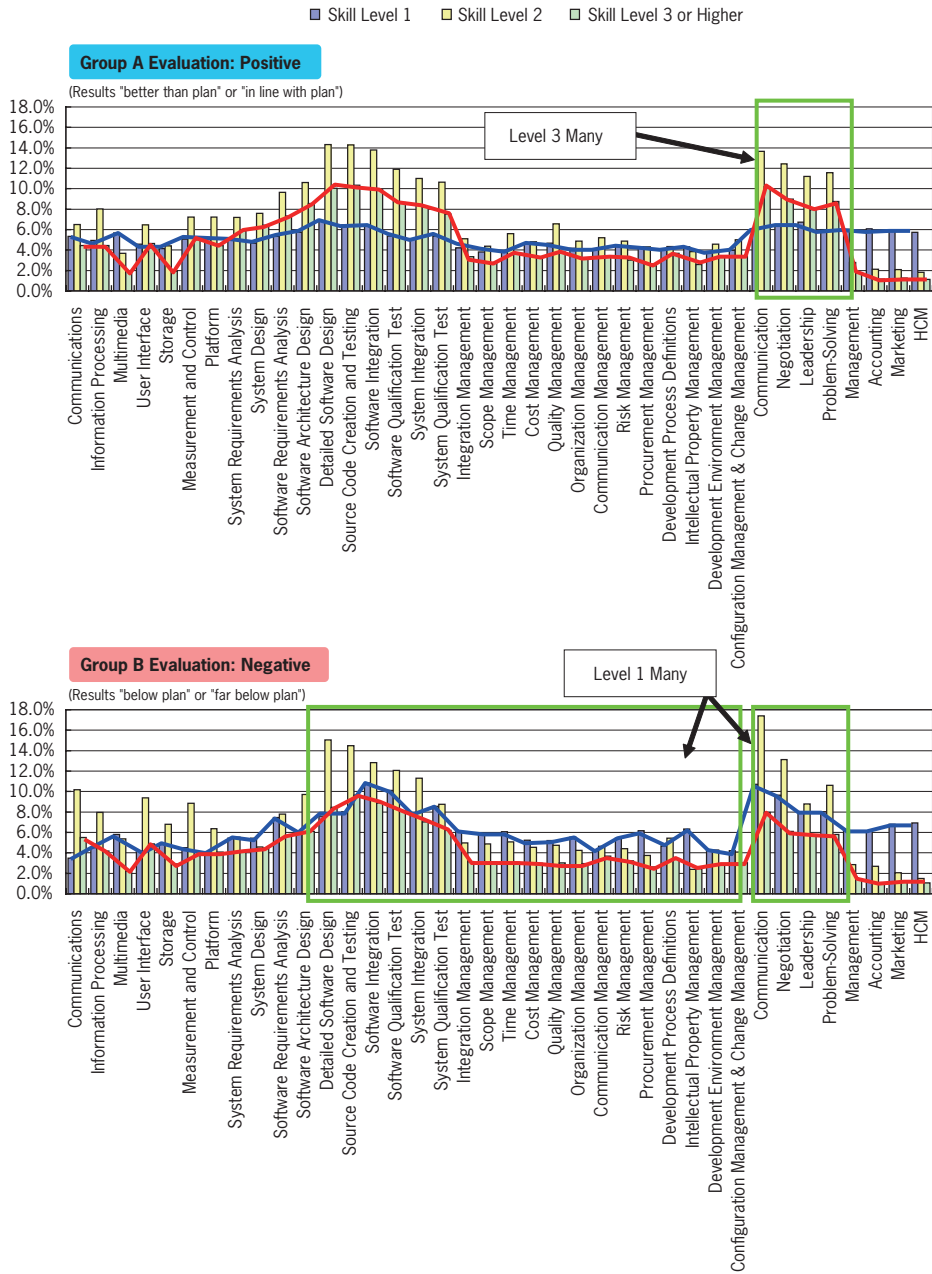


Figure 45: Results compared to plan (function performance)

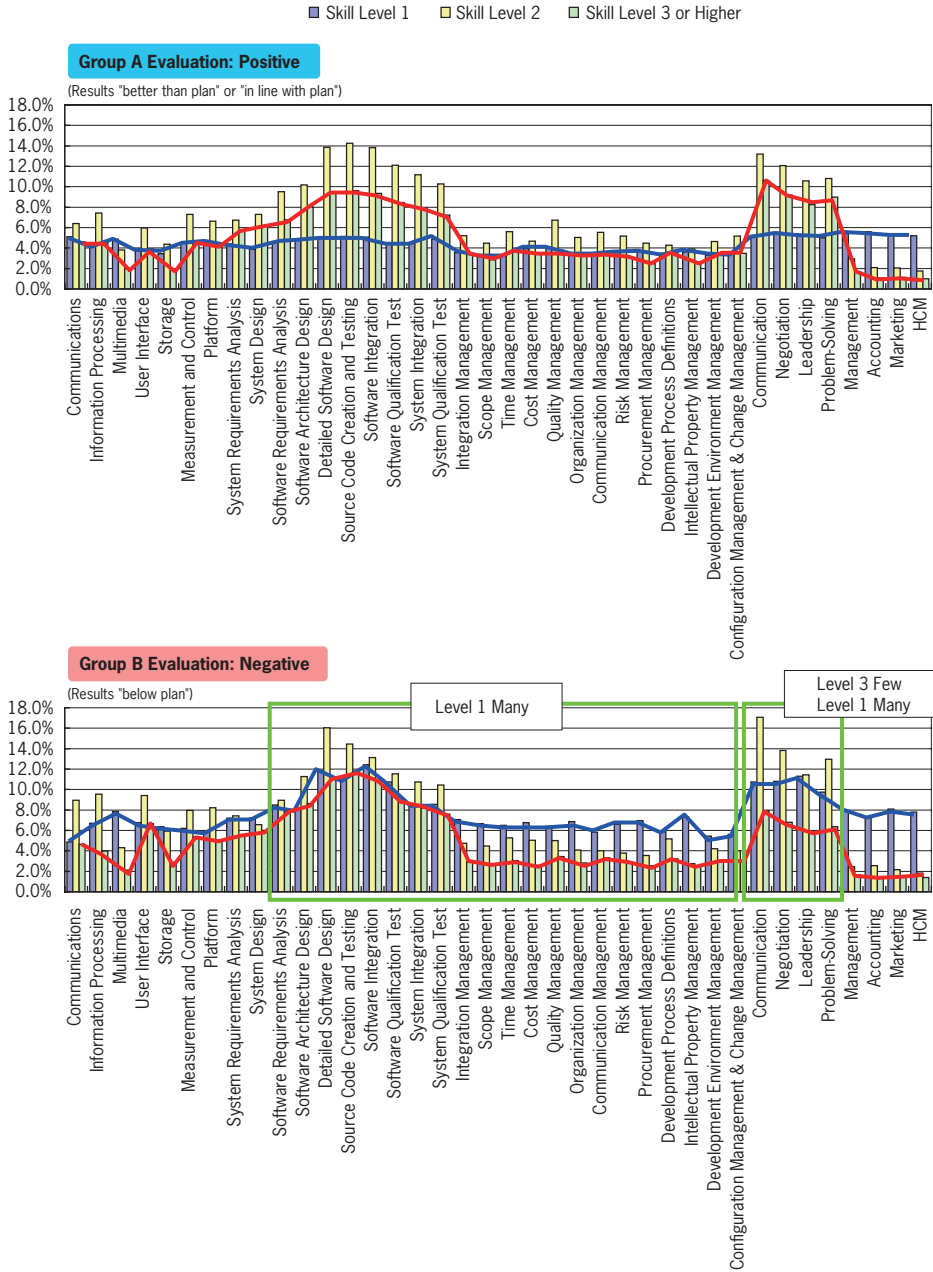


Figure 46: Results compared to plan (quality)

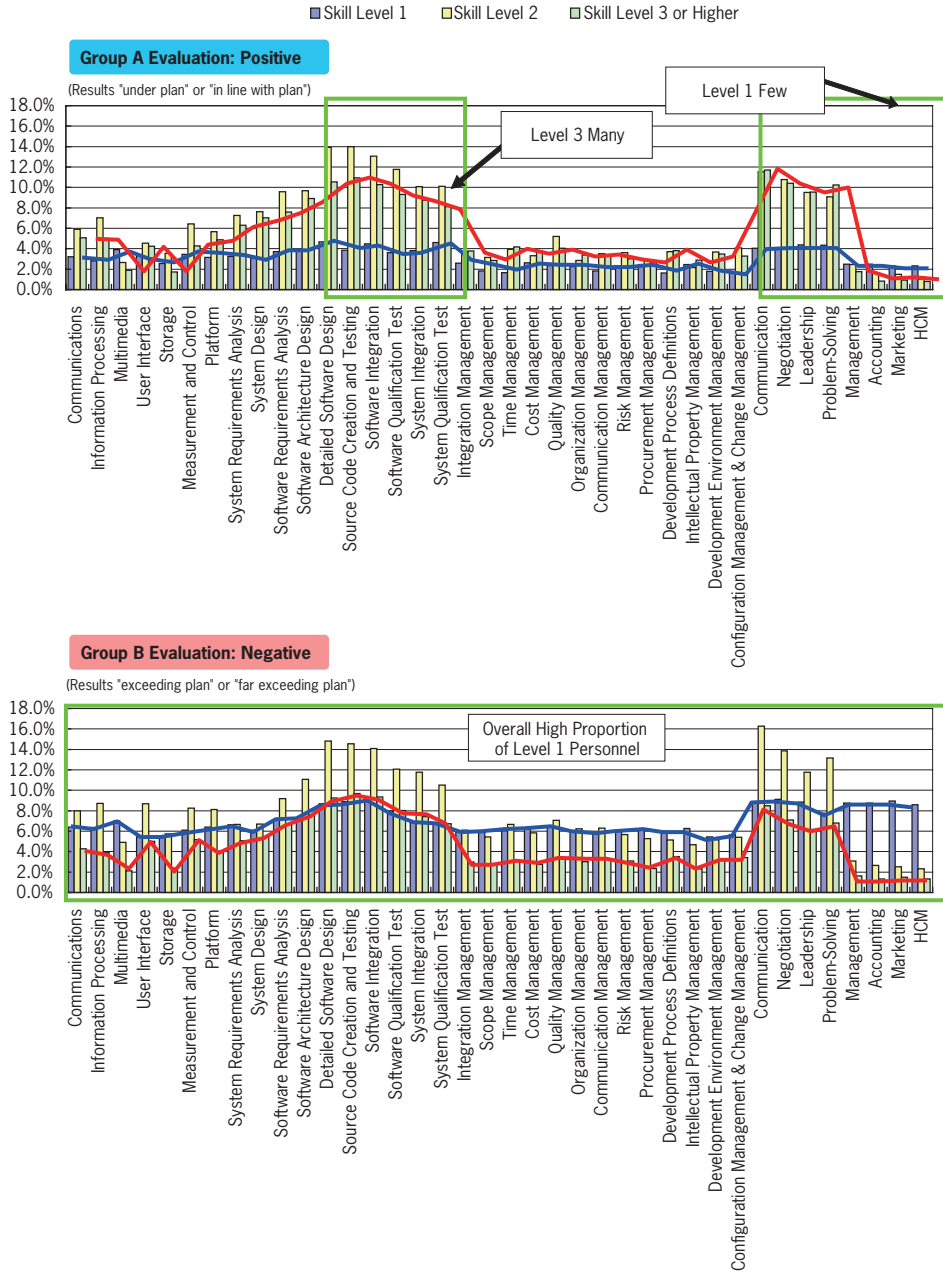


Figure 47: Results compared to plan (development costs)

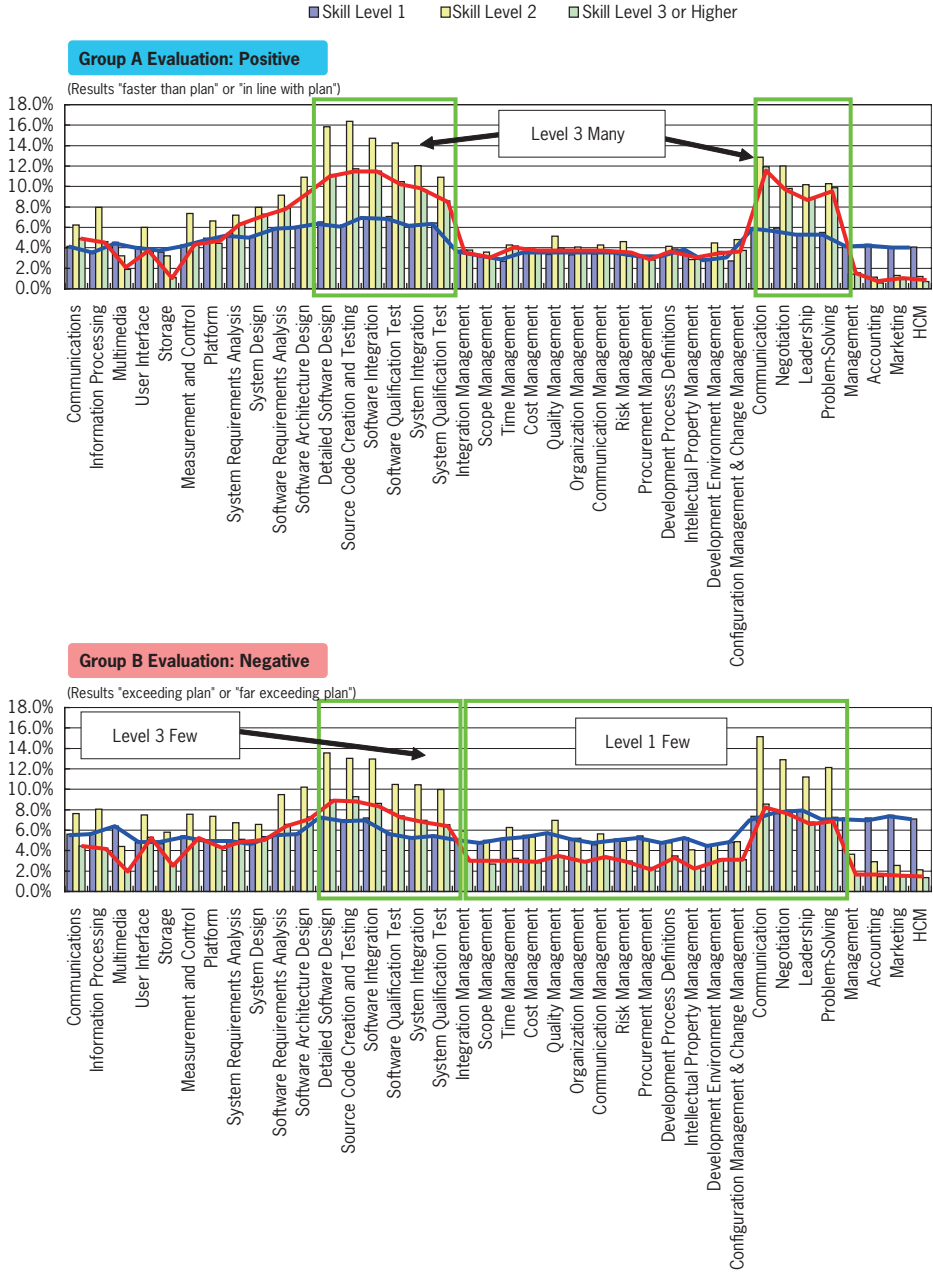


Figure 48: Results compared to plan (development time)

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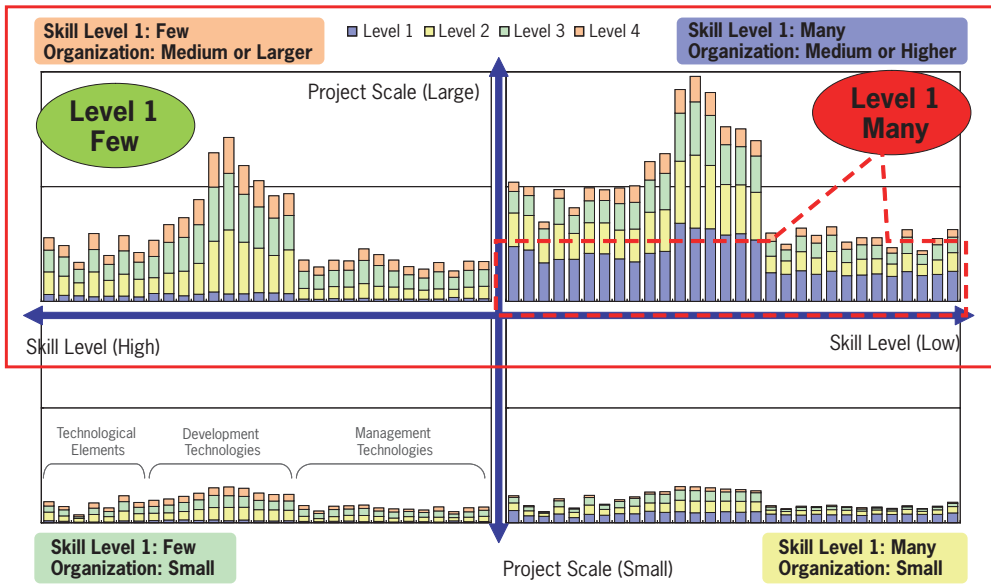


Figure 49: Skill profiles by project type

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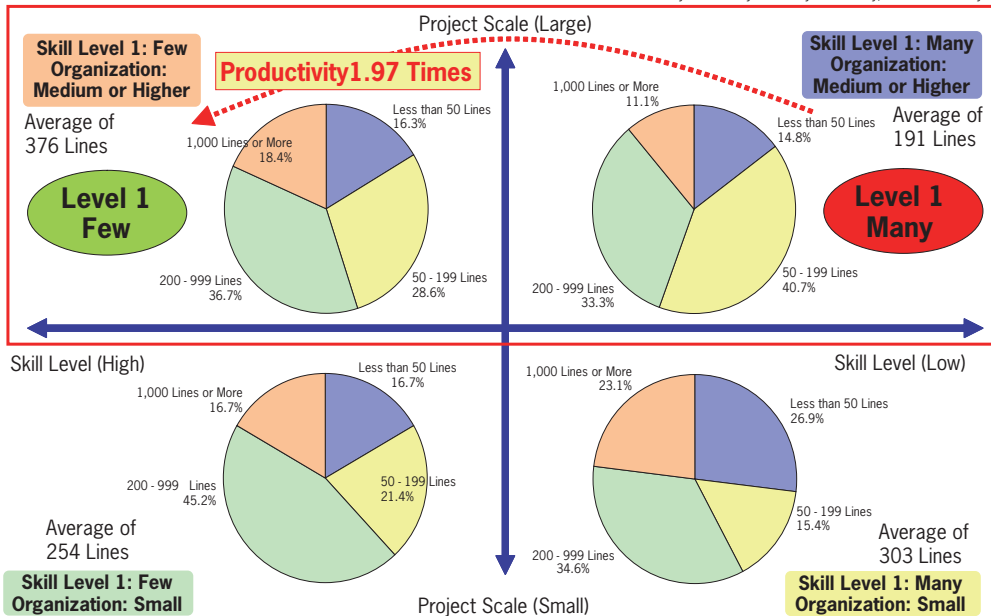


Figure 50: Productivity by project type

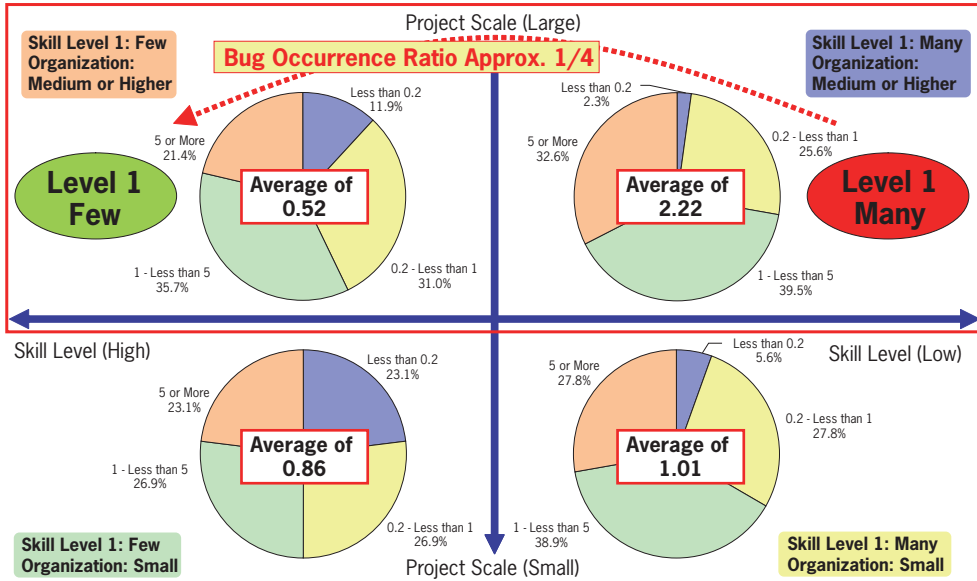


Figure 51: Defect occurrence rate by project type (average number of defects per 1,000 lines)

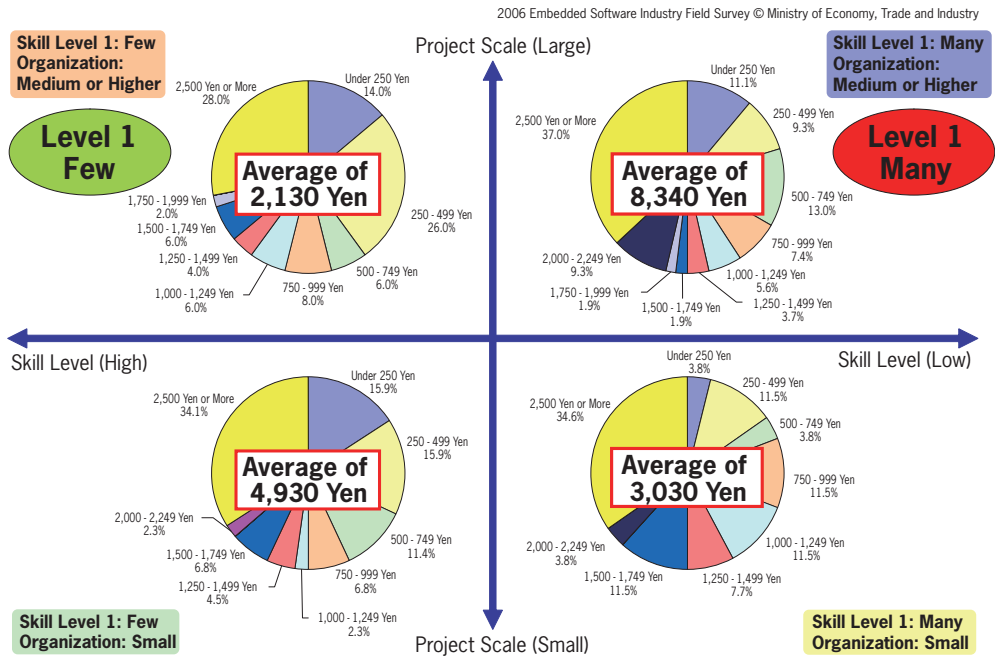


Figure 52: Development costs per newly developed line by project type

Part 3

References

3.1	Glossary of Terms	82
3.2	FAQ	90
3.3	Format Examples	91
3.4	Skills Specification / Skill Diagnosis Sheet	98

3.1 Glossary of Terms

This section contains explanations of terminology used in, or essential to understanding, embedded technology skill standards (hereafter referred to as “ETSS”).

ETSS 3.1.1 Skill, Technology, Career

The ETSS clearly defines the terms “skill,” “technology,” and “career,” to differentiate them and uses them distinctively.

Technology

“Technology,” within ETSS, refers to reproducible processes which have been systematized and proceduralized in order to satisfy economic principles (cost conditions, etc.) for the purpose of producing results which satisfy requirements.

One of the characteristics of technologies is that they can be explicitly intellectualized, and passed on to large numbers of people through documents, products, or education. In other words, technologies are processes which can be objectively validated.

Technological Capability

People sometimes say that a company is “technologically capable,” but in ETSS, “technological capability” specifically refers to the capability to “develop,” “improve,” “revolutionize,” and “implement” a technology.

Technology consists of the processes used to produce results in response to requirements. Technological capability is the ability to create and improve those processes. It can also be considered as the ability to promote technological innovation.

Skill (Expertise)

In ETSS, “skill” refers to the capability of an individual to utilize overall technologies, and parts of technologies (sub-processes) in order to produce results in response to requirements.

Skills depend on individuals, and contain characteristics that cannot be conveyed as written or automated knowledge. Skills mature in individuals as they build up experience, including training, in the extensive use of technologies.

Passing on skills which make extensive use of technologies requires repeated person-to-person training and an appropriate environment.

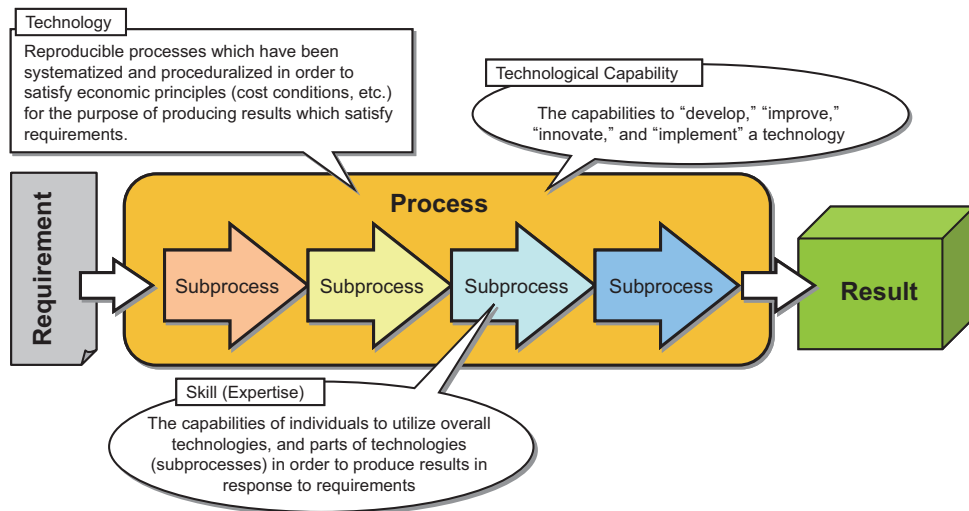


Figure 53: Skills (expertise) and technological capabilities

Engineers and Technicians

ETSS defines engineers and technicians as below.

[Engineer]

Personnel who use technologies, skills, and experience, and have the technological capabilities to realize, improve, or innovate processes using new techniques in order to produce results in response to requirements.

[Technician]

Personnel who can provide the work needed by processes and tasks (sub-processes).

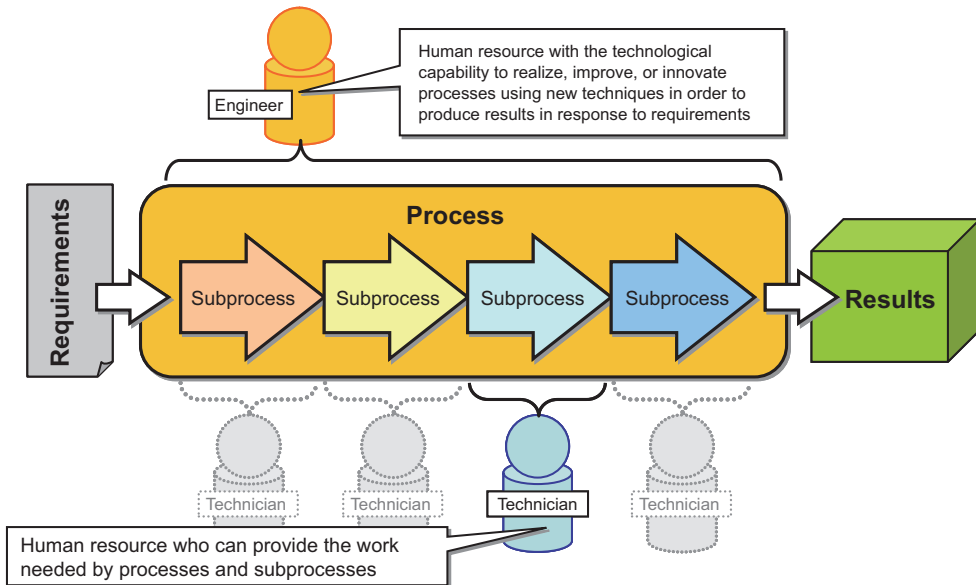


Figure 54: Engineers and technicians

In product development, existing processes or tasks (sub-processes) that are well-established as technologies can be implemented even by technicians. However, it is engineers who improve the existing technologies in response to higher quality requirements and lead organizations and industries by driving innovation. Technicians and engineers, however, should not be regarded as opposing human resources, but rather as coexisting traits within individuals.

Skills Distribution

In ETSS, proficiency in utilizing technologies is assessed on a scale of 1 to 4 for each technological item. Therefore, it should be noted that skill assessments exhibit distributions. Skills are represented as a distribution and not as a single value.

Career

In ETSS, “career specification” defines job category names related to embedded software development, and their duties.

Job Category and Specialty Field

In order to realize development and effective utilization of human resources in the embedded software development field, the ETSS career specification categorize major relevant jobs and specialty fields and define duties and responsibilities, etc. from an engineering viewpoint.

Career specification version 1.1 defines job categories and specialty fields as shown in “Figure 55: ETSS career specification – job categories / specialty fields and career levels.”

Job Category	Product Manager	Project Manager	Domain Specialist	System Architect		Software Engineer		Bridge SE	Development Environment Engineer	Development Processes Improvement Specialist	QA Specialist	Test Engineer
Specialty Field	Embedded System	Embedded Software Development	Embedded-Related Technologies	Embedded Application Development	Embedded Platform Development	Embedded Application Development	Embedded Platform Development	Embedded Software Development	Embedded Software Development	Embedded Software Development	Embedded Software Development	Embedded System Development
Level 7												
Level 6												
Level 5												
Level 4												
Level 3												
Level 2												
Level 1												

Figure 55: ETSS career specification – job categories / specialty fields and career levels

Responsibilities

The ETSS career specification explicitly states the responsibilities of the individual job category involved in embedded software development. Stating specific activity spheres of individual job categories would have the unfortunate effect of limiting the activity spheres, so instead responsibility scopes were indicated, describing the roles which should be met flexibly and realistically by individual job categories.

The ETSS career specification’s career level evaluation is based on the amount a person contributes to business, and as a professional, within the scope of the responsibilities of their job categories or specialized fields.

In this way, the ETSS career specification, from a job category position and career level evaluation standpoint, centers around the responsibilities defined for each job category. There are 7 career levels, based on the same structure as the Skill Standards for IT Professionals previously issued.

Social Skills and Business Skills

The ETSS career level is based on the degree to which the person being evaluated has contributed to business and professional value creation. To realize these contributions, social skills, such as communication and negotiation, and business skills, such as management, accounting, and marketing, are needed. Because of this, the ETSS career specification defines, in addition to the three skills specification skill categories (“technological elements,” “development technologies,” and “management technologies”), business skills and social skills.

Skills Distribution and Careers

The information provided by ETSS career specification skills distribution characteristics are necessary, but not sufficient for the job category career level condition.

The degree to which skills distribution characteristics can be visually represented in figures or tables is limited, so additional notes provide a supplementary explanation.

ETSS 3.1.2 Education Program

The ETSS “education and training specification” is composed of the structure and system for education and training performed in order to implement embedded software development field human resource development.

This section will focus on explaining the terminology used in the ETSS education and training specification.

Education Program Framework

Until now, there have been a multitude of terms and definitions related to human resource development and training, making it difficult to establish a common understanding of scopes and standards when visualizing education contents and sharing education courses. It is against this backdrop that the ETSS education and training specification’s education framework clearly identifies the structure of education methods needed to implement embedded software development field human resource development.

It has been formulated in order that education program frameworks can be utilized and education programs structured in order to improve skills and careers in accordance with ETSS skills specification and career specification.

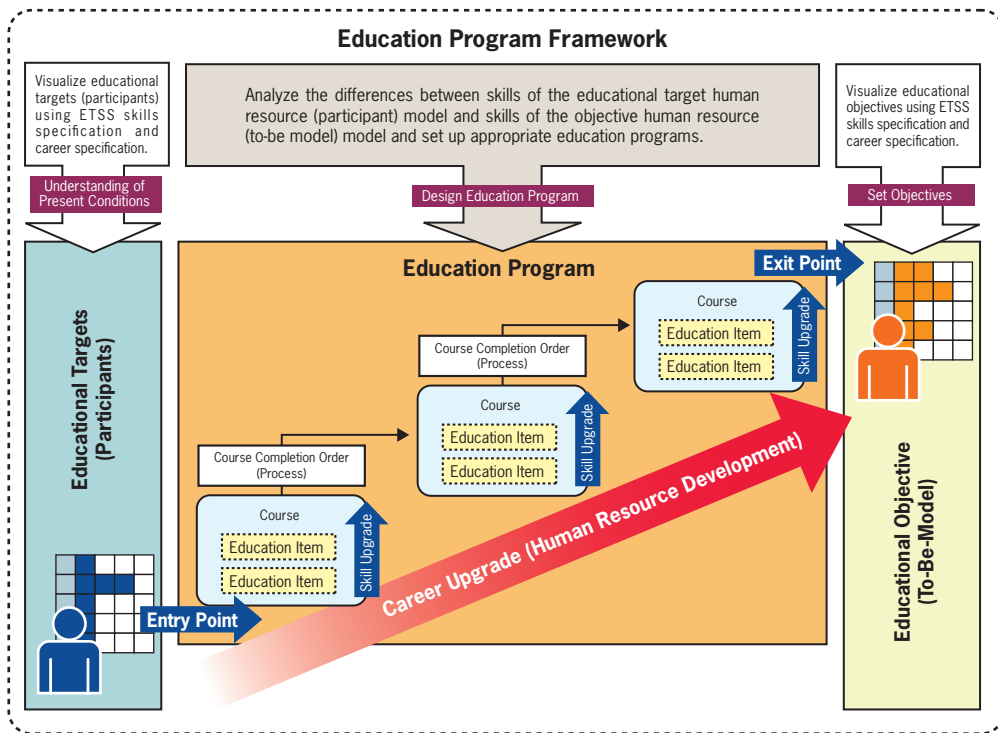


Figure 56: ETSS education and training specification – education program framework components

Education Program

Education programs in the ETSS education and training specification are education systems for turning human resources targeted by the education programs (participants) into the type of human resources that the education program is trying to cultivate (to-be model). Education programs are composed of one or more courses, and provide guidance for effective utilization of those courses.

Education programs can be customized by appropriately selecting and combining courses in accordance with the skills and degree of knowledge achievement of the educational targets, as well as the skills, knowledge fields, and levels used as the targeted educational objectives.

Course

Within the ETSS education program framework, a course is defined as an assembly of education items necessary for the acquisition of knowledge and skills in specific technology fields.

“Education item” here refers to the technological items to be learned through education or training.

Education Program for the Inexperienced

The ETSS education and training specification provides an “Education Program for People Inexperienced in Embedded Software Development” targeted at people without embedded software development experience.

By popularizing education programs targeted at embedded software development beginners, entry-level embedded software development engineer levels can be improved. The programs can also be utilized when migrating engineers from other fields to the field of embedded software development.



3.2 FAQ

Q: Level 1 is described as being able to perform operations with support, but can't anyone do most things if they receive support?

A: Skill diagnosis level 1 requires proofs for “capable of” and “understand” assessments. Optimally, these proofs would consist of actually demonstrating the items, or objectively confirmable proofs, such as attendance of related education, past work history, or similar technology work performance. Blindly stating one’s ability without proof is not sufficient for level 1 assessment.

Q: Isn't the level 2 expression “full-fledged” somewhat vague?

A: Level 2 and above are looking at the presence or absence of actual operation experience for the target technology. Please perform work experience performance assessment from the perspective of “Were they able to perform their work (without support)?”

3.3 Format Examples

This section provides format examples for ETSS implementation related documents, etc.



3.3.1 Operation List

An operation list for ETSS implementation and further human resource development, etc., is provided below.

The table lists operation contents as “Operation Name,” and is structured such that input, output, and completion conditions can be clearly stipulated.

Operation List

Operation Item	Operation Standard Used	Start Conditions	Completion Conditions		Notes
ID: Operation Name		Input	Deliverables	Verification Method	
A: ETSS Utilization Process	ETSS Standard Utilization Process				
A.0: Preparation					
A.0.1: ETSS Promotion Organization Initiation					
A.0.1.1 Promotion Organization Personnel Selection and Assignment			Selection candidate personnel list	Review	
A.0.1.2 Promotion Operation Team Startup		Selection candidate personnel list	Promotion operation team organization chart Role and assignment table	Review	Hold kickoff meeting
A.0.1.3 Level Evaluation Team Startup		Selection candidate personnel list	Level evaluation team organization chart Role and assignment table	Review	Hold kickoff meeting
A.0.2: Operation Process Definition					
A.0.2.1 ETSS Utilization Scope Definition			ETSS utilization guideline	Review	Finalize ETSS utilization target scope
A.0.2.2 Stakeholder Analysis and Finalization			Stakeholder list	Review	
A.0.2.3 Operation Process Tailoring		ETSS utilization guidelines ETSS standard utilization Processes	ETSS utilization process	Review	Internal ETSS utilization process
A.0.2.4 Selection of Tools and Systems Used		ETSS utilization guidelines ETSS utilization processes	Tool and system plan	Review	
A.0.2.5 Operation Process Manual Creation		ETSS utilization process Tool and system plan	Operation manual	Review	Separate operation manuals for promoters, managers, members, etc.
A.0.3: Promoter Training					
A.0.3.1 Promoter Education Planning		ETSS utilization process guideline Promotion operation team organization chart Level evaluation team organization chart	ETSS promoter education plan	Review	Target personnel, timing, location...
A.0.3.2 Promoter Education Implementation		ETSS promoter educational curriculum ETSS promoter education materials ETSS promoter manual	Organization internal ETSS promoter training	Confirmation test	
A.0.4: Implementation Training					
A.0.4.1 ETSS Implementation Training Planning		ETSS utilization process guideline	ETSS implementation training plan	Review	
A.0.4.2 Performance of Operation Briefing for Managers		ETSS utilization process guideline Manager oriented operation manual	Understanding of operationally related manager responsibilities and roles	Confirmation test	
A.0.4.3 Performance of Operation Briefing for Members		ETSS utilization process guideline Member oriented operation manual	Member's understanding of operation	Confirmation test	

A.0.5: Skills Specification Definition						
A.0.5.1	Skill Item Selection		ETSS skills specification	Organization skills specification	Review	
A.0.5.2	Skill Level Customization		ETSS skills specification	Organization skill level definition	Review	
A.0.5.3	Skill Diagnosis Sheet Creation		Organization skills specification	Skill diagnosis sheet	Review Trial	
A.0.6: Career Specification Definition						
A.0.6.1	Job Category Definition		ETSS career specification Organization skills specification	Organization career specification	Review	
A.0.6.2	Career Level Definition		ETSS career specification	Organization career level definition	Review	
A.0.6.3	Career Level Evaluation Specification Definition		Organization career specification Organization career level definition	Career level evaluation specification Evaluation tools and system	Review	
A.1: Planning						
A.1.1: Organization Planning						
A.1.1.1	Requirements (To-Be Model) Analysis		Project plan document Organization structure diagram Function list, etc.	Organization target career distribution diagram Organization target skills distribution diagram	Review	Distribution model that organization wishes to achieve
A.1.1.2	Understanding of Present Conditions (As-Is Model)		Member skill diagnosis results	Present organization career distribution diagram Present organization skills distribution diagram	Review	Understanding of current organization skill and career distribution models
A.1.1.3	Analysis of Difference Between Requirements and Present Conditions		Organization target career distribution diagram Organization target skills distribution diagram Present organization career distribution diagram Present organization skills distribution diagram	Difference analysis results	Review	Analysis of gap between objectives and present conditions
A.1.1.4	Performance Measurement Planning		-	Organization performance measurement plan	Review	
A.1.1.5	Requirements Distribution		Difference analysis results	Target career level for each member Target skills distribution for each member	Review	
A.1.2: Technology Procurement Planning						
A.1.2.1	External Human Resource Procurement Planning		Difference analysis results	External human resource procurement plan	Review	
A.1.2.2	Human Resource Development Curriculum Procurement Planning		Difference analysis results	Educational curriculum plan	Review	
A.1.3: Individual Planning						
A.1.3.1	Understanding of Requirements (To-Be Model)		Target career level for each member Target skills distribution for each member	-	-	Target skills distribution
A.1.3.2	Understanding of Present Conditions (As-Is Model)		Skill diagnosis sheet Skill and career diagnosis tools and system	Skill diagnosis results for each member Career diagnosis results for each member	Review	Skill diagnosis, career diagnosis Confirmation by upper level personnel and level evaluation team
A.1.3.3	Analysis of Difference Between Requirements and Present Conditions		Target career level for each member Target skills distribution for each member Skill diagnosis results for each member Career diagnosis results for each member	Difference analysis results	Review	
A.1.3.4	Performance Measurement Planning		-	Individual performance measurement plan	Review	
A.1.3.5	Education Plan Proposal		Difference analysis Educational curriculum plan Educational curriculum list	Individual educational curriculum plan	Review	
A.2: Implementation						
A.2.1: Human Resource Development (Education & Training)						
A.2.1.1	Education & Training Procurement		Educational curriculum plan	Educational curriculum (training)	-	Confirmation test
A.2.1.2	Education and Training Implementation		Educational curriculum (training)	Training Implementation	Confirmation test Questionnaire Skill diagnosis	
A.2.1.3	Education and Training Evaluation Data Collection		Confirmation test Questionnaire Skill diagnosis	Education and training evaluation data	Review	
A.2.2: Human Resource Management Implementation						
A.2.2.1	Human Resource Management Implementation		Participating personnel skill diagnosis results Non-participating personnel skill diagnosis results Organization target career distribution diagram Organization target skills distribution diagram	Organization career distribution diagram Organization skills distribution diagram Difference analysis results	Review	Use in risk management * Perform "A.1.2: Technology Procurement Planning" and "A.1.3: Individual Planning" as needed
A.2.3: Performance Measurement						
A.2.3.1	Performance Measurement		Performance related data, such as productivity, quality, costs, etc.	Project performance records Performance records for individual members	-	Use of EPM tools, etc.
A.3: Evaluation						
A.3.1: Organization Performance Evaluation						
A.3.1.1	Requirements Evaluation		Project implementation results Project performance records	Organization requirements evaluation report	Review	
A.3.1.2	Planning Item Performance Evaluation		Project implementation results	Organization planning item evaluation report	Review	
A.3.2: Technology Procurement Performance Evaluation						

A.3.2.1	Requirements Evaluation	External human resource procurement plan Educational curriculum plan Project implementation Results Project performance records Performance records for individual members Education and training evaluation data	Technology procurement requirements evaluation report	Review	
A.3.2.2	Planning Item Performance Evaluation	Project implementation results	Technology procurement planning item evaluation report	Review	
A.3.3: Individual Performance Evaluation					
A.3.3.1	Expected Value Evaluation	Target career level for each member Target skills distribution diagram for each member Performance records for individual members Education and training evaluation data	Individual expected value evaluation report	Review	
A.4: Improvement					
A.4.1: Operation Process Improvement					
A.4.1.1	Tools & System Improvement	Tools and system operation issues	Tools and system plan Tools and system improvement consideration and implementation	Review	
A.4.1.2	Operation Process Improvement	Operation process implementation issues	ETSS utilization process improvement consideration and implementation operation manual revision	Review	
A.4.2: Career Specification Improvement					
A.4.2.1	Career Definition Improvement	Project implementation results Member career diagnosis results Performance records for individual members	Career definition revision	Review	
A.4.2.2	Career Level Evaluation Method Improvement	Member career diagnosis results Performance records for individual members	Career level evaluation method revision Reflection in tools and system Operation manual revision	Review	
A.4.3: Skills Specification Improvement					
A.4.3.1	Skill Item Improvement	Project implementation results Member skill diagnosis results Performance records for individual members	Skill item revision	Review	
A.4.3.2	Skill Level Evaluation Method Improvement	Member skill diagnosis results Performance records for individual members	Skill level evaluation method revision Reflection in tools and system Operation manual revision	Review	

Operation Item		Operation Standard Used	Start Conditions Input	Completion Conditions		Notes
ID: Operation Name	Deliverables			Verification Method		
B: ETSS Support Process						
B.1: Education						
B.1.1: Technology Educational Curriculum						
B.1.1.1	Educational Curriculum Planning & Design		Educational target human resource skills distribution Educational objective human resource skills distribution	Educational curriculum list Educational curriculum syllabus, etc.	Review	
B.1.1.2	Education Material Development and Procurement		Educational curriculum list Educational curriculum syllabus, etc.	Education materials (texts, education contents, etc.)	Inspection Trial	
B.1.1.3	Instructor Education and Assignment		Required instructor skills distribution Planned instructor list	Securing of instructors	Interview Skill diagnosis	
B.1.1.4	Educational Curriculum Implementation		Education materials Instructors Classrooms	Educational curriculum implementation	Confirmation test Questionnaire Skill diagnosis	
B.1.1.5	Educational Curriculum Improvement		Confirmation test Questionnaire Skill diagnosis	Educational curriculum improvement consideration and implementation	Review	
B.1.2: ETSS Promoter Educational Curriculum						
B.1.2.1	Educational Curriculum Planning & Design		Educational target human resource skills distribution Educational objective human resource skills distribution	Educational curriculum syllabus, etc.	Review	
B.1.2.2	Education Material Development & Procurement		Educational curriculum syllabus, etc.	Education materials (texts, education contents, etc.)	Inspection Trial	
B.1.2.3	Instructor Education and Assignment		Required instructor skills distribution Planned instructor list	Securing of instructors	Interview Skill diagnosis	
B.1.2.4	Educational Curriculum Implementation		Education materials Instructors Classrooms	Educational curriculum implementation	Confirmation test Questionnaire Skill diagnosis	
B.1.2.5	Educational Curriculum Improvement		Confirmation test Questionnaire Skill diagnosis	Educational curriculum improvement consideration and implementation	Review	
B.1.3: Operation Briefing Support						
B.1.3.1	Operation Briefing Planning & Design		Operation manual	Briefing implementation plan	Review	
B.1.3.2	Education Material Development & Procurement		Briefing implementation plan Operation manual	Education materials (texts, education contents, etc.)	Inspection Trial	
B.1.3.3	Briefing Personnel Education and Assignment		Briefing implementation plan Operation manual	Securing of briefing personnel Briefing rehearsal	Review	
B.1.3.4	Performance of Briefing		Education materials Briefing personnel Location	Performance of briefing	Questionnaire	
B.1.3.5	Briefing Improvement		Questionnaire	Briefing improvement consideration and implementation	Review	

ETSS 3.3.2 Operations Staff Allocation

This is an operation staff allocation table for the operations described in the operation list.

Enter the department name and name of the leader or member responsible for each operation name, and the operation period.

Operation Staff Allocation Table

Operation Item		Staff Member					
ID: Operation Name		Department	Leader	Operation Period	Department	Member	Operation Period
A: ETSS Utilization Process							
A.0: Preparation							
A.0.1: ETSS Promotion Organization Startup							
A.0.1.1	Promotion Organization Personnel Selection & Assignment						
A.0.1.2	Promotion Operation Team Startup						
A.0.1.3	Level Evaluation Team Startup						
A.0.2: Operation Process Definition							
A.0.2.1	ETSS Utilization Scope Definition						
A.0.2.2	Stakeholder Analysis & Finalization						
A.0.2.3	Operation Process Tailoring						
A.0.2.4	Selection of Tools & System Used						
A.0.2.5	Operation Process Manual Creation						
A.0.3: Promoter Training							
A.0.3.1	Promoter Education Planning						
A.0.3.2	Promoter Education Implementation						
A.0.4: Implementation Training							
A.0.4.1	ETSS Implementation Training Planning						
A.0.4.2	Performance of Operation Briefing for Managers						
A.0.4.3	Performance of Operation Briefing for Members						
A.0.5: Skills Specification Definition							
A.0.5.1	Skill Item Selection						
A.0.5.2	Skill Level Customization						
A.0.5.3	Skill Diagnosis Sheet Creation						
A.0.6: Career Specification Definition							
A.0.6.1	Job Category Definition						
A.0.6.2	Career Level Definition						
A.0.6.3	Career Level Evaluation Specification Definition						
A.1: Planning							
A.1.1: Organization Planning							
A.1.1.1	Requirements (To-Be Model) Analysis						
A.1.1.2	Understanding of Present Conditions (As-Is Model)						
A.1.1.3	Analysis of Difference Between Requirements and Present Conditions						
A.1.1.4	Performance Measurement Planning						
A.1.1.5	Requirements Distribution						
A.1.2: Technology Procurement Planning							
A.1.2.1	External Human Resource Procurement Planning						
A.1.2.2	Human Resource Development Curriculum Procurement Planning						
A.1.3: Individual Planning							
A.1.3.1	Understanding of Requirements (To-Be Model)						
A.1.3.2	Understanding of Present Conditions (As-Is Model)						
A.1.3.3	Analysis of Difference Between Requirements and Present Conditions						
A.1.3.4	Performance Measurement Planning						
A.1.3.5	Education Planning Proposal						
A.2: Implementation							
A.2.1	Human Resource Development (Education & Training)						

A.2.1.1	Education & Training Procurement						
A.2.1.2	Education & Training Implementation						
A.2.1.3	Education & Training Evaluation Data Collection						
A.2.2	Human Resource Management Implementation						
A.2.2.1	Human Resource Management Implementation						
A.2.3	Performance Measurement						
A.2.3.1	Performance Measurement						
A.3	Evaluation						
A.3.1	Organization Performance Evaluation						
A.3.1.1	Requirements Evaluation						
A.3.1.2	Planning Item Performance Evaluation						
A.3.2	Technology Procurement Performance Evaluation						
A.3.2.1	Requirements Evaluation						
A.3.2.2	Planning Item Performance Evaluation						
A.3.3	Individual Performance Evaluation						
A.3.3.1	Expected Value Evaluation						
A.4	Improvement						
A.4.1	Operation Process Improvement						
A.4.1.1	Tools & System Improvement						
A.4.1.2	Operation Process Improvement						
A.4.2	Career Specification Improvement						
A.4.2.1	Career Definition Improvement						
A.4.2.2	Career Level Evaluation Method Improvement						
A.4.3	Skills Specification Improvement						
A.4.3.1	Skill Item Improvement						
A.4.3.2	Skill Level Evaluation Method Improvement						

ID	Operation Name	Staff Member				
		Department	Leader	Operation Period	Department	Member
B: ETSS Support Process						
B.1: Education						
B.1.1: Technology Educational Curriculum						
B.1.1.1	Educational Curriculum Planning & Design					
B.1.1.2	Education Material Development and Procurement					
B.1.1.3	Instructor Education and Assignment					
B.1.1.4	Educational Curriculum Implementation					
B.1.1.5	Educational Curriculum Improvement					
B.1.2: ETSS Promoter Educational Curriculum						
B.1.2.1	Educational Curriculum Planning & Design					
B.1.2.2	Education Material Development and Procurement					
B.1.2.3	Instructor Education & Assignment					
B.1.2.4	Educational Curriculum Implementation					
B.1.2.5	Educational Curriculum Improvement					
B.1.3: Operation Briefing Support						
B.1.3.1	Operation Briefing Planning & Design					
B.1.3.2	Education Material Development and Procurement					
B.1.3.3	Briefing Personnel Education and Assignment					
B.1.3.4	Performance of Briefing					
B.1.3.5	Briefing Improvement					

ETSS

3.3.3 Operation Planning

This is an overall detail plan table.

You can use PERT (Program Evaluation and Review Technique) and other techniques to evaluate the reasonableness and doability of plans.

Operation Planning

Operation Item	Role Assignment			Estimate	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15
	ID: Operation Name	Staff	Veri- fication																
A: ETSS Utilization Process																			
A.0: Preparation																			
A.0.1: ETSS Promotion Organization Startup																			
A.0.1.1	Promotion Organization Personnel Selection & Assignment																		
A.0.1.2	Promotion Operation Team Startup																		
A.0.1.3	Level Evaluation Team Startup																		
A.0.2: Operation Process Definition																			
A.0.2.1	ETSS Utilization Scope Definition																		
A.0.2.2	Stakeholder Analysis and Finalization																		
A.0.2.3	Operation Process Tailoring																		
A.0.2.4	Selection of Tools & System Used																		
A.0.2.5	Operation Process Manual Creation																		
A.0.3: Promoter Training																			
A.0.3.1	Promoter Education Planning																		
A.0.3.2	Promoter Education Implementation																		
A.0.4: Implementation Training																			
A.0.4.1	ETSS Implementation Training Planning																		
A.0.4.2	Performance of Operation Briefing for Managers																		
A.0.4.3	Performance of Operation Briefing for Members																		
A.0.5: Skills Specification Definition																			
A.0.5.1	Skill Item Selection																		
A.0.5.2	Skill Level Customization																		
A.0.5.3	Skill Diagnosis Sheet Creation																		
A.0.6: Career Specification Definition																			
A.0.6.1	Job Category Definition																		
A.0.6.2	Career Level Definition																		
A.0.6.3	Career Level Evaluation Specification Definition																		
A.1: Planning																			
A.1.1: Organization Planning																			
A.1.1.1	Requirements (To-Be Model) Analysis																		
A.1.1.2	Understanding of Present Conditions (As-Is Model)																		
A.1.1.3	Analysis of Difference Between Requirements and Present Conditions																		
A.1.1.4	Performance Measurement Planning																		
A.1.1.5	Requirements Distribution																		
A.1.2: Technology Procurement Planning																			
A.1.2.1	External Human Resource Procurement Planning																		
A.1.2.2	Human Resource Development Curriculum Procurement Planning																		
A.1.3: Individual Planning																			
A.1.3.1	Understanding of Requirements (To-Be Model)																		
A.1.3.2	Understanding of Present Conditions (As-Is Model)																		
A.1.3.3	Analysis of Difference Between Requirements & Present Conditions																		

3.4 Skills Specification / Skill Diagnosis Sheet

First Layer	Second Layer	Skill Level					Skill Level Assessment Basis and Reason
		Input	Lv1	Lv2	Lv3	Lv4	
1 Communications	1 Wired						
	2 Wireless						
	3 Broadcast						
	4 Internet						
2 Information Processing	1 Information Input						
	2 Security						
	3 Data Processing						
	4 Information Output						
3 Multimedia	1 Voice						
	2 Still Image						
	3 Moving Image						
	4 Integration						
4 User Interface	1 Human Interface Input						
	2 Human Interface Output						
5 Storage	1 Media						
	2 Interface						
	3 File System						
6 Measurement and Control	1 Physical and Chemical Input						
	2 Measurement and Control Processing						
	3 Physical and Chemical Output						
7 Platform	1 Processor						
	2 Basic Software						
	3 Support Function						

	Evaluation Description
	Capable of designing communications by using the CAN protocol stack
	Capable of designing communications by using the FlexRay protocol stack
	Capable of designing communications by using the multimedia car mounted transmission (MOST/IEEE1394) protocol stack
	Capable of designing communications by using the communications (low-speed CAN/LIN) protocol stacks
	Capable of designing communications by using the multimedia car mounted transmission (DSRC, etc.) protocol stacks
	Capable of designing encryption processing by using encryption technologies
	Capable of designing processing by using filtering technologies
	Capable of designing processing by using voice data processing
	Capable of designing processing by using moving image data processing
	Capable of designing processing by using display data processing
	Capable of designing processing by using EEPROM
	Capable of designing processing by using flash
	Capable of designing processing by using hard disks
	Capable of designing data processing by using sensors
	Capable of designing motor control functions
	Capable of designing power, SLEEP, and WakeUP functions
	Capable of designing data processing by using actuators
	Capable of designing functions by using RTOS (μ ITRON/OSEK)
	Capable of designing drivers by using processor resources
	Capable of debugging by using ICE
	Capable of debugging by using on-chip debugging environments
	Capable of performing software analysis by using simulators

First Layer		Second Layer		Skill Level					Skill Level Assessment Basis and Reason
				Input	Lv1	Lv2	Lv3	Lv4	
1	Communications	1	Wired						
			Wireless						
		3	Broadcast						
			Internet						
2	Information Processing	1	Information Input						
			Security						
		3	Data Processing						
			Information Output						
3	Multimedia	1	Voice						
			Still Image						
		3	Moving Image						
			Integration						
4	User Interface	1	Human Interface Input						
			Human Interface Output						
5	Storage	1	Media						
			Interface						
		3	File System						
6	Measurement and Control	1	Physical and Chemical Input						
			Measurement and Control Processing						
		3	Physical and Chemical Output						
7	Platform	1	Processor						
			Basic Software						
		3	Support Function						

	Evaluation Description
	Capable creating CAN protocol stacks
	Capable of creating FlexRay protocol stacks
	Capable of creating multimedia car mounted transmission (MOST/IEEE1394) protocol stacks
	Capable of creating communications (low-speed CAN/LIN) protocol stacks
	Capable of creating multimedia car mounted transmission (DSRC, etc.) protocol stacks
	Capable of building encryption middleware
	Capable of building filtering technologies
	Capable of building voice data processing
	Capable of building moving image data processing
	Capable of building display data processing
	Capable of building EEPROM drivers
	Capable of building flash drivers
	Capable of building hard disks drivers
	Capable of designing data processing by using sensors (→ capable of building sensor controlled drivers)
	Capable of designing motor control functions (→ capable of building motor control driver)
	Capable of designing power, SLEEP, and WakeUP control functions (→ Capable of building state control processing of power, SLEEP, and WakeUP)
	Capable of designing data processing by using actuators (→ capable of building actuator controlling drivers)
	Capable of building RTOS (μ ITRON/OSEK)
	Capable of building drivers that use processor resources
	Capable establishing chip specifications for ICE
	Capable building on-chip debugging functions
	Capable of building simulators

First Layer	Second Layer	Skill Level					Skill Level Assessment Basis and Reason						
		Input	Lv1	Lv2	Lv3	Lv4							
1	System Requirements Analysis	1	Requirements Acquisition and Adjustment										
		2	System Analysis and Requirements Definition										
		3	Review of System Analysis and Requirements Definition										
	2	System Architecture Design	1	Hardware and Software Function and Performance Assignment Decision									
			2	Implementability Verification and Design Review									
		3	Software Requirements Analysis	1	Software Requirements Definition								
		2	Software Requirements Evaluation and Review										
4	Software Architecture Design	1	Software Structure Determination										
		2	Software Structure Design Review										
	5	Detailed Software Design	1	Detailed Software Design									
			2	Detailed Software Design Review									

	Evaluation Description
	Capable of determining customer requirements and creating system requirement specifications by using interview methods
	Capable of determining the information necessary for design, and creating system requirements specifications by understanding product specifications, operation specifications, control specifications, and the like
	Capable of clarifying pertinent customer requirements, and creating embedded product planning documentation by using marketing methods
	Capable of performing requirement condition analysis, and creating system requirements definition documentation in order to realize the requirements by using concept modeling
	Capable of resolving task timeline problems, and performing system analysis by using timing charts
	Capable of explaining overall system states and event handling using state transition tables
	Capable of understanding system requirements
	Capable of understanding inspection implementation procedures, and performing as a system requirements specification review moderator
	Capable of understanding hardware functions, and determining software based control items by using function diagrams
	Capable of designing software based control items and control order by using hardware manuals, etc.
	Capable of creating block diagrams including hardware and software functionality assignments
	Capable of verifying, comprehending and understanding device design to be realized by using requirement specifications
	Capable of verifying implementability by using benchmarks
	Capable of performing verification of the implementability of required efficiency by understanding hardware and software efficiency
	Capable of deciding which real-time OS to use, and organizing customer software requirements into specifications
	Capable of selecting the appropriate methods to be used in the development model during software development
	Capable of explaining overall system states and event handling by using state transition tables
	Capable of evaluating requirements by using design reviews
	Capable of evaluating requirements by using walkthroughs
	Capable of deciding on the software block structure needed to realize requirement functions
	Capable of creating detailed class diagrams and sequence diagrams based on class diagrams and collaboration diagrams
	Capable of deciding software structure, taking computer architecture into account
	Capable of performing walkthroughs, and confirming software design validity
	Capable of performing program quality confirmation by checking integration levels and removing unnecessary relationships between modules
	Capable of performing detailed software design by using software design methods best suited to the development project
	Capable of deciding on priorities for individual tasks in order to guarantee real-time operability required by the system by understanding task state transitions and priorities
	Capable of performing detailed software design that matches the characteristics of the real-time OS being used
	Capable of confirming detailed software design validity by performing design reviews
	Capable of confirming detailed software design validity by performing walkthroughs

First Layer	Second Layer	Skill Level					Skill Level Assessment Basis and Reason		
		Input	Lv1	Lv2	Lv3	Lv4			
6	Software Coding and Testing	1	Program Creation and Identification of Program Testing Items						
		2	Code Review and Program Test Item Design Review						
		3	Program Test Implementation						
7	Software Integration	1	Software Integration Test Specification Design						
		2	Software Integration Test Implementation						
8	Software Qualification Test	1	Software Qualification Test Preparation and Review						
		2	Software Qualification Test Implementation						
9	System Integration	1	Test Item Selection, Test Procedure Determination And Review						
		2	System Integration Test Implementation						
10	System Qualification Test	1	System Qualification Test Preparation And Review						
		2	System Qualification Test Implementation						

	Evaluation Description
	Capable of creating coding tools optimally suited to the development project
	Capable of selecting compiling options best suited to the development system
	Capable of using development languages such as C, C++, etc. to code function groups such as modules
	Capable of designing individual test items by understanding white box and black box testing
	Capable of creating execution environments for unit tests
	Capable of checking software quality by using static and dynamic analysis tools
	Capable of quantifying path coverage by using coverage tools, etc.
	Capable of deciding software integration test approaches
	Capable of creating stubs and drivers necessary for software integration testing
	Capable of creating test procedures, factoring in processing speed, and performing data volume design
	Capable of determining the completion of software integration testing by using reliability growth curves
	Capable of evaluating whether correction results are correct by performing regression testing
	Capable of identifying program bugs, and confirming whether bugs exist in the correction results by using ICE
	Capable of creating test input condition specifications based on input / output specifications
	Capable of planning effective test implementation orders
	Capable of confirming that no items have been overlooked during testing by walkthroughs
	Capable of creating test environments for the equipment, etc., being used
	Capable of testing functions based on input / output specifications by using actual units
	Capable of organizing test results, and evaluating the results of software qualification test
	Capable of creating test items in accordance with quality properties defined in system design documentation
	Capable of evaluating test contents with a clear categorization of functions realized via hardware and software
	Capable of preparing test environments
	Capable of performing tests in accordance with quality properties defined in system design documentation
	Capable of testing functions based on input / output specifications by using actual units
	Capable of creating test items which satisfy quality properties based on system requirements specifications
	Capable of establishing review plans, and selecting optimal review timing and members
	Capable of performing tests in accordance with quality properties required for the system
	Capable of performing operation and failure handling tests by following operation procedures and failure procedures based on reliability quality properties
	Capable of creating evaluation reports based on test implementation results

First Layer	Second Layer	Skill Level					Skill Level Assessment Basis and Reason
		Input	Lv1	Lv2	Lv3	Lv4	
1 Project Management	1 Integration Management						
	2 Scope Management						
	3 Time Management						
	4 Cost Management						
	5 Quality Management						
	6 Organization Management						
7 Communication Management							
8 Risk Management							
9 Procurement Management							

	Evaluation Description
	Capable of creating project plans by using project planning methods (cost and schedule plans, etc.)
	Capable of performing project plans while maintaining a positive relationship with stakeholders by using leadership, communication, and negotiating skills in implementing
	Capable of performing change management by determining the effect range (schedule, cost, risk, quality, personnel allocation) from performance measurement results accordingly
	Capable of writing a quantitative scope for project objectives (costs, schedule, quality, etc.) by using cost/benefit analysis
	Capable of defining project objectives, necessary tasks, and required deliverables by creating development plans
	Capable of verifying effective completion by comparing work results to defined project scopes, and receiving completion standard approval
	Capable of creating project and network diagrams which establish work order by using activity list based conditional branch diagram methods
	Capable of estimate the amount of time required by using analogous estimating based on actual values from similar previous activities
	Capable of performing schedule changes within schedule management by creating schedule change management rules, and using them
	Capable of performing resource cost estimates using initial project stage analogous estimating based on WBS and necessary resources
	Capable of performing cost management by measuring performance in accordance with established performance reporting rules
	Capable of performing cost change management procedures such as adjusting cost estimates or updating budgets by formulating additional plans needed for changes or problem corrections
	Capable of creating quality plans with clear quality standards and operation standards for the project based on cost/benefit analysis
	Understands QMS based quality properties, and is capable of performing quality evaluation
	Capable of performing project execution result analysis and monitor conformance with required quality standards. If the standards are not being met, the subject can perform quality improvements.
	Capable of creating project organization diagrams by using organization structure standards
	Capable of performing personnel procurement using personnel negotiation
	Capable of creating team education plans, based on a solid understanding of individual skills, and performing team education conformant with those plans
	Capable of performing stakeholder analysis and creating requirement oriented communication management plans
	Capable of performing performance review, and creating and distributing performance reports
	Capable of creating project completion procedures which serve as public project records by using project reports
	Capable of formulating risk management plans
	Capable of performing risk identification (identifying risks and their effects) by using schematic methods, such as characteristic factor diagrams
	Capable of performing risk monitoring and management by regular project risk review and revision
	Capable of selecting procurement sources in accordance with internal standards
	Capable of selecting order suppliers by performing order negotiations, including receiving inspection condition confirmation
	Capable of entering into contracts with suppliers based on systematic procurement inspection review by resolving unresolved contractual issues

First Layer		Second Layer		Skill Level					Skill Level Assessment Basis and Reason
				Input	Lv1	Lv2	Lv3	Lv4	
2	Process Management	1	Development Process Definitions						
		2	Intellectual Property Management						
		3	Development Environment Management						
		4	Configuration Management and Change Management						

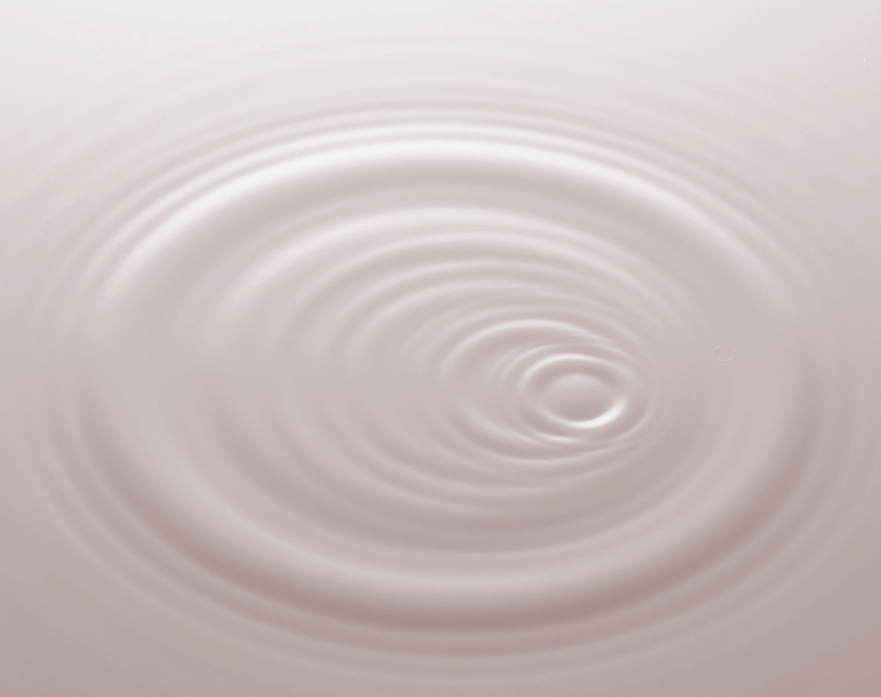
First Layer		Second Layer		Skill Level					Skill Level Assessment Basis and Reason
				Input	Lv1	Lv2	Lv3	Lv4	
1	Social Skills	1	Communication						
		2	Negotiation						
		3	Leadership						
		4	Problem-Solving						
2	Business Skills	1	Management						
		2	Accounting						
		3	Marketing						
		4	HCM (Human Capital Management)						

	Evaluation Description
	Capable of selecting proper development methods based on internal development method selection standards
	Capable of establishing optimal development models based on internal development model standards
	Capable of establishing review processes based on internal design review planning standards
	Capable of performing appropriate patent requests based on patent right application procedures
	Understands copyright law and can apply intellectual property right related regulations
	Capable of confirming that there are no breaches of patent rights or copyrights
	Capable of proposing development tool environment preparation plans and formulating development environment preparation plans
	Capable of performing development tasks analysis and selecting optimal development environments
	Capable of performing development environment evaluation and development environment management
	Capable of performing development processes change management in accordance with processes change management rules
	Understands configuration management operation regulations, and capable of performing configuration management in accordance with operation regulations
	Capable of performing configuration management using configuration management tools

	Evaluation Description
	To speak, listen, write, etc.
	Questions, investigation, statements, etc.
	Capability development, time management, motivation, etc.
	Observation, ideas, problem-solving, analysis, logical reasoning, etc.
	Analysis, strategy, assessment, etc.
	Financial analysis, accounting, etc.
	Analysis, market investigation, strategies, etc.
	Personnel strategies, personnel management, capability development, etc.

Part **4**

Practice Questions





Practice 1 Skill Item Selection

Question 1

The organization you belong to has decided to perform analysis of technological skills necessary for the next strategic product development.

Based on your experience and knowledge, decide on a “hypothetical next strategic product.”

Identify as many technological skill items that will be used in the “hypothetical next strategic product” as you can.

Question 2

Define appropriate layers for the categories of “technological elements,” “development technologies,” and “management technologies,” and use worksheets (1), (2), and (3) starting on page 114 to categorize the skill items you identified in question 1.



Practice 1 **Worksheet for Question 1**

(Hypothetical) Next Strategic Product

Technological Skills Used in Next Strategic Product

Technological Elements

Development Technologies

Management Technologies

Practice 1 Worksheet (1)-1 for Question 2

Technological Elements

First Layer		Second Layer		Third Layer	Fourth Layer	Skill Item
1	Communications	1	Wired			
		2	Wireless			
		3	Broadcast			
		4	Internet			
2	Information Processing	1	Information Input			
		2	Security			
		3	Data Processing			
		4	Information Output			
3	Multimedia	1	Voice			
		2	Still Image			
		3	Moving Image			
		4	Integration			

Practice 1 Worksheet (1)-2 for Question 2

Technological Elements

First Layer		Second Layer		Third Layer	Fourth Layer	Skill Item
4	User Interface	1	Human Interface Input			
		2	Human Interface Output			
5	Storage	1	Media			
		2	Interface			
		3	File System			
6	Measurement and Control	1	Physical and Chemical Input			
		2	Measurement and Control Processing			
		3	Physical and Chemical Output			
7	Platform	1	Processor			
		2	Basic Software			
		3	Support Function			

Practice 1 Worksheet (2)-1 for Question 2

Development Technologies

First Layer		Second Layer		Third Layer	Fourth Layer	Skill Item
1	System Requirements Analysis	1	Requirements acquisition and adjustment			
		2	System analysis and requirements definition			
		3	Review of system analysis and requirements definition			
2	System Architecture Design	1	Hardware and software function and performance assignment decision			
		2	Implementability verification and design review			
3	Software Requirements Analysis	1	Software requirements definition			
		2	Software requirements evaluation and review			
4	Software Architecture Design	1	Software structure determination			
		2	Software structure design review			
5	Detailed Software Design	1	Detailed software design			
		2	Detailed software design review			

Practice 1 Worksheet (2)-2 for Question 2

Development Technologies

First Layer		Second Layer		Third Layer	Fourth Layer	Skill Item
6	Software Coding and Testing	1	Program creation and identification of program testing items			
		2	Code review and program test item design review			
		3	Program test implementation			
7	Software Integration	1	Software integration test specification design			
		2	Software integration test implementation			
8	Software Qualification Test	1	Software qualification test preparation and review			
		2	Software qualification test implementation			
9	System Integration	1	Test item selection, test procedure determination and review			
		2	System integration test implementation			
10	System Qualification Test	1	System qualification test preparation and review			
		2	System qualification test implementation			

Practice 1 Worksheet (3) for Question 2

Development Technologies

First Layer		Second Layer		Third Layer	Fourth Layer	Skill Item
1	Project Management	1	Integration Management			
		2	Scope Management			
		3	Time Management			
		4	Cost Management			
		5	Quality Management			
		6	Organization Management			
		7	Communication Management			
		8	Risk Management			
		9	Procurement Management			
2	Process Management	1	Development Process Definitions			
		2	Intellectual Property Management			
		3	Development Environment Management			
		4	Configuration Management and Change Management			



Reference Examples of Technological Skill Items

Technological Elements

TCP/IP, USB, Bluetooth, IrDA, VoIP, PPP, EPG (Electronic Program Guide), RDB, ODBC, markup language, MP3, JPEG, PNG, H.264, MPEG2/4, mouse control, alpha blending, 3DCG, removable media, ATA/ATAPI, SCSI, PCMCIA, ISO9600, A/D conversion, pressure sensors, motor control, ARM processors, SH processors, embedded Linux, μ ITRON, software updates, tracing

Development Technologies

Interview methods, characteristic factor diagrams, UML, state transition tables, review methods, review check sheets, FTA, performance design methods, benchmark methods, structured analysis methods, walkthrough methods, formal verification methods, object design methods, coding conventions, C programming language, Java, test coverage tools, c PUnit, path test methods, ICE, organization stress test regulations, bug tracking tools

Management Technologies

Spiral development, EVM methods, WBS, arrow diagrams, Gantt charts, analogous estimating methods, benchmarking methods, responsibility assignment matrix methods, OBS, Delphi method, ETSS skills specification, GPL, SLCP, cvs, bug tracking tools



Practice 2 Skill Diagnosis

Question 1

Enter your “technological element” skill levels (1 to 4) in the skill diagnosis sheet. (Enter level 0 if you have no experience)

Question 2

Enter your “development technology” skill levels (1 to 4) in the skill diagnosis sheet. (Enter level 0 if you have no experience)

Question 3

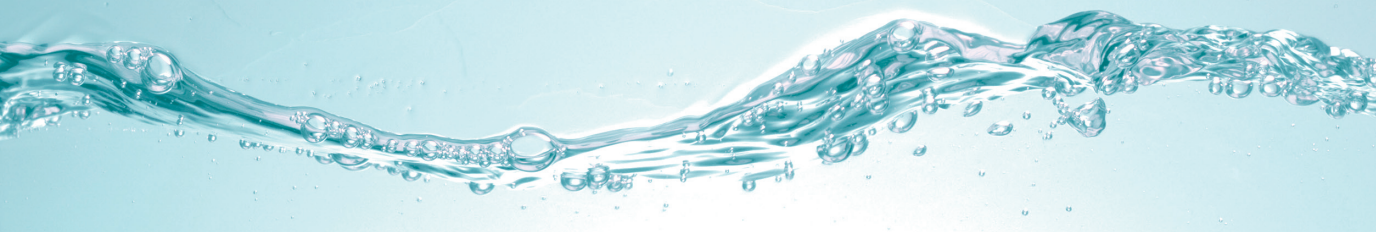
Enter your “management technology” skill levels (1 to 4) in the skill diagnosis sheet. (Enter level 0 if you have no experience)

Practice 2 Worksheet for Question 1

Skill Category	Skill Granularity		Skill Level				Evaluation Description (Can Utilize To Implement Required Functions)	
	First Layer	Second Layer	1	2	3	4		
Technological Elements	Communications	Wired Communications					Capable of embedding TCP/IP technological elements Capable of embedding USB technological elements	
		Wireless Communications					Capable of embedding Bluetooth technological elements Capable of embedding IrDA technological elements	
		Internet					Capable of embedding VoIP technological elements Capable of embedding PPP/PPPoE technological elements	
		Information Processing	Information Input					Capable of embedding EPG (Electronic Program Guide) technological elements
			Security					Capable of embedding DTCP technological elements Capable of embedding AES technological elements
	Data Processing						Capable of embedding RDB technological elements Capable of embedding ODBC technological elements	
	Information Output						Capable of embedding markup language technological elements	
	Multimedia	Audio					Capable of embedding AAC technological elements Capable of embedding MP3 technological elements	
		Still Image					Capable of embedding JPEG technological elements Capable of embedding PNG technological elements	
		Moving Image					Capable of embedding H.264 technological elements Capable of embedding FlashPlayer technological elements	
		Integration					Capable of embedding MPEG2/4 technological elements	
	User Interface	Human Interface Input					Capable of embedding mouse driver technological elements Capable of embedding tablet driver technological elements	
		Human Interface Output					Capable of embedding embedding-oriented window system (2D, 3D) technological elements Capable of embedding alpha blending technological elements Capable of embedding 3DCG technological elements	
			Storage	Media				Capable of embedding removable memory control technological elements Capable of embedding HD control technological elements Capable of embedding optical disc control technological elements
				Interface				
	File System						Capable of embedding UDF standard compliant programs Capable of embedding ISO9660 standard compliant programs	
	Measurement and Control	Physical and Chemical Input					Capable of embedding A/D conversion technological elements Capable of embedding pressure sensor technological elements	
		Measurement and Control Processing					Capable of embedding motor control technological elements	
		Physical and Chemical Output					Capable of embedding D/A conversion technological elements Capable of embedding stepping motor control technological elements	
	Platform	Processor					Capable of embedding ARM processor technological elements Capable of embedding SH processor technological elements Capable of embedding μ TRON platform technological elements Capable of embedding embedded Linux platform technological elements	
							Capable of embedding Symbian platform technological elements	
			Support Function					Capable of embedding software update technological elements Capable of embedding operation traceability technological elements

Practice 2 Worksheet for Question 2

Skill Category	Skill Granularity		Skill Level			
	First Layer	Second Layer	1	2	3	4
Development Technologies	System Requirement Analysis	Requirements acquisition and adjustment				
		System analysis and requirements definition				
		System analysis and requirements definition review				
	System Architecture Design	Hardware and software function and performance assignment decision				
		Implementability verification and design review				
	Software Requirement Analysis	Software requirements definition				
		Software requirements evaluation and review				
	Software Architecture Design	Software structure determination				
		Software structure design review				
	Detailed Software Design	Detailed software design				
		Detailed software design review				
	Software Coding and Testing	Program creation and identification of program testing items				
		Code review and program test item design review				
		Program test implementation				
	Software Integration	Software integration test specification design				
		Software integration test implementation				
	System Integration	Test item selection and test procedure determination and review				
		System integration test implementation				



	Evaluation Description
	Capable of determining customer requirements and creating system requirements specifications by using interview methods
	Capable of performing system requirements priority order analysis and adjustment by using schematics
	Capable of performing requirements condition analysis, and creating system requirements definition documents in order to realize the requirements by using UML use case diagrams
	Capable of illustrating overall system states and event handling by using state transition tables
	Capable of reviewing system requirements documents by using review methods
	Capable of evaluating review accomplishment levels and specifying items requiring corrective measures by using review check sheets
	Capable of analyzing system fault tolerant methods by using FTA (Fault Tree Analysis) method
	Capable of performing hardware / software tradeoff design by using performance design methods
	Capable of verifying system architecture implementability by using benchmark methods
	Capable of determining system architecture design validity, coverage, etc. by using review methods
	Capable of categorizing and defining software requirements by using structured analysis methods
	Capable of explaining overall system states and event handling by using state transition tables
	Capable of evaluating requirements by using design review methods
	Capable of evaluating requirements by using walkthrough methods
	Capable of describing software structure by using UML class diagrams
	Capable of designing and describing interfaces between software modules by using structured design methods
	Capable of evaluating software structure design by using walkthrough methods
	Capable of evaluating the validity of interfaces between software modules by using formal verification methods
	Capable of performing detailed software design by using object design methods
	Capable of performing detailed software design by using structured design methods
	Capable of evaluating detailed software design by using review methods
	Capable of confirming detailed software design validity by using walkthrough methods
	Capable of creating coding rules optimally suited to the development project by using coding conventions
	Capable of programming in C
	Capable of performing software code review by using pair programming
	Capable of evaluating test case coverage by using test coverage tools
	Capable of checking software quality by using static and dynamic analysis tools
	Capable of automating software module testing by using cppUnit
	Capable of identifying software integration test case by using path test method
	Capable of writing software integration test specifications in accordance with organization document regulations
	Capable of evaluating whether correction results are correct by using regression test methods
	Capable of analyzing program bugs and their causes by using ICE
	Capable of performing system integration test case identification in accordance with organization stress test regulations
	Capable of performing system security related integration test case identification in accordance with organization security standards
	Capable of managing bugs in features they are responsible for by using bug tracking tools
	Capable of performing high load system integration testing using organization stress test environments

Practice 2 Worksheet for Question 3

Skill Category	Skill Layer	Skill Granularity		Skill Level				Evaluation Description						
		Second Layer		1	2	3	4							
Management Technologies	Integration Management	Scope Management	Time Management	Cost Management	Quality Management	Organization Management	Communication Management	Risk Management	Procurement Management	Development Process Definitions	Intellectual Property Management	Development Environment Management	Configuration Management and Change Management	Capable of proposing spiral development project development plans
														Capable of proposing schedule and resource integration plans by using EVM methods
	Project Management	Scope Management	Time Management	Cost Management	Quality Management	Organization Management	Communication Management	Risk Management	Procurement Management	Development Process Definitions	Intellectual Property Management	Development Environment Management	Configuration Management and Change Management	Capable of performing project deliverables analysis and creating scope definition documentation by using function analysis methods
														Capable of clarifying project task items with WBS
														Capable of performing project schedule analysis by using ADM (Arrow Diagramming Method) methods
														Capable of performing project schedule plan and actuality management by using Gantt charts
														Capable of creating project cost estimates by using analogous estimating methods
														Capable of predicting final project costs by using EVM methods
														Capable of quantitatively proposing project quality plans by using benchmark methods
														Capable of understanding project quality conditions in relation to the quality plan by using sampling methods
														Capable of proposing project responsibility scopes and assignments by using responsibility allocation matrix methods
														Capable of creating organization structure charts by using OBS (Organization Breakdown Structure)
														Capable of creating a project information sharing system by using mailing lists
														Capable of proposing communication implementation plans by using OBS (Organization Breakdown Structure)
														Capable of identifying latent project risks by using Delphi method
														Capable of proposing quantitative risk handling plans by performing decision tree analysis
Capable of performing objective selection of procurement sources by using weighting methods														
Capable of creating ETSS skills specification based procurement documentation														
Capable of tailoring SLCP compliant development processes														
Capable of analyzing development processes improvement points by using quantitative performance analysis methods														
Capable of formulating policies for GPL (General Public License) related projects														
Capable of proposing project intellectual property management plans in accordance with internal intellectual property management rules														
Capable of performing situation management of project development environments using internal development management documents														
Capable of performing package software license condition compliant software environment management														
Capable of operating configuration management environments with cvs														
Capable of operating traceable operations using bug tracking tools														



Practice 3 Existing Job Category Mapping

Question 1

Enter your current job category name.

Enter the roles and responsibilities the job category entails.

Select the level you feel is correct from below for your job category.

Career Level 5 - 7

You are an organization, company, or industry leader in the roles and responsibilities entailed by the job category

Career Level 3 - 4

You can perform the roles and responsibilities entailed by the job category by yourself (full-fledged)

Career Level 1 - 2

You can perform the roles and responsibilities entailed by the job category with support (half-fledged)

Question 2

What skills and knowledge are necessary to carry out the roles and responsibilities of the job category entered in question 1?

Color the necessary skills and levels on the practice sheet on page 127. Use red for required skills, and blue for required knowledge.



Practice 3 Worksheet for Question 1

Job Category Name

Roles and Responsibilities of the Job Category

Career Level (Check the appropriate box)

Career Level 5 - 7

You are an organization, company, or industry leader in the roles and responsibilities entailed by the job category

Career Level 3 - 4

You can perform the roles and responsibilities entailed by the job category by yourself (full-fledged)

Career Level 1 - 2

You can perform the roles and responsibilities entailed by the job category with support (half-fledged)

Practice 3 Worksheet for Question 2

			L1	L2	L3	L4
Business Skills		HCM				
		Marketing				
		Accounting				
		Management				
Social Skills		Problem-Solving				
		Negotiation				
		Communication				
		Leadership				
Management Technologies	Process Management	Configuration Management & Change Management				
		Development Environment Management				
		Intellectual Property Management				
		Development Process Definitions				
	Project Management	Procurement Management				
		Risk Management				
		Communication Management				
		Organization Management				
		Quality Management				
		Cost Management				
		Time Management				
		Scope Management				
		Integration Management				
		Development Technologies	System Qualification Test			
System Integration						
Software Qualification Test						
Software Integration						
Source Code Creation and Testing						
Detailed Software Design						
Software Architecture Design						
Software Requirements Analysis						
System Requirements Analysis						
System Design						
Technological Components	Platform					
	Measurement and Control					
	Storage					
	User Interface					
	Multimedia					
	Information Processing					
	Communications					