Skill Standards for IT Professionals, Version 3

Part 3: Skills

English edition Draft 2.0   April 2008

INFORMATION-TECHNOLOGY PROMOTION AGENCY, JAPAN
IT Human Resources Development Headquarters
IT Skill Standards Center

Ministry of Economy, Trade and Industry

Contents

Introduction

Part 3: Skill describes skills from the following perspectives: *skill dictionary,* which covers all skill items and all knowledge items for each job career and all specialty fields for each job career; *skill area*, which is organized by skill structure and knowledge structure for each career; *skill proficiency*, which is organized by skill items and proficiency level on each level for the career; and *training roadmap,* which illustrates the training subject that should be learned corresponding to the skill standards for each career.

This part organizes the capabilities necessary in order to achieve the business experience and performance described in the KPI. Those are the indexes utilized while designing education and training.

Figure 1 is the total constitution of Part 3: Skills.
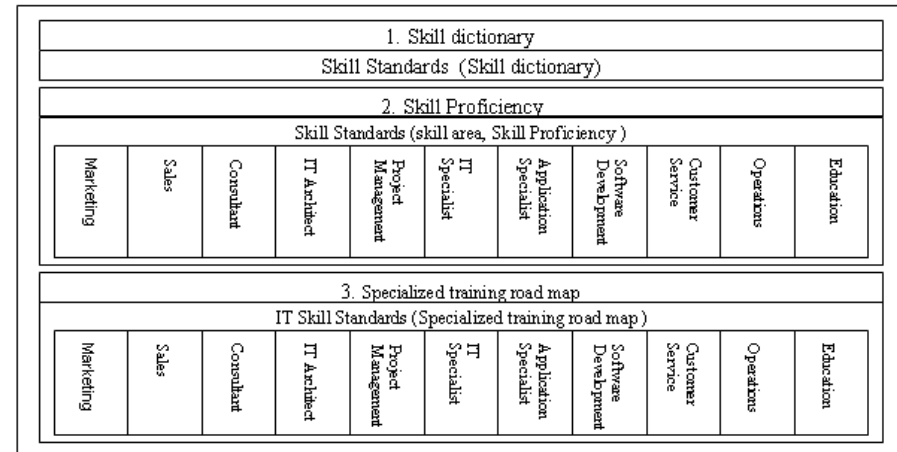

Figure 1. Total constitution of Part 3: Skills

●Revision history

  – 1 April, 2006, First version

  －7 July, 2006, The Education and Training Roadmap V2 released

  －31 October, 2006 V2 2006 released

  －31 March, 2008 V3 released

1. Skill Dictionary

1.1 Skill Dictionary

(1) Skill Dictionary

The skill dictionary covers and organizes all skill items and knowledge items that are defined in the skill standards. Skill items and knowledge items are organized into a hierarchy and show the corresponding job career and specialty fields in catalogue style.

Furthermore, the skill dictionary changes the color for every career, which improves visibility.

[Description Style]

・Job Category: Shows all the job category commonalities or each job category name

・Skill category: Shows the skill classification based on the characteristics, Technology, methodology, project management, business/industry and personal.

・Skill item: Shows the skill item. In addition, the separate column is used for the job category common skill items and specific specialty field skill items.

・Knowledge item: Shows the knowledge item for each skill item. Knowledge items are extended to two layers to describe the detail. Middle layer items (or middle items) are included in the skill description and skill proficiency, but lower layer items (or small items) are only

included in the skill dictionary.

・Specialty field: The corresponding skill item and the knowledge item for the category and specialty field is shown with the "X."

Figure 2. Example of Skill dictionary

(2) Skill Dictionary (The corresponding table)[1]

Skill Dictionary has listed Skill and Knowledge items defined in ITSS, corresponding to those items in ITEE.

Important skills and knowledge for IT professionals are marked by using "X",

---

[1] Skill Dictionary: the table showing the correspondence between ITSS skills and ITEE skills

even if that skills and knowledge are not belonged to the specialty in the job category.

The columns of the corresponding skill and knowledge items in ITEE are shown with colors of job categories of ITSS.

In addition, based on future review of those items of ITEE, the Skill Dictionary of ITSS should be revised.

NO.	Large classification	Middle classification	Small classification	Market Communication	Value chain sales	Visit type product sales	Media use type sales	System development	Software development	Platform	Network	Database	Common Application infrastructure	System Management	Security	Operating system	Application package	Operation software	Middle software	Applied software	Hardware	Software	Facility management	Management	System management	Operation	Service desk	Level 1 and 2 common items
1-1	Basic theory	Basic theory	Discrete mathematics	X	X	X	X	X	X																			
1-2			Applied mathematics	X	X	X	X	X	X	X	X	X	X	X	X													
1-3			Theory for information	X	X	X	X	X	X	X	X	X	X	X	X													
1-4			Theory for communication	X	X	X	X	X	X									X	X	X	X	X	X					
1-5			Theory for Measuring and control	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						X		
2-1		Algorithm and programming	Data structure	X	X	X	X	X	X																			
2-2			Algorithm	X	X	X	X	X	X																			
2-3			Programming	X	X	X	X	X	X												X	X	X	X	X	X	X	
2-4			Programming language	X	X	X	X	X	X															X	X	X	X	
2-5			Other IT languages	X	X	X	X	X	X															X	X	X	X	
3-1	Computer system	Computer components	Processor	X	X	X	X	X	X												X	X	X					
3-2			Memory	X	X	X	X	X	X												X	X	X					
3-3			Bus	X	X	X	X	X	X												X	X	X					
3-4			Input and output device	X	X	X	X	X	X												X	X	X					
3-5			Input and output unit	X	X	X	X	X	X												X	X	X					
4-1		System components	System structure	X	X	X	X	X	X												X	X	X					
4-2			System evaluation index	X	X	X	X	X	X												X	X	X					
5-1		Software	Operating system	X	X	X	X	X	X																			
5-2			Middleware	X	X	X	X	X	X			X	X			X	X				X	X	X					
5-3			File system	X	X	X	X	X	X			X		X	X						X	X	X					
5-4			Development tool	X	X	X	X	X	X	X	X	X		X	X													
5-5			Open source software	X	X	X	X	X	X	X	X	X		X	X	X	X				X	X	X					
6-1		Hardware	Hardware	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					

Figure 3. Example of Skill Dictionary (the corresponding table)

2. Skill Proficiency

"Skill item", "knowledge item", "skill proficiency", and "skill area" are indexes defined in order to utilize business capabilities, which are necessary for the career and specialty field, in education and training.

2.1 Skill items, Knowledge items

The capability for business performance and experience defined in the KPI, is breakdown into elements, then rearranged by "Skill items". "Knowledge items" indicate the knowledge that is utilized in each skill item.
Each skill item is classified into the following categories.

Skill category	Explanation
Technology	Technology skills necessary for successful job performance
Methodology	Skills such as methods, and problem-solving techniques needed for successful job performance
Business / Industry	Knowledge need-to-know for in the job career and specialty field. Industry specific phenomenon, industry trends, laws, codes, etc.
Project Management	Skill necessary for successful project performance
Personal skill	Personal skills needed for job performance

The skill standards does not include the following detailed descriptions from a general perspective as a standard.

- Elemental technology regarding individual products or services that are necessary in the short term according to the project phase
- Industry application knowledge that differs in every industry, such as production or finance
- Individual motivation and traits, including social responsibility and ethics as a professional

These are what each company needs to select for assigned project, business strategy of employer, and the career path of individual imagined. In addition, specific skills, which are necessary for performing assigned jobs, are what an individual needs to voluntarily acquire as a professional.

2.2 Skill Proficiency

(1) Contents of Skill Proficiency

Skill proficiency systematically demonstrates the degree of proficiency and its corroborating knowledge , regarding the skill items necessary for experience and performance indicated in KPI (key business performance indicators).
For example, within the same knowledge item, the degree of understanding differs largely from the level of simply knowing a summary to the level of deep understand sufficient to write a paper. Skill proficiency is an index of clear

degrees of proficiency. Figure 4 is an example of skill proficiency and knowledge items for Project Integration Management, which is a job career common skill items in the project management career.

Figure 4. Example of Skill Proficiency/Knowledge Items (Project Management)

(2) Description Style of Skill Proficiency

Skill proficiency consists of skill items, knowledge items, and criteria for proficiency. It represents the level of each skill item possessed by an individual, and it is defined in expressions of capability, such as "able to do …."

[Description Style]

<Level 7,6,5,4 and 3>

Able to do <degree of action> as a <responsibility> with <quantitative and qualitative job condition> by performing <behavior content>

• Quantitative and qualitative job condition: Provides the quantitative and qualitative aspects of experience and performance. The details differ depending on the career, specialty, and level.

• Responsibility: The range of responsibility and authority.

• Behavior content: The contents of behavior for a skill item, regardless of levels.

• Degree of behavior: Describes the degree or a range of capability to perform behavior contents, such as "able to perform successfully", "able to carry out", and so on.

<Level 2 and Level 1>

Able to do <degree of application> as <a responsibility> with <contents> of skill and knowledge items

· Content: Level 2 － "Fundamental knowledge",
        Level 1 － "Introductory-level knowledge"

· Degree of application: Level 2－Utilizes skills and knowledge, and

perform assinged duties under the direction of higher-level professionals

Level 1－Have skills and knowledge

For responsibility, the roles assumed in each level are provided as follows.

Level	Responsibility
Level 7	
Level 6	As a person responsible
Level 5	
Level 4	As a leader
Level 3	
Level 2	As a member
Level 1	

Skill proficiency describes the middle-layer items. Detailed knowledge items for the low-layer are described in the skill dictionary only.

2.3 Skill Area

The skill area rearranges the necessary skill items and knowledge items in each category and specialty field. Skill items are defined after dividing the category common skill items and specialty field specific skill items.

In lower levels (level 2, level 1), it is important to acquire skills and knowledge widely with a goal of high-level IT HR, and the range of ITEE is defined as the skill areas.

Figure 5. Example of Skill Area (Project Management)

Important skills and knowledge for IT professionals are listed in the skill dictionary even if those skills and knowledge are not belonged to the

specialty in the job category.

Among the job category common skill items, the skill items that are listed in the next table are defined commonly for all categories.

Skill Category	Skill Item	Knowledge items
Project Management	Project Management[2]	Project integration management
		Project scoop management
		Project time management
		Project cost management
		Project quality management
		Project human resource management
		Project communication management
		Project risk management
		Project procurement management
Personal	Leadership	Leadership
	Communication	Two-way communication, transmission of information, organization, analysis, and retrieval of information
	Negotiation	Negotiation

The skill items common to all job categories are necessary skills as a base for business.

For example, it is common to work in the project form in the information service industry; therefore, basic knowledge about project management is required regardless of the level (for example, even in entry level).

However, even though the skill item names are same, these details, which are required in each job category, are not identical because of the difference in subjects, ranges, and responsibilities of exercising skill in performing the assigned duties. These skill items, which differ in every category, vary with the circumstances and environment. Therefore, the definition of each category simply describes the common level as the knowledge item.

The statement of the details differ depending upon the category even though the skill item names are the same and include the meaning that it is necessary for considering the skill contents, which are adjusted for their business. This is a point that should be considered during a skill appraisal.

[2] The description of Project Management is consistent with "A Guide To The Project Management Body Of Knowledge, Third Edition".

3. The Education and Training Roadmap

3.1 The Education and Training Roadmap

(1) The objective of Education and Training Roadmap

The Education and Training Roadmap should be used as a reference model to educate and train employees in the corporations that use the ITSS corresponding to Education and Training.

In order to increase the business capabilities as IT professionals, it is fundamental for individuals to accumulate their business experiences and obtain results being aware of the issues intentionally. On the other hand, it is also important to master prerequisite knowledge adequately in inexperienced fields. The Education and Training Roadmap is designed to help individuals acquire such knowledge.

(2) Points to remember

The Education and Training Roadmap design relies on IT service companies and industry professionals unlike the corporate curricula designed as in-house educational packages. This is based on the need for corporations to flexibly reflect practical business circumstances in educational packages. This, in turn, requires the company to create a blueprint of its educational needs—what technologies should be acquired by employees and how. Such an approach is useful for not only the corporate education program ,but also

the objective understanding of the corporate technical strengths and weaknesses.

For IT service companies to increase their competitiveness in the industry, it is important to invest in the education of human resources in the same way that manufacturing companies invest in R&D and facilities. Such investments include a systematic educational system for their employees. However, most companies find it difficult to prepare complete education programs in-house. To ensure the quality of the educational program, it is effective for companies to cooperate with external educational institutions, private education providers, and industry associations.

3.2 The Education and Training Roadmap Structure

(1) Course Groups (System chart)

The system chart shows the course groups to increase the business capabilities in their job categories or transfer to another category.
Figure 6 shows samples of Education and Training Roadmap for an IT specialist work category.

	Beginner Level	Entry Level		Middle Level		High Level		
		Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
Technology	IT Fundamentals 1 / IT Fundamentals 2	System Development Fundamentals	Component Technology	Latest IT Trends		Community Activities		
			System Design	High level System Design				
			System Construction	High level System Construction				
			System Operation/ Maintenance	High level System Operation/ Maintenance				
Methodology				Solution Methodology				
					System Management Solution			
				Consulting Methodology				
Project Management				Project Management Fundamentals				
Business/ Industry			Industry Operation Knowledge Fundamentals	Industry Applications Trends				
				Latest Business Trends				
Personal		Leadership Fundamentals		Leadership for IT Specialist				
		Communication Fundamentals		Communication for IT Specialist				
		Negotiation Fundamentals		Negotiation for IT Specialist				

: Common to All Types of Professions   : Choice by Specialty Fields

Figure 6. Example IT Specialist (Platform) Course Group

The horizontal direction of Course Groups shows the levels of trainees. Trainees plan to receive the course corresponding to current level of own.

Before the Entry level, "the Beginner Level" course is created for individuals who need to have education to entry for professionals in ITSS. The "Beginner Level" courses are designed to master the basics of IT for entry-level IT professionals (i.e., to have a job in the IT service industry).
The companies in IT industry hope the job applicants have basic IT skills and

knowledge for IT professionals. However, the current situation in Japan is such that university graduates with insufficient knowledge of IT are being hired by companies. Companies must then bear the cost of additional education. The fact that Beginner Level has been created reflects the need for this type of education at the university level, and is an implicit message from the industry to the educational community.

On the other hand, high-level knowledge is not teachable by lesson. The high-level professionals improve their business capability by the difficult and responsible tasks and community activity with other high-level professionals. The high-level professionals should participate in community activity to contribute to society and industry. The high-level professionals should develop subordinates also.

The vertical direction of Course Groups shows the five categories of technical contents: technology, methodology, project management, business /industry and personal. This is the same classification shown in the skill items.

Skill category	Explanation
Technology	Technical skills necessary for successful job performance
Methodology	Skills such as methods, and problem-solving techniques needed for successful job performance
Project Management	Skill necessary for successful project performance
Business / Industry	Knowledge need-to-know for in the job category and specialty field. Industry specific events industry trends, laws, codes, etc.
Personal	Personal skills needed for job performance

(2) List of Education Courses

The list of the Education Courses shows the contents of each Education courses, delivery method and number of sessions or hours.

Category of Course Group		Course Group	Course Title	Delivery Method			Duration	
				e-Learning	Lecture	Workshop	e-Learning (Time Normally Required)	Class (Days Normally Required)
Common to All Types of Professions	Entry-Level Course	IT Fundamentals 1	Introduction to IT	X			60	
			Introduction to Personal Skills	X	X	X	12	3
		IT Fundamentals 2	IT Engineer Fundamentals	X		X	36	
			Programming Fundamentals	X	X	X	30	5
	Fundamental Course	System Development Fundamentals	Application Development Fundamentals	X			24	
			Database Fundamentals	X			12	
			Network Fundamentals	X			24	
			Security Fundamentals	X			18	
		Leadership Fundamentals	Leadership Fundamentals	X	X		9	1
		Communication Fundamentals	Communication Fundamentals	X	X		9	1
		Negotiation Fundamentals	Negotiation Fundamentals	X	X		9	1
		System Design	System Design Fundamentals	X	X	X	30	5
			Main Application Design (Common to All Industries)	X			6	
			Main Application Design (Industry)	X			6	
		System Construction	System Construction	X		X	60	5
		System Operation/Maintenance	System Operation/Maintenance	X	X	X	30	5
		Industrial Operation Knowledge Fundamentals	Industrial Operation Knowledge Fundamentals	X			12	
		Methods of Defining System Requirements	Methods of Defining System Requirements	X		X	12	3
		Consulting Methodology	Consulting Methodology	X		X	12	2
		Project Management Fundamentals	Project Management Fundamentals	X			30	
	Advanced course	Leadership in Application Specialist	Leadership in Application Specialist			X		3
		Communication for Application Specialist	Communication for Application Specialist			X		3
		Negotiation for Application Specialist	Negotiation for Application Specialist			X		3
	Special Course	Latest IT Trends	Latest IT Trends		X			1
		Industry Application Trends	Industry Application Trends	X	X		12	2
		Latest Business Trends	Latest Business Trends	X	X		3	0.5
		Community Activities	Community Activities	-	-	-	-	-
Choice by Area of Specialization	Fundamental Course	Component Technology Fundamentals	Component Technology Fundamentals	X			12	
	Advanced course	Advanced Component Technology	Component Technology for Platform	X			18	
			Component Technology for System Management Basis		X	X		5
			Component Technology for Database	X	X		18	3
			Component Technology for Network	X			12	
			Component Technology for Distributed Computing System	X	X		18	3
			Component Technology for Security	X	X		18	3
		Advanced System Design	Advanced Business Application System Design		X	X		5
		Advanced System Construction	Advanced Business Application System Construction	X		X	30	5
		Advanced System Operation/Maintenance	Advanced Business Application System Operation/Maintenance	X		X	60	5
		System Development Methodology	Business Application System Development Methodology	X		X	30	5

Figure 7. Example Application Specialist (Operating Systems) Course Content

Applicable method for each Education Course is indicated by an "X", and the

average numbers of sessions or hours are provided as well.

■ E-learning

This delivery method enables students to acquire skills using their own computers, without attending the class session. Instructional materials such as CD-ROMs and online training through ASPs (Application Service Providers) are available.

■ Lecture

This delivery method is a face-to-face method where one instructor teaches multiple students. In general, it takes the form of one-way communication where information is conveyed only in one direction—from the instructor to the student.

■ Workshop

In contrast to the lecture delivery method, this method is based on two-way communication—between the instructor and the student. Generally, the number of students participating in workshops is less than in lectures.

The duration shows normally required hours in e-learning and normally required days in class (lectures and workshops).

(3) Education Course Description

Shown below is a list of the courses and their description. It shows the course outline, audience, prerequisites, educational objectives, etc.

Course Description \ Course Title	Architect Fundamentals: Overview of IT Architect
Classification of Course	☐ Entry-Level Course ■ Fundamental Course ☐ Advanced Course ☐ Special Course
Target Field of Specialization	■ Common to IT Architect ☐ Application ☐ Data Service ☐ Network ☐ Security ☐ System Management
Overview	This course is designed to help students understand the fundamental methodology of consulting, a consulting process, and the technique used in the consulting process. In the first half of this course (e-Leaning), students will: - Learn about the flow of the overall consulting process: consulting techniques, collection, arrangement, and methods of analyzing data, methods of clarifying and analyzing problems, methods of reviewing and determining solutions, logical and effective reporting of problem solution processes, presentation techniques, negotiation techniques. In the second half of this course (workshop), students will: - Learn how to apply consulting processes to evaluate examples (workshop).
Audience	This course is intended for students who: - Have experience participating in multiple projects as a technical member - Have an aim to lead the architectural part in projects as a technical team leader - Have an aim to be a level 4 or 5 in "IT Architect"
Prerequisites	- Fundamental knowledge of IT and system development - An experience to participate in a project as a technical member
Delivery Methods	e-Learning, lecture
Duration	First half of course: time normally required: 6 hours (e-Learning: 6 hours a day x 1 day), last half: days normally required: 3 days (classroom)
Educational Objectives	- Ability to understand basic duties, designs, and frameworks of IT architect - Ability to build successful solution architecture with knowledge of building architecture, design, and the latest technology as a technical team leader or a person in charge of a technical team.

Figure 8. Example of IT Architect (First Half) Course Content

■ Classification of Course

The Education Courses have been classified into Entry-level courses, Fundamental courses, High-level courses and Special courses:

Entry-level courses	Beginner to Level 1
Fundamental courses	Level 1 to 3
High-level courses	Level 3 and above
Special courses	Courses for learning the latest trends in business and technology

The Education and Training Roadmap shown in Figure 7 assumes that the IT service companies will provide education courses. E-learning is highly recommended, because it enables busy professionals to obtain knowledge in their own pace in an efficient way. The lecture and the workshop delivery methods are also important in that they present content linked to practical business cases. In order to achieve highly efficient education, it is important that "who teaches what" and "how." Therefore, high-level professionals' contribution is essential.

■ Target Specialty Field

The Education Courses have been divided into the courses for all IT professionals and the courses for specialists

■ Overview

This item describes the objective of the training course and the highlights.

■ Audience and Prerequisites

This item describes who can take the course and the prerequisite knowledge and experience required for enrollment.

■ Delivery Methods and Duration

The shown reference samples help to design the education courses. The duration figure indicated here is a rough estimate. The combination of lectures and workshops is described as a classroom.

■ Educational Objectives

This figure shows the expected degree of accomplishment of students in business capability after the completion of their course.

Target Skill Item	Related Knowledge

Architecture Building	-Solution architecture building
	  Analysis and definition of business requirements, examination and preparation of solution structure
	-Analysis of requirements
	  Business goals, understanding of business goals, analysis of business requirements, definition, prioritization

Design	-Reutilization technique
	  Software patterns, software patterns, software components
	-Utilization and practice of technical verification technique
	  Prototyping, simulation, modeling
	-Scale-estimation
	-Application of IT standards
	-Understanding of architecture models
	  Functional models, operational models

Technology	-Latest IT Trends
	  Understanding of the latest hardware technology trend, understanding of current technology trends on middleware, understanding of current technology trends on platforms, understanding of current technology trends on networks, understanding of current technology trends on databases, understanding of current technology trends on security, and understanding of current technology trends on system management services.
	-Current IT markets trends
	  Understanding of current domestic and foreign IT markets trend and their scales, understanding current technology trends on applications, understanding of current technology trends on business patents, understanding of e-Business and its development for the next generation

Figure 9. Example of   IT Architect (Second Half) Course Content

■ Target Skill Items/Related Knowledge

"Target Skill Items" and "Related Knowledge" in the education courses list the skills items and knowledge items of ITSS that most closely resemble the skills required in the course. This list was created after a careful consideration of skills available in the IT services industry, such as those offered in ITEE and in the PMBOK (the Project Management Body of Knowledge) systems. Consistency its style has been maintained between the IT Skill Standards and the Education and Training Roadmap, and all essential content has been included.

(4) Matrix Chart of Knowledge Items and Education Courses

Shown below is a figure including a matrix of the knowledge items and courses. The Knowledge Items that should be mastered in each education course are marked with an "X".

Figure 10. Matrix Chart of Education Courses and Knowledge Items for Application Specialist (Partial)

Figure 10 can be used in two ways. One use is to place emphasis in the horizontal direction (education course groups and names). By placing emphasis on the education courses, the student can easily refer to the list of Knowledge Items contained in each education course, making it easier to confirm the Knowledge Items required when taking multiple education courses.

The second use is to place emphasis in the vertical direction. By placing emphasis on the Knowledge Items, students can easily understand the courses they must take.

3. 3 Using the Education and Training Roadmap

(1) Transition within an Education Course

The course groups are mapped on the Education Roadmap. Course participants select a course corresponding to their current level. The course provides the necessary and sufficient condition knowledge items for the next level. For example in Figure 10, "System Development Fundamentals" is shown as an education course for level 1. A student may acquire the necessary knowledge of level 2 by taking this.
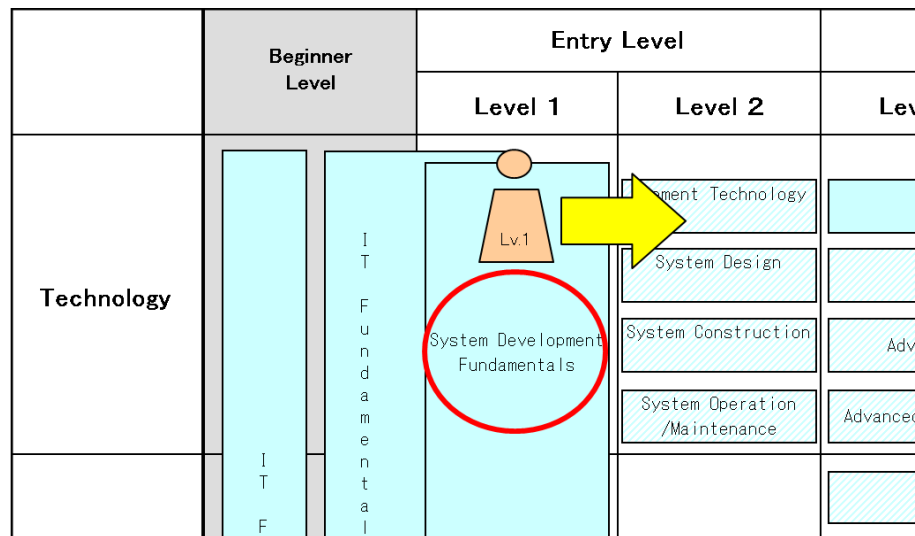

Figure 11.Example of a Transition

The level of course corresponds to the current level of an individual. Therefore, Beginner level is made before level 1. This level is for novice computer users such as students who have never worked in the IT service industry. For the same reason, lower level courses are made in some job categories. The lower level courses provide the knowledge for the lowest level defined in the ITSS. For example, in Project Management, level 2 is a preparation course for level 3.

For individuals who are seeking to move up to higher levels, it is recommended to have education course of the preceding level.

(2) Education Courses at multiple levels

There are also some courses in the Education Roadmap that are mapped at multiple levels. This has two implications.

First, it means that the course requires continuous learning. For example, if a course is mapped from level 3 through level 5, it shows that the course is not only for students at level 3, but also for those who have completed it and are now in levels 4 or 5. The courses that fall under this category are for students whose knowledge requires constant content updates in the latest industry and technology trends.
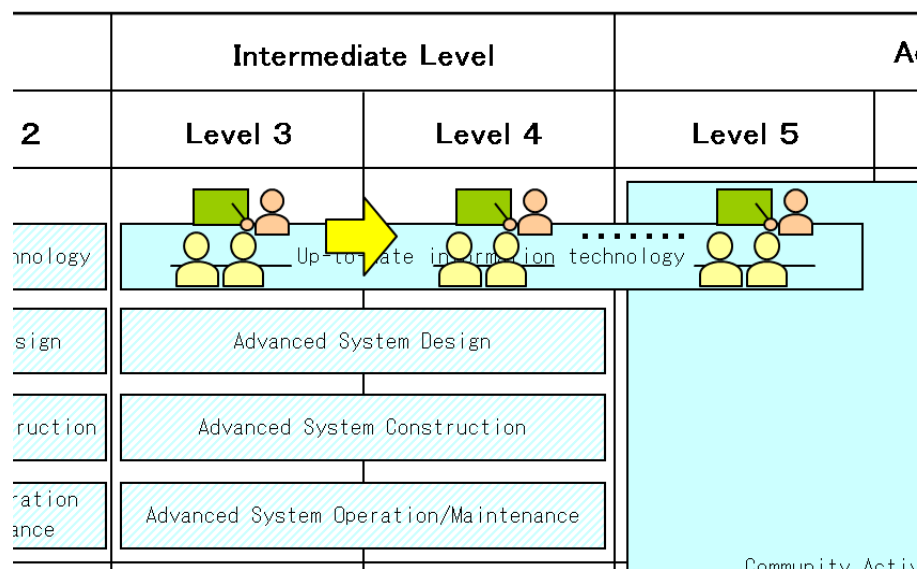
Figure 12. Example of courses that require continuous education
(Latest trend of Information technology)

Figure 13.Example of courses to be taken to achieve a target level
(Complex Project Management)

Second, it means that these courses are prerequisites for courses to reach a target level. For example, if a course is mapped from level 4 to level 5, it implies that this course must be taken before taking a course at level 6. Many courses on fundamental knowledge and technology fall under this category.
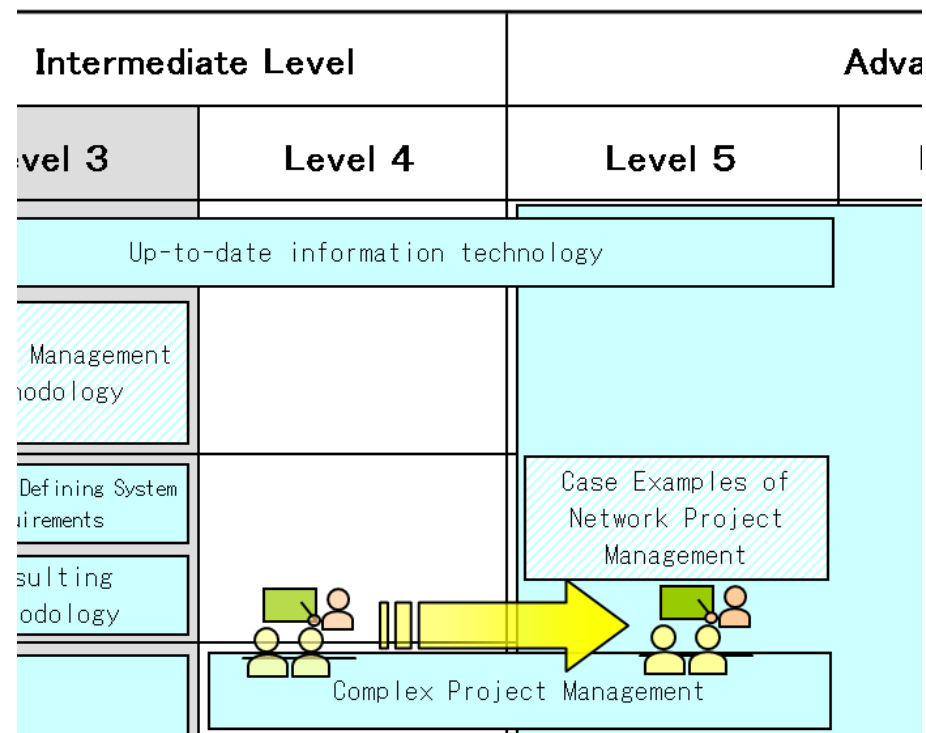
(3) ITSS and Knowledge Items in the Education and Training Roadmap

The Education and Training Roadmap includes some Knowledge Items that are not described in the ITSS. Knowledge Items in ITSS are selected as required knowledge for the job category, but the Roadmap lists recommended knowledge.

(4) Project Management Fundamentals

One important point in the Education and Training Roadmap in ITSS is that Roadmaps of all job categories have "Project Management Fundamentals." The assigned job for IT professional may be related to a project. Therefore all the IT professionals in every job category are recommended to have the fundamentals of project management. All the IT specialists are encouraged to use their specialty field skills with understanding of fundamentals of project management.

This document refers to PMBOK® terms.

"PMBOK" is a trademark of PMI® registered in the U.S. and other nations.