MINISTRY OF ICT AND NATIONAL GUIDANCE

UJ-CONNECT
ICT INDUSTRY PROMOTION PROJECT

ICT SKILLSET STANDARDS

UGANDA ICT Industry Promotion Project

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FOREWORD

Digital transformation is reshaping economies, industries, and societies at an unprecedented pace. At the heart of this transformation lies Information and Communication Technology (ICT)—the catalyst that enables innovation, connectivity, automation, and data-driven decision-making.

The National Development Plan IV recognizes Digital Transformation as a critical contributor to the 10-fold development programme and achieving the Vision 2040. Similarly, the Digital Transformation Roadmap recognises the need for digital skilling as a key pillar to achieving Uganda's digital transformation. To harness the full potential of digital transformation, it is essential to build a workforce equipped with the right ICT skills.

Since the ICT space is highly private sector led, it is critical that we build the necessary capacity and skills required to strengthen the industry. However, rapid technological change presents a critical challenge: ensuring that individuals and organizations are aligned with the evolving demands of the digital landscape. This is where the ICT Skillset Standard plays a pivotal role.

This standard provides a clear, structured framework for the development, assessment, and recognition of ICT competencies across different levels and roles. It outlines the knowledge, skills, and abilities required to thrive in digital environments, from foundational digital literacy to advanced technical and strategic ICT capabilities.

By establishing a common language and benchmark for ICT proficiency, the standard supports:

- Education and training alignment with industry needs
- Workforce upskilling and reskilling in the face of automation and AI
- Policy development for inclusive digital growth
- Organizational readiness for innovation and competitiveness

Moreover, this standard is a key enabler of digital transformation across public and private sectors, ensuring that technology adoption is not only about tools—but about people who are capable, adaptable, and forward-looking. The skills defined in this booklet were guided by input of private sector and I am confident that if implemented properly, the industry shall be stronger. Because we are dealing with a very dynamic industry, this standard shall be a living document that shall be regularly revised as guided by the industry trends.

We commend the collaborative efforts of the educators, industry experts, policymakers, and our development partners – the Japan International Cooperation Agency (JICA)- who contributed to the creation of this framework. As we move deeper into the digital age, let us leverage this standard to empower individuals, strengthen institutions, and build a resilient, digitally capable society.

Dr. Aminah Zawedde
PERMANENT SECRETARY

ACKNOWLEDGEMENT

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I. Introduction

The Vision for a Digital Uganda envisages an empowered Ugandan society with more services delivered and accessed digitally resulting in improved service delivery, greater and inclusive citizen participation in national development for their socio-economic transformation. The vision states five aspirations including:

a) Transformation of Service Delivery
b) A Digital and Data Driven Economy
c) ICT- enabled Businesses and working Investment
d) Improved Global Competitiveness
e) Digital Inclusion and Empowerment that reduces poverty and vulnerability

Arising out of the above aspirations, the MoICT&NG in partnership with JICA designed and is implementing the ICT Industry Promotion Project code named "U-J Connect". The objective of the project is to strengthen Uganda's ICT ecosystem and establish a growth model for priority ICT subsectors.

Objective 4 of the Digital Transformation Programme under the Third National Development Plan (NDPIII) seeks to increase the ICT human resource capital through developing a well-grounded ICT professional workforce; develop an ICT professionals' quality assurance framework; provide digital literacy training; review and implement ICT training curriculum at all levels of Education system in line with the emerging technologies; and implement targeted capacity building for teachers to incorporate ICT in pedagogy. The above are strategic actions to be undertaken during the NDPIII **to ensure Uganda produces technically viable ICT professional cadres that can compete globally. It is, therefore, necessary to acquire skills that meet global standards. This booklet of the Skill Set Standard could serve as guidelines in this regard.**

Output 1 of the ICT Industry Promotion project undertook a baseline study and identified priority areas for ICT human resource development as follows:

- **Application software development (mobile app, web app)**
- **Database management & analysis**
- **Cybersecurity**
- **Cloud services**
- **Data science including AI and Big data**.

The above identified areas are also aligned with the NDPIII Qualifications and Skills Needs for ICT and Digital Technology Programme.

This booklet[1] organizes the skill sets for each priority area. There are two main objectives of organizing the skill set standards which are to:

i) define the skills required in each priority area; and
ii) specify the types and levels of jobs that will be needed.

In organizing the skill sets, reference was made to the career/skill framework of the Skill Standard of IT Professionals (ITSS) defined by the Information-technology Promotion Agency, Japan (IPA)[2], to define the skills required for each job title and level. The "Skills Framework for the Information Age (SFIA)," a skill standard in the UK, was also utilized as a reference for the framework.

This booklet is a living document, and will be revised on a regular basis utilizing most updated information from IPA and SFIA.

1 This booklet was drafted under the Uganda ICT Industry Promotion Project which is supported by a JICA Technical Cooperation in 2023.
2 IPA has a close relationship and collaborates with SFIA, having worked on skill standard for the development and assessment of IT professionals. Therefore, ITSS was designed based on benchmarking SFIA to some extent.

II. Methodology

ITSS aims at assessment of business capabilities of HR who are working as professionals engaged in the IT service industry. It mainly focuses on the IT service industry providing customers with IT services and has come into widespread use as indices of skills of human resources among companies in the IT service industry in Japan since the establishment in 2002. Based on the common career/skill framework, as presented in the table 1 below, skills are categorized into 7 levels.

Table 1: Skill Levels and Common Definitions

Skill category		Common Definitions of Skill Levels
Level 7	High-end player in domestic market and world class player	A level of leadership in technology, methodologies and business transformation both within the company and externally, and both domestically and internationally. A world-class player with experience and proven track record of leading the creation of advanced services and products with market impact.
Level 6	High-end player in domestic market	A level of technology, methodology and business transformation leadership both within the company and externally in domestic market. A high-end domestic player with experience and a proven track record that is recognized as a professional not only within the company, but also in the marketplace.
Level 5	High-end player within the company	A level of leadership in technology, methodology, and business transformation within the company. A high-end player recognized within the company.
Level 4	High level knowledge and skill	A level of professionalism that has acquired one or more specialties and uses specialized skills to lead the identification and resolution of business challenges. Contributes to the conversion of experience into knowledge and its application (training of future generations) as required of a professional.
Level 3	Applied knowledge and skill	The level at which the candidate performs all required tasks independently. Aiming to be a professional with a specialty and possessing the necessary applied knowledge and skills.
Level 2	Fundamental knowledge and skill	A level of ability to perform some of the required tasks independently under the guidance of a superior. Possesses the basic knowledge and skills necessary to become a professional.
Level 1	Required minimum basic knowledge	The level to perform the required tasks under the guidance of a superior. Possesses the basic knowledge and skills necessary to become a professional.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 -. Outline of Job Category and Key Performance Indicator .

With the purpose of assessment and benchmarking of ICT specialists in Uganda, we would rather pay attention to middle and advanced skill levels that fall into the level 3-7 as the level 1 and 2 are rated as entry levels. This booklet summarizes job description, skills and knowledge items, skill proficiency of each level targeting 5 priority areas identified by MoICT&NG in Uganda.

Among the 5 priority areas, skillset information of application software and database management & analysis are prepared based on the “Skill Standards for IT Professionals V3” (IPA, 2010). Skillset information of cybersecurity, cloud services, and data science are prepared according to the Digital Skill Standard Ver. 1.1 (IPA, 2023) and Ver. 1.2 (IPA, 2024) which integrated recent digitalization elements such as generative AI. The Digital Skill Standard introduced the “Common Skill List,” which is commonly applied to five human resource categories (1. Business architect, 2. Designer, 3. Data scientist, 4. Software engineer, 5 Cybersecurity) and organizes the skills required of personnel who promote digital transformation into five categories (business transformation, data application, technology, security, personal skills) and 12 subcategories. The importance of common skills are defined as Table 2 below.

Table 2: Common Skill Importance Level and Definition[3]

A /Level 6	Requires a high level of practice and expertise
B /Level 5	Requires a certain level of practice and expertise
C /Level 4	Requires understanding at a level that can be explained
D /Level 3	Requires understanding of positioning and relevance

Source: IPA website (https://www.ipa.go.jp/jinzai/skill-standard/dss/ps6vr700000083ki-att/000106872.pdf) (https://www.ipa.go.jp/jinzai/skill-standard/dss/ps6vr700000083ki-att/000106874.xlsx). Japanese version was translated to English by the project team .

Due to the limited availability of streamlined information for all job categories, multiple information sources are utilized to define the levels of skillset. The defined skill standard and the levels of importance for each job category can be utilized to consider the weight of educational content for different subject areas.

Reference information on common competences required to be a professional is included in Annex 1.

3 Most of the Levels defined in ITSS presented in the table 1 are mapped with categories in SFIA.

Chapter 1
Application Software

1.1 Application Software Job Description

Application software development has been and will be one of the major focus areas of ICT industry in Uganda. The application software development job category is classified into the Operating system, Middleware, and Application software. Among specialty fields in software development, basic responsibility and tasks for application software is described as below.

Table 1.1 Application Software – Responsibilities and Tasks

Specialty	Responsibilities and tasks
Application Software	[Responsibility] Contribute to planning, designing, development, customization, and technical support related to application software to satisfy the designed quality goal (functionality, reliability, etc.)
	[Tasks] Performs design, development and technical support on software that supports busi-ness transformation, business process improvement and work efficiency using information system for a certain purpose or in a certain area such as application packages (including ERP and CRM) and office suite.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0.
Remarks: SFIA 8[4] presents examples of job titles related to software engineering practitioners, such as Software Engineer, Principal Software Engineer, Senior Software Engineer, Software Development Engineer, and Cloud Software Engineer. It also provides examples of job titles related to the management of software engineering practices, including Engineering Manager, Senior Engineering Manager, Director of Engineering, Senior Director of Engineering, Vice President (VP) of Engineer-ing, and Senior Vice President (SVP) of Engineering.

1.2 Skill & Knowledge Items for Application Software

According to the “Skill Standards for IT Professionals V3” (IPA, 2010), skills and knowledge items required for Application Software (mobile app, web app) Development Specialists are as below.

Table 1.2 Application Software – Skills & Knowledge Item list

Skill items	Contents
1. Software engineering	Web application technologies, Program design, Design Methods, Development Methods, Utilization of development support tools, Program Implementation, Programming Techniques, Testing Techniques, Reuse Methods, Implementation and Inspection of Security Systems, External design, etc.
2. Technology	Latest Technology Trends, Internet Application Fundamental Technology, Database design, Computer Science Fundamentals, Computer system, System development environment, Database technologies, Design of Database Operations, etc.
3. Design	Design Methods, Understanding and Utilization of Modeling Techniques, Architecture process, Database, Middleware, Distributed Computing Design, Design of Development Environment, Requirements Definition, Estimation and Schedule Methods
4. Development methods design	Selection of Adaptive Standards, Fundamentals of Risk Management, Software development process, Quality Inspection (Software Development), Creation of Test Implementation Plan
5. Analysis and requirements definition	Understanding of Market Trends and Competitive Trends, Formulation of Software Product Strategy, Formulation of Project and Plan, Management of Business Issues, Intellectual property rights, Knowledge of Relevant Regulation, etc.
6. Project management	Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management
7. Business application design	Understanding and Utilization of Application Software Knowledge

Source: IPA. MOETI Japan. 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 .

4 SFIA 8 illustrative skill profiles.
https://sfia-online.org/en/tools-and-resources/standard-industry-skills-profiles/sfia-skills-for-role-families-job-titles#au-totoc-item-autotoc-46

Proficiency levels and criteria for each skill items required for Application Software are shown in following tables.

(1) Software Engineering

Skill Proficiency	
Level 6	Able to perform software development, by carrying out design for program implementation, design for operation, design for failures prevention, program production, evaluation, and performance tuning of the whole project, with utilization of software engineering technology, as a person responsible for application software development project with 15 or more management staff during peak periods
Level 5	Able to perform software development, by carrying out design for program implementation, design for operation, design for failures prevention, program production, evaluation, and performance tuning of the whole project, with utilization of software engineering technology, as a person responsible for application software development project with 5 or more but less than 15 management staff during peak periods
Level 4	Able to perform software development, by carrying out design for program implementation, design for operation, and design for failures prevention, program production, evaluation, and performance tuning, with utilization of software engineering technology, as a team leader of application software development project with 5 or more but less than 15 participation staff during peak periods
Level 3	Able to perform software development, by carrying out design for program implementation, design for operation and design for failures prevention, program production, evaluation, and performance tuning, as a team member of application software development project.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0

(2) Technology

Skill Proficiency	
Level 6	Able to lead technical team about highly complex technical problems, by leading selection of application technology based on the latest technology trends, as a person responsible for application software development project with 15 or more management staff during peak periods
Level 5	Able to carry out technical guidance for the technical team, and to practice solving of highly complex technical problems, by leading selection of application technology based on the latest technology trends, as a person responsible for application software development project with 5 or more but less than 15 management staff during peak periods.
Level 4	Able to practice solving of highly complex technical problems, by leading selection of application technology based on the latest technology trends, as a team leader of application software development project with 5 or more but less than 15 participation staff during peak periods.
Level 3	Able to practice technical problems solving, and to carry out selection of application technology based on the latest technology trends in the assigned area, as a team member of application software development project.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 .

(3) Design

Skill Proficiency

Level 6	Able to perform software design, by carrying out selection and utilization of optimum modeling techniques and design techniques, as a person responsible for application software development project with 15 or more management staff during peak periods
Level 5	Able to perform software design, by carrying out selection and utilization of optimum modeling techniques and design techniques, as a person responsible for application software development project with 5 or more but less than 15 management staff during peak periods
Level 4	Able to perform software design, by carrying out selection and utilization of optimum modeling techniques and design techniques, as a team leader of application software development project with 5 or more but less than 15 participation staff during peak periods.
Level 3	Able to perform software design, by carrying out selection and utilization of optimum modeling techniques and design techniques, as a team member of application software development project.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 .

(4) Development methods design

Skill Proficiency

Level 6	Able to design optimum, effective and efficient development methods in application software development project, by carrying out review, analysis, and evaluation on development process, development method, development tools, development environment and development language of the whole project, as a person responsible for application software development project with 15 or more management during staff peak periods
Level 5	Able to design optimum, effective and efficient development methods in application software development project, by carrying out review, analysis, and evaluation on development process, development method, development tools, development environment and development language of the whole project, as a person responsible for application software development project with 5 or more but less than 15 management staff during peak periods
Level 4	Able to design optimum, effective and efficient development methods in application software development project, by carrying out review, analysis, and evaluation on development process, development method, development tools, development environment and development language, as a team leader of application software development project with 5 or more but less than 15 participation staff during peak periods.
Level 3	Able to design optimum, effective and efficient development methods, in application software development project, by carrying out review, analysis, and evaluation on development process, development method, development tools, development environment, and development language, as a team member of application software development project

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 .

(5) Analysis and requirements definition

Skill Proficiency

Level 6	Able to carry out formulation of software product strategy and software product development plan for application software development, by understanding and analyzing market trends and customer demands, as a person responsible for application software development project with 15 or more management staff during peak periods
Level 5	Able to carry out formulation of software product strategy and software product development plan for application software product development, by understanding and analyzing market trends and customer demands, as a person responsible for application software development project with 5 or more but less than 15 management staff during peak periods
Level 4	Able to carry out formulation of software product strategy and software product development plan for application software product development, by understanding and analyzing market trends and customer demands, as a team leader of application software development project with 5 or more but less than 15 participation staff during peak periods.
Level 3	Able to carry out formulation of software product strategy and software product development plan for application software product development, by understanding and analyzing market trends and customer demands, as a team member of application software development project.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 .

(6) Project management

Skill Proficiency

Level 6	Able to perform the project management such as project plan formulation, implementation, and change management, in collaboration with project managers, as a person responsible for application software development project with 15 or more management staff during peak periods
Level 5	Able to perform the project management such as project plan formulation, implementation, and change management, in collaboration with project managers, as a person responsible for the application software development project with 5 or more but less than 15 management staff during peak periods
Level 4	Able to perform the project management such as project plan formulation, implementation, and change management, in collaboration with project managers, as a team leader of an application software development project with 5 but less than 15 participation staff during peak periods.

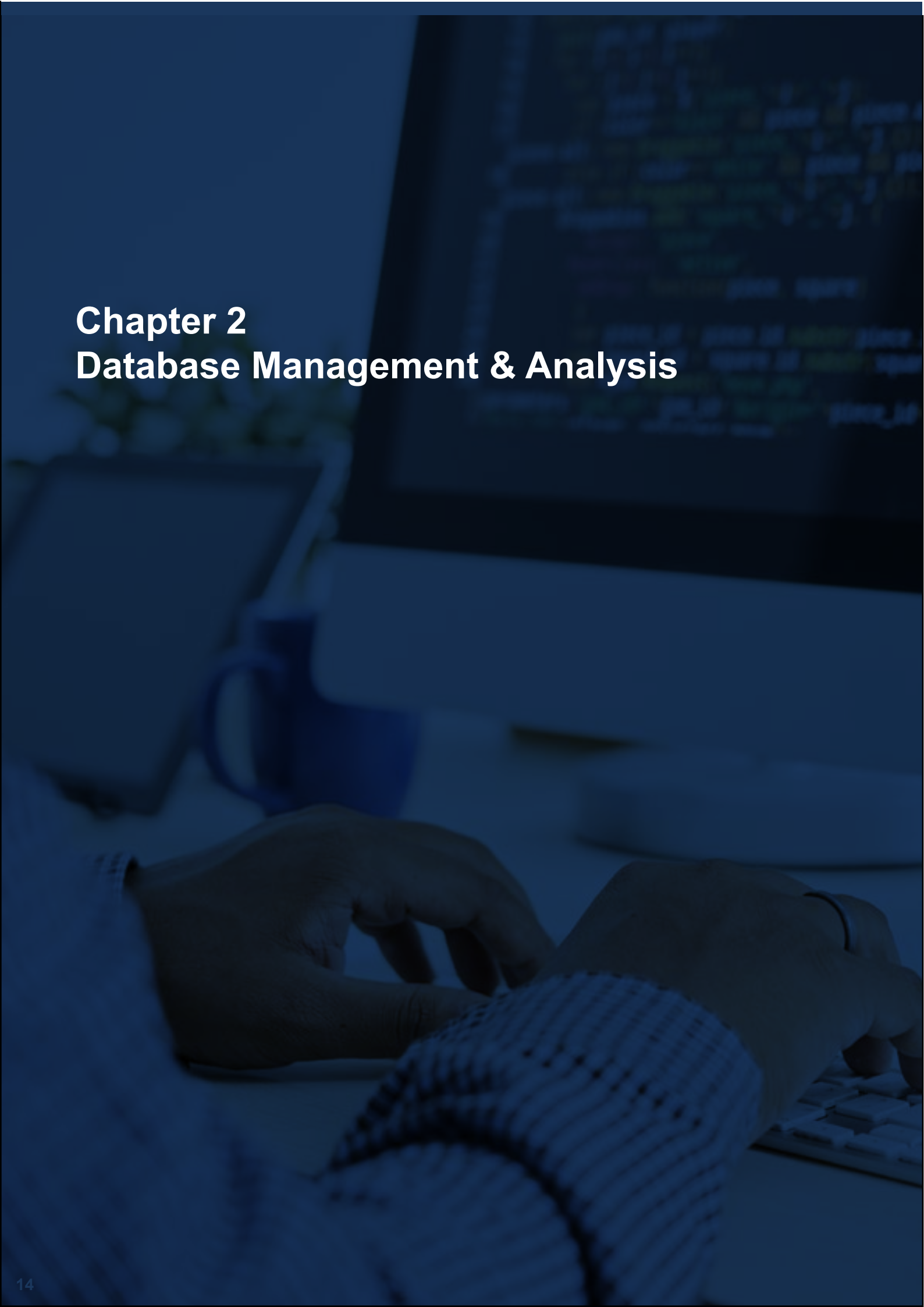
Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 .

(7) Business application design

Skill Proficiency

Level 6	Able to carry out effective design for implementation methods and processing methods for application software, by understanding operating system and middleware architecture, as a person responsible for application software development project with 15 or more management staff during peak periods
Level 5	Able to carry out effective design for implementation methods and processing methods for application software, by understanding operating system and middleware architecture, as a person responsible for application software development project with 5 or more but less than 15 manage-ment staff during peak periods.
Level 4	Able to carry out effective design for implementation methods and processing methods for application software, by understanding operating system and middleware architecture, as a team leader of an application software development project with 5 or more but less than 15 participation staff during peak periods.
Level 3	Able to carry out effective design for implementation methods and processing methods for application software, by understanding operating system and middleware architecture, as a team member of an application software development project.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 .



Chapter 2
Database Management & Analysis

2.1 Database Management & Analysis Job Description

Among IT specialist job categories, database is classified as one of the specialties as below[5].

Table 2.1 IT Specialist in Database – Responsibilities and Tasks

Specialty	Responsibilities and tasks
IT Specialist in Database	[Responsibility] IT specialists perform s design, construction, and installation of optimum sys-em infrastructure for customer environment by utilizing hardware and software related expertise. Has responsibility for non-functional requirements of constructed system infrastructure (performance, recoverability, and availability, etc.). In the IT investment phases, development (component design (system), solution construction (development, implementation)), operation, and maintenance (solution operation (system), solution maintenance (system)) are the main activity areas. Performs the following: - Development • Analysis and design of system components • Construction and installation of systems - Operation and maintenance • System operation • System maintenance
	[Tasks] Database specific tasks are as follows; performs design, construction, and installation of database, such as logical and physical design, and recovery management.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 -. Outline of Job Category and Key Performance Indicator .
Remarks: SFIA 8[6] provides examples of job titles related to the data engineering practitioners, including Data engineer, Cloud Data engineer, and Cloud Data Architect. It also presents examples of job titles related to data operations practitioners, such as Data operations engineer, ML operations engineer, Data production engineer, Database Administrator, and Cloud Database Administrator.

Skill proficiency levels for database management jobs are defined from the level 3 to the level 6 (see table 1).

2.2 Skill & Knowledge Items for Database Management & Analysis

According to the “Skill Standards for IT Professionals V3” (IPA, 2010), skills and knowledge items required for an IT Specialist **in Database** are listed as below.

Skill items	Contents
1. Technology	Latest technology trends, Latest IT Market Trends, Basis of Computer Science, Computer System Structure, Basic Knowledge of Product, Understanding and Utilization of Network Technology, Internet Technology, Relational Database Fundamentals, IT Infrastructure Development Process, System Management, Problem Solving Techniques, Security and Personal Information, Basis of System Non-Functional Requirement
2. Software engineering	Application Development Process, Application Development Technology
3. Analysis of business operations	Business Knowledge, Industry knowledge, Generic Business Contents, Latest Trends of Generic Business Operation, Compliance and Regulations,

5 IT Specialist job career category is classified into the following specialty fields (Platform, Network, Database, Communication Application Infrastructure, System Management, Security). Source: IPA, MoETI, Japan. 2020. Skill Standards for IT Professionals V3 2008 Release 1.0.
6 SFIA 8 illustrative skill profiles. https://sfia-online.org/en/tools-and-resources/standard-industry-skills-profiles/sfia-skills-for-role-families-job-titles#autotoc-item-autotoc-46

Skill items	Contents
4. Consulting techniques utilization	Selection and utilization of consulting techniques, Understanding and Utilization of Analysis Tools and Models
5. Knowledge management and utilization	Management and utilization of knowledge
6. Project management	Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project, Human Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management
7. Database	· Database System Architecture Database Requirement Definition, Logical Database Design Technology, Transaction Design Technology, Reliability Design of Database System, Data Migration Design, Database, Operation Design, Implementation and Test to Database Management System (DBMS), Database Operation Technology, etc. · Utilization Technology of Database Product Utilization Technology of Database Related Product · Database Component Related Technology Significant Technology of Database Development, Conceptual Data Modeling Techniques, Database Related Technology Trends, Relational Model

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 -. Outline of Job Category and Key Performance Indicator .

Proficiency levels and criteria for **skill items required for IT Specialist in Database** are shown in following tables.

(1) Technology

Skill Proficiency

Level 6	Able to lead the selection of application technologies based on the latest technology trends, and to formulate the database framework design, development, and installation methodology, as a person responsible for a technical team in the project with 50 persons or more during peak periods. In addition, able to lead technical team about highly complex technical problems.
Level 5	Able to lead the selection of application technologies based on the latest technology trends, to practice solving of highly complex technical problems and to provide technical guidance to team, as a person responsible for technical team in the project with 10 or more but less than 50 persons during peak periods.
Level 4	Able to lead the selection of application technologies based on the latest technology trends, and to practice solving of highly complex technical problems, as a technical team leader in the project with less than 10 persons during peak periods.
Level 3	Able to carry out the selection of application technologies based on the latest technology trends in the assigned area, and to practice technical problems solving, as a technical team member.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 -. Outline of Job Category and Key Performance Indicator.

(2) Software Engineering

Skill Proficiency

Level 6	Able to perform the operation, by leading technical team on software engineering technologies such as optimum development techniques, development support tools, and testing techniques, as a person responsible for technical team in the project with 50 persons or more during peak periods.
Level 5	Able to perform the operation, by providing technical guidance to team on software engineering technologies such as optimum development techniques, development support tools, and testing techniques, as a person responsible for technical team in the project with 10 or more but less than 50 persons during peak periods.
Level 4	Able to perform the operation, by providing advice to less-experienced members on software engineering technologies such as optimum development techniques, development support tools, and testing techniques, as a technical team leader in the project with less than 10 persons during peak periods.
Level 3	Able to practice the operation by utilizing software engineering technology in the assigned area, as a technical team member

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 -. Outline of Job Category and Key Performance Indicator .

(3) Analysis of Business Operations

Skill Proficiency

Level 6	Able to carry out complex and advanced analysis of business operation and technical requirements, from the perspective of industry and technical trends, as a person responsible for technical team in the project with 50 persons or more during peak periods
Level 5	Able to carry out analysis of business operation and technical requirements, as a person responsible for technical team in the project with 10 or more but less than 50 persons during peak periods.
Level 4	Able to carry out analysis of business operation and technical requirements, as a technical team leader in the project with less than 10 persons during peak periods.
Level 3	Able to carry out analysis of business operation and technical requirements in the assigned area, as a technical team member.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 -. Outline of Job Category and Key Performance Indicator .

(4) Utilization of consulting techniques

Skill Proficiency	
Level 6	Able to carry out the project successfully by utilizing consulting techniques, as a person responsible for a technical team with 50 persons or more during peak periods.
Level 5	Able to carry out the project successfully by utilizing consulting techniques, as a person responsible for a technical team with 10 or more but less than 50 persons during peak periods.
Level 4	Able to carry out the project by utilizing consulting techniques, as a technical team leader in the project with less than 10 persons during peak periods
Level 3	Able to carry out the project, by utilizing consulting techniques, as a technical team member.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 -. Outline of Job Category and Key Performance Indicator .

(5) Knowledge management and utilization

Skill Proficiency	
Level 6	Able to perform the project effectively and with high quality, by carrying out proper database creation, utilization, maintenance, and management of knowledge in the whole process from project preparation, start to completion, and post completion, as a person responsible for a technical team with 50 persons or more during peak periods.
Level 5	Able to perform the project effectively and with high quality, by carrying out properly database creation, utilization, maintenance, and management of knowledge in the whole process from project preparation, start to completion, and post completion, as a person responsible for technical team in the project with 10 or more but less than 50 persons during peak periods.
Level 4	Able to perform the project effectively and with high quality, by carrying out database creation, utilization, maintenance, and management of knowledge, as a technical team leader of the project with less than 10 persons during peak periods.
Level 3	Able to perform the project effectively and with high quality, by carrying out database creation, utilization, maintenance, and management of knowledge, as a technical team member.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 -. Outline of Job Category and Key Performance Indicator

(6) Project management

Skill Proficiency	
Level 6	Able to perform the project by carrying out project plan formulation, plan implementation, and change management in collaboration with project managers, as a person responsible for a technical team with 50 persons or more during peak periods.

Level 5	Able to perform the project by carrying out project plan formulation, plan implementation, and change management in collaboration with project managers, as a person responsible for a technical team with 10 or more but less than 50 persons during peak periods.
Level 4	Able to perform the project by carrying out project plan formulation, plan implementation, and change management in collaboration with project managers, as a technical team leader with less than 10 persons during peak periods.
Level 3	Able to perform the project plan formulation, plan implementation, and change management in the assigned area, as a technical team member

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 -. Outline of Job Category and Key Performance Indicator

(7) Database system architecture

Skill Proficiency	
Level 6	Able to lead database system architecture, as a person responsible for a technical team with 50 persons or more during peak periods. In addition, the person should be able to lead a technical team in highly complex system architecture.
Level 5	Able to lead database system architecture, as a person responsible for a technical team with 10 or more but less than 50 persons during peak periods. In addition, able to provide technical guidance to the team in highly complex system architecture.
Level 4	Able to lead database system architecture, as a technical team leader in the project with less than 10 persons during peak periods.
Level 3	Able to carry out database system architecture in the assigned area, as a technical team member

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 -. Outline of Job Category and Key Performance Indicator .

(8) Utilization technology of database product

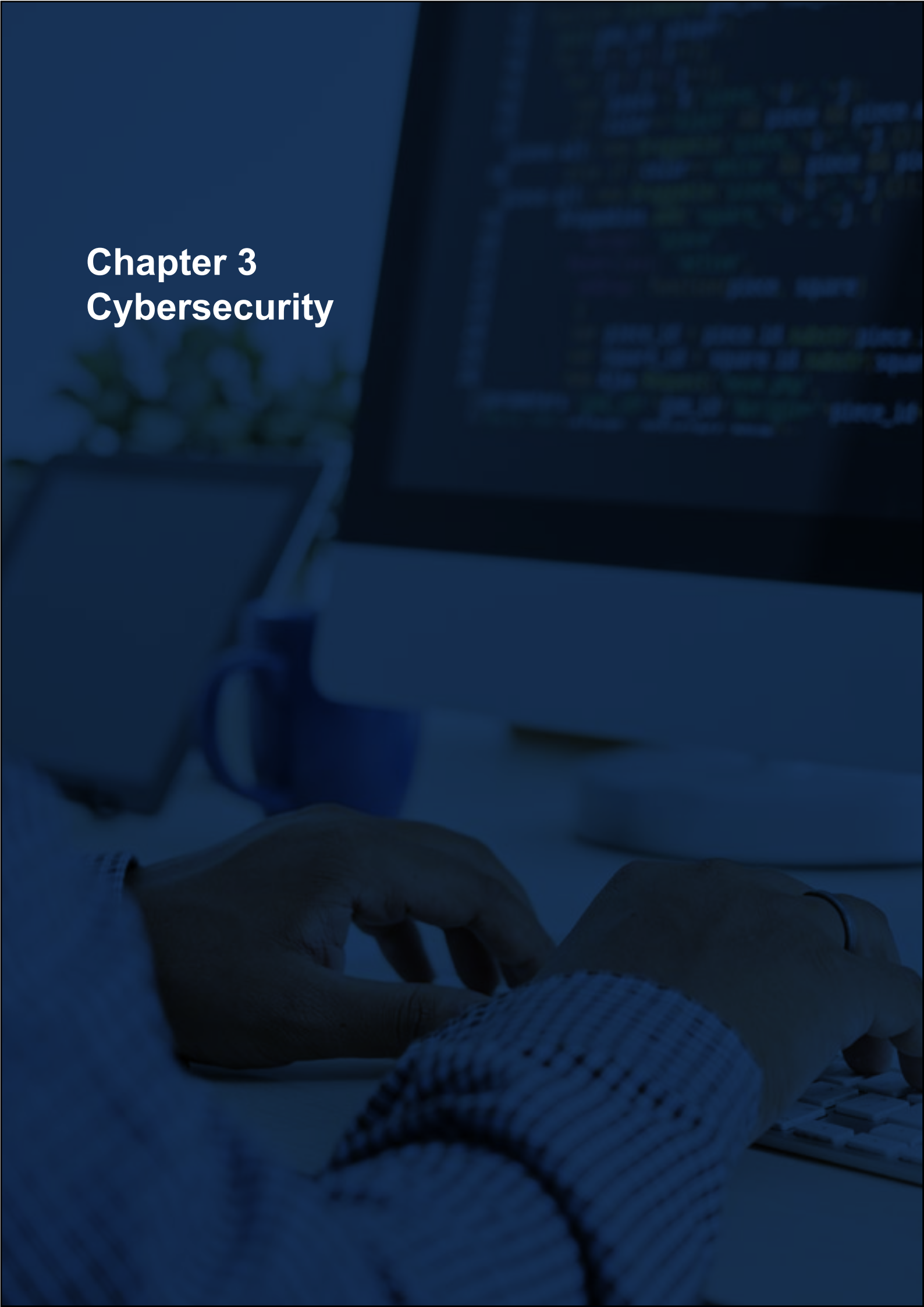
Skill Proficiency	
Level 6	Able to lead technical team about highly complex technical problems, based on latest technical trend of database product utilization technology, as a person responsible for technical team in the project with 50 persons or more during peak periods.
Level 5	Able to provide technical guidance to a team, as well as to carry out highly complex technical problem solving, based on the latest technical trend of database product utilization technology, as a person responsible for technical team in the project with 10 or more but less than 50 persons during peak periods.
Level 4	Able to carry out highly complex technical problem solving, based on the latest technical trend of database product utilization technology, as a technical team leader in the project with less than 10 persons during peak periods.
Level 3	Able to carry out technical problem solving, based on the latest technical trend of database product utilization technology in the assigned area, as a technical team member.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 -. Outline of Job Category and Key Performance Indicator

(9) Database component related technology

Skill Proficiency	
Level 6	Able to lead a technical team about highly complex technical problems, based on the latest technical trend of database component related technology, as a person responsible for a technical team with 50 persons or more during peak periods.
Level 5	Able to provide technical guidance to a team as well as to carry out highly complex technical problem solving, based on the latest technical trend of database component related technology, as a person responsible for a technical team with 10 or more but less than 50 persons during peak periods.
Level 4	Able to carry out highly complex technical problem solving, based on the latest technical trend of database component related technology, as a technical team leader in the project with less than 10 persons during peak periods.
Level 3	Able to practice technical problem solving, based on the latest technical trend of database component related technology in the assigned area, as a technical team member.

Source: IPA. MOETI Japan, 2010. Skill Standards for IT Professionals V3 2008 Release 1.0 -. Outline of Job Category and Key Performance Indicator .



Chapter 3
Cybersecurity

3.1 Cybersecurity Job Description

According to the DX promotion skill standard (IPA, 2023)[7], major responsibilities and tasks of Cybersecurity Man-ager and Cybersecurity Engineer are shown in following tables.

Table 3.1 Cybersecurity Manager and Engineer - Responsibilities and Tasks

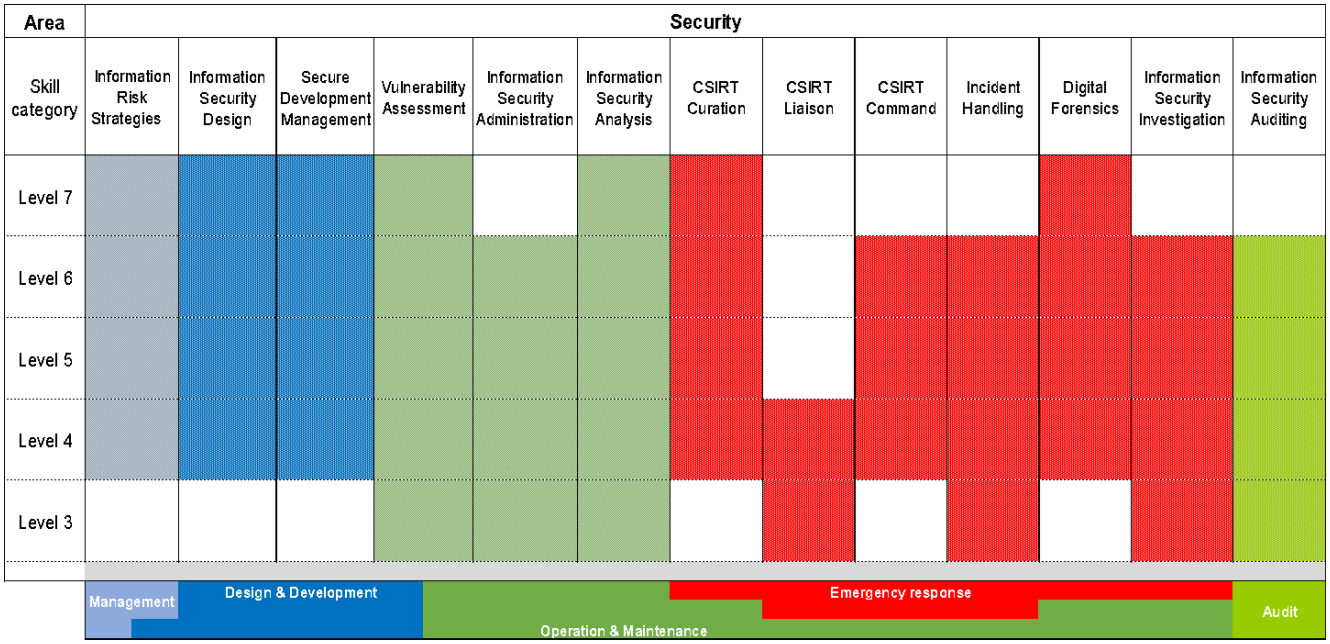
Specialty	Responsibilities and tasks
Cybersecurity Manager	[Responsibility] Contribute to increasing confidence in businesses with high customer value by considering and assessing cyber security risks associated with the use of digital technology when planning businesses that expand customer value, and by leading the management and control of countermeasures to mitigate the impact of such risks.
	[Tasks] Assess the cybersecurity, safety, and privacy risks that arise through the use of digital technology in new business - Develop strategies to mitigate the impact of cybersecurity risks, and the framework for implementing countermeasures, based on a balance of risk and return - Manage and audit the implementation of countermeasures to mitigate cybersecurity risks Manage and audit the implementation of measures to mitigate cybersecurity risks - Respond to cybersecurity incidents that occur in the digital environment used to conduct business
Cybersecurity Engineer	[Responsibility] Contribute to the stable provision of business with high customer value through the implementation, maintenance, and operation of measures to control digital utilization related cybersecurity risks associated with business implementation
	[Tasks] Deploy and implement security products and services that address technical controls to limit the impact of digital-related risks - Operate and maintain security products and services - Manage cybersecurity-related changes to systems, services, and settings in digital applica-tions - Evaluate performance and manage vulnerability responses in digital applications

Source: IPA. MoETI, The Digital skill standard Ver. 1.1 (2023) and Ver. 1.2 (2024)
Remarks: SFIA presents examples of job titles related to security operations, such as Cyber Security Technician, Information Security Technician, Security Operations Manager, Infrastructure Specialist, Operations Support Analyst, Security Operations Centre (SOC) Service Desk Analyst, Security Operations Centre (SOC) Analyst. It also provides examples of job titles related to incident management practitioners, including Incident analyst, Incident Manager, Major Incident Manager, Lead Incident Manager, and Cyber Incident Manager. It presents example of job titles related to security risk management, audit and compliance, including IT auditor, Info sec compliance consultant, Security assessment auditor, and Audit manager. It provides examples of job titles related to security leadership, strategy and management, including Chief Information Security Officer CISO, Information security manager, Security architect, Cloud security architect, Information security analyst, Cyber security manager, Cyber security governance manager, Cyber security analyst, and Information Security Lead

7 The Digital Skill Standard Ver. 1.1 (IPA, 2023) and Ver. 1.2 (IPA, 2024) introduced the “Common Skill List,” which is commonly applied to five human resource categories (1. Business architect, 2. Designer, 3. Data scientist, 4. Software engineer, 5 Cybersecurity). The Digital Skill Standard organizes the skills required of personnel who promote DX into five categories (business transformation, data application, technology, security, personal skills) and 12 subcategories.
8 SFIA 8 illustrative skill profiles. https://sfia-online.org/en/tools-and-resources/standard-industry-skills-profiles/sfia-skills-for-role-families-job-titles#autotoc-item-autotoc-46

The table below provides definitions of skills and proficiency levels specifically for security according to ITSS+ (IPA, 2020). Security skill proficiencies are defined from the level 3 to the level 7 according to different skills. Cybersecurity Specialists are required to attain a relatively higher skill level compared to specialists in other IT areas. In particular, undertaking the tasks such as information risk strategies, security design and analysis, secure development management, vulnerability assessment, CSIRT curation and digital forensics, cybersecurity specialists could be required the world-class skills of the level 7.

Table 3.2 Security - Proficiency Level



Source: IPA, 2022. ITSS+ Security https://www.ipa.go.jp/jinzai/skill-standard/plus-it-ui/itssplus/ps6vr70000001hs8-att/000058688.xlsx (In Japanese). Translated by the Project team.

3.2 Skill & Knowledge Items for Cybersecurity

According to ITSS+ (IPA, 2020), security specific skills are defined as below.

Table 3.3 Security – Skills & Knowledge Item list

Skill items	Contents
Information Risk Strategies	Recognize information risks that may hinder the business execution of the organization or contractor, and promote the formulation of information security strategies and policies, including the development of organizational structures and various rules, in order to control the impact of such risks. To look over the entire information security related operations in the organization or contractor, and make decisions on resource allocation, including outsourcing, etc.
Information Security Design	Design architectures and policies to ensure the security of information systems from a "security-by-design" perspective, and support the development and establishment of organizations, rules, and processes necessary to realize these architectures and policies
Secure Development Management	Based on the viewpoint of risk response for information systems and products, the committee oversees the information security lifecycle from the aspect of information security including functional safety, covering planning, development, manufacturing, and maintenance, and is responsible for the implementation of countermeasures.
Vulnerability Assessment	Inspect the network, OS, middleware, and applications for secure programming and evaluate the diagnostic results.
Information Security Administration	It incorporates the organization's information security strategies and policies into concrete plans and procedures, and oversees the concretization and implementation of information security measures in its own organization or contractors through planning and implementation (instruction and supervision) of the measures and their review, etc. It also plans and promotes information security awareness and education for users. In addition, it plans and promotes information security awareness and education for users.
Information Security Analysis	Conduct an assessment of the current status of information security measures, evaluate risks based on the gap analysis with the ideal state, and consider solutions that should be introduced in accordance with the business plan of the own organization or the entrusted party. Confirm the effectiveness of the implemented solutions and reflect them in the improvement plan.
CSIRT Curation	For the purpose of studying countermeasures against information security incidents, gather information on security events, threat and vulnerability information, attacker profiles, international situations, media trends, etc., and select which information should be applied to your own organization or contractors.

Skill items	Contents
CSIRT Liaison	Serve as a liaison between the CSIRT and related organizations outside the organization, legal affairs, liaison, IT department, public relations, and each business unit within the organization, and coordinate and disseminate information related to information security incidents. Play a coordinating role between the IT department and the CSIRT as necessary.
CSIRT Command	Conduct overall control of information security incidents in the organization and determine priorities in responding to the incidents. Liaise with the CISO and management on major incidents. Also, support the CISO and management in their decision making.
Incident Handling	Perform initial response immediately after the occurrence of a security incident (implementation of measures to prevent damage from spreading) and processing related to recovery from damage, either in your own organization or in a contracted company. If the processing is outsourced to a security vendor, provide instructions and collaborate with the vendor. Manage the status of response to information security incidents and report to the person in charge of CSIRT command tasks.
Digital Forensics	Preserve evidence of activities targeted at information systems and networks by malicious actors, as well as perform systematic forensics, close inspection, analysis, and reporting to recover erased data and trace traces.
Information Security Investigation	Investigate external and internal crimes for information security incidents. The target of investigation is narrowed down logically while confirming the motive for the criminal act, securing evidence, and speculating on the next event to occur.
Information Security Auditing	To provide assurance or advice by verifying or evaluating, in accordance with the standards, the status of maintenance and operation of appropriate control measures based on risk assessment, so that the management of risks related to information security is effectively implemented.

Source: IPA. 2022, ITSS+ Security
https://www.ipa.go.jp/jinzai/skill-standard/plus-it-ui/itssplus/ps6vr70000001hs8-att/000058688.xlsx
（In Japanese）. Translated by the Project team.

According to the DX promotion skill standard (IPA, 2023)[9]common skills and importance for each skill for Cybersecurity Manager and Cybersecurity Engineer are shown in following tables.

Table 3.4 Skill Proficiency Importance

A/Level 6	Requires a high level of practice and expertise
B/Level 5	Requires a certain level of practice and expertise
C/Level 4	Requires understanding at a level that can be explained
D/Level 3	Requires understanding of positioning and relevance

Source: IPA website (https://www.ipa.go.jp/jinzai/skill-standard/dss/ps6vr700000083ki-att/000106874.xlsx). Japanese version was translated to English by the project team .

9 The Digital Skill Standard Ver. 1.1 (IPA, 2023) and Ver. 1.2 (IPA, 2024) introduced the “Common Skill List,” which is commonly applied to five human resource categories (1. Business architect, 2. Designer, 3. Data scientist, 4. Software engineer, 5 Cybersecurity). The Digital Skill Standard organizes the skills required of personnel who promote DX into five categories (business transformation, data application, technology, security, personal skills) and 12 subcategories.

Table 3.5 Cybersecurity – Importance of Common Skill Items by Specialties

Category	Skill Items	Contents	Importance	
			Cyber-security manager	Cybersecurity engineer
1. Business Transformation				
1.1 Strategy, Management Systems	Business Strategy Development and Execution	• Skills to formulate business strategies, including startup ecosystem building, and product (product/service) portfolio management	B	C
	Product Management	• Skills to define the value proposition of a product (product or service), and to conceptualize and implement ways to generate revenue by providing value, the product itself, and related processes.	C	C
	Change Management	• Skills to identify potential impediments (organizational structure, culture and climate, various systems, human resources, and business processes) to promote DX, and to formulate measures to address them. • Skills to involve stakeholders in organizational and operational changes.	B	C
	System Engineering	• Skills to view everything as a collection of interacting elements (a system) and to conceptualize an approach to achieve overall optimization while taking into account diverse values that span multiple areas of expertise.	C	C
	Enterprise Architecture	• Skills to organize the business, operations, data, IT systems, and other elements that make up an organization, and to optimize them as a whole through hierarchical structuring and standardization.	C	C
	Project Management	• Skill in iterating over very short periods of time and responding to changes in the business environment and requirements. • Skill in executing a program that includes a project or multiple projects on time, to a given quality, budget, and timeframe.	B	C
1.2 Business Model and Process	Business Research	• Skills to understand social issues, business megatrends, industry market size and growth potential, and success factors and growth issues in business, products, and operations	C	D
	Business Model Design	• The skill to develop an objective and vision for a product or service based on success factors and growth issues. • Skill to design a mechanism to generate revenue by examining revenue models, etc., after organizing cost structure and channels.	C	D
	Business Analysis	• The skills to visualize the current status and goals of activities required to provide products and services, and to identify the activities that are particularly important and that create value. • Skills to identify areas for digitization to achieve the desired state.	C	D
	Verification (business perspective)	• Skills to verify the sustainability of the developed product or service as a business (how much revenue can be obtained, how much competitive advantage can be secured, and how much cost can be reduced).	C	D
	Marketing	• Skills to verify the business sustainability of developed products and services (how much revenue can be generated, how much competitive advantage can be secured, and how much cost can be reduced).	C	D
	Branding	• Skills to develop and execute strategies to increase customer loyalty to and differentiate the company's brand.	C	D
1.3 Design	Understanding of customers and users	· Skills to design and conduct user surveys (customer satisfaction, usage data, interviews, etc.) and market/competitive research. · Skills to understand and analyze customer expectations and dissatisfaction, new needs, competition, and trends from user survey results, and to derive insights.	C	D
	Value Discovery and Definition	· Skills in facilitating stakeholders to diverge ideas and define value propositions based on customer/user needs.	C	D
	Design	· Skills to clarify the necessary functions and content based on the needs of customers and users. · Design the structure and framework of functions and content, taking into account ease of understanding and finding for customers and users. · Design skills to design the appearance and dynamic elements that are desirable to the user	C	D
	Verification (customer/user perspective)	· Skills to verify whether the value propositions defined are actually experienced by customers through the implemented products and services, and whether they are useful experiences for customers.	C	D
	Other design skills	· Design skills for designing graphics for digital media related to marketing. · Skill to layout and organize e-books, catalogs and other magazines in an easy-to-read format.	C	D
2. Data Application				

Category	Skill Items	Contents	Importance	
			Cybersecu-rity manager	Cybersecurity engineer
2.1 Strategic Use of Data and AI	Data understanding and utilization	・ Skills to accurately understand statistical information including graphs, charts, and graphs, as well as the results of data analysis by applying various analytical methods, and to gain deep insight into the meaning and background of such information	B	C
	Data/AI utilization strategy	・ Skills to propose solutions to problems and new business models using data and AI technologies based on business strategies, organizational issues, customer needs, etc.	B	C
	Design, business implementation, and evaluation of data/AI utilization operations	・ Skills to implement and continuously improve data and AI analysis mechanisms in the field after designing an approach to realize data and AI strategic objectives.	B	C
2.2 AI, Data Science	Mathematical Statistics	・ Multivariate analysis and data visualization ・ Skills in analyzing data and gaining insight into the results using methods based on statistical knowledge	C	C
	Machine Learning and Deep Learning	・ Machine learning and deep learning, natural language processing, image recognition, speech recognition, and other techniques are used to build and evaluate appropriate models.	C	C
2.3 Data Engineering	Data Utilization Infrastructure Design	・ Skills to establish the necessary system environment, collected data, tables, and other requirements in preparation of a data utilization infrastructure that produces results from the data.	C	C
	Implementation and Operation of Data Utilization Infrastructure	・ Data handling skills necessary to implement and smoothly and effectively operate a data utilization infrastructure that produces results from data.	C	C
3. Technology				
3.1 Software Development	Computer science	・ Skills related to data structures, algorithms, etc. required in software development	C	B
	Team development	・ Skills needed to increase productivity of software development in a team environment	D	B
	Software design methodology	・ Skills to study data structures and internal architectures and incorporate them into the design in order to implement software that meets the objectives of the project	C	B
	Software development process	・ Skills to manage development planning and quality in software development	D	B
	Web application fundamentals	・ Basic skills required for web application design and development	D	B
	Front-end system development	・ Design and development skills for screens that are the direct point of contact with users	D	B
	Back-end system development	・ Design and development skills for server-side functions that are not visible to the user	D	B
	Cloud infrastructure utilization	・ Skills in building and operating system infrastructure using cloud services	B	A
	SRE process	・ Skills to cooperate with development and operations to improve release cycles and service stability	C	A
	Service utilization	・ Skills in data integration and system integration with multiple systems within the company, including core systems, and external services	C	B
3.2 Digital tech-nology	Physical computing	・ The skills to handle the digitization of physical events through sensors, robots, IoT of existing equipment, etc.	C	B
	Other advanced technologies	・ Knowledge of implementation technologies other than the above or those with few applications	C	B
	Technology Trends	・ Knowledge of businesses and services that apply new digital technologies	C	C
4. Security				
4.1 Security Management	Security System Establishment and Operation	・ Skills to establish a system to implement security measures and to smoothly maintain and operate the system (including securing and training personnel) ・ Skills to develop a security culture as an organization within a company	A	C
	Security Management	・ Skills to implement appropriate organizational processes for security management of information, cyberspace, OT/IoT environments, etc.	A	B
	Incident Response and Business Con-tinuity	・ Skills to mitigate the impact of various risks (cyber-attacks, negligence, internal fraud, disasters, failures, etc.) when they materialize as security incidents in digital utilization, and to enable business continuity.	A	B
	Privacy Protection	・ Skills in understanding and implementing the requirements for the protection of personal data and other privacy information	A	B

Category	Skill Items	Contents	Importance	
			Cybersecu-rity manager	Cybersecurity engineer
4.2 Security Technology	Secure design, development, and construction	・ Skills to design, develop, and build digital services and products based on standards and requirements that must be adhered to in order to make them less susceptible to cyber-attacks and various types of fraud. ・ Skills to understand the vulnerabilities of digital services and products, and to perform appropriate diagnoses (including outsourced implementation).	B	A
	Security operation, maintenance, and monitoring	・ Skills to properly implement maintenance and countermeasures to ensure the secure operation of digital service ・ Skills to properly monitor security and investigate the causes of incidents	B	A

Source: IPA website (https://www.ipa.go.jp/jinzai/skill-standard/dss/ps6vr700000083ki-att/000106872.pdf) (https://www.ipa.go.jp/jinzai/skill-standard/dss/ps6vr700000083ki-att/000106874.xlsx).

Japanese version was translated to English by the project team .

Chapter 4
Cloud Services

4.1 Cloud Service Job Description

According to the Digital Skill Standard (IPA, 2024)[10], responsibilities and tasks of **Cloud Engineers/ Service Reliability Engineering (SREs)** are described as below.

Table 4.1 Cloud Engineers/SREs - Responsibilities and Tasks

Specialty	Responsibilities
Cloud Engineers/SREs	[Responsibility] - Responsible for the optimization and reliability of the software development and operating environment for the provision of services using digital technology
	[Major Tasks] - Understand the needs of users of services using digital technology and realize a software development and operating environment that enables users to realize their needs - Optimize the operational environment based on feedback from software engineers in other roles - Conduct ongoing monitoring during service operation and, based on the results, take the necessary system and software actions to improve the reliability of the service

Source: IPA. MoETI, The Digital skill standard Ver. 1 1 (2023) and Ver. 1.2 (2024)
Remarks: SFIA 8[11] presents examples of job titles related to DevOps practitioners, such as *DevOps Engineer, Senior DevOps Engineer, Site Reliability Engineer, Cloud Platform Engineer,* and *Cloud Site Reliability Engineer* It also provides examples of job titles related to the DevOps practice management, including *DevOps Manager*, *DevOps Director*, and *DevOps VP.*

4.2 Skill & Knowledge Items for Cloud Services

Skill proficiency criteria for Cloud Engineers are shown in following tables.

Table 4.2 Skill Proficiency Importance

A/Level 6	Requires a high level of practice and expertise
B/Level 5	Requires a certain level of practice and expertise
C/Level 4	Requires understanding at a level that can be explained
D/Level 3	Requires understanding of positioning and relevance

Source: IPA website (https://www.ipa.go.jp/jinzai/skill-standard/dss/ps6vr700000083ki-att/000106874.xlsx). Japanese version was translated to English by the project team .

10 The Digital Skill Standard Ver. 1.1 (IPA, 2023) and Ver. 1.2 (IPA, 2024) introduced the “Common Skill List,” which is commonly applied to five human resource categories (1. Business architect, 2. Designer, 3. Data scientist, 4. Software engineer, 5 Cybersecurity). The Digital Skill Standard organizes the skills required of personnel who promote DX into five categories (business transformation, data application, technology, security, personal skills) and 12 subcategories.
11 SFIA 8 illustrative skill profiles. https://sfia-online.org/en/tools-and-resources/standard-industry-skills-profiles/sfia-skills-for-role-families-job-titles#autotoc-item-autotoc-46

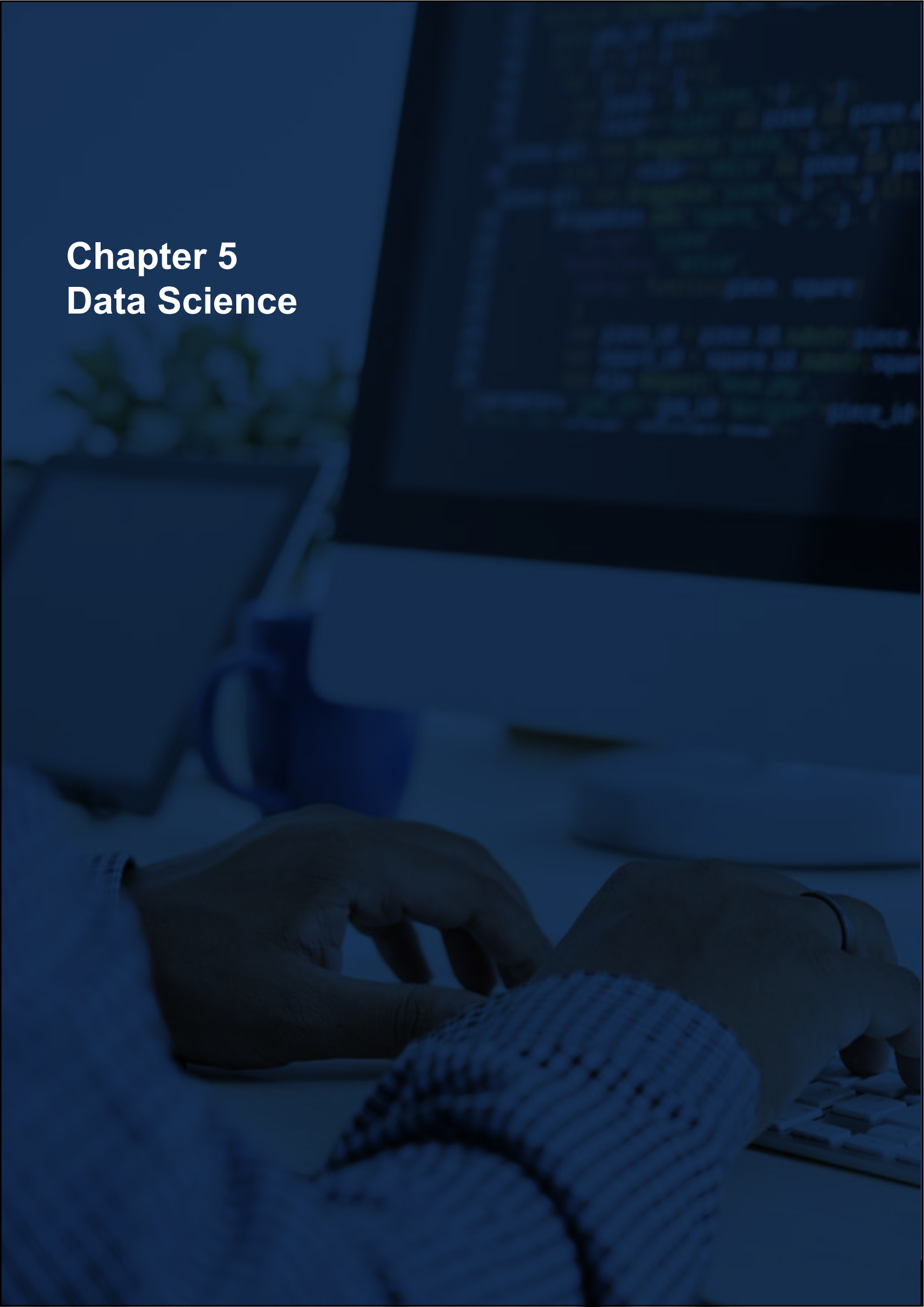
Table 4.3 Cloud Engineer/SREs – Importance of Skill Items by Specialties

Category	Skill items	Contents	Importance
			Cloud Engineer /SREs
1. Business Transformation			
1.1 Strategy, Management Systems	Business Strategy Development and Execution	• Skills to formulate business strategies, including startup ecosystem building, and product (product/service) portfolio management	D
	Product Management	• Skills to define the value proposition of a product (product or service), and to conceptualize and implement ways to generate revenue by providing value, the product itself, and related processes.	C
	Change Management	• Skills to identify potential impediments (organizational structure, culture and climate, various systems, human resources, and business processes) to promoting DX, and to formulate measures to address them. • Skills to involve stakeholders in organizational and operational changes.	D
	Systems Engineering	• Skills to view everything as a collection of interacting elements (a system) and to conceptualize an approach to achieve overall optimization while taking into account diverse values that span multiple areas of expertise.	C
	Enterprise Architecture	• Skills to organize the business, operations, data, IT systems, and other elements that make up an organization, and to optimize them as a whole through hierarchical structuring and standardization.	D
	Project Management	• Skill in iterating over very short periods of time and responding to changes in the business environment and requirements. • Skill in executing a program that includes a project or multiple projects on time, to a given quality, budget, and timeframe.	B
1.2 Business Models & Processes	Business Research	• Skills to understand social issues, business megatrends, industry market size and growth potential, and success factors and growth issues in business, products, and operations	D
	Business Model Design	• The skill to develop an objective and vision for a product or service based on success factors and growth issues • Skill to design a mechanism to generate revenue by examining revenue models, etc., after organizing cost structure and channels.	D
	Business Analysis	• The skills to visualize the current status and goals of activities required to provide products and services, and to identify the activities that are particularly important and that create value. • Skills to identify areas for digitization to achieve the desired state.	D
	Validation (Business Perspective)	• Skills to verify the sustainability of the developed product or service as a business (how much revenue can be obtained, how much competitive advantage can be secured, and how much cost can be reduced).	D
	Marketing	• Skills to verify the business sustainability of developed products and services (how much revenue can be generated, how much competitive advantage can be secured, and how much cost can be reduced).	D
	Branding	• Skills to develop and execute strategies to increase customer loyalty to and differentiate the company's brand.	D

Category	Skill items	Contents	Importance Cloud Engineer /SREs
1.3 Design	Customer/User Understanding	• Skills to design and conduct user surveys (customer satisfaction, usage data, interviews, etc.) and market/ competitive research. • Skills to understand and analyze customer expectations and dissatisfaction, new needs, competition, and trends from user survey results, and to derive insights.	D
	Value Discovery and Definition	• Skills in facilitating stakeholders to diverge ideas and define value propositions based on customer/user needs.	D
	Design	• Skills to clarify the necessary functions and content based on the needs of customers and users. • Design the structure and framework of functions and content, taking into account ease of understanding and finding for customers and users. • Design skills to design the appearance and dynamic elements that are desirable to the user	D
	Validation (customer/user perspective)	• Skills to verify whether the value propositions defined are actually experienced by customers through the implemented products and services, and whether they are useful experiences for customers.	C
	Other design techniques	• Design skills for designing graphics for digital media related to marketing. • Skill to layout and organize e-books, catalogs and other magazines in an easy-to-read format.	D
2. Data Application			
2.1 Strategic Use of Data and AI	Data Understanding and Utilization	• Skills to accurately understand statistical information including graphs, charts, and graphs, as well as the results of data analysis by applying various analytical methods, and to gain deep insight into the meaning and background of such information	B
	Data/AI utilization strategy	• Skills to propose solutions to problems and new business models using data and AI technologies based on business strategies, organizational issues, customer needs, etc.	C
	Design, business implementation, and evaluation of data/AI utilization operations	• Skills to implement and continuously improve data and AI analysis mechanisms in the field after designing an approach to realize data and AI strategic objectives.	C
2.2 AI and Data Science	Mathematical Statistics, Multivariate Analysis, Data Visualization	• Multivariate analysis and data visualization • Skills in analyzing data and gaining insight into the results using methods based on statistical knowledge	C
	Machine learning, deep learning	• Machine learning and deep learning, natural language processing, image recognition, speech recognition, and other techniques are used to build and evaluate appropriate models.	C
2.3 Data Engineering	Data utilization infrastructure design	• Skills to establish the necessary system environment, collected data, tables, and other requirements in preparation of a data utilization infrastructure that produces results from the data.	B
	Implementation and operation of data utilization infrastructure	• Data handling skills necessary to implement and smoothly and effectively operate a data utilization infrastructure that produces results from data.	B
3. Technology			

Category	Skill items	Contents	Importance Cloud Engineer /SREs
3.1 Software development	Computer Science	・ Skills related to data structures, algorithms, etc. required in software development	A
	Team Development	・ Skills needed to increase productivity of software development in a team environment	B
	Software Design Methodology	・ Skills to study data structures and internal architectures and incorporate them into the design in order to implement software that meets the objectives of the project	B
	Software Development Process	・ Skills to manage development planning and quality in software development	B
	Web Application Fundamentals	・ Basic skills required for web application design and development	B
	Front-end system development	・ Design and development skills for screens that are the direct point of contact with users	B
	Back-end system development	・ Design and development skills for server-side functions that are not visible to the user	B
	Cloud Infrastructure Utilization	・ Skills in building and operating system infrastructure using cloud services	A
	SRE Process	・ Skills to cooperate with development and operations to improve release cycles and service stability	A
	Service Utilization	・ Skills in data integration and system integration with multiple systems within the company, including core systems, and external services	C
3.2 Digital technology	Physical Computing	・ The skills to handle the digitization of physical events through sensors, robots, IoT of existing equipment, etc.	C
	Other Advanced Technologies	・ Knowledge of implementation technologies other than the above or those with few applications	C
	Technology Trends	・ Knowledge of businesses and services that apply new digital technologies	C
4. Security			
4.1 Security Management	Security System Establishment and Operation	・ Skills to establish a system to implement security measures and to smoothly maintain and operate the system (including securing and training personnel) ・ Skills to develop a security culture as an organization within a company	D
	Security Management	・ Skills to implement appropriate organizational processes for security management of information, cyberspace, OT/IoT environments, etc.	C
	Incident Response and Business Continuity	・ Skills to mitigate the impact of various risks (cyber-attacks, negligence, internal fraud, disasters, failures, etc.) when they materialize as security incidents in digital utilization, and to enable business continuity.	C
	Privacy Protection	・ Skills in understanding and implementing the requirements for the protection of personal data and other privacy information	D
4.2 Security Technology	Secure Design, Development and Construction	・ Skills to design, develop, and build digital services and products based on standards and requirements that must be adhered to in order to make them less susceptible to cyber-attacks and various types of fraud. ・ Skills to understand the vulnerabilities of digital services and products, and to perform appropriate diagnoses (including outsourced implementation).	B
	Security Operation, Maintenance and Monitoring	・ Skills to properly implement maintenance and countermeasures to ensure the secure operation of digital services ・ Skills to properly monitor security and investigate the causes of incidents	A

Source: IPA website (https://www.ipa.go.jp/jinzai/skill-standard/dss/ps6vr700000083ki-att/000106872.pdf) (https://www.ipa.go.jp/jinzai/skill-standard/dss/ps6vr700000083ki-att/000106874.xlsx). Japanese version was translated to English by the project team .



Chapter 5
Data Science

5.1 Data Science Job Description

According to Digital skill standard Ver. 1 (IPA, 2022) and Ver. 1.2 (IPA 2024)[12] responsibilities and tasks of each role related to Data Science are defined as below.

Table 5.1 Data Science – Responsibilities and Tasks by Specialty

Specialty	Responsibility and Tasks
Data business strategist	[Responsibility] Think about strategies for using data in line with business strategies, and lead the materialization and realization of those strategies to achieve operational transformation and business creation that expand customer value.
	[Task] • Determine the pros and cons of using data in the company's business strategy and develop a data utilization strategy to realize the business strategy. • Plan and lead the process to realize the data utilization strategy, coordinate collaboration with other human resource types and other roles, and manage projects in the area of data utilization. • Design and review operations that utilize data in cooperation with field divisions to create new businesses and achieve reform and improvement of field operations • Grasp the results of initiatives and issues, and link them to the next initiatives.
Data science professional	[Responsibility] Through data processing and analysis, derive meaningful insights that lead to operational changes and business creation that expand customer value.
	[Task] • Process and analyze data based on expertise in the areas of AI and data science, and evaluate and analyze the results appropriately. • Generate insights from the results of data processing and analysis that lead to the creation of new businesses and the transformation and improvement of on-site operations, and visualize them appropriately. • Create a mechanism for data utilization in the field divisions and provide education and support to end users. • Improve analytical models based on the operational status of data utilization mechanisms and new business requirements. • Keep abreast of new technologies in the AI and data science domain and examine their potential
Data engineer	[Responsibility] Achieve operational transformation and business creation to expand customer value through the design, implementation, and operation of an effective data analysis environment.
	[Task] • Design a system environment that allows the collection, processing and analysis of data appropriate to the goal (e.g. operational data or log data), among others, to be carried out effectively, lead its implementation and achieve its optimal operation • Coordinate and achieve an optimal real-time, dynamic and automatic data analysis environment in accordance with changes in the situation • Process data and create data marts required for data analysis • Develop an environment that allows other roles to conduct monitoring appropriately

Source: IPA, MoETI. The Digital Skill Standards - Ver. 1.1 (2023) and Ver. 1.2 (2024)

12 The Digital skill standard Ver. 1.1 (IPA, 2023) and Ver.1.2 (IPA, 2024) introduced the "Common Skill List," which is common to five human resource categories (1. Business architect, 2. Designer, 3. Data scientist, 4. Software engineer, 5 Cybersecurity), organizes the skills required of personnel who promote DX into five categories (business transformation, data application, technology, security, personal skills) and 12 subcategories.

13 SFIA 8 illustrative skill profiles. https://sfia-online.org/en/tools-and-resources/standard-industry-skills-profiles/sfia-skills-for-role-families-job-titles#au-totoc-item-autotoc-46

Remarks: SFIA 813 presents examples of job titles related to data science practitioners, such as Data scientist, Lead data scientist, Quantitative analyst, and *Data analyst.* It also provides examples of job titles related to the data engineering practitioners, including *Data engineer*, *Cloud Data engineer*, and *Cloud Data Architect.*

5.2 Skill & Knowledge Items for Data Science

According to the Digital Skill Standard (IPA, 2024)[14], importance of common skills for **Data Science** are shown in the following tables.

Table 5.2 Skill Proficiency Importance

A/Level 6	Requires a high level of practice and expertise
B/Level 5	Requires a certain level of practice and expertise
C/Level 4	Requires understanding at a level that can be explained
D/Level 3	Requires understanding of positioning and relevance

Source: IPA website (https://www.ipa.go.jp/jinzai/skill-standard/dss/ps6vr700000083ki-att/000106874.xlsx). Japanese version was translated to English by the project team .

14 The Digital Skill Standard Ver. 1.1 (IPA, 2023) and Ver. 1.2 (IPA, 2024) introduced the “Common Skill List,” which is common to five human resource categories (1. Business architect, 2. Designer, 3. Data scientist, 4. Software engineer, 5 Cybersecurity), organizes the skills required of personnel who promote DX into five categories (business transformation, data application, technology, security, personal skills) and 12 subcategories.

Table 5.3 Data Science – Importance of Skill Items by Specialties

Category	Skill Items	Contents	Importance		
			Data business strategist	Data science	Data engineer
1. Business Transformation					
1.1 Strategy, Management Systems	Business Strategy Development and Execution	• Skills to formulate business strategies, including startup ecosystem building, and product (product/service) portfolio management	B	D	D
	Product Management	• Skills to define the value proposition of a product (product or service), and to conceptualize and implement ways to generate revenue by providing value, the product itself, and related processes.	C	C	C
	Change Management	• Skills to identify potential impediments (organizational structure, culture and climate, various systems, human resources, and business processes) to promoting DX, and to formulate measures to address them • Skills to involve stakeholders in organizational and operational changes.	C	C	C
	Systems Engineering	• Skills to view everything as a collection of interacting elements (a system) and to conceptualize an approach to achieve overall optimization while taking into account diverse values that span multiple areas of expertise.	C	C	B
	Enterprise Architecture	• Skills to organize the business, operations, data, IT systems, and other elements that make up an organization, and to optimize them as a whole through hierarchical structuring and standardization.	C	D	B
	Project Management	• Skill in iterating over very short periods of time and responding to changes in the business environment and requirements. • Skill in executing a program that includes a project or multiple projects on time, to a given quality, budget, and timeframe.	B	C	C

Category	Skill Items	Contents	Importance		
			Data business strategist	Data science	Data engineer
1.2 Business Models & Processes	Business Research	• Skills to understand social issues, business megatrends, industry market size and growth potential, and success factors and growth issues in business, products, and operations	B	D	D
	Business Model Design	• The skill to develop an objective and vision for a product or service based on success factors and growth issues. ・ Skill to design a mechanism to generate revenue by examining revenue models, etc., after organizing cost structure and channels.	B	C	D
	Business Analysis	• The skills to visualize the current status and goals of activities required to provide products and services, and to identify the activities that are particularly important and that create value. • Skills to identify areas for digitization to achieve the desired state.	B	C	C
	Validation (Business Perspective)	• Skills to verify the sustainability of the developed product or service as a business (how much revenue can be obtained, how much competitive advantage can be secured, and how much cost can be reduced).	B	C	D
	Marketing	• Skills to verify the business sustainability of developed products and services (how much revenue can be generated, how much competitive advantage can be secured, and how much cost can be reduced).	C	D	D
	Branding	• Skills to develop and execute strategies to increase customer loyalty to and differentiate the company's brand.	C	D	D
1.3 Design	Customer/ User Understanding	• Skills to design and conduct user surveys (customer satisfaction, usage data, interviews, etc.) and market/competitive research. • Skills to understand and analyze customer expectations and dissatisfaction, new needs, competition, and trends from user survey results, and to derive insights.	B	C	C
	Value Discovery and Definition	• Skills in facilitating stakeholders to diverge ideas and define value propositions based on customer/ user needs.	B	C	C
	Design	• Skills to clarify the necessary functions and content based on the needs of customers and users • Design the structure and framework of functions and content, taking into account ease of understanding and finding for customers and users. • Design skills to design the appearance and dynamic elements that are desirable to the user	C	D	C
	Validation (customer/ user perspective)	• Skills to verify whether the value propositions defined are actually experienced by customers through the implemented products and services, and whether they are useful experiences for customers.	B	B	C
	Other design techniques	• Design skills for designing graphics for digital media related to marketing. • Skill to layout and organize e-books, catalogs and other magazines in an easy-to-read format.	D	D	D
2. Data application					

Category	Skill Items	Contents	Importance		
			Data business strategist	Data science	Data engineer
2.1 Strategic Use of Data and AI	Data Understanding and Utilization	・ Skills to accurately understand statistical information including graphs, charts, and graphs, as well as the results of data analysis by applying various analytical methods, and to gain deep insight into the meaning and background of such information	A	B	B
	Data/AI utilization strategy	・ Skills to propose solutions to problems and new business models using data and AI technologies based on business strategies, organizational issues, customer needs, etc.	A	C	C
	Design, business implementation, and evalua-tion of data/AI utilization operations	・ Skills to implement and continuously improve data and AI analysis mechanisms in the field after designing an approach to realize data and AI strategic objectives.	A	B	C
2.2 AI and Data Science	Mathematical Statistics, Multivariate Analysis, Data Visualization	・ Multivariate analysis and data visualization ・ Skills in analyzing data and gaining insight into the results using methods based on statistical knowl-edge	C	A	C
	Machine learning, deep learning	・ Machine learning and deep learning, natural language processing, image recognition, speech recognition, and other techniques are used to build and evaluate appropriate models.	C	A	C
2.3 Data Engineering	Data utilization infra-structure design	・ Skills to establish the necessary system environment, collected data, tables, and other requirements in preparation of a data utilization infrastructure that produces results from the data.	C	C	A
	Implementation and operation of data utilization infrastructure	・ Data handling skills necessary to implement and smoothly and effectively operate a data utilization infrastructure that produces results from data.	C	C	A
3. Technology					
3.1 Software development	Computer Science	• Skills related to data structures, algorithms, etc. required in software development	D	B	B
	Team Development	• Skills needed to increase productivity of software development in a team environment	B	B	B
	Software Design Methodology	• Skills to study data structures and internal architectures and incorporate them into the design in order to implement software that meets the objectives of the project	C	C	B
	Software Development Process	• Skills to manage development planning and quality in software development	C	C	B
	Web Application Fundamentals	• Basic skills required for web application design and development	D	D	C
	Front-end system development	• Design and development skills for screens that are the direct point of contact with users	D	D	C
	Back-end system development	• Design and development skills for server-side functions that are not visible to the user	D	D	B
	Cloud Infrastructure Utilization	• Skills in building and operating system infrastructure using cloud services	D	D	B
	SRE Process	• Skills to cooperate with development and operations to improve release cycles and service stability	C	C	C
	Service Utilization	• Skills in data integration and system integration with multiple systems within the company, including core systems, and external services	C	C	B

Category	Skill Items	Contents	Importance		
			Data business strategist	Data science	Data engineer
3.2 Digital Technology	Physical Computing	• The skills to handle the digitization of physical events through sensors, robots, IoT of existing equipment, etc.	C	C	C
	Other Advanced Technologies	• Knowledge of implementation technologies other than the above or those with few applications	C	C	B
	Technology Trends	• Knowledge of businesses and services that apply new digital technologies	C	C	C
4. Security					
4.1 Security Management	Security System Establishment and Operation	• Skills to establish a system to implement security measures and to smoothly maintain and operate the system (including securing and training personnel) • Skills to develop a security culture as an organization within a company	D	D	D
	Security Management	• Skills to implement appropriate organizational processes for security management of information, cyberspace, OT/IoT environments, etc.	C	C	C
	Incident Response and Business Continuity	• Skills to mitigate the impact of various risks (cyber-attacks, negligence, internal fraud, disasters, failures, etc.) when they materialize as security incidents in digital utilization, and to enable business continuity.	C	C	B
	Privacy Protection	• Skills in understanding and implementing the requirements for the protection of personal data and other privacy information	B	B	B
4.2 Security Technology	Secure Design, Development and Construction	• Skills to design, develop, and build digital services and products based on standards and requirements that must be adhered to in order to make them less susceptible to cyber-attacks and various types of fraud. • Skills to understand the vulnerabilities of digital services and products, and to perform appropriate diagnoses (including outsourced implementation).	D	D	B
	Security Operation, Maintenance and Monitoring	• Skills to properly implement maintenance and countermeasures to ensure the secure operation of digital services • Skills to properly monitor security and investigate the causes of incidents	D	D	C

Source: IPA website (https://www.ipa.go.jp/jinzai/skill-standard/dss/ps6vr700000083ki-att/000106872.pdf) (https://www.ipa.go.jp/jinzai/skill-standard/dss/ps6vr700000083ki-att/000106874.xlsx). Japanese version was translated to English by the project team . According to SFIA 9, responsibilities of Artificial intelligence (AI) and data ethics skills are defined as below.

According to SFIA 9, responsibilities of Artificial intelligence (AI) and data ethics skills are defined as below.

Table 5.4 AI and data ethics – Responsibilities and Tasks by Specialty

Specialty	Responsibility and Tasks
AI and Data Ethics	[Responsibility] Implementing and promoting ethical practices in the design, development, deployment and use of AI and data technologies.
	[Task] - providing expert advice on ethical policies, procedures and governance - designing AI and data systems that embed ethical considerations - conducting ethical impact assessments to identify risks and ensure responsible use of technology responding to ethical dilemmas and incidents - keeping up to date with ethical standards, regulations and recommended practices - creating ethical risk models and frameworks - collaborating with experts in fields such as legal, public relations, data science and AI - promoting a culture of ethical awareness and responsibility within the organization.

Source: SFIA 9 https://sfia-online.org/en/sfia-9/skills/ai-data-ethics

Table 5.5 Skill Proficiency

Level 6	· Sets direction for ethics in AI and data initiatives. · Defines governance processes to ensure compliance with ethical standards. Engages with industry bodies and experts to develop and drive industry recommended practices. · Develops and implements strategic ethical frameworks. Leads high-level reviews and decision-making processes. · Allocates resources to support the organization's commitment to ethical practices. Ensures the organization has resources and skills for ethical assurance.
Level 5	· Provides expert advice to integrate ethics into AI and data projects and programs. · Oversees governance and assurance activities. Reviews and approves impact assessments and audits. · Promotes awareness of ethical principles and their application across the organization. · Contributes to the development of policy, standards and guidelines related to AI and data ethics.
Level 4	· Engages stakeholders to communicate ethical considerations and influence design decisions. · Conducts detailed impact assessments and makes recommendations. Manages ethical reviews to ensure compliance with standards. · Evaluates risks and proposes measures to address ethical concerns. Leads discussions with stakeholders on ethical issues. · Designs and executes ethical impact assessments. Prepares reports based on audit findings.
Level 3	· Supports ethical reviews and conducts basic impact assessments under direction. · Gathers and analyses information for assessments. Reports on ethical issues and compliance with guidance from others. Documents findings from audits and reviews. · Assists with documentation and communication of ethical policies. · Supports others in responding to incidents.

Source: SFIA 9 https://sfia-online.org/en/sfia-9/skills/ai-data-ethics

Annex 1 Common Competencies

SFIA 9 defines generic attributes, business skills and behavioral factors as below.

Title	Description	Examples of actions
Autonomy	The level of independence, discretion and accountability for results in your role.	· Work under varying levels of direction and supervision. · Make independent decisions in line with responsibility. Taking accountability for actions and their outcomes. · Delegate tasks and responsibilities appropriately. · setting personal, team, or organizational goals.
Influence	The reach and impact of your decisions and actions, both within and outside the organization.	· Expand interaction and impact. · Move from transactional to strategic interactions. · Engage with stakeholders at higher seniority levels. · Shape decisions with greater organizational impact. · Contribute to team, department, and organizational direction.
Complexity	The range and intricacy of tasks and responsibilities that come with your role.	· Handle varied and unpredictable work environments. · Address a wider range of technical or professional tasks. · Solve increasingly complex problems. · Manage diverse stakeholders. · Contribute to policy and strategy. · Leverage emerging technologies for business value.
Knowledge	The depth and breadth of understanding required to perform and influence work effectively.	· Apply role-specific knowledge to routine tasks. · Integrate general, role-specific, and industry knowledge. · Use knowledge of technologies and processes to achieve results. · Apply expertise to solve complex problems. · Leverage broad knowledge to influence strategy. · Shape organizational knowledge management.
Collaboration	Working effectively with others, sharing resources and coordinating efforts to achieve shared objectives.	· Work cooperatively within teams. · Share information and resources effectively. · Coordinate efforts to achieve common goals. · Facilitate cross-functional teamwork. · Build influential relationships across the organization. · Manage strategic partnerships.
Communication	Exchanging information, ideas and insights clearly to enable mutual understanding and cooperation.	· Communicate effectively within teams. · Exchange information and ideas clearly. · Use verbal, written, and listening skills with the right tools. · Adapt communication for diverse audiences. · Simplify complex concepts for decision-making. · Influence strategy through dialogue with senior stakeholders.
Improvement mindset	Continuously identifying opportunities to refine work practices, processes, products, or services for greater efficiency and impact.	· Identify areas for improvement in processes, products, or services. · Implement changes to boost efficiency and effectiveness. · Assess and refine improvements. · Promote a continuous improvement mindset in others. · Align improvements with organizational goals. · Foster a culture of ongoing optimization.

Title	Description	Examples of actions
Creativity	Generating and applying innovative ideas to enhance processes, solve problems and drive organizational success.	· Generate innovative ideas and solve complex problems creatively. · Improve processes through creative thinking and encourage innovation in others. · Foster a culture of innovation aligned with organizational strategy.
Decision making	Applying critical thinking to evaluate options, assess risks and select the most appropriate course of action.	· Evaluate information, assess risks, and understand the organizational context. · Balance intuition with logic to make informed decisions. · Choose the best course of action and take accountability for outcomes.
Digital mindset	Embracing and effectively using digital tools and technologies to enhance performance and productivity.	· Apply digital technologies and adapt to fast-changing digital environments. · Leverage digital tools, AI, and data to improve processes and drive innovation. · Understand emerging technologies' impact and ensure digital governance and compliance.
Leadership	Guiding and influencing individuals or teams to align actions with strategic goals and drive positive outcomes.	· Show personal responsibility and ownership of work and growth. · Guide and influence others while enhancing team capabilities. · Align actions with organizational goals and lead positive change.
Learning and development	Continuously acquiring new knowledge and skills to enhance personal and organizational performance.	· Continuously learn and apply new knowledge while addressing skill gaps. · Share insights, foster personal and team development, and promote learning to support strategic goals. · Inspire a culture of learning aligned with business objectives.
Planning	Taking a systematic approach to organizing tasks, resources and timelines to meet defined goals.	· Set objectives, plan timelines, organize tasks, and allocate resources effectively. · Align activities with broader goals and adapt plans as needed. · Monitor progress, evaluate outcomes, and drive strategic objectives.
Problem-solving	Analyzing challenges, applying logical methods and de-veloping effective solutions to overcome obstacles.	· Identify and understand problems, analyze solutions, and implement effective resolutions. · Evaluate outcomes to learn and improve. · Proactively address potential issues and ensure problem-solving aligns with organizational goals.
Adaptability	Adjusting to change and persisting through challenges at personal, team and organizational levels.	· Embrace change and proactively adopt new methods and technologies. · Adapt to varying team dynamics and work needs. · Support others in navigating challenges and lead teams through transitions. · Drive major organizational changes and foster a culture of adaptability.

Title	Description	Examples of actions
Security, privacy and ethics	Ensuring the protection of sensitive information, upholding privacy of data and individuals, and demonstrating ethical conduct within and outside the organization.	· Follow professional work practices and organizational rules. · Apply standards and best practices to foster a culture of security, privacy, and ethics, including addressing challenges from emerging technologies like AI and ensuring legal compliance. · Lead efforts to integrate security, privacy, and ethical principles into the organization's culture and daily operations.

Source: SFIA Foundation. SFIA 9 generic attributes – directory (https://sfia-online.org/en/sfia-9/generic-attributes-a-z)

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- Software engineering competencies https://sfia-online.org/en/sfia-8/sfia-views/software-engineering-competencies/?path=/glance
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