

Information Technology Engineers Skill Standards

Technical Engineers (System Management)

Contents

1. Overview	1
2. Key Activities.....	4
3. Skill Criteria	9
4. Body of Knowledge	27

Translated this Skill Standard (update on September 29, 2000) from Japanese into English on July 31, 2000

Japan Information Processing Development Corporation
Central Academy of Information Technology

1. Overview

1.1 Background of developing the “Information Technology Engineers Skill Standards”

At present, great hopes are placed on information technology as the sources of industry regeneration and new economic growth. This is because the roles of IT have been expanded from the tools for manufacturing cost reduction and service speedup to those for effective collaboration among enterprises and the creation of new industries. From now on, the rise or fall of an enterprise will be determined by quality of computerization investment. It is therefore an urgent matter to bring up engineers who construct advanced information systems and those who utilize them.

In view of this, the Central Academy of Information Technology has repeated a study on how to bring up, evaluate, and select good engineers who can show their practical ability on actual jobs. As a conclusion, the academy decided to establish the “information technology engineers skill standards” centering on the criteria to determine whether the required jobs can be performed adequately or not.

1.2 Significance and objective of developing the “Information Technology Engineers Skill Standards”

The results of surveys that the Central Academy of Information Technology has conducted on information processing engineers have suggested an important issue to be solved in the industrial world and by educational institutions such as schools. The issue is the establishment of the guidelines that clearly define what the industrial and educational worlds are expecting to get. While these guidelines need to define the level of knowledge, skills and capability to be equipped with by IT personnel (engineers) who do the actual jobs in the industrial world, they need to define the models of IT engineers who can be accepted internationally, and the ways how schools and other educational institutions should conduct education training on the basis of these models. One example of the guidelines is the “Skill Standard for IT Engineers” developed by the Northwest Center for Emerging Technologies (NWCET) as part of the establishment of “Skill Standards” by the US Department of Labor.

The “Information Technology Engineers Skill Standards” have been developed as a tool that solves the issue mentioned above, and apply to all the sections of the information technology engineers examinations as criteria to evaluate the skills of engineers who have been brought up. The application of this skill standard is significant for the industrial world in “recruiting human resources with the guaranteed ability to do actual jobs.” For educational institutions such as schools, this is significant for “understanding and confirming the knowledge, ability, and the achievement levels of the engineers required by enterprises.” For government agencies, this is significant for “grasping the technical level of the entire industrial world.”

1.3 Configuration of the “Information Technology Engineers Skill Standards”

The “Information Technology Engineers Skill Standards” is a tool that provides information about knowledge and skill needed to do jobs such as building, operational control, usage and evaluation of IT system in organizations such as corporations. It also provides indicators to determine the outcome of jobs. “Information Technology Engineers Examinations: Overview of the New System” and “Information Technology Engineers Examinations: Scope of Examinations” describe knowledge, technology (technical knowledge), and ability that information processing engineers need to have, and performance indicators (listed in 1), 2), and 3) below). The established skill standards describe these points more specifically by consulting actual jobs.

- 1) Roles and jobs
- 2) Expected technical levels
- 3) Scopes of examinations: examination in the morning and that in the afternoon
(The above information can be downloaded to access
<http://www.jitec.jipdec.or.jp/>.)

The “Information Technology Engineers Skill Standards” consists of three kinds of technical information described below. In this standard, individual skill standards are established for each examinees classified according to examination categories.

(1) Key activities

This chapter describes jobs that are keys unique to each examination categories. It describes the “roles and jobs” in 1) above more specifically.

(2) Skill criteria

This chapter describes what knowledge and skill should be used to do the key activities in (1) above, and also describe performance indicators to determine what outcome should be obtained. It describes “expected technical levels” in 2) above more specifically.

(3) Body of knowledge

This chapter systematically describes common knowledge independent of examination categories and knowledge needed to do the key activities in (1) above. This chapter also covers the “scopes of examinations” in 3) above.

1.4 Image of “Technical Engineers (System Management)” and Skill Standards

These skill standards have been prepared, applying the framework of the above-mentioned Information Technology Engineers Skill Standards for “technical engineers (system management).”

(1) Image of applicable engineers

For typical information systems, technical engineers (system management) are to be engaged as system administrators in various types of information system management, improvement activities for stable and efficient operation of information systems, planning and execution of system migration, and to support the operation for system users. These system engineers are required to have excellent capabilities in system management and system configuration etc. as well as the basic operations of information systems, such as planning, construction, operation management, system evaluation, reception and migration of new systems with respect to information system bases including resources, security and performance.

(2) Skill standards

The following skill standards are to apply to the technical engineers (system management).

- 1) IT common body of knowledge
- 2) Technical engineers (system management)
 - Key activities, skill criteria, practical body of knowledge, and core body of knowledge

2. Key Activities

Key activities refer to the contents of work taken from various management tasks, which are fundamental for technical engineers (system management) in the planning, construction and operation of information systems. This job area is to be called “system operation management job process.”

As shown in Figure 2-1, jobs in the system operation management job process are broken down into 10 basic “activities.”

System management plan
System management
Resource management
Fault management
Security management
Performance management
System maintenance
Development of new systems and system migration
System evaluation on operation management
System user support

Figure 2-1 System operation management job process

Each activity is further broken down into detailed jobs called “tasks.” This skill standard presents the system operation management job process in the following format:

Activity	Task	Job outline
1. Act 1	1-1 Task 1	x x x x x x x x x x x x x
	1-2 Task 2	x x x x x x x x x x x x
	1-3 Task 3	x x x x x x x x x x
2. Act 2	2-1 Task 1	x x x x x x x x x x x
	2-2 Task 2	x x x x x x x x x x x x
	2-3 Task 3	x x x x x x x x x x x x x
	2-4 Task 4	x x x x x x x x x x x x

Technical engineers (system management) mainly take charge of the “system management plan,” “system management,” “resource management,” “fault management,” “security management,” “performance management,” “system maintenance,” “development of new system and system migration,” “system evaluation on operation management,” and “system user support” shown in Figure 2-1. In these processes, technical engineers are to display their expertise capabilities on system management through tasks, such as the “management of various types of system component elements,” “tradeoff of services and costs,” “performance evaluation,” and “fault supervision, discovery of problems, investigation of cause, recovery and investigation of preventive measure.”

Technical Engineers (System Management) Skill Standards (Key Activities)

[Technical engineer (System management) key activities]

Activity	Task	Job outline
1. System management plan	1-1 Definition of system management requirements	Clarify priority areas of management and information resources for management according to the policies and computerization strategies requested by managerial layers or high-level manager layer. Problem areas and needs with higher priorities are also collected from information system users. The system management requirements are defined according to the information.
	1-2 Clarification of system management services	Define system and services provided as the system operation management department according to the system management requirements. Clarify what functions are included in the systems and services, at what level the system management department will make them implemented, and how to guarantee the contents.
	1-3 Calculation of cost/counter values for services	Calculate costs for system operation and management and shows users cost/counter values for providing systems and services. The final costs/counter values are adjusted by service range and level and tradeoff with user budget, and are determined via discussions.
	1-4 Preparation of operation rules	To maintain “Stable provision of services,” the primary purpose of system operation and management, set operation rules as the system providing side. Items that users must observe for stable operation are determined taking into account the operation costs and technical level of users.
	1-5 Preparation of system management plan	Prepare long- and short-term system management plans according to the system management requirements. Plans for users, policies on supervision and management and plans to be implemented are presented to perform collaboration reviews with users with respect to the possibilities of achievements on user requirements and the possibilities of adoption of alternative plans. Plans for self-departments, policies and concrete plans are clarified related to the execution system and key management elements.

Technical Engineers (System Management) Skill Standards (Key Activities)

Activity	Task	Job outline
2. System management	2-1 System operation	Perform schedule creation of system operation, standardization of processing procedure, creation of system operation manual, job execution management, management of materials and consumables, and input/output data management. In addition, periodically report system operation to users and high-level administrators in accordance with the reporting procedure of the enterprise.
	2-2 User management	Register/take off users and make various types of management related to registered users information. For user management, define management items and perform actual management according to the items, and report the status to high-level administrators.
	2-3 Operation management	Establish operation execution system, set job scope and determine method of specifying jobs. Manage job results management of operation, and analyze operation results to propose reform measures. Since operation quality is achieved by team play among operators, importance is put on team operation to promote management activities.
	2-4 Charging management	Determine the charging method, explain to users the concept to obtain their consent. Collect and analyze charging data. If there is a difference in chargeback, make improvements to correct defects in the chargeback.
	2-5 Cost management	Identify cost elements related to system operation and calculate the unit price of each element. At the end of terms, perform comparison between schedule and result and consider reform measures through analysis of differences. In addition to the system operation cost, propose measures for reducing total cost taking into account TCO in cooperation with users, if necessary.
	2-6 Personnel management	For personnel engaged in the system operation, set the duty system, improve health management, and support the obtainment of knowledge and acquisition of knowledge and technique, and contribute to the promotion of stable system operation. When personnel are procured from outside, perform job management related to consignment.
	2-7 Distribution site management	Seize problems on distribution system management, establish a method of managing systems on the distribution site and execute the method. Place distribution site managers, if necessary, and make efforts to improve the management efficiency and quality in cooperation with site managers.
	2-8 Use of operation management system	Cope with the increase of the amount of jobs related to system operation and complexities of job contents, and try to save operation jobs. In addition, introduce an operation management system for the purpose of improving the accuracy, efficiency and swiftness of operation, and use the system. For the development of an operation management system, extract job areas that may be made effective through automation, and take part in the system design phase and reflect operation requirements to promote the effects of development.

Technical Engineers (System Management) Skill Standards (Key Activities)

	2-9 Standardization	To improve the stability and efficiency of system operation, promote the setup and application of the standards related to the system operation management as well as conformance to the standards. In addition, evaluate effects related to the contents of the standard and reconsider them periodically.
--	---------------------	---

Technical Engineers (System Management) Skill Standards (Key Activities)

Activity	Task	Job outline
3. Resource management	3-1 Hardware management	Identify hardware resources to be managed, prepare management registers, and set management methods for each applicable resource to make management of the resources and their changes. In addition, maintenance of the hardware is conducted.
	3-2 Software management	Identify software resources to be managed and set management methods for each applicable resource to make management of the resources and their changes. Management tool is used for the library or document, if necessary. Also, preserve contract items on software use and protect intellectual property rights.
	3-3 Data management	In conformance to information resource management rules of enterprises, perform management of system catalogs, files, operation on database, and backup/recovery to cope with the occurrence of faults while receiving support from technical engineers (database). In addition, create audit support materials to cope with an audit on database.
	3-4 Network resource management	Identify network elements to be managed and set management methods for each applicable resource to make management of the resources and their changes. While receiving support from technical engineers (network), also perform network operation, configuration change and fault management as well as create audit support materials to cope with an audit on network.
	3-5 Facilities and equipment management	Manage power facilities, air-conditioning facilities, processor water-cooler, communication incidental facilities, buildings, incidental facilities, and so on in the computer center. Also, divide duties with distribution site administrators, if necessary, to manage facilities at sites.
4. Fault management	4-1 Fault supervision	Set applicable items to be supervised and determine the contents of supervision, supervisory method and the method of collecting supervisory information. Also establishes a contact system to prepare for occurrence of faults.
	4-2 Investigation of fault cause	Identify faults from supervisory information. After detecting faults, locate the faults swiftly and pursue the causes. Establish a system for investigation of causes and manage the course of the investigation. After specifying the causes, determine the method of reactivation.
	4-3 Recovery processing	Make a procedure as the preparation work related to recovery and carry out recovery work when faults occur. If a procedure is difficult to make for failures, determine workaround by judging the situation. If a procedure has been determined against faults, perform the recovery process according to the procedure.
	4-4 Fault record and preventive measures	If faults occur, record and manage their phenomena exactly and completely, and analyze the contents of the faults and take preventive measures against reoccurrence of the faults. To prevent reoccurrence of faults, standardize actions to be taken for faults that have occurred and make procedures for the faults.
	4-5 Fault management of distribution system	Supervise faults characteristic to distribution systems, make faults clear, and investigate recovery procedure to take appropriate actions against the occurrence of faults.

Technical Engineers (System Management) Skill Standards (Key Activities)

Activity	Task	Job outline
5. Security management	5-1 Establishment of security management system and policy setup	Set security management system and management policy according to the security policy of enterprises. Make a plan for physical, technical and administrative measures against intrusion of security and execute the plan. Also make a security education plan for users.
	5-2 Supervision of intrusion of security and status analysis	Collect information on intrusion of security, analyzes situations, and reports to high-level administrators and users. When reporting, attach security related information such as “information on new type of virus” and “examples for security.”
	5-3 Security management of distributed site	Set security management system and management policy at distributed sites. As in the case of the center, assign duties with distributed site administrators to make physical, technical and managerial measures against intrusion of security at sites, and perform them.
	5-4 Security intensity check	Conduct an experiment on intrusion of security and analyze the strength of security. If problems are found, make a plan to increase the strength and perform the plan.
	5-5 Security audit support	Prepare materials for audit to support security audit.
6. Performance management	6-1 Execution of performance evaluation	Determine performance evaluation criteria according to the following procedure and analyze and evaluate the performances based on them. (1) Determine a performance target, create a model to seize the performances, and set performance evaluation criteria. Also, determine the method of performance supervision. (2) Collect performance supervisory data, analyze measurement data and evaluate performances. Report the results of evaluation to high-level administrators and users.
	6-2 Capacity management	Identify capacities to be managed and calculate the system load such as current resource utilization factor. Also estimate future load according to the current load trend and user needs. Make a plan for intensifying the capacity based on the decrease of service level caused by increase of load, new product information and trend of technologies, etc.
	6-3 Performance management of distributed system	Assigns duties with distributed site administrators, make performance evaluation standards suitable for distributed system configuration, and conduct performance management and the evaluation.
	6-4 Capacity management in distributed system	Taking into account the importance of operation and the situations characteristic to distributed sites, manage the capacity.

Technical Engineers (System Management) Skill Standards (Key Activities)

Activity	Task	Job outline
7. System maintenance	7-1 Creation of system maintenance plan	Consulting the purpose and necessity of maintenance, seizure requests for maintenance and determine the maintenance items and the contents of maintenance. Consider the budget, requests for maintenance, and status of outdated/deteriorated status, time of required maintenance, etc., make a system maintenance plan.
	7-2 Execution of maintenance work	Make a maintenance execution plan, consider influences on the work caused by maintenance work, and perform maintenance work after taking a measure for protection. Check the results of maintenance for appropriateness and reports the results to high-level administrators and users. For software, examine the necessity of maintenance, the contents of maintenance, and scope of maintenance to make a contract for maintenance, and draft a maintenance plan according to the update schedule and repair work schedule.
8. New system development and system migration	8-1 Draft of development plan	Clarify the basic requirements for system operation, maintenance and system migration at planning stages of system development and reflect them in the development plan.
	8-2 Design of system operation method	Design a system operation method as well as policies on operation system, personnel, operation procedure, etc.
	8-3 Migration and operation test	Before migration test, select items to which the migration test is applied, and investigate differences among development environment, migration test environment, and this environment, and prepare migration test program, JCL, data, verification items, etc. Then conduct migration test according to the work instructions and evaluate the test results. If a hitch is expected from the evaluation, request technician for system development to make improvements. After the migration test is completed, conduct operation test under this environment or the equivalent environment by assuming the normal operation form, fault operation form and maintenance operation form, and evaluate the results of test.
	8-4 System migration	Before performing system migration, identify system to be migrated, determine the migration method, investigate migration tool, migration procedure and measures against faults that may occur during migration operation to make a plan for performing migration work. Under the direction of a responsible person for migration, manage the process of migration work and determine whether the work be disconnected or continued when troubles occur. When system migration is completed, take over operation work and collect basic data on operation to evaluate applicable migration systems.
	8-5 Management of development environment	As far as the system operation continues under this environment, manage the development environment at the same time. This management requires not to affect this environment but requires to manage software of both old and new versions to prevent confusion caused by software of a new version. In the development environment under the distribution environment, development and usage are distributed but the management is made at the entire level.

Technical Engineers (System Management) Skill Standards (Key Activities)

Activity	Task	Job outline
9. System evaluation on operation	9-1 Setup of evaluation purpose and items to be evaluated	Clarify the purpose of system evaluation and determine the scope of evaluation, contents of evaluation and period of evaluation.
	9-2 Setup of evaluation items and evaluation standards, and execution of evaluation	Sets standards for such as level of system service, quality of system, operation, system reliability, and economical efficiency of system operation and evaluate them.
	9-3 Proposal for system improvement	Identify functional insufficiency or defects on operation from the results of system evaluation, makes a plan for improvement, and revise the system or present a request for system reconstruction. Then apply the system development specification to the proposal for improvement.
	9-4 Evaluation of distributed system	Sets the system evaluation standard seizing characteristics of distributed system and evaluate the distributed system according to the standard.
10. System user support	10-1 Clarification of items to be observed by users	Taking into account users' capabilities of usage, specifies the observance items, makes users understand and obtain consent from users to promote stable, efficient and smooth system operation.
	10-2 User support	Determine the scope of support for users and present concrete menus. Especially, plan and execute educational training for users and put emphasis on the establishment and support of help desk. For services executed, record them, clarify problems and carry out a reform measure.
	10-3 Support of new requests by users	As a result of investigating the degree of users' satisfaction with the system, seize various requests for current system from users and identify new requests that may lead to system improvements. To achieve new request, propose system improvements as well as improvements of system operation itself.
	10-4 User consulting	Consult computing activities of end users themselves by using techniques/know-how on system environment preparation and operation management accumulated in the course of system management.

3. Skill Criteria

Skill standard corresponds to tools (tables) that provide indicators to check the status of achievement of the system operation management job process described by technical engineers (system management) in the key activities. With these criteria, it is determined whether or not a series of jobs has been promoted successfully by using proper methods, proper knowledge and proper techniques according to proper procedure with respect to the system operation management job process.

The skill criteria provide indicators to indicate what outcome needs to be obtained (“performance indicators”) as a result of job execution for “tasks” of 10 types of activities. They also provide knowledge (“required knowledge”) and skill (“required skill”) required to do jobs.

[Technical engineer (system management) skill criteria]

1. System management plan				
No.	Task	Performance indicators	Required knowledge	Required skill
1-1	Define system management requirements	<ul style="list-style-type: none"> • Questions to managerial layer/high-level administrator layer and users are appropriate. • Information can be collected by the investigation method adopted in average enterprises. • Users have been persuaded for requests in opposition. • Consistency with managerial target is assured. • Areas out of management are clarified. • Current problems are distinguished and correspondent priorities are clarified. 	<ul style="list-style-type: none"> • Contents of user jobs, and knowledge about terms • Knowledge about information collection • Knowledge about problem analysis methods • Knowledge about present and future trends of the business type, industry, and business category that the company belongs to • Knowledge about current and future trends of information technologies • Knowledge about overall system management operation 	<ul style="list-style-type: none"> • Ability to understand computerization strategy • Ability to specify main information source of user needs • Ability to execute information collection methods and procedures • Ability to analyze replies from individuals and groups • Ability to apply job analysis methods to propose job improvements and reformation • Ability to apply problem analysis methods to solve problems on system management • Ability to document the results of analysis and reformation plan and to explain them to applicable persons
1-2	Clarify system management services	<ul style="list-style-type: none"> • Services to be provided and services not to be provided are discriminated from each other. • Duties are clearly assigned to users and serving side. • The contents of service level are documented accurately and completely, and approval has been obtained from users. 	<ul style="list-style-type: none"> • Knowledge about user jobs • Knowledge about system usage • Knowledge about system management • Knowledge about the risk of system operation management • Knowledge about present situation of the company, available technologies, and the levels • Knowledge about methods of quantifying the contents of services 	<ul style="list-style-type: none"> • Ability to clearly document the scope of services to users • Ability to negotiate with users about the contents of services, service levels, and scope of responsibility • Ability to identify the scope and level of services corresponding to budget • Ability to identify the limit of the scope and level of services that can be provided

Technical Engineers (System Management) Skill Standards (Skill Criteria)

1-3	Calculate cost/counter value for services	<ul style="list-style-type: none"> • Source for calculating cost for system operation is clarified. • Cost/counter value for personal services is clarified divided by types of services and levels of techniques. • Actions to be taken for exceptional cases and when service target values are not implemented are clarified. • Users have received explanation about cost/counter value and have given approval. 	<ul style="list-style-type: none"> • Knowledge about accounting • Knowledge about methods of accounting cost • Knowledge about factors for generating/changing cost for system management • Knowledge about cost for procurement by the company and cost for procurement outside 	<ul style="list-style-type: none"> • Ability to analyze elements forming services • Ability to estimate the amount of investment in resources and running cost • Ability to explain cost/counter value to users, make adjustments, if necessary, and obtain approval
1-4	Prepare operation rules	<ul style="list-style-type: none"> • Appropriate rules have been provided for all system management jobs. • Appropriate usage rules have been provided for all resources available. • All operation rules have been documented and explained to concerned parties for operation department and users, and approval has been obtained. • Operation rules are properly reconsidered. 	<ul style="list-style-type: none"> • Knowledge about overall system management jobs • Knowledge about standardization and procedures • Knowledge about usage of resources • Knowledge about alteration management 	<ul style="list-style-type: none"> • Ability to give procedural and standardization forms to daily operations • Ability to document rules completely, accurately and clearly • Ability to detect differences between rules and actual situations and decide on reform measures • Ability to explain rules and obtain approval • Ability to understand opposite opinions
1-5	Prepare system management plan	<ul style="list-style-type: none"> • System management requirements are reflected in the plan. • Joint review with users has been conducted about long- and short-term plan of system management, and approval has been obtained. 	<ul style="list-style-type: none"> • Knowledge about overall system management jobs • Knowledge about drafting plans • Knowledge about system operation • Knowledge about system maintenance 	<ul style="list-style-type: none"> • Ability to draft short- and long-term plans • Ability to clearly explain plans to users • Ability to consider system operation management from a global viewpoint

Technical Engineers (System Management) Skill Standards (Skill Criteria)

2. System management				
No.	Task	Performance indicators	Required knowledge	Required skill
2-1	System operation	<ul style="list-style-type: none"> • System operation policy has been documented. • System operation schedule has been set and approval has been obtained from users. • Results of operation are consecutively recorded. • Data for service level evaluation is consecutively collected. • System operation status is periodically reported to high-level administrators and users, and approval is obtained. 	<ul style="list-style-type: none"> • Knowledge about scheduling • Knowledge about system operation • Knowledge about how to prepare manuals • Knowledge about data for service level evaluation and collection of data • Knowledge about analysis and evaluation of collected data 	<ul style="list-style-type: none"> • Ability to obtain an approval from users about the appropriateness of schedule • Ability to consider order of jobs and arrange job items efficiently • Ability to consider the degree of difficulty in jobs and skill levels of personnel in charge and expect the operation time • Ability to report to high-level administrators the results of analyzing and evaluating the current situation and problems of system operation
2-2	User management	<ul style="list-style-type: none"> • Users have been registered/taken off according to the standard operation. • Changes in personal user information are reflected in the management register. • The management register is kept in security. • Users are periodically checked for observance of the observance items. • Security for users is kept. • The status of management is periodically reported to high-level administrators and users, and approval is obtained. 	<ul style="list-style-type: none"> • Knowledge about policies and purposes of user management • Knowledge about management registration • Knowledge about security management and privacy management 	<ul style="list-style-type: none"> • Ability to identify items to be observed at the system side and items to be observed by users • Ability to check for inconsistency between information in the management register and the user usage status • Ability to explain to users the necessity of items to be observed by users • Ability to report to high-level administrators the results of analyzing and evaluating the current status and problems of user management

Technical Engineers (System Management) Skill Standards (Skill Criteria)

2-3	Operation management	<ul style="list-style-type: none"> • Operation instruction system is established for normal and abnormal states. • Operation convention is defined and documented accurately and completely. • Operators understand the job area and support scope and operate jobs. • The system is stable. • Job instructions and procedure for taking over jobs between personnel in charge are established. • As a team play, improvement activities and the quality evaluation are performed periodically. 	<ul style="list-style-type: none"> • Knowledge about the job area of operation • Knowledge about operation rules • Knowledge about fault management and fault recovery • Knowledge about constraint conditions and consideration points for preparation of job schedule • Knowledge about personnel management • Knowledge about contract with external personnel 	<ul style="list-style-type: none"> • Ability to estimate the work volume and the required number of personnel • Ability to appropriately determine whether jobs are within the applicable scope or exceed the scope • Ability to check that operation is carried out exactly within the authority without delay • Ability to analyze the results of operation and propose a reform measure for system operation • Ability to seize operations as team jobs and establish rules to make the team performances the best
2-4	Charging management	<ul style="list-style-type: none"> • Source for charging standards is clarified. • Data on charge is exactly and completely collected by using appropriate tools. • The amount of charge is calculated corresponding to the consumed quantity of resources. • If there is a difference between the expected chargeback and the amount of charge, appropriate measure for correction is proposed and approval is obtained from users. • Charging information is reported to high-level administrators and users periodically. 	<ul style="list-style-type: none"> • Knowledge about methods of calculating cost and methods of cost chargeback • Knowledge about collection of charging information • Knowledge about methods of analyzing differences in chargeback 	<ul style="list-style-type: none"> • Ability to work out methods of collecting expenses for system resources installed and introduced • Ability to explain to users about methods of charging and obtain consent • Ability to identify chargeable items • Ability to identify the cause of difference between the expected amount of chargeback and actual amount of charge by analyzing it • Ability to explain to users about changes in methods of charging and obtain consent

Technical Engineers (System Management) Skill Standards (Skill Criteria)

2-5	Cost management	<ul style="list-style-type: none"> • Cost items and units for elements for system operation are appropriately set. • Budget for system operation has been made, and has been approved by high-level administrators. • Cost is appropriately managed classified by cost items. • Differences between budget and actual result are exactly analyzed and the results are reported to high-level administrators. • The results of system operation expenses are explained to users and approval is obtained. • Operation cost is analyzed and proposal for effective cost reduction is presented. 	<ul style="list-style-type: none"> • Knowledge about methods of settling on budget • Knowledge about methods of collecting actual cost • Knowledge about initial cost and running cost • Knowledge about lease and rental • Knowledge about methods of adding up expenses • Knowledge about contract and payment • Knowledge about methods of analyzing differences between budget and actual result 	<ul style="list-style-type: none"> • Ability to divide cost items by resources and set cost • Ability to consider appropriate procurement by comparing lease, rental and purchase with respect to system resources • Ability to determine the appropriateness of budget and actual result • Ability to analyze differences between budget and actual result and reports the results of the analysis to high-level administrators
2-6	Personnel management	<ul style="list-style-type: none"> • Duty hours and obtainment of leaves conform to the laws and regulations concerning labor. • Health of personnel is managed and measures against bad health are taken. • Ability of personnel is evaluated, education and training are planned for appropriate operation of the system and quality improvements, and the plan is executed. • Short- and long-term personnel reshuffles are decided according to the personnel training plan. • Proper contract for personnel dispatched to external enterprises is made and the contract items are carried out. 	<ul style="list-style-type: none"> • Knowledge about Labor Standard Law • Knowledge about Law concerning the Promotion of Equal Opportunity and Treatment between Men and Women in Employment and Other Welfare Measures for Women Workers Amendment of Labor Standards Law • Knowledge about Industrial Safety and Health Law • Knowledge about education and training • Knowledge about contract for external commitment • Knowledge about laws concerning worker dispatch • Knowledge about duty management 	<ul style="list-style-type: none"> • Ability to calculate required number of man-hours • Ability to calculate the required labor quality • Ability to establish proper duty system • Ability to manage the duty status and health condition of personnel • Ability to support improvement of abilities of personnel • Ability to make adjustments and negotiations between organizations over personnel rotation • Ability to make adjustments and negotiations with external contractors over personnel arrangement
2-7	Distributed site management	<ul style="list-style-type: none"> • System operation management plan of distributed site is explained to users of the site and approval is obtained. • Responsible person for distributed site is placed, if necessary, and required authority and responsibilities for operation are assigned. • Distributed system resources are used at levels that users request. • Education and training and support that users request are carried out. 	<ul style="list-style-type: none"> • Knowledge about problems on system operation management at distributed sites • Knowledge about system configuration and component elements of distributed sites • Knowledge about user jobs at distributed sites • Knowledge about distributed system technologies • Knowledge about EUC 	<ul style="list-style-type: none"> • Ability to understand requirements for system operation management at distributed sites • Ability to create a management system from a system management plan of distributed sites and obtain approval from users • Ability to understand problems on distributed system operation management and consider measures for management • Ability to create user education and training plan for distributed sites and execute it

Technical Engineers (System Management) Skill Standards (Skill Criteria)

2-8	Use of operation management system	<ul style="list-style-type: none"> • The purpose for using the operation management system and expected effects are clarified. • Negative factors caused by use of the operation and management system do not occur. • Use of the operation system has achieved improvements in stability, reliability and efficiency. 	<ul style="list-style-type: none"> • Knowledge about general system operation jobs • Knowledge about operation management system • Knowledge about requirements for systemization • Knowledge about available package software for operation management 	<ul style="list-style-type: none"> • Ability to seize problems on system operation management and consider a proposal for improvements • Ability to quantify the effects of operation management system introduction • Ability to determine the adaptability of package software for jobs of the company • Ability to consider a proposal for improvements against problems on management characteristic to the distributed system
2-9	Standardization	<ul style="list-style-type: none"> • Operation job procedure, various types of management standards, and service standards are set for system operation management and are applied. • Rules on reorganization of standards are described. • Methods of making standards and observance of them known thoroughly are decided and executed. • Methods and standards for determining the status of observance of standards are clarified and are investigated periodically. • Present status and future plan of standardization are reported to high-level administrators periodically. 	<ul style="list-style-type: none"> • Knowledge about general jobs of system operation • Knowledge about procedure for standardization • Knowledge about management of reorganizing standards 	<ul style="list-style-type: none"> • Ability to give fixed/common form to jobs • Ability to prepare operation manual and written management standard and explain to persons concerned about them • Ability to set workload standards and explain to persons concerned about them • Ability to explain to standard users about necessity of observance of standards • Ability to seize the current situation of applicable jobs and determine the conformity to standards

Technical Engineers (System Management) Skill Standards (Skill Criteria)

3. Resource management				
No.	Task	Performance indicators	Required knowledge	Required skill
3-1	Hardware management	<ul style="list-style-type: none"> • Applicable scope of management and inapplicable scope of management are discriminated from each other. • Policies of maintenance are clarified. • All hardware resources are properly managed according to the specified policies. • Hardware asset management, hardware configuration management, hardware alteration management and hardware maintenance are properly carried out. • Management information is registered, changed or taken off without delay. • The management status and current status problems are periodically reported to high-level administrators. 	<ul style="list-style-type: none"> • Knowledge about overall hardware configuration • Knowledge about hardware configuration components • Knowledge about hardware • Knowledge about management register • Knowledge about asset management • Knowledge about configuration management • Knowledge about alteration management • Knowledge about hardware maintenance 	<ul style="list-style-type: none"> • Ability to prepare management register and manage appropriate hardware assets • Ability to make managements for hardware assets currently possessed to maintain proper usage values for the promotion of system operation management • Ability to specify the scope of effects on operation involved in hardware configuration change • Ability to compare economical efficiencies in terms of difference in possession forms (purchase, lease and rental)
3-2	Software management	<ul style="list-style-type: none"> • Applicable scope of management and inapplicable scope of management are discriminated from each other. • Policies of modification, upgrade and replacement are clarified. • All software resources are properly managed according to the specified policies. • Software configuration and software changes are properly managed and are reported to persons concerned. • Management information is registered, changed or taken off without delay. • The management status and current status problems are periodically reported to high-level administrators. 	<ul style="list-style-type: none"> • Knowledge about overall software configuration • Knowledge about software configuration elements • Knowledge about software • Knowledge about management register • Knowledge about configuration management • Knowledge about alteration management • Knowledge about software life cycle • Knowledge about contract for software license • Knowledge about software vendor support • Knowledge about copyright • Knowledge about library management tools • Knowledge about document management tools 	<ul style="list-style-type: none"> • Ability to prepare management register and manage appropriate software assets • Ability to evaluate adaptability of individual package software for the company from a viewpoint of operation • Ability to specify the scope of effects on operation involved in software configuration change • Ability to compare differences in requirements for protecting intellectual property rights due to differences in development form (in-house development, commitment development, and purchase of package software)

Technical Engineers (System Management) Skill Standards (Skill Criteria)

3-3	Data management	<ul style="list-style-type: none"> • Applicable scope of management and inapplicable scope of management are discriminated from each other. • Data storage period and procedure for data disposal are clarified. • Data resources are properly managed according to the specified policies. • Appropriate managements are made for life cycles of data. • Data resources are used without delay within the authority given to users. • Changes in data are appropriately managed. • The management status and current problems are periodically reported to high-level administrators. • Appropriate materials are prepared for audit on data and are reported. 	<ul style="list-style-type: none"> • Knowledge about data of enterprises • Knowledge about enterprises' policies of data security • Knowledge about information resource management • Knowledge about life cycles of data • Knowledge about data management • Knowledge about DBMS • Knowledge about database management • Knowledge about system catalog • Knowledge about data dictionary/directories • Knowledge about information resource dictionaries • Knowledge about standardization of data • Knowledge about procedures for data audit 	<ul style="list-style-type: none"> • Ability to understand the importance of data • Ability to evaluate adaptability of security management tool, data management tool and data analysis tool for the company from a viewpoint of operation • Ability to exactly explain data for audit and cooperate with auditors
3-4	Network resource management	<ul style="list-style-type: none"> • Applicable scope of management and inapplicable scope of management are discriminated from each other. • Plans for medium-and long-term and short-term expansion and reinforcement are made. • Network resources are properly managed according to the specified policies. • Network resource management, network configuration management, network alteration management, and network maintenance are properly carried out. • Network resources are used without delay within the authority given to users. • The management status and current problems are periodically reported to high-level administrators. • Appropriate materials are prepared for audit on network and are reported. 	<ul style="list-style-type: none"> • Knowledge about overall network configuration • Knowledge about network configuration elements • Knowledge about network • Knowledge about communication equipment and communication services • Knowledge about management register • Knowledge about configuration management • Knowledge about alteration management • Knowledge about network maintenance • Knowledge about network management • Knowledge about network audit procedure 	<ul style="list-style-type: none"> • Ability to prepare management register and properly manage network assets • Ability to make managements for network assets currently possessed to maintain proper usage values for the promotion of system operation management • Ability to evaluate the adaptability of individual communication systems, network equipment and network software for the company from a viewpoint of operation • Ability to compare economical efficiencies in terms of difference in communication systems • Ability to specify the scope of effects on operation involved in network configuration change • Ability to make exact explanations for network audit and cooperate with auditors

Technical Engineers (System Management) Skill Standards (Skill Criteria)

3-5	Facilities and equipment management	<ul style="list-style-type: none"> • Applicable scope of management and inapplicable scope of management are discriminated from each other. • Medium-and long-term plans for obtainment and disposal are made. • Resources introduced and installed are used without delay within the authority given to users. • The management status and current status problems are periodically reported to high-level administrators. 	<ul style="list-style-type: none"> • Knowledge about buildings and subsidiary facilities • Knowledge about computer operation facilities • Knowledge about subsidiary facilities for communications • Knowledge about laws concerning safety measures for facilities and equipment • Knowledge about forms of possession of facilities and equipment (purchase, lease, rental and leasehold) • Knowledge about damage insurance • Knowledge about information system security measure standards 	<ul style="list-style-type: none"> • Ability to understand the importance of equipment • Ability to understand consideration points on equipment management • Ability to understand weak points of equipment management and carry out necessary countermeasures • Ability to compare economical efficiencies in terms of difference in possession forms (purchase, lease, rental and leasehold) • Ability to understand weak points of facilities and equipment at distributed sites and carry out necessary countermeasures
-----	-------------------------------------	---	--	---

Technical Engineers (System Management) Skill Standards (Skill Criteria)

4. Fault management				
No.	Task	Performance indicators	Required knowledge	Required skill
4-1	Fault supervision	<ul style="list-style-type: none"> Items to be supervised are identified and the contents of supervision and methods of supervision are exactly and completely documented. The supervisory system is normally operating. A contact system against the occurrence of faults is established. Faults are supervised and all faults that occurred are detected without any omissions. Education and training are conducted for detection of faults and for contact. Faults detected are reported to departments concerned without delay. 	<ul style="list-style-type: none"> Knowledge about items to be supervised Knowledge about supervisory systems Knowledge about types of system faults and individual characteristics Knowledge about methods of detecting signs of faults Knowledge about past fault cases 	<ul style="list-style-type: none"> Ability to work out methods of detecting faults at an early stage Ability to work out supervisory forms in supervisory actions Ability to distinguish signs of faults Ability to determine whether or not a sign of fault leads to the occurrence of the fault Ability to determine the degree of importance of faults that occurred Ability to determine how the business of the company is affected by faults that occurred
4-2	Investigation of fault cause	<ul style="list-style-type: none"> Procedure for investigating cause of faults is completely and simply documented. Information necessary to pursue cause of faults is collected without any omissions. Systematic procedure is adopted for the investigation of cause of faults. Detected faults are isolated at early stages. Scope of influences by faults is localized and proper restart is conducted. Education and training are conducted to isolate faults and investigate the causes. The status of fault occurrence is reported to related departments without delay. 	<ul style="list-style-type: none"> Knowledge about types of system faults and characteristics of individual faults Knowledge about methods of analyzing factors of faults Knowledge about past fault examples 	<ul style="list-style-type: none"> Ability to draft and execute plans for educations and training to isolate faults at early stages and investigate the causes Ability to specify appropriate personnel for investigating causes according to the characteristics of faults and to obtain cooperation Ability to localize the scope of influences by faults Ability to determine the status of faults and proper restart.

Technical Engineers (System Management) Skill Standards (Skill Criteria)

4-3	Recovery processing	<ul style="list-style-type: none"> • Procedure for recovery from faults is documented exactly, completely and simply. • Early recovery is made without expansion of scope of influences by faults. • After recovery, users can use all information system resources without delay. • Persons concerned are notified of the influences by the contents, schedule and recovery of jobs without delay. • Plan is made to take alternative methods in case of failure in recovery jobs. • Status of progress in recovery jobs and the results are reported to persons concerned without delay. • Education and training are conducted for fault recovery process. 	<ul style="list-style-type: none"> • Knowledge about data recovery process • Knowledge about network recovery process • Knowledge about hardware recovery • Knowledge about software recovery 	<ul style="list-style-type: none"> • Ability to work out recovery methods that have smaller influences on user jobs • Ability to make multiple recovery methods and select optimum method • Ability to work out measures for recovery against faults, which cannot be given procedural form easily • Ability to distinguish persons concerned according to the contents of recovery jobs • Ability to make a plan for education and training for fault recovery
4-4	Fault causes are classified and encoded.	<ul style="list-style-type: none"> • The causes of faults are classified and encoded • Proper recovery action is taken against faults and the faults do not reoccur. • Phenomena, jobs and situations of faults are recorded exactly and completely ranging from the occurrence to the recovery. • Preventive measures against reoccurrence are decided and executed. • Loss by faults and cost for preventive measures against the reoccurrence of faults are compared. • Details, cause and correction measures of faults are reported to persons concerned without delay. 	<ul style="list-style-type: none"> • Knowledge about types of faults • Knowledge about classification and encoding • Knowledge about estimate of jobs for preventive measures against the reoccurrence of faults 	<ul style="list-style-type: none"> • Ability to describe items of faults in the specified format exactly and effectively. • Ability to analyze fault causes completely and to take actions to prevent reoccurrence • Ability to predict faults that may occur in the company's environment • Ability to evaluate the practical results of preventive measures against the reoccurrence of faults

Technical Engineers (System Management) Skill Standards (Skill Criteria)

4-5	Fault processing of distributed system	<ul style="list-style-type: none">• Cooperation with the responsible administrator for distributed site operation is obtained.• Appropriate actions are taken ranging from the occurrence of faults to the recovery, and the situation at time of recovery is reported without delay.	<ul style="list-style-type: none">• Knowledge about types of system faults and characteristics of individual faults• Knowledge about methods of analyzing factors of faults• Knowledge about system recovery process	<ul style="list-style-type: none">• Ability to specify appropriate personnel for investigating causes according to the characteristics of faults and to obtain cooperation• Ability to work out recovery methods that have smaller influences on user jobs
-----	--	--	--	---

Technical Engineers (System Management) Skill Standards (Skill Criteria)

5. Security management				
No.	Task	Performance indicators	Required knowledge	Required skill
5-1	Establishment of security management system and setup of policies	<ul style="list-style-type: none"> The system conforms to the company's security policy. The security management system is established and is documented exactly and completely. The amount of damage due to intrusion of security and the cost for security measures are compared. The risk of the case where security measures are not taken is investigated. The standards for measures against security intrusion are observed and the security at the enterprises' target level is maintained. Education and training for measures against security intrusion are conducted. 	<ul style="list-style-type: none"> Knowledge about security requirements Knowledge about the plan for coping with unexpected cases Knowledge about potential risks Knowledge about security management tools Knowledge about database Knowledge about network Knowledge about physical, technical and managerial security measures Knowledge about laws concerning security Knowledge about cases where security was invaded Knowledge about technologies for measures for security and cases where such technologies were implemented Knowledge about cost for techniques for measures for security 	<ul style="list-style-type: none"> Ability to identify the possibility of security intrusion in the company Ability to understand the security policies of enterprises and security built in the system Ability to evaluate risks based on the amount Ability to calculate cost-effect ratio for security measures Ability to make a plan for physical security measures, technical security measures and managerial security measures and to execute the plan
5-2	Supervisory of security intrusion and status analysis	<ul style="list-style-type: none"> Contact system against the occurrence of security intrusion is established. Methods of security supervision is set up and supervisory data is collected All security intrusions that occurred are detected without any omissions. For supervisory data, security intrusions are pursued and investigated, and the intrusions are identified. Education and training are conducted to supervise security intrusions. The status of the occurrence of security intrusions is reported to related departments without delay. 	<ul style="list-style-type: none"> Knowledge about types of security intrusions and individual characteristics Knowledge about techniques for detecting security intrusions Knowledge about past cases of security intrusions Knowledge about the execution of measures against security intrusions Knowledge about monitoring using information system Knowledge about security check software 	<ul style="list-style-type: none"> Ability to discriminate signs of security intrusions Ability to determine whether or not signs of security intrusions lead to the actual security intrusions Ability to determine the degree of seriousness of security intrusions that occurred Ability to determine in what degree the business of the company is affected by the occurrence of security intrusions

Technical Engineers (System Management) Skill Standards (Skill Criteria)

5-3	Security management at distributed sites	<ul style="list-style-type: none"> • Security intrusions do not occur. • The company's security policy is observed. • Security management requirements characteristic to distributed sites are reflected. • The amount of damage due to intrusion of security and the cost for security measures are compared. • Contact system against the occurrence of security intrusion is established. • All security intrusions that occurred are detected without any omissions. • The status of the occurrence of security intrusions is reported to related departments without delay. 	<ul style="list-style-type: none"> • Knowledge about types of security intrusions and individual characteristics • Knowledge about cases where security was invaded. • Knowledge about technologies for measures for security and cases where such technologies were implemented • Knowledge about cost for techniques for measures for security • Knowledge about techniques for detecting security intrusions 	<ul style="list-style-type: none"> • Ability to identify the possibilities of security intrusions at distributed sites of the company • Ability to evaluate damages due to security intrusions at distributed sites of the company • Ability to evaluate the effectiveness of measures for security at distributed sites of the company • Ability to distinguish signs of security intrusions at distributed sites • Ability to determine whether or not signs of security intrusions at distributed sites lead to the actual security intrusions • Ability to determine the degree of seriousness of security intrusions at distributed sites where security intrusions occur
5-4	Check of security intensity	<ul style="list-style-type: none"> • Target security strength is set. • Complete confirmation test is performed conforming to the security strength check list. • Measures against cases where target strength is not achieved are taken, and recheck is done. 	<ul style="list-style-type: none"> • Knowledge about security attack software • Knowledge about security strength check list 	<ul style="list-style-type: none"> • Ability to understand the significance of security strength confirmation test • Ability to understand the contents of check items in the security strength check list and the acceptance criteria • Ability to determine the effectiveness of applied security strength inspection methods in the company
5-5	Security audit support	<ul style="list-style-type: none"> • The company's security policy is observed. • Appropriate materials are prepared for audit on security and re-reported. • Reform measures for the items pointed out in the audit report and the execution schedule are clarified. 	<ul style="list-style-type: none"> • Knowledge about the procedure for security audit 	<ul style="list-style-type: none"> • Ability to explain security audit exactly and cooperate with the auditors

6. Performance management				
No.	Task	Performance indicators	Required knowledge	Required skill
6-1	Execution of performance evaluation	<p>(1) Setting performance evaluation criteria</p> <ul style="list-style-type: none"> • Performance supervising model of enterprise standard and its evaluation criteria are set and are documented exactly and completely. • Selected evaluation items conform to the service items. • The setup performance evaluation model adapts to the company's characteristics. • Methods of collecting evaluation indicator data are clarified. • Performance evaluation criteria are updated when system configuration is changed. <p>(2) Performance analysis and evaluation</p> <ul style="list-style-type: none"> • Differences from standard performances are analyzed and the causes are investigated. • The results of performance evaluation are periodically reported to high-level administrators and users. • If problems occur or the occurrence of problems is predicted, points of the problems and measures against the problems are reported to high-level administrators and users without delay. 	<ul style="list-style-type: none"> • Knowledge about performance supervisory model • Knowledge about hardware performance specifications • Knowledge about methods of evaluating system performances • Knowledge about system configuration • Knowledge about network <ul style="list-style-type: none"> • Knowledge about items to be used as the performance evaluation indicators of hardware, methods of collecting them, and standard values • Knowledge about items to be used as the performance evaluation indicators of software, methods of collecting them, and standard values • Knowledge about items to be used as the performance evaluation indicators of network, methods of collecting them, and standard values • Knowledge about items to be used as the total performance evaluation indicators, standard values and methods of collecting them • Knowledge about performance measurement tools • Knowledge about statistics 	<ul style="list-style-type: none"> • Ability to combine existing or new performance evaluation models to set performance evaluation model according to the characteristics of the company • Ability to set a target value corresponding to the service level in each performance evaluation indicator item • Ability to select methods of collecting data suitable for each performance evaluation indicator item • Ability to identify bottleneck resources by analyzing performance data <ul style="list-style-type: none"> • Ability to decide on a reform measure when the result of evaluation is lower than the target value • Ability to select performance measurement tools suitable for requirements of the company

Technical Engineers (System Management) Skill Standards (Skill Criteria)

6-2	Capacity management	<ul style="list-style-type: none"> • Necessary capacities of system resources are appropriately managed to prevent troubles due to unexpected arrival at the capacity/performance limit. • Limit values are set for all resources affecting service items. • Methods of collecting evaluation indicator data are clarified. • Expansion of demands for system resources are exactly expected and proper increase plan is drafted and documented. • Resources are used efficiently. • Analyses are made appropriately with respect to the risk of arrival at capacity/performance limit. • The status of resource usage is periodically reported to high-level administrators and users. • If problems occur or the occurrence of problems is predicted, points of the problems and measures against the problems are reported to high-level administrators and users without delay. 	<ul style="list-style-type: none"> • Knowledge about constraint of resources • Knowledge about relations of resources and performances • Knowledge about capacities • Knowledge about system operation at the capacity/performance limit • Knowledge about changes in user business environment 	<ul style="list-style-type: none"> • Ability to advise proper usage of resources • Ability to estimate system load, predict the capacity/performance limit exactly, and avoid troubles • Ability to analyze the causes of performance drop from various angles • Ability to appropriately propose the expansion of equipment and system renewal, taking into account cost-effect ratio • Ability to predict changes in the system usage status from changes in users' business environment
6-3	Distributed system performance management	<ul style="list-style-type: none"> • Performance management requirements characteristic to distributed systems are reflected. • Selected evaluation items conform to the service items. • The setup performance evaluation model adapts to the company's characteristics. • Methods of collecting evaluation indicator data are clarified. • The results of performance evaluation are periodically reported to high-level administrators and users. • If problems occur or the occurrence of problems is predicted, points of the problems and measures against the problems are reported to high-level administrators and users without delay. 	<ul style="list-style-type: none"> • Knowledge about performance evaluation model • Knowledge about items to be used as the performance evaluation indicators of hardware, methods of collecting them, and standard values • Knowledge about items to be used as the performance evaluation indicators of software, methods of collecting them, and standard values • Knowledge about items to be used as the performance evaluation indicators of network, methods of collecting them, and standard values • Knowledge about items to be used as the total performance evaluation indicators, standard values and methods of collecting them 	<ul style="list-style-type: none"> • Ability to combine existing or new performance evaluation models to set performance evaluation model according to the characteristics of the company • Ability to set a target value corresponding to the service level in each performance evaluation indicator item • Ability to select methods of collecting data suitable for each performance evaluation indicator item • Ability to decide on a reform measure when the result of evaluation is lower than the target value

Technical Engineers (System Management) Skill Standards (Skill Criteria)

6-4	Capacity management at distributed system	<ul style="list-style-type: none"> • Proper plan for increase of resources is made taking into account the features of distributed system and is documented. • Capacity management is done at both sides of client and server. • Limit values are set with respect to all resources affecting service items. • Methods of collecting evaluation indicator data are clarified. • The status of resource usage is periodically reported to high-level administrators and users. • If problems occur or the occurrence of problems is predicted, points of the problems and measures against the problems are reported to high-level administrators and users without delay. 	<ul style="list-style-type: none"> • Knowledge about relations of the resources of distributed system, system configuration, communication system and performances • Knowledge about phenomena that occur when resources arrive at the limit values • Knowledge about changes in business environment 	<ul style="list-style-type: none"> • Ability to make a plan for increase of capacity/performances, taking into account low service life of hardware and innovation speed • Ability to decide on methods of avoiding system stop (limitation of consumed quantity of resources etc.) • Ability to predict the consumed quantity of resources in future from the tendency of the status of resources that have been used • Ability to predict changes in the status of system usage from changes in users' business environment
-----	---	---	--	---

Technical Engineers (System Management) Skill Standards (Skill Criteria)

7. System maintenance				
No.	Task	Performance indicators	Required knowledge	Required skill
7-1	Creation of system maintenance plan	<p>(1) Seizure of request for system maintenance</p> <ul style="list-style-type: none"> • System maintenance needs are collected from appropriated persons concerned. • Maintenance needs are identified exactly and completely and are documented. • Maintenance needs are managed properly. <p>(2) Creation of system maintenance plan</p> <ul style="list-style-type: none"> • A maintenance plan meeting the system management requirements is created. • Medium-and long-term and short-term plans are decided. • Priorities are given to items. • Persons concerned who are capable of doing maintenance take part in the plans. • The maintenance plans meet the system management requirements. • The scope of influences involved in maintenance jobs is analyzed and investigated. • Risk of a case where maintenance jobs are not done is analyzed. • The maintenance plans are explained to users and approval is obtained. 	<ul style="list-style-type: none"> • Knowledge about hardware maintenance • Knowledge about software maintenance • Knowledge about facility and equipment maintenance <ul style="list-style-type: none"> • Knowledge about maintenance • Knowledge about companies in charge of system maintenance • Knowledge about hardware maintenance • Knowledge about software maintenance • Knowledge about contract for software maintenance • Knowledge about upgrade plans of software vendors • Knowledge about alternation management of software • Knowledge about network maintenance • Knowledge about facility and equipment maintenance 	<ul style="list-style-type: none"> • Ability to select information source of maintenance needs • Ability to arrange maintenance needs • Ability to analyze maintenance needs • Ability to give priorities to maintenance needs • Ability to understand needs in opposite <ul style="list-style-type: none"> • Ability to make a maintenance plan meeting the needs of users • Ability to distinguish the scope of influences on user jobs involved in the execution of maintenance jobs

Technical Engineers (System Management) Skill Standards (Skill Criteria)

7-3	Execution of maintenance jobs	<ul style="list-style-type: none"> • Maintenance procedure is documented and approval is obtained from persons concerned. • The results of executing maintenance are checked and evaluated, and are documented exactly, completely and simply. • Maintenance information is arranged and analyzed. • The progressive status of maintenance jobs and the results of execution are reported to persons concerned without delay. <p>(Software maintenance)</p> <ul style="list-style-type: none"> • Maintenance is carried out not affecting other software. • Maintenance is carried out taking into account the effectiveness of investment. • The results of alteration are reported without delay. 	<ul style="list-style-type: none"> • Knowledge about system maintenance procedure • Knowledge about software alteration management <ul style="list-style-type: none"> • Knowledge about software maintenance • Knowledge about distribution software • Knowledge about contract for maintenance 	<ul style="list-style-type: none"> • Ability to minimize the scope of influences on users' jobs involved in the execution of maintenance jobs • Ability to decide a reform measure against problems detected during the execution of maintenance jobs <ul style="list-style-type: none"> • Ability to consider the influences brought by software upgrades • Ability to negotiate with software vendors • Ability to negotiate with external contractors for software development • Ability to determine the necessity of maintenance • Ability to make maintenance job schedule
-----	-------------------------------	--	---	--

Technical Engineers (System Management) Skill Standards (Skill Criteria)

8. New system development and system migration				
No.	Task	Performance indicators	Required knowledge	Required skill
8-1	Making a development plan	<ul style="list-style-type: none"> • The development plan is reviewed from viewpoints of system migration, system test and operation under the practical environment. • The promotion system of system operation management, the environment, support system in case of faults, and system renewal requirements are exactly defined and documented. • The achievability of system operation management is verified. • Policies of databases, network migration and operation procedure are clearly defined and documented. • Basic requirements for education and training, such as purpose, scope, system, environment and schedule, are defined and documented. 	<ul style="list-style-type: none"> • Basic knowledge on system development • General knowledge on system maintenance jobs • General knowledge on system test jobs • General knowledge on system migration jobs 	<ul style="list-style-type: none"> • Ability to propose improvements in system development from a viewpoint of system operation management • Ability to explain an idea of system operation plan and obtain approval • Ability to evaluate the possibility of executing the requirements for system operation management • Ability to make negotiations and adjustments with persons concerned to system development
8-2	Design of system operation method	<ul style="list-style-type: none"> • Online system, batch system, centralized system, distribution system or systems related to operation are designed and documented. • The consistency with the operation system of existing job systems is investigated. • Adoption of operation management tools sold on the market is investigated. 	<ul style="list-style-type: none"> • Knowledge about computer architecture • General knowledge about system management jobs • General knowledge about problems on operation management in the current status of the company • Knowledge about the trends of operation management technologies • Knowledge about operation management tools sold on the market 	<ul style="list-style-type: none"> • Ability to decide on measures for solving problems on the operation management in the current status of the company • Ability to evaluate the adaptability of operation design methods

Technical Engineers (System Management) Skill Standards (Skill Criteria)

8-3	Migration and operation test	<ul style="list-style-type: none"> • The contents of jobs, evaluation indicators and test tools are prepared to test the migration execution system to the practical environment of newly developed/improved development systems. • The migration execution system is tested, and problems expected to occur during the execution of migration jobs are collected and documented. • Environment necessary for the execution of migration jobs, the procedure and load are expected and documented. • The operation form is tested and evaluated on the assumption that the newly developed/improved development system is actually operating. 	<ul style="list-style-type: none"> • Knowledge about test tools • Knowledge about system operation 	<ul style="list-style-type: none"> • Ability to select applicable items of the system migration test • Ability to select test tools to be used in the migration jobs • Ability to estimate the confirmation jobs of the migration results • Ability to determine the appropriateness of system operation • Ability to determine the appropriateness of system backup recovery
8-4	System migration	<ul style="list-style-type: none"> • The migration plan of the system is created and reviewed exactly, and an approval is obtained. • The newly developed/improved development system is actually migrated to the practical environment, and the operation is checked for normalcy. • All problems detected during the execution of migration jobs are documented. • When problems occur in execution of migration, decision on whether or not the continuation of the migration jobs is appropriate is made taking into account the entire efficiency of the jobs. • The progressive status of migration jobs and the results of execution are reported to persons concerned without delay. • After the system is completely migrated, operation jobs and a set of operation system are appropriately taken over. • Data on migration is accumulated and is stored in a form where it can be evaluated. 	<ul style="list-style-type: none"> • Knowledge about new and old systems • Knowledge about migration tools • Knowledge about data migration • Knowledge about problems on migration jobs that occurred in the past 	<ul style="list-style-type: none"> • Ability to minimize influences on user jobs involved in the migration jobs • Ability to explain to the persons concerned about the system migration plan and to adjust different opinions • Ability to determine whether or not the system migration be continued while the migration is being performed

Technical Engineers (System Management) Skill Standards (Skill Criteria)

8-5	Management of development environment	<ul style="list-style-type: none"> • Management policy set according to the characteristics of individual development jobs. • The management policy of development environment is thoroughly known to users. • The management status of development environment is periodically reported to high-level administrators. • Paralleling the operation of this running system, the development environment is managed with the consistency maintained. • The development environment does not affect this running system. 	<ul style="list-style-type: none"> • Knowledge about system configuration • General knowledge about system development • Knowledge about development environment and characteristics of the users 	<ul style="list-style-type: none"> • Ability to maintain the status where there is no difference from this running system • Ability to maintain the status where other systems are not affected • Ability to maintain the status where problems can be solved when they occur in new systems • Ability to adjust assignment of resources according to the progressive status of development • Ability to make negotiations and adjustments with the users of the development environment
-----	---------------------------------------	--	--	---

Technical Engineers (System Management) Skill Standards (Skill Criteria)

9. System evaluation on operation				
No.	Task	Performance indicators	Required knowledge	Required skill
9-1	The purpose of system evaluation on operation is clarified.	<ul style="list-style-type: none"> The purpose of system evaluation on operation is clarified. The framework of evaluation (time of evaluation, contents of evaluation, and applicable scope of evaluation) is clearly set. 	<ul style="list-style-type: none"> Knowledge about operation management jobs Knowledge about information system resources Knowledge about system life cycle 	<ul style="list-style-type: none"> Ability to evaluate the achievability of operation at the system design stage Ability to evaluate the operation system, performances and capacity at the system design stage Ability to evaluate the functionality, efficiency, and reliability at the system migration stage Ability to evaluate the efficiency of the entire system operation at system operation stage
9-2	Setting of evaluation items and evaluation criteria, and execution of evaluation	<ul style="list-style-type: none"> The system evaluation items and evaluation criteria are made clear. Methods of collecting evaluation indicator data are clarified. The results of evaluations in the past can be referred to in time series. 	<ul style="list-style-type: none"> Knowledge about operation management jobs Knowledge about information system resources Knowledge about evaluation methods Knowledge about general reference values of evaluation indicator data 	<ul style="list-style-type: none"> Ability to determine the appropriateness of evaluation criteria Ability to analyze the factors of cases where the result of evaluation is lower than the target value
9-3	Proposal for system improvement	<ul style="list-style-type: none"> Problems on operation are distinguished from the results of evaluation, and the factors are analyzed. The progressive status of evaluation jobs and the results of evaluation are reported to high-level administrators without delay. Cost for improvement jobs and the effects by the improvement are compared. The system improvement plan is applicable not for specific users but universally. 	<ul style="list-style-type: none"> Knowledge about the estimation of improvement jobs 	<ul style="list-style-type: none"> Ability to make persons concerned understand the proposal for improvement. Ability to distinguish true cause of problems on operation and to decide on measures for solution Ability to understand both proposals in opposition Ability to solve global problems

Technical Engineers (System Management) Skill Standards (Skill Criteria)

9-4	Evaluation of distributed system	<ul style="list-style-type: none"> • The distributed system is evaluated understanding the features of the system. • Evaluations are made taking into account the total economical efficiency. • Problems on operation are distinguished from the results of evaluation, and the factors are analyzed. 	<ul style="list-style-type: none"> • Knowledge about distributed system configuration • Knowledge about the estimate of improvement jobs 	<ul style="list-style-type: none"> • Ability to distinguish true cause of problems on operation at distributed sites and to decide on measures for solution • Ability to verify that the global proposal for solution on problems is made
-----	----------------------------------	---	--	---

Technical Engineers (System Management) Skill Standards (Skill Criteria)

10. System user support				
No.	Task	Performance indicators	Required knowledge	Required skill
10-1	Clarifying user observance items	<ul style="list-style-type: none"> For the usage of information system resources, the rules for users to observe are documented exactly and by using the words within a range where the users can understand them. Users recognize the importance of the observance of the rules. Wrong use and wasteful use of resources, and usage examples that may cause risks as well as obstructions to effective operation are explained to users. Guidance and advices are given to unskilled users. 	<ul style="list-style-type: none"> Knowledge about user jobs Knowledge about technical levels of users Knowledge about relationships between violation of rules and faults Knowledge about preparation of rules 	<ul style="list-style-type: none"> Ability to identify whether or not problems on system operation management arise from the violation of the rules Ability to spread and establish the rules
10-2	User support	<ul style="list-style-type: none"> The needs of users are exactly identified. The scope of support where the needs of users are satisfied is defined. Users are supported according to their levels. The contents of education and training for users meet the needs of users. The effects of education and training are evaluated. 	<ul style="list-style-type: none"> Knowledge about methods of collecting information Knowledge about technical information, know-how and materials related to the needs of users. 	<ul style="list-style-type: none"> Ability to recognize and analyze the needs of users and to provide a measure for solution to satisfy the needs of users Ability to describe the contents of education and training exactly and simply and to make users understand them Ability to evaluate the capabilities of users who need education and training and to set an appropriate target of education Ability to prepare the education and training environment Ability to give guidance and advices to users according to their levels of understanding and technique
10-3	Support for new requests of users	<ul style="list-style-type: none"> The status of satisfaction at service levels is exactly managed. New requests of users are recorded in detail and controlled for reference in time series. New requests are analyzed and trends are seized. 	<ul style="list-style-type: none"> Knowledge about the scope of services Knowledge about system environment and component elements Knowledge about procedures for using resources Knowledge about the investigation of the degree of users' satisfaction 	<ul style="list-style-type: none"> Ability to distinguish the degree of the needs of users for operation and the priorities Ability to understand problems on system operation management technologies Ability to decide on a measure for improving the degree of users' satisfaction from a viewpoint of operation

Technical Engineers (System Management) Skill Standards (Skill Criteria)

4. Body of Knowledge

In the body of knowledge for technical engineers (system management), the knowledge which is needed to perform the key activities described in Chapter 2, “Key Activities,” and to solve various problems such as decline in the system quality, increase of operation management cost, and diversification and complication of the requests of users is divided into groups according to technical and problem-solving concepts, and is classified in a hierarchical structure.

The body of knowledge which technical engineers (system management) must have consists of the following two kinds:

- 1) IT common body of knowledge
- 2) Practical and core bodies of knowledge for technical engineers (system management)

The “IT common body of knowledge” in 1) is not limited to technical engineers (system management), but it is necessary for examinees of all examination categories. It is therefore provided in a separate volume. For details, refer to the “Information Technology Engineers Skill Standards: IT Common Body of Knowledge.”

By consulting “Information Technology Engineers Examinations: Scope of Examinations,” we can know that technical engineers (system management) are tested for knowledge at the following technical levels in the six fields of the IT common body of knowledge:

- “II. Computer systems (level II)”
- “III. System development and operation (level III)”
- “IV. Network technology (level II)”
- “V. Database technology (level II)”
- “VI. Security (level II)”

“VII. Standardization (level II)”

In 2) “practical and core bodies of knowledge for technical engineers (system management),” knowledge needed for technical engineers (system management) to demonstrate their maximum abilities for planning, construction and operation of the information system foundation is clarified, and knowledge and techniques required for system evaluation taking into account future diversity of the requests of users is also arranged.

Knowledge corresponding to the practical body of knowledge is classified as follows:

- “A. System management plan” and “B. System Management” necessary for safe and stable operation of the information system,
- “C. Resource management” necessary for managing various resources forming information systems,
- “D. Fault management,” “E. Security management,” and “G. System maintenance” necessary for removing factors that prevent information systems from safe and stable operation,
- “F. Performance management” and “I. System evaluation on operation management” necessary for evaluating the safe and stable operation status of information systems,
- “H. New system development and system migration” necessary for cooperation with other development system engineers in developing information systems, and
- “J. System user support” necessary for increasing the satisfaction of users in using information systems

Currently, the knowledge is not classified as a portion corresponding to “core body of knowledge,” but an attempt will be made to prepare the body of knowledge in future.

[Practical body of knowledge and core body of knowledge for technical engineers (system management)]

Knowledge field	Major classification	Intermediate classification	Minor classification
A. System management plan			
	1. Definition of system management requirements	1.1 System management requirements at the managerial level	1.1.1 Long-term computerization strategy
			1.1.2 Short-term computerization strategy
			1.1.3 Important items requested to system management
			1.1.4 Important computerization resources for management
		1.2 System management requirements at the user job level	1.2.1 Scope of system management
			1.2.2 System management policy
			1.2.3 System management system
			1.2.4 System management method
			1.2.5 System management schedule
			1.2.6 System management budget
	2. Clarification of system management services	2.1 Clarification of system and services to be provided	2.1.1 Applicable systems to be provided and inapplicable systems
			2.1.2 Applicable services to be provided and inapplicable services
		2.2 Clarification of service levels	2.2.1 Service levels
			2.2.2 Scope of responsibility
	3. Calculation of cost/counter value to service	3.1 Types of cost/counter value	3.1.1 Basic cost (fixed)
			3.1.2 Individual cost (depending on consumed quantity, and depending on service levels)
		3.2 Adjustment with users for setting cost/counter value	3.2.1 Trade-off of provision scope and cost
			3.2.2 Trade-off of provided contents/level and cost
	4. Preparation of operation rules	4.1 Duties of system management department	
		4.2 Items to be observed by users	
	5. Preparation for system management plan (long-and short-term)	5.1 System management plan (for users)	5.1.1 Plan for various types of services (service hours, availability, responsivity, quantity of provided information, quickness for response, education, help desk, distributed site support, and set and revision of standards, participation in system development process)
			5.1.2 Review for management plan with users
		5.2 System management plan (for operation side)	5.2.1 Placement of system management department (in-house cost center, in-house profit center, and independent enterprises)
			5.2.2 Operation execution system
			5.2.3 Plan for various types of management (system operation management, personnel management, cost management, user management, resource management, fault management,

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

			performance management, maintenance management, and security management)
--	--	--	--

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

Knowledge field	Major classification	Intermediate classification	Minor classification
B. System management			
	1. System operation	1.1 Operation management jobs	1.1.1 Classification by applicable systems Operation management (for key information system, distributed system, network system, operation system, and equipment)
			1.1.2 Classification by job contents Operation, resources, configuration, security, faults, performance, maintenance, management, system transition, system evaluation
		1.2 Operation schedule	1.2.1 Setting schedule
			1.2.2 Adjustment with users for schedule
		1.3 Standardization of handling procedure	1.3.1 Handling procedure
			1.3.2 User of automatic operation software
			1.3.3 Operation manual
		1.4 Operation materials and consumables management (recording media, output paper, and consumables)	
		1.5 Data input/output management, and warehousing/delivery management	
		1.6 System operation management report (report content and report system)	
	2. User management	2.1 User registration and management	2.1.1 User registration/deletion
			2.1.2 User management items (user information, shared resources, network information, user side resource information, maintenance information, and user support items)
		2.2 Management method	2.2.1 Placement of administrator
			2.2.2 Authentication method, and access control
		2.3 User management report	2.3.1 Usage status of privilege users
			2.3.2 Usage status of general users
	3. Operation management	3.1 Operation indication	3.1.1 Operation system
			3.1.2 Operator job scope
			3.1.3 Operation rules (malfunction prevention, operation prohibition out of authority)
			3.1.4 Operation job indication method
		3.2 Job result management	3.2.1 Schedule management and job management
			3.2.2 Job process result check
			3.2.3 Result check of operation jobs
		3.3 Analysis and improvement of operation jobs	
		3.4 Operation of operator team	3.4.1 Clarification of job duty assignments
			3.4.2 Clarification of job take-over rule
			3.4.3 Activities for operation quality improvements

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

	4. Charging management		
	4.1	Charging system	4.1.1 Cost system and chargeback system
			4.1.2 Chargeable resources
			4.1.3 Selection of charging system
	4.2	Collection of charging data, and tools	4.2.1 Collection of charging data
			4.2.2 Tools for collecting charging data
	4.3	Charge calculation unit and calculation method	4.3.1 Selection of chargeable unit
			4.3.2 Calculation of chargeable volume
	4.4	Analysis of difference between chargeback and charge, and measures	4.4.1 Analysis of difference in charge, and measures
			4.4.2 Reconsideration of calculation methods with system environment changed
	5. Cost management		
	5.1	System operation cost	5.1.1 Initial cost items (expenses for building, incidental facilities, installation and field procurement, purchase of equipment, development operation software, reinforcement for aseismatic structure)
			5.1.2 Operation cost items (expenses for facilities and equipment, operation personnel, consumables, external consignment, power, maintenance, insurance, etc.)
			5.2
	5.2.2 Collection of result values		
	5.3	Management of system operation cost	5.3.1 Analysis of difference in system operation cost between budget and result
			5.3.2 Efforts and methods for reducing system operation cost
	5.4	Consideration of TCO	5.4.1 User side cost
			5.4.2 Measures for reducing total cost
	6. Personnel management		
	6.1	Duty system	6.1.1 Proper number of personnel
			6.1.2 Duty system
			6.1.3 Duty management
			6.1.4 Laws and regulations related to duty management
	6.2	Health management	6.2.1 Seizure of bad health factors, and measures
			6.2.2 Laws and regulations related to health
	6.3	Personnel education and training	6.3.1 Planning of personnel education and training, and execution
			6.3.2 Development of personnel education and training curriculum
			6.3.3 Change of duties of personnel, and organization rotation
	6.4	External consignment management	6.4.1 Selection of consignment contractor
			6.4.2 Contract for external consignment
			6.4.3 Consignment job management

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

	7. Distributed site management		
	7.1	Problems on the distributed system	
		7.1.1	Problems on management (network, security, and installation environment)
		7.1.2	Data and program distribution
		7.1.3	Support for various users
		7.1.4	Multi-vendor environment (hardware, OS, and application)
	7.2	Distributed system operation management	
		7.2.1	Placement of distributed system administrators (duties of administrators, and authority and jobs of administrators)
		7.2.2	Management system of the distributed system
		7.2.3	User education and training, and user support
	8. Using operation management system		
	8.1	Problems on system operation management and measures	
		8.1.1	Limit, inefficiency, and unquickness of manual operation
		8.1.2	Measures by automatization (operation management system) of operation management, and problems
		8.1.3	Design of operation management system
	8.2	Use of operation management system	
		8.2.1	Operation support system
		8.2.2	Remote operation system
		8.2.3	Automatic operation system
		8.2.4	Unmanned system operation
	8.3	Use of operation management system in the distributed system	
		8.3.1	Requirements for systematization in distributed system operation
		8.3.2	Management functions characteristic to distributed system operation
	9. Standardization		
	9.1	Setting system management standards	
		9.1.1	Determining the scope of system management standards
		9.1.2	Setting system operation standardization items
		9.1.3	Standardization of operations
		9.1.4	Workload standards
		9.1.5	Supervising and managing the status of observance
		9.1.6	Management of system alteration (revision and reorganization)
	9.2	Standardization of the distributed system	
		9.2.1	Standardization of distributed system operation
	9.3	Reconsideration of standards	
		9.3.1	Periodical reconsideration
		9.3.2	Collection of requests for reconsideration
		9.3.3	Execution of standard reorganization

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

Knowledge field	Major classification	Intermediate classification	Minor classification
C.	Resource management		
	1. Hardware management	1.1 Identifying items to be managed	
		1.1.1	Computer and peripheral equipment in the center
		1.1.2	Computer and peripheral equipment at distributed sites
		1.2 Hardware resource management	
		1.2.1	Preparation for management register
		1.2.2	Asset management
		1.3 Configuration management	
		1.3.1	Hardware equipment configuration management
		1.3.2	Alteration management
		1.4 Hardware resource maintenance	
	2. Software management	2.1 Identifying items to be managed	
		2.1.1	Programs (OS, middleware, application sold on the market, applications developed by the company, and distributed environment software)
		2.1.2	Documents (application form, contract, manuals, and operation manual)
		2.2 Software life cycle and resource management	
		2.2.1	Management at the software development stage
		2.2.2	Management at the software operation stage
		2.2.3	Management for software updates
		2.3 Library management	
		2.3.1	Library management functions
		2.3.2	Library management procedure
		2.3.3	Library management tools
		2.4 Package software distribution management	
		2.5 Document management	
		2.5.1	Document management procedure
		2.5.2	Document alteration management
		2.5.3	Document alteration management tools
		2.6 Legal protection of software resources	
		2.6.1	Purchase/rental software license contract
		2.6.2	Contract for external commitment for software development
		2.6.3	Copyright Law and Product Liability Law
	3. Data management	3.1 Data life cycle and resource management	
		3.1.1	Information resource management (IRM)
		3.1.2	Management for data security (access control)
		3.1.3	Management for saving and discarding data
		3.2 Data management	

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

			3.2.1 Data administrator 3.2.2 Data maintenance 3.2.3 Database management system 3.2.4 Distributed database management
		3.3	Efficient data management at the overall company level
			3.3.1 Standardization of data 3.3.2 Data dictionary 3.3.3 Data directory 3.3.4 Information system dictionary
		3.4	Database audit support
	4.	Network resource management	
		4.1	Identification of items to be managed
			4.1.1 Communication circuits/communication services 4.1.2 Network equipment 4.1.3 Network software
		4.2	Network resource management
			4.2.1 Preparation for management register 4.2.2 Asset management 4.2.3 Naming rules and standardization
		4.3	Configuration management
			4.3.1 Network equipment configuration diagram, and connection diagram 4.3.2 Address management 4.3.3 Alteration management
		4.4	Network resource maintenance
		4.5	Network management
			4.5.1 Network operation supervision 4.5.2 Network fault management 4.5.3 Network security management 4.5.4 Network performances and capacity management 4.5.5 Network supervisory system
		4.6	Network audit support
	5.	Facility and equipment management	
		5.1	Power equipment management (Power receiving equipment, emergency power equipment, and uninterruptible power supply)
		5.2	Air conditioning equipment management (air conditioner, cooling tower and duct)
		5.3	Processor water-cooler management (refrigerator, cooling equipment, hydrostat, and cooling water)
		5.4	Communication incidental equipment management (main distributing frame, intermediate distributing frame, test distributing frame, private branch exchange, wiring)
		5.5	Building management (location, structure and layout)
		5.6	Incidental equipment management (firefighting equipment, crime prevention equipment, aseismatic equipment, delivery equipment, and soundproof equipment)
		5.7	Management of equipment at distributed sites
		5.8	Information system safety measure criteria (installation standards, Building Standard Law, and Fire Service Law)

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

Knowledge field	Major classification	Intermediate classification	Minor classification
D. Fault management			
	1. Fault supervision	1.1 Setting items to be supervised	1.1.1 Items to be supervised (hardware, network, software, equipment, persons (operator, system development engineer, user, visitor, cleaner, employee of transportation companies, etc.)
			1.1.2 Consideration points of items to be set (level of influence, processing priority, operation time zone, range, processing method, anti-fault system, and equipment configuration)
		1.2 Contents of supervision and supervisory methods	1.2.1 Important supervisory items
			1.2.2 Supervision by supervisory system
			1.2.3 Investigation point of supervisory methods
		1.3 Contact in case of faults	1.3.1 Preparation for contact system
			1.3.2 Contacting information system department
			1.3.3 Contacting responsible operation administrator
			1.3.4 Contacting support engineers
			1.3.5 Contacting users
	2. Investigation of cause of faults	2.1 Collection of fault information	2.1.1 Collecting fault information (automatic collection and manual collection)
			2.1.2 Candidate information of fault causes
		2.2 Isolating faults	2.2.1 Locating faulty places
			2.2.2 Point for specifying causes at early stages (investigation of difference from stationary days, investigation of the contents of problems, investigation of items altered, investigation of similarity, and detector and trigger information)
			2.2.3 Measures against faults whose cause cannot be specified
		2.3 Investigation of the cause of faults	2.3.1 Determining personnel for investigating cause
			2.3.2 Establishment of a system for pursuing the cause of faults, and management of investigation processes
			2.3.3 Determining start-up methods (Switching to standby system, degeneracy operation, and manual initialization)
	3. Recovery processing	3.1 Preparation jobs for recovery	3.1.1 Establishment of procedures for coping with faults (preparation of operation manual in case of fault)
			3.1.2 Measures against faults that are difficult to give a procedural form
			3.1.3 Actions to be taken for recovery process during normal operation
			3.1.4 Test of recovery procedure and training

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

		3.2	Recovery process	3.2.1	Form of recovery process (system restart-up, restart of jobs in the standby system, partial recovery, and isolation)		
				3.2.2	Recovery in case of faults in host computers (recovery type restart-up, initialization type restart-up, normal action, and temporary action)		
				3.2.3	Recovery in case of database fault (data destruction, deadlock, DBMS trouble, roll back, and roll forward)		
				3.2.4	Recovery in case of network faults (recovery by using spare circuit, communication route change, and data transmission and reception program)		
				3.2.5	Recovery in case of faults in related equipment (switchover to spare equipment, and isolation)		
				3.2.6	Recovery in case of abnormal job process		
				3.2.7	Notifying persons concerned of fault recovery		
		4. Fault record and measures against reoccurrence					
		4.1	Recording and reporting the contents of faults	4.1.1	Storage period and contents of record		
				4.1.2	Report items		
		4.2	Measures against reoccurrence	4.2.1	Analysis of fault causes		
				4.2.2	Evaluation and improvement of procedures for coping with faults		
				4.2.3	Execution of preventive actions (inspection of similar equipment, and inspection of similar software)		
				4.2.4	Standardizing the procedures for coping with faults, and giving the procedural form		
		5. Fault management of the distributed system					
			5.1	Fault problems on the distributed system	5.1.1	Influences due to many items to be managed	
	5.1.2				Influences due to the diversity of forms in use		
	5.1.3				Influences due to wide area of items to be managed		
	5.1.4				Influences due to complication in fault detection, isolation and action		
	5.1.5				Influences due to insufficient/incomplete standardization of the operations over the items to be managed		
	5.2		Fault supervision of the distributed system	5.2.1	Detection of faults in the distributed system environment		
				5.2.2	Setting fault supervisory items		
	5.3		Investigation of fault causes in the distributed system	5.3.1	Importance of fault information collection		
				5.3.2	Times required for isolation and investigation of cause		
	5.4		Fault recovery of the distributed system	5.4.1	Daily preparation jobs		
				5.4.2	Recovery process in causes		
	5.5		Preventing the reoccurrence of faults in the distributed system	5.5.1	Effective execution items to prevent reoccurrence		
				5.5.2	Substantial help desk		

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

Knowledge field	Major classification	Intermediate classification	Minor classification
E. Security management	1. Measures for security management	1.1 Determination of measures for security management	1.1.1 Security policy (purpose and execution policy)
			1.1.2 Plan for coping with unexpected cases
			1.1.3 Security management system (management organization, responsible system, education system, training, assurance of security in external contract jobs)
			1.1.4 Items to be managed (identification of threat, and items to be protected)
			1.1.5 Risk management (risk analysis, risk evaluation, and insurance)
		1.2 Execution of physical security measures	1.2.1 Facility and equipment management (backup facilities and equipment, detector, disaster prevention equipment, crime prevention equipment, and criminal prevention equipment at distributed sites)
			1.2.2 Disaster management (earthquake, fire, flood, power failure, and leak)
			1.2.3 Information equipment management (installation methods, installation place, procedure for installation, inventory, reuse, circuit connection, and electromagnetic wave radiation)
		1.3 Execution of technical security measures	1.3.1 System security measures (system backup, system capacity, check point restart, computer virus, session management, and detection of security intrusion)
			1.3.2 Data security measures (file backup, password, access control, terminal identification function, and preventive measures against unauthorized usage)
		1.4 Execution of managerial security measures	1.4.1 Operation management (management of entry and leaving, terminal management, and information management)
			1.4.2 Crime prevention management (data/program falsification, behavior of destruction, hacker, tapping, and illegal data leakage)
		1.5 Related laws and regulations	1.5.1 Safety Standard of Information System
			1.5.2 Standards for Measures against Computer Virus
			1.5.3 Standards for Measures against Unauthorized Access to Computer
	2. Execution of security management	2.1 Security management guide	2.1.1 Manual for operation administrator
			2.1.2 User manual
			2.1.3 Security check list
		2.2 Intrusion records	2.2.1 Monitoring (collection of audit log data)
			2.2.2 Investigation and analysis (investigation and analysis of log list)
		2.3 Distributed site security	2.3.1 Security policy of distributed sites
			2.3.2 Security management at distributed sites
		2.4 Security strength test	2.4.1 Setting targeted security strength
			2.4.2 Execution of security strength test and analysis
		2.5 Security audit support	

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

Knowledge field	Major classification	Intermediate classification	Minor classification
F. Performance management			
	1. Performance evaluation	1.1 Performance evaluation criteria	1.1.1 Clarifying the purpose of performance evaluation
			1.1.2 Setting performance evaluation items (activity ratio related to CPU, memory, disk and circuit)
			1.1.3 Modeling performance supervision (model viewed from system configuration, users, operation and load)
			1.1.4 Setting methods of performance evaluation (identification of performance measurement data, and performance measurement tool)
			1.1.5 Setting performance evaluation criteria (job classification (online, TSS, and batch), check of the target value, and setup of evaluation measure in models and devices)
			1.1.6 Determining methods of performance supervision (supervisory data, supervising time, output method of obtained data, determination of output timing, and performance supervision scheduling)
			1.1.7 Periodical reconsideration of performance evaluation criteria and supervisory methods
		1.2 Performance analysis and evaluation	1.2.1 Time of performance evaluation (at time of system planning, design, and migration, and during operation)
			1.2.2 Obtaining performance data (conditions for obtaining data, storage of data, and issuance of supervisory report)
			1.2.3 Analysis of performances (analysis of target achievement status, analysis of system operation status, and analysis of problems)
			1.2.4 Phenomena derived from performance problems (bottleneck and slashing)
			1.2.5 Proposal for performance improvements (activity ratio of CPU, disk usage rate, and allocation of performances with priority)
	2. Capacity management	2.1 Capacity evaluation	2.1.1 Identification of capacity management items (power capacity, CPU processing speed, main memory capacity, cache memory capacity, disk capacity, disk access speed, and communication line speed)
			2.1.2 Current system load
			2.1.3 Future estimation of system load
		2.2 Capacity improvement	2.2.1 Capacity increase simulation (simulation tool, limit performance calculation, and selection of increase candidate)
			2.2.2 Proposal for system improvements (reduction of user service level, calculation of budget, estimate of investment effectiveness, time of increase, new product information, and technical trends)
			2.2.3 Education for appropriate usage of systems for users
	3. Performance management of the distributed system	3.1 Viewpoint of performance criteria in the distributed system	3.1.1 Consideration of the features of system form (load distribution type and function distribution type)
			3.1.2 Consideration of the features of life cycle (short-term development, accelerated changes of IT, and early outdating)
			3.1.3 Consideration of request diversification (complexity of organization, unevenness of users' satisfaction, and difference in performance evaluation criteria)
		3.2 Performance criteria in the distributed system	3.2.1 Performance evaluation in servers
			3.2.2 Performance evaluation in clients
			3.2.3 Consideration of system configuration, data flow, and shared resources
	4. Capacity management in the distributed system	4.1	Consideration points in the capacity of distributed system (cost for migration for capacity increase, short life cycle, and cost performance)
		4.2	Capacity management items (CPU processing speed, main memory capacity, and disk capacity)
		4.3	Consideration point on capacity management (consideration of balance between server and client)

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

Knowledge field	Major classification	Intermediate classification	Minor classification
G. System maintenance			
	1. Making a system maintenance plan	1.1 Request for system maintenance	1.1.1 Setting system maintenance items (hardware, software and facilities)
			1.1.2 Setting levels corresponding to the contents of maintenance
		1.2 System maintenance plan	1.2.1 Maintenance budget
			1.2.2 Maintenance requirements
			1.2.3 Maintenance system
			1.2.4 Maintenance commitment
			1.2.5 Personnel in charge of maintenance
			1.2.6 Maintenance execution schedule
			1.2.7 Replace
		1.3 Execution form of system maintenance	1.3.1 Daily inspection
			1.3.2 Periodical maintenance
			1.3.3 Preventive maintenance
			1.3.4 Ex post facto maintenance
	2. Execution of maintenance jobs	2.1 Procedure for performing maintenance job	2.1.1 Maintenance execution plan
			2.1.2 Measures for protection for maintenance
			2.1.3 Reflecting the results of maintenance in the analyses and maintenance plan later
			2.1.4 Maintenance completion report
		2.2 Software maintenance	2.2.1 Software developed by the company
			2.2.2 Software developed by contractor
			2.2.3 Software sold on the market
			2.2.4 Contract for software maintenance
			2.2.5 Contract for system integration and maintenance
		2.3 Hardware maintenance	2.3.1 Contract for hardware maintenance
			2.3.2 Spare of hardware maintenance parts and storage

Knowledge field	Major classification	Intermediate classification	Minor classification
H. Development of new systems and system migration	1. Making a development plan	1.1 Participation in the development planning phase	
		1.2 System operation and migration plan	1.2.1 System operation plan
			1.2.2 System migration plan
	2. Design of system operation system	2.1 Design of system operation method	
	3. Migration and operation test	3.1 Migration test (function check of program for migration, and rehearsal of migration work)	
		3.1.1 Investigation of influences brought by migration to this environment (difference in system software, hardware, OS, configuration equipment, connection equipment and network environment)	
		3.2 Operation test (check by system operation)	
		3.2.1 Test and evaluation of temporary operation form (in parallel operation etc.)	
		3.2.2 Test and evaluation of the operation form during normal operation	
		3.2.3 Test and evaluation of the operation form in case of fault	
		3.2.4 Test and evaluation of operation form during maintenance	

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

	4. System migration	4.1 System migration plan	4.1.1	Determining migration items (software, database, file, network, server and magnetic disk device)
			4.1.2	Assuming job operation rules (temporary rules)
			4.1.3	Determining migration methods (simultaneous migration, step-by-step migration, platform switching)
			4.1.4	Determining migration procedure (procedure for executing software used for migration, procedure for setting execution environment, procedure for checking the execution results, and restoration point setting)
			4.1.5	Determining migration tools (basic software, common application software, individual application software, and applicable software for migration)
			4.1.6	Migration work execution plan
			4.1.7	Migration personnel plan
	4.2 Execution of system migration		4.2.1	Persons concerned to migration work (responsible person for migration, responsible person for system operation management, personnel in charge of migration work, responsible person for development, personnel in charge of development, technical engineer (network) and technical engineer (database))
			4.2.2	Execution of migration and judgment of situation
	4.3 System migration evaluation		4.3.1	Taking over operation jobs
			4.3.2	Evaluation of migrated system (CPU, memory, input/output device, circuit (speed, number of lines, and rate of flow), workload, scheduling and operation time zone)
	5. Management of development environment	5.1 Configuration of development environment	5.1.1	Environment of development stage and configuration
			5.1.2	Environment of migration stage and configuration
			5.1.3	Environment of operation stage and configuration
		5.2 Management of development environment	5.2.1	Methods of operation management of development environment
			5.2.2	Notes on operation management of development environment
		5.3 Consideration points of development environment management in the distribution environment	5.3.1	Management of changes in network configuration
			5.3.2	Management of methods for coping with faults
			5.3.3	Performance management and capacity management
			5.3.4	Software version management and software distribution
			5.3.5	Hardware management
			5.3.6	Security management at distributed sites
			5.3.7	Data integrity management
			5.3.8	Management of data generated in development
			5.3.9	Communication management between developers

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

Knowledge field	Major classification	Intermediate classification	Minor classification
I. System evaluation related to operation			
	1. Evaluation items		
		1.1 Setting the purpose of evaluation	
			1.1.1 Purpose of evaluation
			1.1.2 Time of evaluation (during system planning, operation system design, migration, or operation)
		1.2 Setting evaluation items (hardware, software, network, database and operation)	
	2. Evaluation items and evaluation standards		
		2.1 Performances	
			2.1.1 Response time of transaction
			2.1.2 Turnaround time of jobs
			2.1.3 Throughput
			2.1.4 Recovery time from faults
			2.1.5 Response timing of console message
		2.2 System operation quality	
			2.2.1 Functional evaluation (conformance to purpose, universality, and standardizability)
			2.2.2 Stability evaluation (reliability, safety, and availability)
			2.2.3 Usability (understandability, learnability, and operability)
			2.2.4 Maintainability (easiness for identifying fault cause, recoverability, modifiability, and easiness of test)
		2.3 Operation	
			2.3.1 Operability
			2.3.2 Processing time
			2.3.3 Using operation management system
		2.4 Economical efficiency of system operation	
			2.4.1 Operation cost
			2.4.2 Trade-off of system quality and economical efficiency
	3. Proposal for system improvements		
		3.1 Proposal for system modification/reconstruction (collection of evaluation data, classification of problems by outdating of system, and proposal for system improvements)	
		3.2 Proposal for improvements of system development specifications (collection of evaluation data, detection of defects in development process, and proposal for system improvements)	
	4. Evaluation of distributed system		
		4.1 Features of distributed system evaluation	
			4.1.1 Importance of duty assignments between server and client
			4.1.2 Consideration of network shared resources
		4.2 Necessity of setting system evaluation criteria	

Technical Engineers (System Management) Skill Standards (Body of Knowledge)

Knowledge field	Major classification	Intermediate classification	Minor classification
J.	System user support		
	1.	Clarifying items to be observed by users	
		1.1	Clarifying the available scope of computer resources
		1.2	Clarifying observance items for usage
	2.	User support	
		2.1	Scope of user support
		2.2	Providing user services and recording the execution results
		2.3	User education and training
			2.3.1 Plan for user education and training
			2.3.2 Execution of user education and training
		2.4	Help desk
	3.	Coping with new requests of users	
		3.1	Identification of new requests from users and management of requests for improvements
		3.2	Proposal for system operation improvements
	4.	User consulting	
		4.1	Providing know-how about preparation of user environment
		4.2	Providing know-how related to system operation

**Information Technology Engineers Skill Standards
Technical Engineers (System Management)**

Published on July 31, 2000

Publisher	Japan Information Processing Development Corporation Central Academy of Information Technology 19th Floor, Time 24 Building, 2-45 Aomi, Koto-ku, Tokyo 135-8073
Tel	+81 3 5531 0171 (key number)
Fax	+81 3 5531 0170
URL	http://www.cait.jipdec.or.jp

© July 31, 2000 Japan Information Processing Development Corporation