IT Passport

MANAGEMENT

Chapter

4

Development technology

Chapter 4 explains system development processes and test techniques, as well as software development processes and development methods.
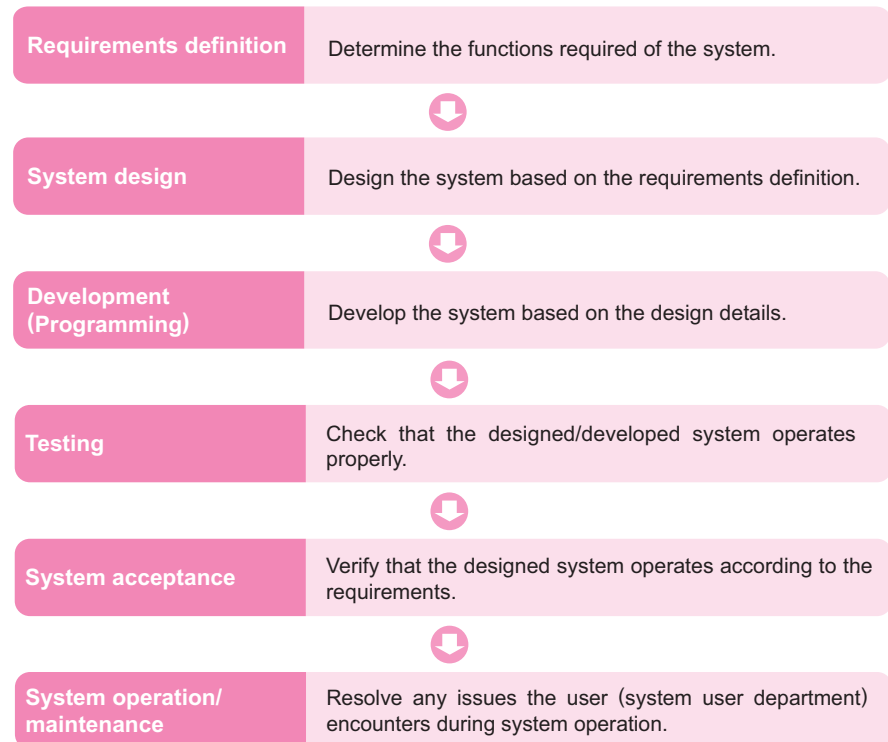
4-1-1 Process of system development

Systems used in business operations are expected to perform the necessary functions properly, but must also be easy for the user (system user department) to utilize.

It is important for the department developing a system to survey/analyze requirements in cooperation with the various departments that will use the system, and reflect the results into the system under development.

System development does not necessarily have to be carried out internally, and may also be outsourced to a company that specializes in system development.

A **"service contract"** is a typical method for forming an agreement when system development is outsourced to another company.

The general procedure for developing a system is as shown below.

Requirements definition	Determine the functions required of the system.
System design	Design the system based on the requirements definition.
Development (Programming)	Develop the system based on the design details.
Testing	Check that the designed/developed system operates properly.
System acceptance	Verify that the designed system operates according to the requirements.
System operation/ maintenance	Resolve any issues the user (system user department) encounters during system operation.

❶ Requirements definition

A **"requirements definition"** clarifies the function, performance, and content required of the system and software, and includes a **"system requirements definition"** and a **"software requirements definition."** The demands of the user (system user department) are surveyed/analyzed to determine whether they are technologically feasible, and the requirements for achieving the demands are then defined in detail.

This is the first step in system design, which plays a critical role in determining the success or failure of the subsequent system.

In order to develop a better system, the requirements are defined in cooperation with the various departments that will use the system.

●System requirements definition

In a **"system requirements definition,"** the types of functions that are required for computerization are clearly stipulated.

In general, factors that determine system reliability such as operating conditions, security performance, and hardware used are stipulated. Accordingly, it is necessary to set priorities in order to maximize results within a limited budget, and determine whether the content described in the system requirements definition is worth the cost.
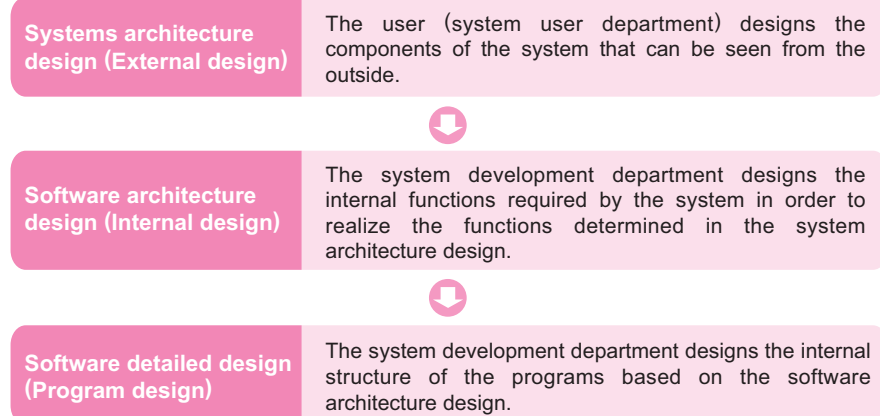
●Software requirements definition

In a **"software requirements definition,"** the required software content is specified on the basis of the actual business content.

In general, details such as the system interface, operability, functions required for business, operation, and maintenance are stipulated. At such time, hearings are conducted with the users (system user department) in order to gather as many opinions as possible, although it is also necessary to analyze/consider whether those requirements can be realized.

❷ System design

The system is designed based on the requirements definition.
The procedure for designing a system is summarized below.

Systems architecture design (External design)	The user (system user department) designs the components of the system that can be seen from the outside.
Software architecture design (Internal design)	The system development department designs the internal functions required by the system in order to realize the functions determined in the system architecture design.
Software detailed design (Program design)	The system development department designs the internal structure of the programs based on the software architecture design.

(1)Systems architecture design (External design)

In a systems architecture design, components that are visible to the user (system user department) are designed.

The functions required for the system are identified by considering how operations will change if the system is developed, and human interfaces such as input/output screens and forms/slips are designed. System architecture design is also referred to as an **"outline design"** as it outlines the type of system that will be used.

In system architecture design, **"human interface design"** such as input/output screens and forms/slips, as well as **"data design"** and **"code design"** are implemented.

●Human interface design

"Human interfaces" are points of contact between people and computers. They are also referred to as **"user interfaces."** In human interface design, the input/output screens of the system and print images such as forms/slips are designed.

●Data design

In data design, table data is designed in order to utilize relational databases. By extracting all data items used in operations and normalizing the data, redundant data is removed.

●Code design

In a system, various codes such as product numbers and customer numbers are handled. As these codes require regularity, the rules and items to be encoded are determined by the code design.

(2)Software architecture design (Internal design)

In software architecture design, an internal system is designed, which considers **"how to implement"** the necessary functions of the system. In other words, it is designed from the perspective of using programming to implement the functions determined in the system architecture design.

The user (system user department) does not participate in software architecture design since it is a design of the system's internal functions.

(3)Software detailed design (Program design)

The internal structure of programs is designed based on the software architecture design.

In software detailed design, function details in programs are defined, and detailed processing units of the program structure such as database access methods (SQL statements) are designed.

The user (system user department) does not participate in software detailed design since it is design of the system's internal functions.
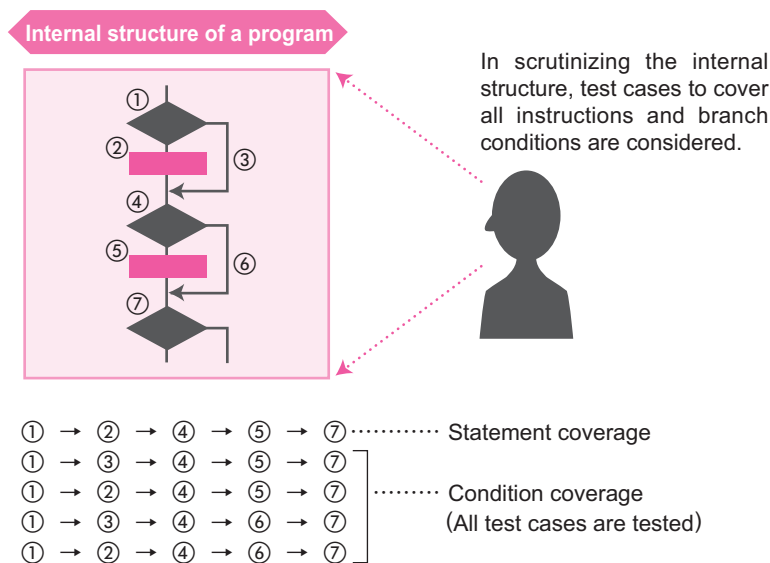
❸ Development (Programming)

Individual programs are created based on the content designed during the system design stage. In order to run the system, it is important to create the individual program processing procedures, processing details, and processing results according to the design.

Furthermore, **"unit testing (module testing)"** is conducted to confirm that the individual modules created operate normally according to the **"program design specification."** Unit testing is conducted in order to discover logical errors in modules one by one, and to check whether the modules function as per the established specifications. In unit testing, verification is conducted by using **"white box tests"** and **"compilers."**

(1)White box test

A **"white box test"** is a technique for checking the internal structure and logic of a program, focusing on program control and flow.

Internal structure of a program

In scrutinizing the internal structure, test cases to cover all instructions and branch conditions are considered.

① → ② → ④ → ⑤ → ⑦ ·········· Statement coverage
① → ③ → ④ → ⑤ → ⑦
① → ② → ④ → ⑤ → ⑦ ········· Condition coverage
① → ③ → ④ → ⑥ → ⑦ (All test cases are tested)
① → ② → ④ → ⑥ → ⑦

(2)Compiler

A **"compiler"** is software that transforms code created using a programming language into a program executable by a computer.

Using a compiler, it is possible to confirm bugs (errors) in the created programs.

❹ Testing

When unit testing is completed, the modules are integrated and testing is carried out to confirm that the designed/developed system operates normally and is fit for operation. Testing is an important process for confirming program and system quality.

Tests are conducted according to test plans, and work continues to proceed while performance is evaluated.

(1)Test execution procedure

The procedure for conducting each test is as follows.

Test plan creation	Determine items such as test schedule, participants, and evaluation criteria. Tests with the aim of improving the quality of the program are not repeated.

⬇

Test specifications design	Design items such as test data and response to predicted results according to the design specifications.

⬇

Test environment setting	Create test data and prepare the test environment including apparatus to be used in the test. If the program creator prepares the test data or designs the test environment, unexpected errors that could occur are less likely to actually occur. Therefore, it is best if someone other than the program creator is responsible for preparing the test environment.

⬇

| Test execution	Execute the test according to the test specifications. If the program is modified after completing the test, repeat the test. When doing so, supplement the original test data with data containing modifications that can be confirmed.

⬇

Test result evaluation	Evaluate the system on the basis of the test results, and determine whether there are any problems.

(2)Testing techniques

One of the main testing techniques in system development is the **"black box test**.**"**

A **"black box test"** is a technique for checking whether functions are in accordance with specifications, focusing on the output results of input data. It is a technique used in many test processes.

System or program

```
Data  →  [■■■■]  →  Result
```

Considered a black box
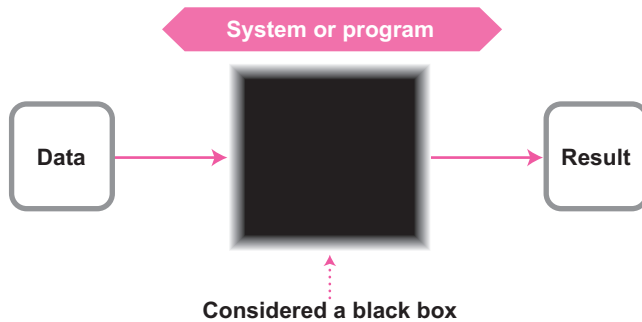
(3)Test planning

In test planning, data is prepared in order to verify whether the expected output results are obtained for the input data. However, it is not sufficient to end testing when the results for correctly inputted data are confirmed. In reality, correct data is not always inputted during tasks, and systems are not necessarily used in a normal state. Therefore, a variety of cases are assumed, and the following kinds of test data are prepared.

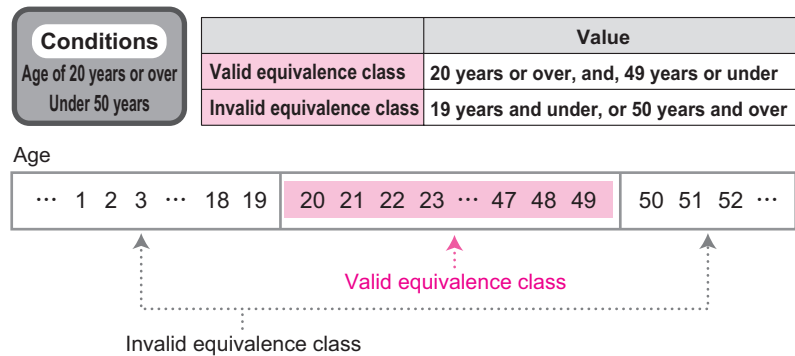| Normal data	Confirms that tasks are processed normally.
Exception data	Confirms whether exception data generated by tasks are processed as exceptions.
Error data	Confirms whether erroneous data are properly detected as errors.

*After first testing with normal data, testing is conducted with exception data and error data.

Two of the main methods used to create test data for conducting black box tests are **"equivalence partitioning"** and **"boundary value analysis**.**"**
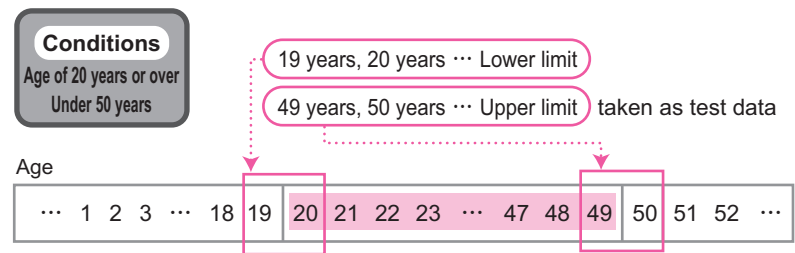
●Equivalence partitioning

"Equivalence partitioning" is a method that divides input data into a **"valid equivalence class"** or an **"invalid equivalence class,"** and adopts values that are representative of each class as test data. A characteristic of this method is that test data can be created easily.

Valid equivalence class	Range of values that are processed normally as input data
Invalid equivalence class	Range of values that are errors as input data

Conditions Age of 20 years or over Under 50 years		Value
	Valid equivalence class	20 years or over, and, 49 years or under
	Invalid equivalence class	19 years and under, or 50 years and over

Age

··· 1 2 3 ··· 18 19	20 21 22 23 ··· 47 48 49	50 51 52 ···

Valid equivalence class

Invalid equivalence class

●Boundary value analysis

"Boundary value analysis" is a method that adopts values at the boundaries of the equivalence partitioning classes as test data. Due caution is required for complex boundary conditions as omissions can easily occur.

Conditions
Age of 20 years or over
Under 50 years

19 years, 20 years ··· Lower limit
49 years, 50 years ··· Upper limit) taken as test data

Age

··· 1 2 3 ··· 18 **19** **20** 21 22 23 ··· 47 48 **49** 50 51 52 ···

(4)Test execution

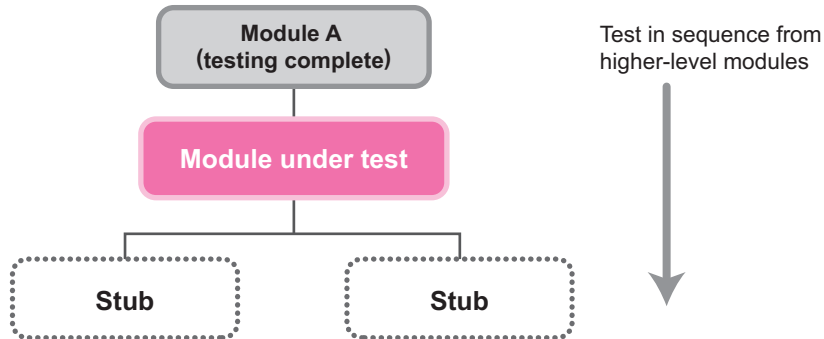The following types of testing are conducted in system development.

●Integration testing (Consolidated testing)

In **"integration testing,"** modules and programs are integrated and verified whether they can be executed correctly according to the software architecture design. Integration testing is conducted between modules and between programs for which unit testing is complete. It can confirm whether screen transition and data passing between programs is carried out correctly. Integrated testing is utilized by the system development department.

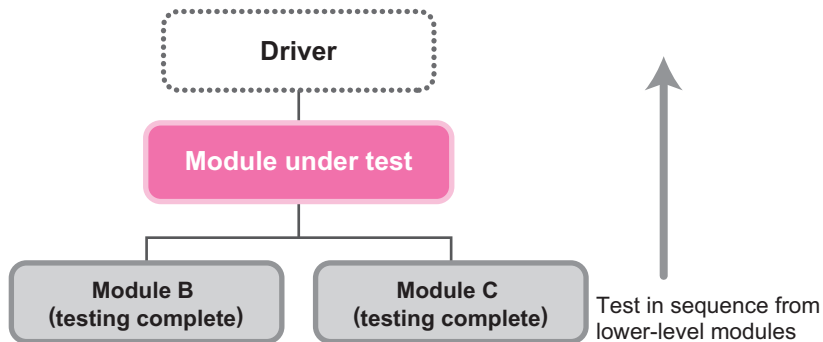The following types of testing are included in integration testing.

•Top-down testing

"Top-down testing" is a method of testing in sequence starting from the higher-level modules. In many cases, however, the lower-level modules are not all complete. **"Stubs"** are then prepared, which are temporary modules that are called upon by the higher-level modules.

```
            Module A
         (testing complete)          Test in sequence from
                │                     higher-level modules
                │
         Module under test                  │
            │        │                       │
        ┌───┴──┐  ┌──┴───┐                   │
        │ Stub │  │ Stub │                   ▼
        └──────┘  └──────┘
```

•Bottom-up testing

"Bottom-up testing" is a method of testing in sequence starting from the lower-level modules. If the higher-level modules are not complete, **"drivers,"** which are temporary modules that call upon the lower-level modules are prepared.

```
            Driver
                │
                │
         Module under test                   ▲
            │        │                        │
        ┌───┴────┐ ┌─┴──────┐                 │
        │Module B│ │Module C│        Test in sequence from
        │(testing│ │(testing│        lower-level modules
        │complete)│ │complete)│
        └────────┘ └────────┘
```

●System testing (Comprehensive testing)

"System testing" verifies whether the overall functions fulfill the requirements specification designed with the system architecture design. It is conducted after integrating programs for which integration testing is complete, and utilized in cooperation by the system development department and the user (system user department).

In system testing, the following types of testing may be conducted depending on the purpose.

Name	Description
Function testing	Verifies that all of the required functions are included.
Performance testing	Verifies that the processing performance, including response time, turnaround time, and throughput, fulfills the requirements.
Exception handling testing	Verifies that error processing functions and recovery functions operate normally.
Load testing (Rush testing)	Applies a load to the system through such means as inputting a large amount of data and simultaneously increasing the number of operating computer terminals, and verifies that the system can withstand the load.
Operability testing	Verifies that the system is easy to operate for the user (system user department).
Regression testing	Verifies that no other programs were affected when errors discovered in any of the test processes were modified or when changes were made to the specifications.
Penetration testing (Intrusion testing)	Detects the system's security holes and firewall weak points (vulnerability) by actually attempting an attack or intrusion from outside.

●Operational testing

"Operational testing" uses real business data to verify whether the system is appropriate for the realities of the business and whether it can be operated in accordance with the operation manual. It is conducted mainly by the user (system user department).

In operational testing, the following items are tested.

| Item	Description
Business function	Verifies that functions required in conducting business are fulfilled.
Operability	Verifies that the system is easy to operate for the user (system user department).
Anomaly measures	Verifies that measures have been taken in case of anomalies such as data anomalies, abnormal operation, and equipment anomalies.
Throughput	Verifies that throughput is sufficient using the current equipment configuration.
Processing time	Verifies that response times are within the acceptable range.

(5)Test result evaluation

In order to receive system inspection, satisfactory test results must first be achieved. At such time, it is necessary to consider the criteria for evaluating the system based on the test results.

Typical evaluation criteria include **"bug control charts."** A bug control chart is a graph showing the relationship between test time and cumulative number of bugs detected.

An ideal bug control chart forms a curve referred to as a **"Gompertz curve (reliability growth curve)."**
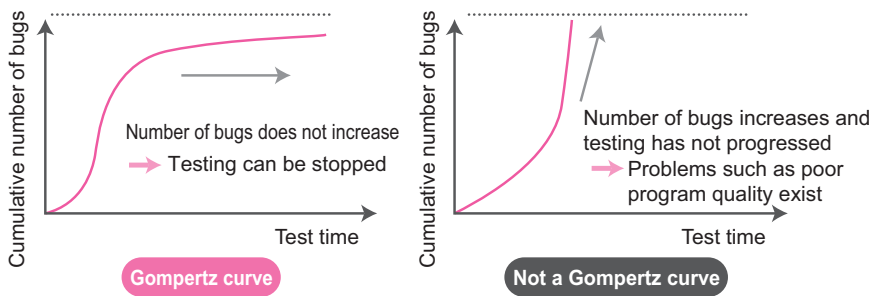
⑤ Software acceptance

Software acceptance occurs when system development is outsourced to an external specialist and software is delivered from the outsourcer (developer) to the customer (user). It involves confirming whether all of the requirements of the user (system user department) are fulfilled, and whether the software operates normally. If there are no problems, the software is delivered and educational and training programs for the user (system user department) are conducted. It is also referred to as an **"approval test (acceptance test)."**

⑥ System operation and maintenance

When system development is complete, the user (system user department) starts utilizing the system. The usage status and operation status of the system are then observed, and any issues that arise are resolved. In order to respond to developments in information technology or changes in business strategy, programs may also be modified or changed.

(1)Precautions about operation and maintenance

Precautions about system operation and maintenance are listed below.

- When performing any modification work, first backup the system before directly modifying a program in operation. After making the modification, conduct testing in an environment that is equivalent to the actual environment.
- When any changes are made to a program, always record them in a modification log. This information may prove to be useful when investigating matters such as fault causes. A regression test should also be conducted to confirm that other programs are not affected by the changes.
- Always keep the complete set of documents concerning system development (such as specifications and operating procedures) up-to-date.
- Monitor issues such as whether there is insufficient disc space due to an increase in data volume, and whether there is a decrease in performance, and make improvements/address issues as necessary.

Reference

User manual

A "user manual" is a manual that explains how to use the software and system.

Before operation, the user manual is used to provide a tutorial of basic operations, and after the system is in operation, it is referenced to learn specific operations according to the respective content of work.

Reference

Document storage

It is important to leave documentation in each system development process. Specific documents include "requirements definition documents," "design specifications," "developed programs," "test execution plans," and "test execution reports."

For example, design specifications can be used as a design drawing for the system under development, which those in charge can reference to check progress and advance development. Furthermore, if any changes to the program must be made at the operation/maintenance stage, the test execution report becomes the only document that can provide an adequate understanding of the existing system.

(2)System maintenance

The following are key maintenance tasks for preventing failures.

Type of maintenance	Description
Preventative maintenance	Remove the causes for future failures before they occur.
Scheduled maintenance	Perform daily checks. Also, enter into a maintenance agreement with a specialist and request hardware checks once a month, for example.
Remote maintenance	Enter into a maintenance agreement with a specialist, and remove causes of failure remotely (remote operation) by connecting the specialist and the user (system user department) via communication lines.

(3)System failure

In terms of maintaining system operation, it is important to take preventive measures so that failures do not occur. However, for reasons such as system modification as a result of tax rate changes, workflow changes, or hardware lifespan, failures in the existing system could occur and further modification may be unavoidable.

During system development, it is necessary to consider the occurrence of failures as unavoidable. The key is to be well-prepared with effective countermeasures that will prevent failures from adversely affecting the entire system or stopping operations.

4-1-2 Software estimation

Computerizing operations requires an awareness of cost when determining which functions to incorporate into the system.

The following are methods for estimating system development costs.

Type	Description	Characteristics
Program step method	A method for estimating the number of program steps (number of lines) in the entire system from past records.	Suited to estimations for development of core business systems with significant accumulation from the past.
FP (Function Point) method	A method for estimating system development person-hours and development costs by quantifying the number of input/output screens and files to be used, and the level of difficulty of functions to be developed. Quantified items are referred to as "function points."	Suited to estimations for development using GUI and object orientation.

Software development management techniques

4-2-1 Software development process and methods

When developing software, a development process and methods that suit the processing content and scale of the entire system must be determined.

1 Software development methods

"Software development methods" are methods for advancing the software development process. The following are typical development methods.

Method	Description	Characteristics
Structured method	A method of programming that divides the program into individual processes and forms a hierarchical structure. Also referred to as "structured programming.	Dividing the program into individual processes makes it easy to verify or modify operations, and perform maintenance.
Object orientation	A method for modeling a business and creating a program by considering what items (objects) are required to advance the business, and defining the object characteristics.	Business data (properties) and roles (behavior) are treated as groups of objects (components), which facilitates partitioning into components and reuse.
Data oriented approach	A method of carrying out system development based on databases created by focusing on the structure of data used in the business.	The structure of the core data will not change even if the business content changes, which makes it easy to carry out system modifications.
Process oriented approach	A method of carrying out system development by focusing on business processes and functions.	Each system is created based on the business content and if it changes, the system must be significantly modified.

Reference

Agent orientation

"Agent orientation" is a developed form of object orientation. An "agent" is software that operates and processes tasks independently in order to accomplish a purpose without detailed instructions from the user. Agent orientation refers to that approach and function.

❷ Software development models

The typical software development models are summarized below.

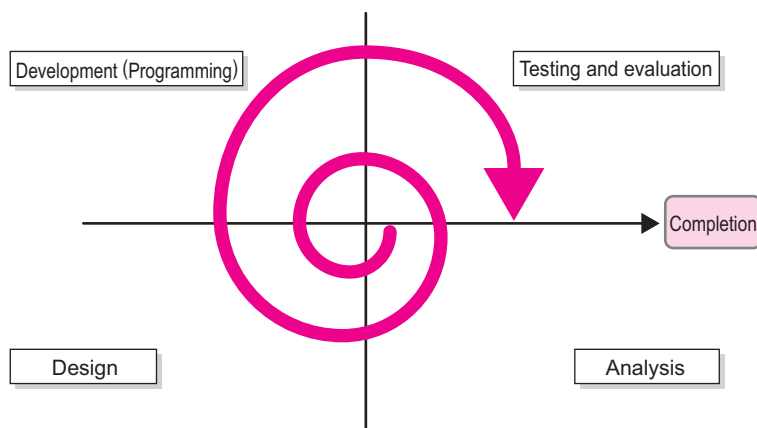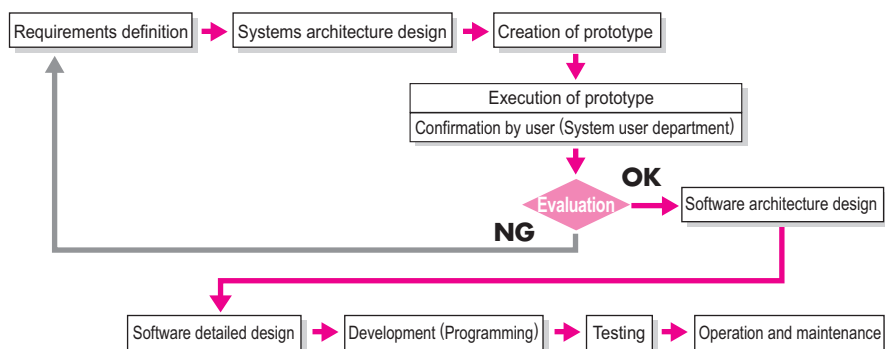| Model	Description	Characteristics
Waterfall model	A development model that advances each process in sequence without backtracking, similar to the flow of a waterfall. Also, dividing the system into a number of subsystems and repeatedly carrying out requirements analysis, design, development, testing, and implementation is called an "incremental model."	This is the most common development model. Costs can be estimated relatively easily, and this model is often used in large scale developments. However, the amount of work that must be repeated if the system specifications change is extremely large.
Spiral model	A development model that divides the system into a number of subsystems and repeats the cycle from "requirements analysis" to "operation" for each subsystem. It develops the system by allowing it to evolve as it grows.	It can shorten the period until the first subsystem is operated. Each subsystem is verified by the user (system user department), making it possible to incorporate their opinions into the next cycle.
Prototyping model	A development model that creates prototypes from an early stage of system development and obtains confirmation from the user (system user department) as development advances.	It can identify any potential misunderstandings about the system between the user (system user department) and the developer at an early stage. It also has the effect of raising the awareness of the user (system user department) regarding the system. However, if prototypes are created repeatedly, cost management can become an issue.

Waterfall model

Requirements definition
→ Systems architecture design
→ Software architecture design
→ Software detailed design
→ Development (Programming)
→ Testing
→ Operation and maintenance

Spiral model

Development (Programming)   Testing and evaluation

Completion

Design   Analysis

Prototyping model

Requirements definition → Systems architecture design → Creation of prototype
↓
Execution of prototype
Confirmation by user （System user department）
↓
OK
Evaluation → Software architecture design
NG

Software detailed design → Development (Programming) → Testing → Operation and maintenance

❸ Common frame

A **"common frame"** is a frame that standardizes the terminology and content of work in software development, including planning, development, operation, and maintenance. With a common frame, a system vendor and a user can clarify the details of their transaction such as their respective roles, scope of business, work content, and scope of responsibilities. This enables both parties to share a mutual understanding, which prevents misunderstandings and problems from occurring.

Reference

SLCP

"SLCP" is a common frame for transactions and software development centered on software.
Abbreviation for "Software Life Cycle Process."
In Japan, the "SLCP-JCF98 (Common Frame 98)" was established based on the ISO/IEC international standards, which takes into account the characteristics of Japanese commerce and Japan's software industry. In September 2007, the contents of the SLCP-JCF98 were reinforced and expanded, and the "SLCP-JCF2007 (Common Frame 2007)" was published.
Abbreviation for "SLCP-Japan common frame."

4-3 Chapter quiz

4-1 When the information system department performs the procedure of the requirements definition, system design, programming, and testing in the flow of software development, which of the following most needs the participation of the user departments?

a) Requirements definition
b) System design
c) Programming
d) Unit test

4-2 When the scale of software development is estimated, which of the following is an appropriate element that should be considered?

a) Developer's skills
b) Development organization
c) Number of screens
d) Schedule

4-3 Which of the following shows part of the phases of software development in the order of implementation?

a) System design, testing, programming
b) System design, programming, testing
c) Testing, system design, programming
d) Programming, system design, testing

4-4 Which of the following is the software development model that performs the requirements definition, system design, programming, and testing in that order, and checks carefully so as not to return to the previous phase when each phase is completed?

a) RAD (Rapid Application Development)
b) Waterfall model
c) Spiral model
d) Prototyping model

Chapter

5

Project management

Chapter 5 explains the processes of project management and techniques of project scope management.

5-1 Project management

5-1-1 Project management

In pursuing various corporate activities such as the development of new information systems and services, it is important for a corporation to execute plans in unison with a sense of purpose that is shared throughout the corporation. In general, it is efficient to execute a plan by assembling a project organization and executing the project as an organization, while managing various aspects such as progress of the project, cost, quality, and members.

❶ Project

A **"project"** is temporarily assembled in order to execute activities and achieve a specific purpose within a specified time.
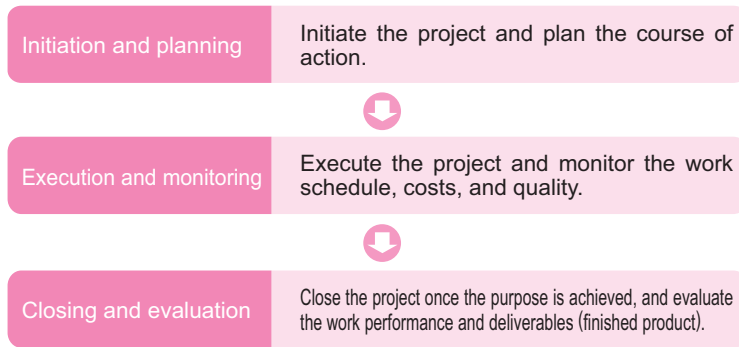The main characteristics of a project are summarized below.

> •A clear purpose is defined before the project is initiated.
> •A series of activities is undertaken to achieve the purpose.
> •Activities are executed by a temporary group.
> •Persons with specialized knowledge from various fields are assembled.
> •Work that is non-routine and non-repetitive is executed.
> •Activities are undertaken using defined resources.
> •The project is disbanded after achieving the purpose.

A project is engaged for the purpose of executing non-routine work instead of simple and routine work. An example is the development of a new information system. In order to achieve such purposes, it is important to manage the project using defined management resources (people, materials, money, and information).

❷ Project management

"Project management" is a management technique to facilitate every process of a specified project within the corporation from initiation to completion.

The typical processes for a project are summarized below.

Initiation and planning	Initiate the project and plan the course of action.
Execution and monitoring	Execute the project and monitor the work schedule, costs, and quality.
Closing and evaluation	Close the project once the purpose is achieved, and evaluate the work performance and deliverables (finished product).

(1)Project initiation and planning

The **"project manager"** plays a central role in initiating the project. The project is usually initiated after the client (commissioning party) that requests the systems development approves the documentation that describes the project outline. At that point, a **"kick-off"** meeting is conducted with the **"project members"** to discuss various aspects such as the framework and key points of the project, progress (schedule), and management method. Afterwards, a detailed plan is formulated and a **"project plan"** is prepared.

(2)Project execution and monitoring

After the project plan is completed, the project moves into the execution phase and work begins. During project execution, the project manager makes sure to communicate with project members and the client, and monitors the performance of the project including the progress of the project, cost, and quality. The project manager makes adjustments as the need arises.

(3)Project closing and evaluation

After the target system is completed, the project is closed and disbanded. Once the client has accepted the system, a **"project completion report"** is prepared.

The project completion report includes a performance evaluation of all work such as the actual cost and progress, and a list of the final deliverables (finished product). The evaluation contains information that will be useful for the next project such as variance between the plan and actual performance, changes occurred and their causes, and risks encountered and their countermeasures.

Reference

Milestone

A "milestone" is a term used in project management to denote an important point in the work schedule such as the integration testing date or customer review date.

Reference

Project manager

A "project manager" is an individual who manages and oversees projects or is nationally certified to manage a project. In the case of the former, a project manager organizes project members, manages the project schedule, and makes decisions concerning work processes.

Reference

Project member

A "project member" refers to one of the members of a project.

Reference

Stakeholder

In the context of project management, a "stakeholder" refers to an individual who is variously impacted by the project or has a stake in its success or failure. Project stakeholders include the project client, project manager, project members, and users. It is important to manage each respective stakeholder in an appropriate manner.

5-1-2 Project scope management

"Project scope management" is a management technique that analyzes the final deliverables of the project and the work scope required, and manages the relationship between the deliverables and work scope.

The **"Project Management Body of Knowledge (PMBOK)"** is an international standard that provides guidelines for project managers to execute projects in an integrated manner using project scope management techniques.

PMBOK recognizes the nine knowledge areas listed below.

Scope	Define the deliverables and work scope.
Time	Coordinate the work processes and schedule.
Cost	Determine the budget.
Quality	Define the quality targets and inspect the quality.
Human resources	Procure and train the project members.
Communication	Achieve mutual understanding and share information between the project members and teams.
Risk	Predict the risks and determine countermeasures to avoid and address the risks.
Procurement	Select the necessary resources, issue orders, and sign agreements.
Integration	Integrate the other knowledge areas and manage the overall project.

The key characteristic of PMBOK is that it achieves an overall balance of these knowledge areas to enable flexibility in response, even if there are significant changes to the deliverables or work scope.

❶ Scope

"Scope" refers to the final deliverables of the project, and the work scope required to produce the deliverables. The scope is defined using a **"WBS (Work Breakdown Structure)."**

●Work breakdown structure

A **"WBS (Work Breakdown Structure)"** is a chart that breaks down the work scope of the project into detailed items, and organizes the items into a hierarchy. The procedure for preparing a WBS is outlined below.

> **Determine the individual deliverables of the project.**
>
> ⬇
>
> **Determine the work scope required to achieve the deliverables.**
>
> ⬇
>
> **Break down the work scope into parts, and determine the work.**
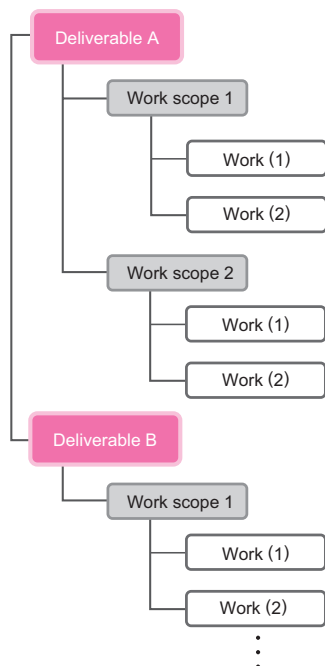
Once the WBS is prepared, it becomes the foundation for all work areas under PMBOK.

In addition, if any excesses or deficiencies are found in the WBS or while the project is in progress, the scope is reviewed to ensure that it is always up-to-date, and it is updated as any changes arise.

2 Time

The work content identified by WBS is used as the basis for estimating the approximate number of days required. The estimated number of days is used to divide the schedule for each piece of work according to the planned delivery dates in order to manage progress.

The schedule plan is determined based on the calculated number of operating days, clarifying the confirmation of progress, completion date, and handover of each individual piece of work.

"Arrow diagrams" and **"PERT (Program Evaluation and Review Technique)"** charts are used to prepare the schedule plan. A **"Gantt chart"** is used to illustrate the planned schedule.

Since there is a variety of work for each project, it is necessary to estimate the number of days required for each piece of work.

Reference

Arrow Diagram, PERT chart, Gantt chart

Refer to "Chapter 1-1-2 OR (Operations Research) and IE (Industrial Engineering)."

Chapter **5**

Project management

In the following arrow diagram example, work E can be started when work C and work D are both finished. In other words, work E can be processed seven days after the work is started.
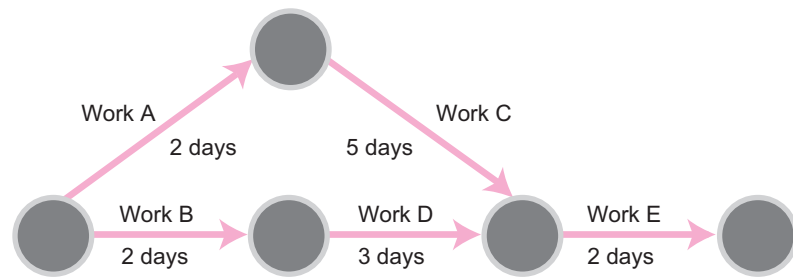
Example

In the following arrow diagram, calculation for the overall number of days required if work C can be shortened to three days is illustrated.
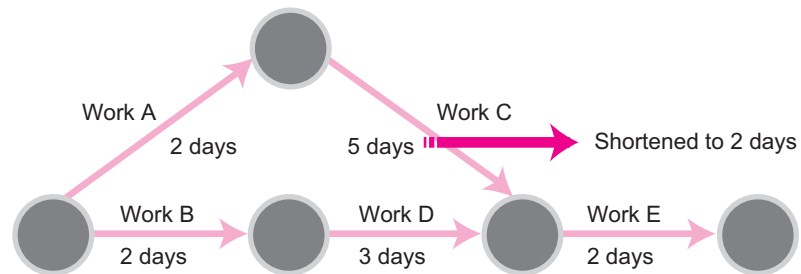
The overall number of days required is calculated as follows (before work C is shortened to three days).

Work A (2 days) + Work C (5 days) = 7 days

Work B (2 days) + Work D (3 days) = 5 days

Seven days are needed until both work C and work D are finished, so the overall number of days required is: 7 days + Work E (2 days) = 9 days.

If work C is shortened to three days, at most five days are needed until work C and work D are finished. Therefore, the overall number of days required is: 5 days + Work E (2 days) = 7 days.

❸ Cost

The work content identified by WBS is used to estimate the approximate cost required. The estimated cost is used as the basis to define and manage the budget. An "EVMS (Earned Value Management System)" is used for cost management.

●Earned value management system

An **"EVMS (Earned Value Management System)"** is a technique for quantitatively evaluating the progress of a project by comparing it with the budget and work schedule.

EVMS is used to prepare a cost plan based on the estimated person-hours derived from the breakdown of work from the WBS, and the variance of the schedule and cost is measured. The measured results are then analyzed to forecast work delays and over-budgeting, and adjustments are made to the schedule and budget.

❹ Quality

Quality is maintained and improved by defining and managing the desired quality targets of the deliverables, which are based on the deliverables identified by WBS. The following items are reviewed and summarized in a **"quality management plan:"** targets, quality maintenance and improvement plan, quality inspection technique, review plan, and testing method.

❺ Human resources

Project members are procured based on the deliverables identified by WBS, as well as work scope, time, cost, and quality. The project team is also structured and trained according to the deliverables and work scope.

The success of the project hinges on manpower and teamwork. In order to effectively capitalize on the capabilities of all persons involved in the project, it is necessary to prepare an optimum environment and assign the right project members to the right positions.

❻ Communication

It is necessary to manage communication so that there is sharing of information, and mutual understanding between working project members and the project manager. E-mail is typically used for communication, but other methods are also used to share information within the project such as preparing mailing lists and using groupware. In addition, regular meetings are held to encourage mutual understanding between project members, information sharing, and reporting on progress.

Reference

EVMS

Abbreviation for "Earned Value Management System."

Reference

Person-hours

"Person-hours" represent the volume of work required for activities such as system development. Person-hours are typically indicated in person-month units.

Reference

Person-months

"Person-months" are a unit of person-hours. One person-month equals the amount of work performed by one person in a single month.
Example Work that takes one person three months to accomplish represents three person-months of work.
Example Work that takes two persons three months to accomplish represents six person-months of work.

Reference

Mailing list

Refer to "Chapter 9-4-3 Network application."

Reference

Groupware

Refer to "Chapter 3-1-2 Concept of business process."

7 Risk

The deliverables and work scope identified by WBS are used as the basis for predetermining the possible locations and types of risks that may occur, as well as the extent of the losses and the degree of impact that those risks may entail. The predetermined risks should be ranked – starting with the highest rate of occurrence and the largest loss impact – to determine which risks should be prioritized and dealt with. In addition, it is integral to the process that sufficient countermeasures are prepared in advance for the predetermined risks.

If a risk actually arises, it is dealt with according to the course of action that has been devised based on the risk analysis and countermeasures. It is also necessary to be prepared to deal with legal issues due to the possibility of various contractual risks that could arise.

8 Procurement

Necessary technologies and services are procured from an external source in order to execute a project.

The deliverables and work scope identified by WBS are used as the basis for examining the technologies and services that need to be externally procured, followed by the selection of candidate suppliers. This process is referred to as **"solicitation."** Suppliers are typically chosen through bidding or quotation, or they are directly designated. The workflow from processing orders and contracts to receiving inspection is managed in a comprehensive manner.

9 Integration

All of the work areas are comprehensively managed to achieve unity in the entire project. Overall policies and plans for the project are formulated, and any changes that occur during the execution of the project are addressed. In some cases, new or more efficient technologies are developed during the course of a long-term project, requiring the ability to flexibly adapt when necessary. Accordingly, any new developments such as major schedule delays, delivery date extensions, and cost increases should be thoroughly discussed. In short, the overall project should be managed in a manner that ultimately yields the desired deliverables.

5-2 Chapter quiz

5-1 When one day is reduced for Activity C and three days are reduced for Activity B in the arrow diagram shown below, how many days can be reduced in total?
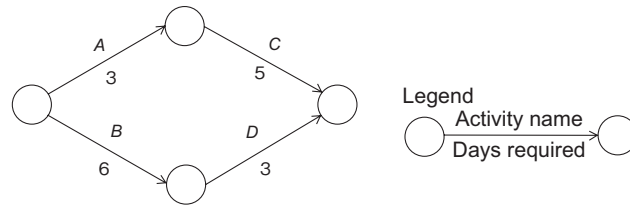
a) 1
b) 2
c) 3
d) 4

5-2 A project with 50 work items of equivalent labor was planned to be finished in 10 days. The fifth day is now over, and only 20 work items have been completed so far. By how many days is the project delayed at this point? Here, the delay is given by the difference from the number of days it should have taken to complete the work items that are currently finished.

a) 1
b) 2
c) 4
d) 5

5-3 Which of the following is described in a project plan?

- a) Screen layout
- b) Workflow
- c) Schedule
- d) Program structure

5-4 It takes 24 days for Mr. *A* to complete a certain software development and 12 days for Mr. *B*. When both Messrs. *A* and *B* work together, 25% of all the working hours in a day are needed for preliminary discussion. When both Messrs. *A* and *B* work together, how many days does it take to complete the development?

- a) 6
- b) 8
- c) 11
- d) 12

Service management

Chapter 6 explains the basic roles and components of IT service management including the management of information system operations, service support, the concept of system environment development, and the basic principles of system audits.

Service management

6-1-1 Service management

"Service management" is the act of operating an information system in a stable and efficient manner to maintain and improve the quality of user services.

❶ IT Service management

"IT service management" is a method of management that associates the operation of information systems with the provision of IT service in order to facilitate stable and efficient operations.

For example, by providing various IT services, entities such as financial institutions and transportation companies are supporting business management and society overall. If trouble arises in those IT services, it could have a major impact not only on those companies themselves but also on the entire society, leading to accidents and confusion.

For that reason IT services are managed in such a way as to ensure efficient operation and to maintain and improve the quality of the services themselves.

❷ ITIL

"ITIL" is a framework of know-how, best approaches, best practices, etc. designed to create a successful business utilizing IT services. It was put together in the form of a series of books published by the **"OGC,"** a UK government agency, in the late 1980s and serves as the **"de facto standard"** of IT service management.

ITIL is a comprehensive set of guidelines for IT services, but not all IT service operations need to be brought into line with it. It is best to compare the actual work against the framework and use the relevant parts as a reference for operations.

Reference

ITIL

Abbreviation for "Information Technology Infrastructure Library."

Reference
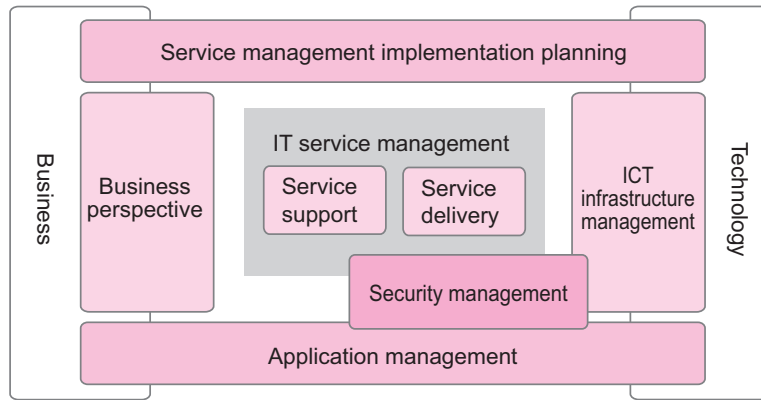
OGC

Abbreviation for "Office of Government Commerce."

Reference

De facto standard

A "de facto standard" is an industry standard that is established not through formal approval, but through widely-accepted use within the industry.

(1)ITIL system diagram

The ITIL framework can be expressed with the following diagram.

(2)ITIL framework

ITIL is summarized in the following seven books.

Service support	Guidelines for daily operations and support. Explains the method how to provide support to users so that they can appropriately use IT services.
Service delivery	Guidelines for formulating a medium- to long-term plan and making improvements to it. Explains the method how to appropriately provide IT services, touching on things like investment effects and availability.
Service management implementation planning	Explains the method how to formulate a plan for implementing IT service management.
Business perspective	Explains the best practices for service support and service delivery, focusing on the business perspective.
Application management	Explains the life cycle and investment effect of software.
ICT infrastructure management	Explains the best practices for infrastructure management.
Security management	Explains how to ensure the security and confidentiality of data.

"Service support" and **"service delivery**,**"** which are components of **"IT service management**,**"** form the core of ITIL.

These two items can be broken down into the processes listed below.

Service support

- ・Incident management
- ・Problem management
- ・Configuration management
- ・Change management
- ・Release management
- ・Service desk

Service delivery

- ・Service level management
- ・IT service financial management
- ・Capacity management
- ・IT service continuity management
- ・Availability management

6-1-2 Service support

"**Service support**" is a set of processes for supporting service operations and is one part of the ITIL framework. It consists of five processes and a service desk. IT services are managed in an integrated fashion by executing these processes.

The processes of service support are summarized below.

(1)Incident management (fault management)

"**Incident management**" minimizes the length of service interruptions and the external impact when incidents occur in IT services, and takes steps to restore normal service as quickly as possible and resolve the incident. An incident that is resolved before it becomes serious is known as a "**close call**," and management is exercised in such a way as to utilize these lessons as well.

(2)Problem management

"**Problem management**" treats the causes of incidents as "**problems**" and looks for the root cause. Measures to resolve the problems are reviewed and carried over into change management.

(3)Configuration management

"**Configuration management**" involves managing assets that comprise IT services such as hardware and software, and keeping them in top shape in order to provide better IT services.

(4)Change management

"**Change management**" involves reviewing the solutions produced by problem management and changes to configuration made necessary by life cycles, and performing an evaluation to determine whether to proceed to release management.

(5)Release management

"**Release management**" implements the changes decided upon in the process of change management.

(6)Service desk

The "**service desk**" is the point of contact where user inquiries are handled. Other names for it include "**help desk**", "**call center**", and "**user support**."
In general, the service desk accepts inquiries on how to use products and services and how to fix problems and deals with repair requests and complaints. Inquiries may be accepted in the form of phone calls, e-mails, faxes, etc., but if multiple points of contact are set up depending on the contents of the inquiry, it can become difficult to determine the appropriate point of contact, which results in wasted time. It is then necessary to implement measures such as consolidating the points of contact.
If the inquiries received are registered in a database, they can be published as a FAQ on a website or analyzed and used to improve products and services.

6-1-3   Service delivery

"Service delivery" is a set of processes for implementing long-term plans for and improvements to IT services, and is one part of the ITIL framework. It consists of five processes, and by executing them, stable IT services can be provided.

The processes of service delivery are summarized below.

(1)Service level management

"Service level management" is the process of maintaining and making improvements to the service level based on the agreement between the IT service provider and user.

The **"service level agreement (SLA)"** and **"service level management (SLM)"** are executed and managed in order to ensure quality and provide stable IT services.

●Service level agreement (SLA)

A **"service level agreement"** is a **"quality assurance agreement"** formed between the IT service provider and user with respect to the management of operations, and it defines the quality and scope of the IT services. The agreement includes the scope of the system services, pricing, support hours, target recovery time for system failures, etc.

This form of contract was originally popularized by telecommunications carriers to guarantee the quality of communications in network services. Standards are set for things like minimum data transfer speeds and maximum downtimes, and rules for penalties and compensation are stipulated for instances where the standards are not met. These agreements are currently utilized in a wide range of IT services.

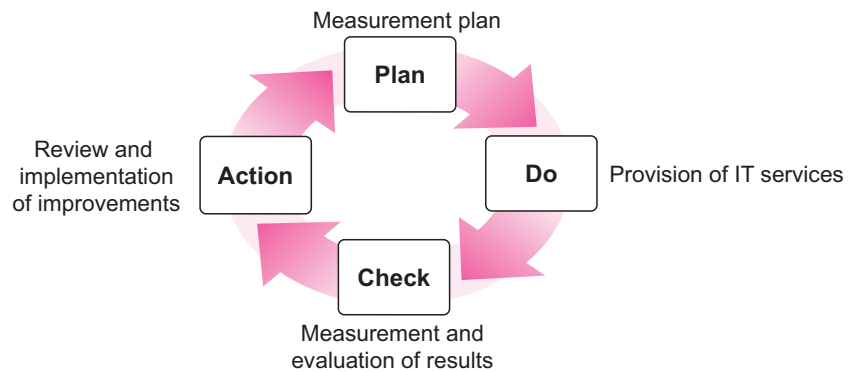Reference

SLA
Abbreviation for "Service Level Agreement."

●SLM (Service Level Management)

"SLM (Service Level Management)" is a method of management that works to maintain and improve the service level by measuring whether the agreed service level is being met.

The PDCA cycle for service level management is as follows.

(2)IT service financial management

"IT service financial management" is the process of managing the costs necessary to provide IT services. For IT services, the costs vary depending on the scope and level of service, making it necessary to clarify the required services and control the financial situation in a comprehensive manner.

(3)Capacity management

"Capacity management" is the process of ensuring services that meet the necessary performance requirements can be developed while taking the budget and cost effectiveness into account.

(4)IT service continuity management

"IT service continuity management" is a process designed to prevent IT services from being interrupted even in the event of an earthquake, fire, or other disaster, and to minimize the damage or impact if there is such an interruption. Restoring the IT services within the timeframe agreed upon with the customer is also important for ensuring the continuity of IT services.

(5)Availability management

"Availability management" is the process of managing the quality of IT services. For example, it involves ensuring operations run 24 hours a day, 7 days a week so that the user can receive service at any time, and working to prevent the system from going down.

6-1-4 Facility management

"Facility management" is maintaining the company's computers, network, equipment, facilities, etc., and keeping them in top condition.

It originally referred to management techniques for managing and operating a company's real estate, buildings, and other facilities. When applied to information systems, the purpose is to maintain the system environment according to the facility management policy, and keep the systems in optimal condition.

❶ System environment development

Information systems are supported by various system environments. When it comes to facility management for information systems, it is important to enact measures for natural disasters such as earthquakes and floods, and accidents such as fires. Checks need to be carried out regularly on windows, air conditioning, etc. to ensure that nothing impedes equipment operations such as noise, water leaks or electrical leaks, and measures should be taken as necessary.

For example, the following points need to be considered in order to protect devices and equipment used in the information system from power outages or surges caused by lightning and disasters such as earthquakes.

> •**Install an uninterruptible power supply as a measure against power outages and surges.**
> •**Use OA taps that come with surge protection.**
> •**Install information equipment in places with firm foundations and minimal vibration to prevent it from tipping over or falling off the shelf in the event of an earthquake. Also consider vibration-free floors to absorb and mitigate tremors from earthquakes.**

●Uninterruptible power supply

An **"uninterruptible power supply**,**"** also referred to as a **"UPS**,**"** is a backup power supply to prevent interruptions in the supply of power in the event of a power outage or surge. In the event of a power outage, power is supplied via a battery, but generally a UPS can only supply power continuously for about 10 to 15 minutes. For that reason, it is important to quickly save data that is being worked on and shut the system down.

●Surge protection

A **"surge"** is a sudden burst of voltage. When lightning strikes nearby, a powerful current resulting from the high voltage (thousands to tens of thousands of amperes) sometimes runs through power lines and phone lines, which can break computers. Damage from surges can be prevented by using OA taps with **"surge protection**.**"**

6-2 System audit

6-2-1 System audit

System audits are crucial as companies engage in developmental operations.

❶ System audit

A **"system audit"** is a comprehensive verification and evaluation of the system by an independent third-party **"system auditor."** After the audit is performed, the system auditor provides suggestions and advice to the concerned parties.

(1)Purpose of system audits

The purpose of system audits is to determine whether or not an information system is contributing to management efforts based on a wide-perspective investigation of the system.

The following are general items to consider.

> •Whether there are safeguards in place to ensure the reliability of the information system with respect to failure
> •Whether there are safeguards in place to ensure the safety of the information system with respect to disasters and unauthorized access
> •Whether the information system is efficiently contributing to the company's management policy and strategy

(2)Processes in system audits

The processes in system audits are as follows.

```
┌─ Planning ──────────────────────────┐
│   ┌──────────────────────────────┐  │
│   │   Formulation of audit plan  │  │
│   └──────────────────────────────┘  │
└──────────────────│──────────────────┘
                   ▼
┌─ Implementation ────────────────────┐
│   ┌──────────────────────────────┐  │
│   │      Preliminary audit       │  │
│   └──────────────────────────────┘  │
│                 │                    │
│                 ▼                    │
│   ┌──────────────────────────────┐  │
│   │          Main audit          │  │
│   └──────────────────────────────┘  │
└──────────────────│──────────────────┘
                   ▼
     ┌──────────────────────────────┐
     │ Preparation of system audit  │
     │           report             │
     └──────────────────────────────┘
                   │
                   ▼
┌─ Reporting ─────────────────────────┐
│   ┌──────────────────────────────┐  │
│   │   Opinion exchange meeting   │  │
│   └──────────────────────────────┘  │
│                 │                    │
│                 ▼                    │
│   ┌──────────────────────────────┐  │
│   │     Audit report meeting     │  │
│   └──────────────────────────────┘  │
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                   ▼
     ┌──────────────────────────────┐
     │          Follow-up           │
     └──────────────────────────────┘
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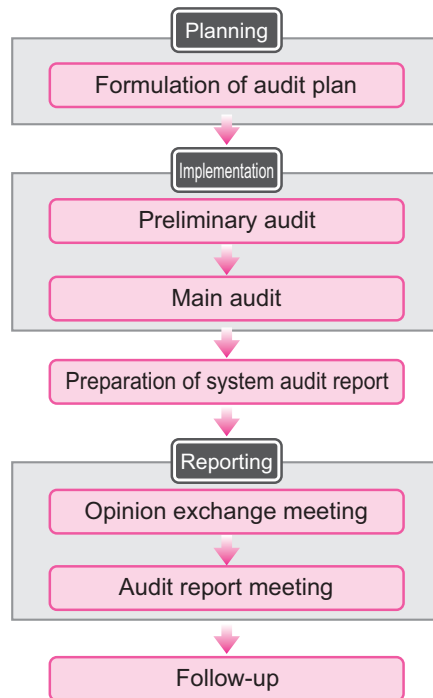
●Formulation of system audit plan

Research the company's business conditions and policies, problems with the information system, etc., and identify the purpose of the audit as well as the department and information system to be audited.

In this step, the **"documented audit plans"** are prepared. These include the **"documented medium- and long-term plan"**, which covers a period of several years, the **"documented basic plan"**, which covers the fiscal year, and the **"individual documented plans"**, which cover individual audit items.

●Preliminary audit

The **"preliminary audit"** is carried out before the main audit in order to get a general grasp of the system. It involves meeting with the manager of the department to be audited and checking documents. It makes it possible to divide audit items into those that require a detailed investigation during the main audit and those that do not, and modify the individual documented plans that were prepared earlier.

●Main audit

In the **"main audit**,**"** a detailed audit, analysis, and review are carried out according to the items and procedures laid out in the system audit plan.

The audit techniques generally include interviews, on-site inspections, document and record checks, and questionnaire surveys. The information obtained is kept as **"audit evidence**.**"**

●Preparation of system audit report

Once the system audits are complete, a **"system audit report"** is prepared to accurately inform management, the audited department, and the related departments of the results.

The audit report includes the **"audit results"**, a **"general overview"**, the **"strong points"**, **"suggestions"**, and **"things that need to be improved."**

●Opinion exchange meeting

At the **"opinion exchange meeting,"** opinions are exchanged with the representative of the audited department to make sure there are no factual errors in the audit report. Opinion exchange is a characteristic process of system audits.

The opinion of the audited department as shared at the opinion exchange meeting is reflected in the system audit report, and additions or changes are made as necessary to put the finishing touches on it.

●Audit report meeting

An **"audit report meeting"** is held to provide an explanation of the audit results to management based on the final audit report.

●Follow-up

The effectiveness of system audits hinges on the provision of suggestions for improvement. For that reason, the system auditor checks on the status of improvements and supports the implementation thereof. This is called **"follow-up."** Regular audits are carried out to check on the status of improvements, and follow-up audits are performed as necessary.

❷ Other Audit Work

Other typical audit work is as follows.

Accounting audit	Accounting and financial statements are audited and approved by a third party. These audits are performed by a certified public accountant or an auditing firm.
Operations audit	The results of a company's business and management activities, the management methods used, etc. are verified and evaluated by a third party. These audits are performed by internal auditors or the company's auditor.
Information security audit	The criteria, methods, etc. of information security measures are audited, corrected, verified, and evaluated by a third party. These audits are performed by internal auditors or the company's auditor.

6-2-2 Internal control

"Internal control" and **"IT governance"** are means of ensuring sound management.

❶ Internal control

"Internal control" involves constructing a system for the company to engage in business activities in an appropriate manner.

(1)Purposes of internal control

Internal control serves four purposes in the support of business activities. The purposes of internal control are summarized below.

●**Efficiency and effectiveness**

"Effectiveness of operations" refers to the degree to which business objectives are being achieved. **"Efficiency of operations"** refers to the rational use of time, human resources, costs, etc. to achieve the objectives. The achievement of business objectives is supported by putting together a system by which to measure and evaluate the degree of achievement and rationality.

●**Reliability of financial reporting**

A system is put together to prevent false information from finding its way into financial reports and thereby support the reliability of financial reporting.

●**Compliance with laws and regulations**

A system is put together to ensure compliance with laws, standards, regulations, etc. related to the business activities in order to support legal compliance.

●**Protection of assets**

A system is put together to ensure that acquisition, use and disposal of assets is carried out in accordance with appropriate procedures and thereby support the protection of the company's assets.

(2)Basic elements of internal control

Internal control is comprised of six basic elements that are required in order to fulfill each of the above purposes. These elements are taken from the **"COSO Framework,"** which is the global standard for internal control. The basic elements of internal control are summarized below.

●**Control environment**

A proper environment (climate) must be set up within the organization. Putting together a better environment affects the awareness of everyone within the organization and provides the foundation for the basic elements.

Reference

COSO

"COSO" is an organization established by organizations such as the American Institute of Certified Public Accountants in response to the numerous incidents of accounting fraud and management failures in the 1970s and 80s.
The "COSO Framework" was announced in 1992. The "COSO Cube" is a graphical representation of the COSO Framework.
Abbreviation for "Committee of Sponsoring Organizations of the Treadway Commission."

●Risk evaluation and response

Measures against risk are reviewed after identifying, analyzing and evaluating risks that pose a threat to the achievement of organizational objectives.

●Control activities

"Control activities" are policies and procedures for incorporating internal control into business activities.

In order to implement them, a company must consider the following points.

> •**Identify the risks that are produced by business processes, illegal acts, fraudulent acts, etc.**
> •**Identify the authority and responsibilities of the persons in charge and work on the segregation of duties.**
> •**Establish rules to be followed when responding to risks along with a system for checking whether they are properly implemented.**

●Information and communications

An environment is established in which everyone within the environment can properly acquire, communicate, and share the necessary information.

●Monitoring

Evaluations are carried out to make sure internal controls are functioning properly.

This includes **"daily monitoring**,**"** which is carried out on an ongoing basis, regular **"independent evaluations"** and a **"whistle-blowing system"** for people to report illegal and fraudulent acts. These monitoring activities are utilized to monitor, evaluate, and correct the internal control situation.

●Response to IT

"Response to IT" is the act of appropriately incorporating the necessary information systems within operations after establishing policies and procedures to achieve the organizational objectives. A better system of internal control is constructed by introducing information systems and improving the efficiency and effectiveness of operations.

❷ IT Governance

"IT governance" is a framework for establishing an IT strategy to utilize information systems and governing its implementation.

A company's relative merits and competitiveness depend on how well it utilizes information systems. For example, even if a large investment is made to introduce information systems, there will not have a significant investment effect if they do not conform to the management policy or meet the users' needs.

The purpose of IT governance, therefore, is to ensure the achievement of the goals of the business strategy through the utilization of information systems, and to improve competitiveness.

6-3 Chapter quiz

*See page 10 in the "Answers and Explanations" booklet for the correct answers.

6-1 Which of the following is appropriate as an item for evaluating the service level to the user of a system?

a) The cost concerning the system development
b) The recovery time from system failure
c) The number of programs that make up the system
d) The number of disk input/output

6-2 Which of the following is responsible for receiving various inquiries, such as operations of the product, solutions at the time of troubles, and complaints from the users of the system?

a) Access counter
b) Webmaster
c) Data center
d) Help desk

6-3 Which of the following is a characteristic of a service desk in operations management of information systems?

a) Inquiries are about temporary issues, so records are not necessary.
b) Service desks passively await user inquiries; they do not initiate communication.
c) Service desks should be consolidated into a single window for inquiries.
d) The scope of inquiries is limited to the method of operations.

6-4 Which of the following is the appropriate description concerning the introduction of an uninterruptible power supply (UPS)?

a) The highest priority device that should be connected to the UPS is a network printer shared by each PC.
b) There is a limit in the capacity of the UPS, so the measure to shut down within several minutes after detecting a power failure is required.
c) The UPS has a power generation function, so it is effective if it connects the computers, lighting, television sets, and other appliances.
d) The UPS uses a special battery that can be used semi-permanently, so the maintenance cost after introduction is unnecessary.

6-5 Which of the following shows the steps of system audit in the order of implementation?

a) Planning, investigation, report
b) Cause investigation, correction, test
c) Design, programming, test
d) Requirements definition, proposal request, proposal evaluation

6-6 Which of the following is the role of system auditors?

a) Advising audited departments about recommendations and measures for improvements
b) Appointing auditors
c) Determining security policies
d) Requesting audited departments to make improvements

6-7 Which of the following is included in the internal control for inhibiting an employee's dishonesty?

a) Publishing the information security plan of a company on the Internet
b) Assigning separately the operator and approver of a business task
c) Supporting events as corporate sponsors which are held by cities, towns, and villages for contribution to regional vitalization
d) Taking the measures against mass media to avoid the deterioration of corporate image by the revealed scandal