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Business Field

06 Project Management and
Technical Communication

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I. Business Communication Overview

►►► Recent Trends and Major Issues

In business, communication with the other party is the most important part of business activities. Business communication is one of the important elements of business activities because effective and efficient communication can reduce business costs and bring good results.

►►► Learning Objectives

1. To be able to explain the concept and main elements and types of business communication.
2. To be able to explain how to communicate effectively with stakeholders.

+ Preview for practical business

K System decided to enter the online bank business centering on payment and settlement services of the FinTech industry.

However, in order to start the online bank business, you must submit a business plan to the Financial Services Commission and obtain approval after being reviewed through presentation.

CEO Lee of K System decided to promote the project by appointing Kim as the director of the project progress.

In order to proceed with the new online bank business, Director Kim formed a task force with Deputy General Manager Choi, Manager Park, and Deputy Manager Oh, and Mr. Yoo, a new employee, as members of the online bank business team., starting communication with each stakeholder.

Director Kim decided to conduct an analysis of the current situation of K System and the external environment of the online bank business, and to prepare a business plan including strategies to build an online bank. He also appointed Deputy Manager Oh to be in charge of the presentation to the Financial Services Commission to conduct intensive training and practice.

Director Kim is striving to promote a successful online banking business through active communication with team members with strong personalities.

In IT business practice, communication means the beginning and the end. Learn how to define business communication, techniques do address business issues, and write documents necessary for business communication.

01 Concept and Elements of Business Communication

In order to examine what business communication is, we will first look at business and communication, respectively, and then make a final definition of business communication. Finally, we seek to understand the general overview of business communication by looking at the key elements that make up business communication.

A) Definition of business communication

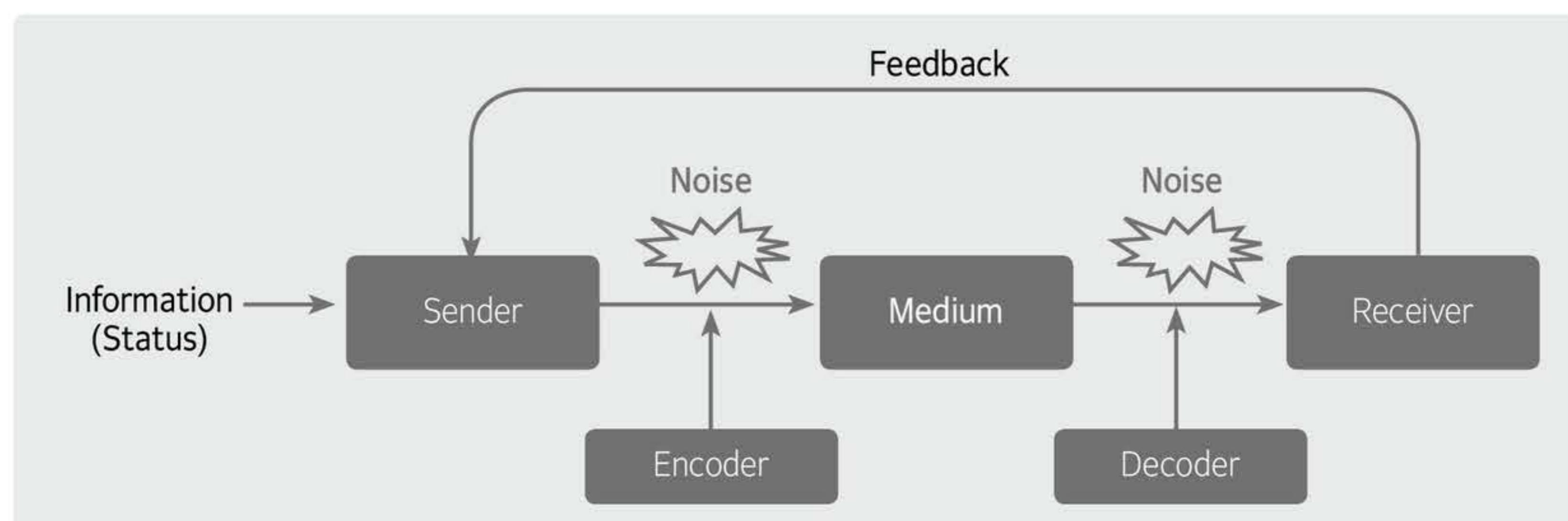
Business, by definition, means continually managing something in a structured manner with a certain purpose and plan¹. In general, the term business refers to all the activities performed by a general company, but in some cases, it refers to a business item or a business area. In business administration, business is a series of activities that provide products and services to customers and obtain profits in return.

Communication in English comes from the Latin word *communicare*, meaning “to share”. Communication refers to a system or process that shares information or meaning through mutually understood means between two different people or groups.²

Business communication refers to a system and process in which a company shares with various stakeholders information and meanings arising in the process of performing a series of business to provide products or services to customers in return for profits. The goal is to achieve business goals through this.

In order to share information in the process of achieving business goals, meeting or making calls, exchanging e-mails, making presentation materials, etc. are conducted based on transference and understanding, among various stakeholders regardless of individuals or groups.

B) Elements of business communication



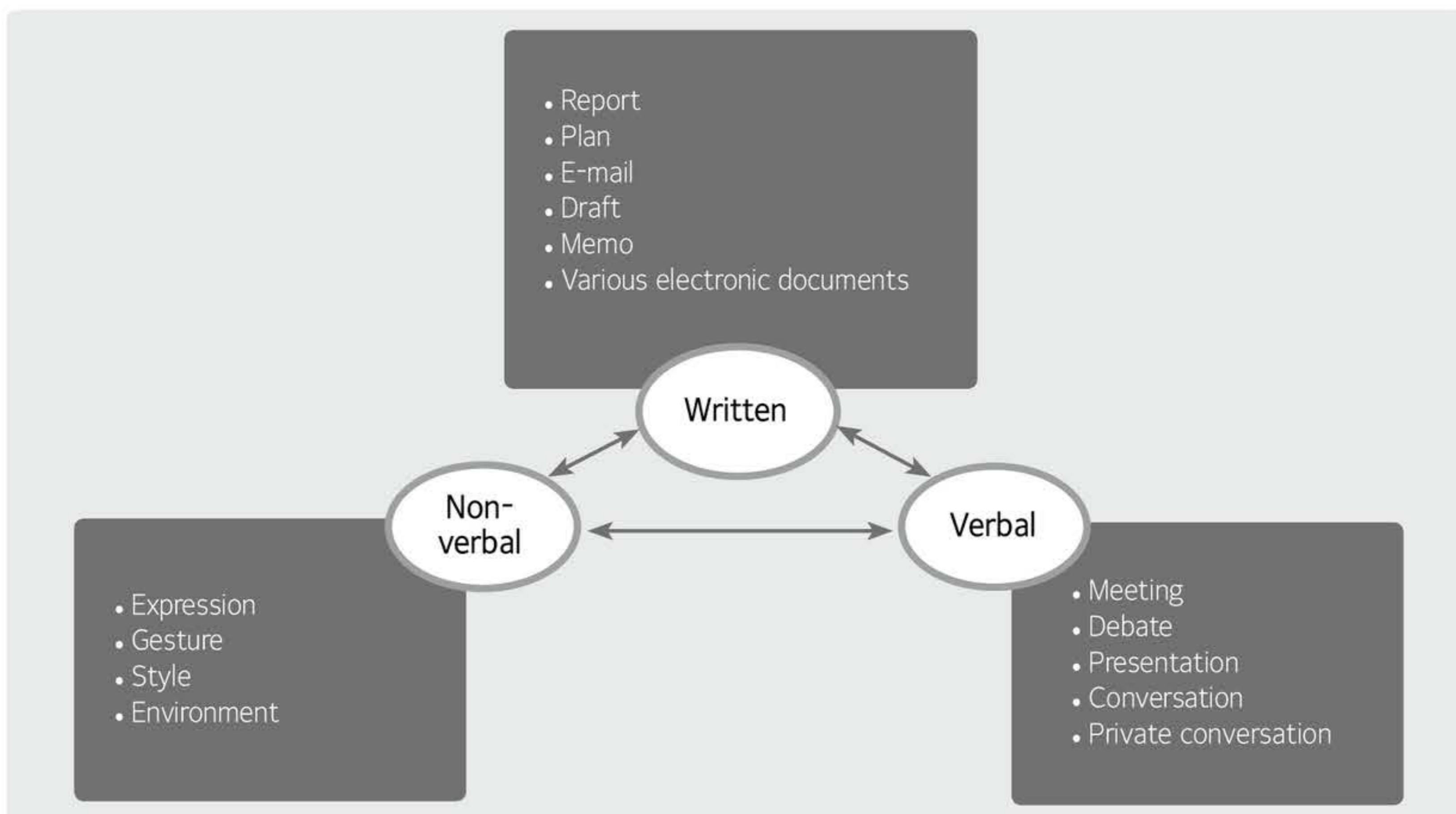
[Figure 1] Business communication Process and Elements

1 Source: NAVER Korean Dictionary (<http://krdic.naver.com/detail.nhn?docid=18569500>)

2 Source: Wikipedia (https://en.wikipedia.org/wiki/Communication#cite_note-1)

The key elements of business communication are the information to be shared, the sender and receiver of the information, and the medium for information sharing, like for any other form of communication. In addition, in order for the sender to include information in the medium, an encoding process is required, and in order for the receiver to obtain information from the medium, a decoding process is required. During this process, noise may inevitably occur from all elements of the sender, encoding, medium, decoding, and receiver. Therefore, in the process of performing business communication, a feedback process is essential to minimize noise and confirm whether clear information is received.

C) Types of business communication



[Figure 2] Types of Business Communication

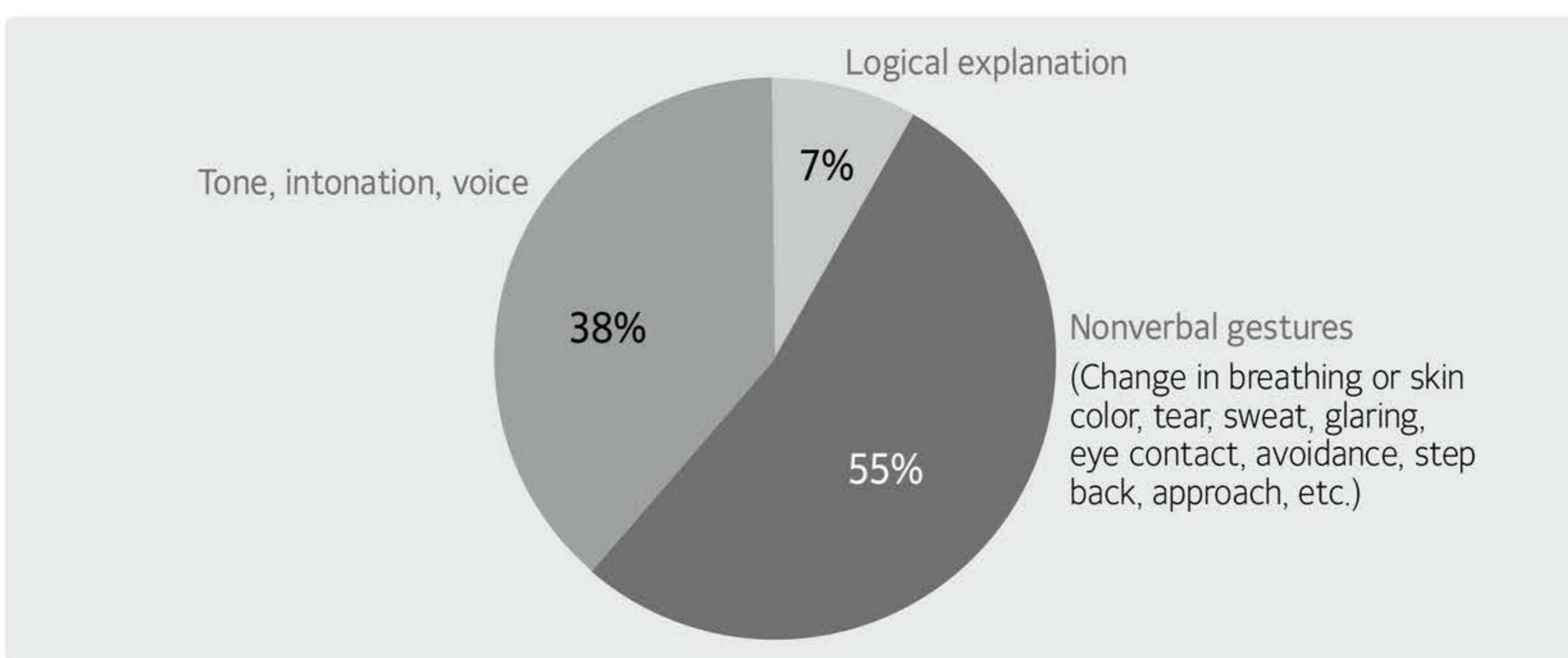
<Table 1> Features of Communication by Type

Classification	Explanation
Written	<ul style="list-style-type: none"> Conduct communication in a certain format using letters Various formats can be used depending on the purpose of communication Only one-way communication is available at a specific time point in which feedback is available with some time gap
Verbal	<ul style="list-style-type: none"> Conduct communication in a relatively flexible format using words Various formats can be used depending on the purpose of communication Communication with real-time feedback available
Non-verbal	<ul style="list-style-type: none"> Communication through facial expressions, voices, and gestures There are flexible formats available that fit the situation rather than a specially defined format Appeal to emotion rather than reason

There are various types of communication in all situations, and it can be classified into verbal (spoken), written (writing), and non-verbal (gesture). Since verbal language and gestures can naturally help grasp the situation,

it is possible to communicate relatively accurately, but in the case of writing, as it is difficult to communicate in consideration of various environments, a certain format is required. For example, when writing an email, you need a certain strategy for how to write it, such as a subject line, a summary of the important points, a full text, and an extra explanation.

The most important type of communication is gestures (non-verbal). It can be thought that gestures are less definitive than speech or voice, but not only logics but non-verbal elements significantly affect the delivery of communication.



[Figure 3] The Law of Mehrabian

For example, if your voice is more attractive than any other part of your face and body, like many successful movie stars with good voice, it is easy to focus the other person's attention on your words. Just putting on a bright smile on your face while talking to the other person will help you achieve a certain level of communication goals.

02 Methods of Business Communication

A) Bottom-up, top-down, horizontal business communication

Business communication can be largely divided into two types: horizontal communication and vertical communication. Horizontal communication means communication between colleagues, and vertical communication means communication between supervisors and subordinates. In each case, a different way of communication is required.

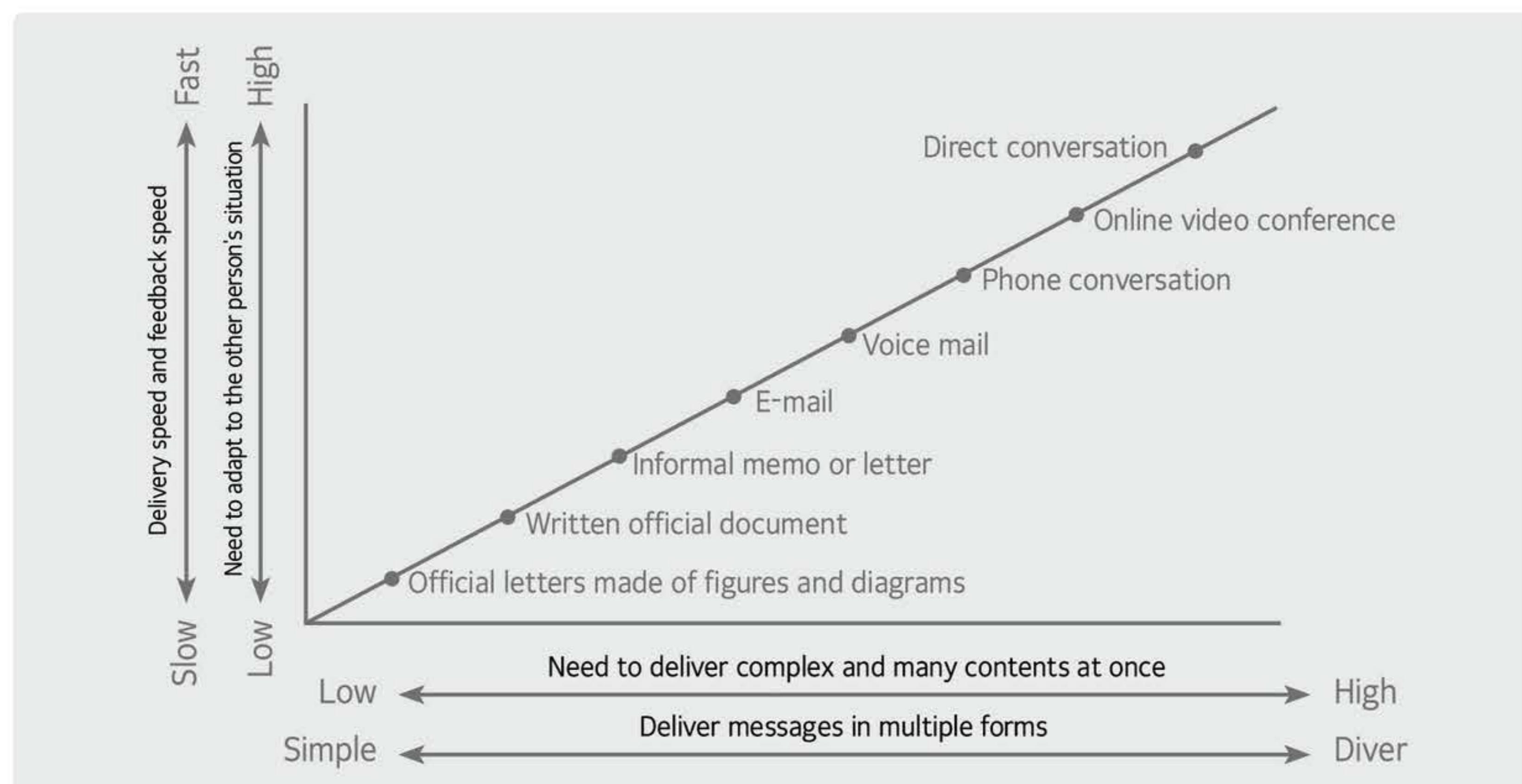
Vertical communication can be divided into top-down communication and bottom-up communication. Top-down communication includes instructions, commands, and deliveries from top to bottom of the organization,

and bottom-up communication includes reports from bottom to top of the organization. In general, formal communication with the boss requires a certain standardized document format and delivery technique.

Horizontal communication refers to communication between members or departments at a similar level within an organization. In the process of performing work, it is possible to achieve common goals through organic interactions within a functionally divided organization. In recent years, the importance of horizontal communication is increasing, as new problems or challenges of increasingly complex and converged forms are emerging. Examples include prior consultation, circulation, committees, and task forces.

B) Communication channels and information integrity

There are many channels for business communication, but usually meetings, emails, phone calls, reports, and official letters are used. The amount and diversity of information that can be delivered are different for each communication channel. The amount and degree of diversity of information that can be delivered by communication channel is called information integrity.



<Figure 4> Communication Channel Selection According to Information Integrity

In the figure below, you can see that, in the case of direct conversation, the level of information integrity is very high in that the amount of information to be transmitted is large, can be delivered in various languages, and the speed of delivery and feedback are also fast. In contrast, mediums such as official letters have very low level of information integrity. E-mail, which is frequently used for business communication in recent years, has a moderate level of information integrity. E-mail can help overcome time and space constraints of a face-to-face conversation, and deliver a message at a fast speed and attach various documents, and unlike phone calls, the content of e-mails sent and received becomes a record of your communication.

Table 2 shows the features and strengths and weaknesses of discussions, meetings, and e-mails.

<Table 2> Comparison of Discussion, Meeting, and Email

Classification	Discussion	Meeting	Email
Definition	<ul style="list-style-type: none"> A form of communication in which the proponents and opponents of the thesis present their ideas with logical grounds and make a rebuttal 	<ul style="list-style-type: none"> A meeting in which relevant people gather at a fixed time on a certain topic to discuss and draw a point of discussion 	<ul style="list-style-type: none"> A form of communication that exchanges electronic mails in the Internet environment
Purpose	<ul style="list-style-type: none"> To make good decisions and judgments through correct judgment and logical thinking on the topic 	<ul style="list-style-type: none"> Information delivery and sharing Acquisition of agreement on decisions Discussion on multiple topics Check progress against plan 	<ul style="list-style-type: none"> Information delivery and sharing Acquisition of agreement on decisions Various purposes such as business-related requests
Process	<ul style="list-style-type: none"> Presentation Confirmation question Refutation Final remarks 	<ul style="list-style-type: none"> Share related information before the meeting Establishment of a meeting plan Appoint a moderator Proper allocation of the meeting schedule Organize and share contents after the meeting 	<ul style="list-style-type: none"> Write a subject line Determine a recipient and referrer Write concisely and attach related documents
Features	<ul style="list-style-type: none"> Proponents and opponents present their arguments based on logical grounds 	<ul style="list-style-type: none"> Real-time exchange of opinions Attendance of stakeholders 	<ul style="list-style-type: none"> Internet technology utilization Free from time and space constraints
Strengths	<ul style="list-style-type: none"> Cultivate logical judgment Data collection and analysis based on valid evidence Develop the correct attitude to listen to others 	<ul style="list-style-type: none"> Ease of information sharing Real-time exchange of opinions Draw conclusions relatively fast 	<ul style="list-style-type: none"> Communication without time and space constraints Can discuss various topics Used as evidence and source materials
Weaknesses	<ul style="list-style-type: none"> Lose track of the point at issue In case of insufficient data collection in advance, it can be turned into a place of unilateral delivery of opinions. It can be reduced to a place of indiscriminate criticism or argumentation 	<ul style="list-style-type: none"> Discussion without conclusion Waste of time 	<ul style="list-style-type: none"> Real-time communication unavailable Difficulty in conveying various topics Can be exploited for security or hack attacks, or spamming
In Business Settings	<ul style="list-style-type: none"> In many areas that require decision-making, especially in R&D or engineering, debates are conducted in the process of determining solutions for specific technical issues. 	<ul style="list-style-type: none"> Often used in practice. If you clarify the topic of the meeting and focus on the discussion, you can share a lot of information in a short time. In contrast, there are many cases where too much time is wasted. 	<ul style="list-style-type: none"> Frequently used in practice. E-mail is widely used as a tool for sharing information on progress and source materials when conducting business with various stakeholders. It is important to write simple, concise email with a topic and concluding sentence.

C) Methods of logical explanation and persuasion

In order to persuade stakeholders through business communication, a logical explanation is essential. The logical explanation is to connect the objective grounds and the subjective arguments as a basis of your argument, to draw the attention of the other person. Let's look at deductive and inductive reasoning, which are representative methods of logic development.

Deductive reasoning is a method of deriving a specific fact from general premises that are already known. There is direct reasoning that derives one fact from one premise, and indirect reasoning that derives concrete facts from two or more premises (First premise, Second premise). The example below is a representative example of deductive indirect reasoning.

All men are mortal. (First premise)

Socrates is a man. (Second premise)

Therefore, Socrates is mortal. (Conclusion)³

Inductive reasoning is a method of reasoning invented by Francis Bacon in 1620. According to Bacon, it refers to a method of making guesses or hypotheses and principles from empirical facts and judging truth/falsehood with empirical facts.⁴ In other words, it is a method of deriving a general principle from several concrete facts. The example below is a representative example of inductive reasoning.

Socrates is dead. (Concrete fact)

Socrates is a man.

Therefore, a man is mortal. (General principle)

Both deductive and inductive reasoning are methods of reasoning for logical explanation, but logical explanation alone is not enough to persuade stakeholders. In order to effectively persuade stakeholders, there is more to be needed than logical explanation.

In some cases, it is necessary to explain or verify an established hypothesis using a statistical method, and the two mutually exclusive statements used in this case are the null hypothesis and the alternative hypothesis. The null hypothesis is an initial argument that is recognized based on existing knowledge, while the alternative hypothesis is a new argument that we hope to prove as a new truth through testing. For example, if there is an existing claim that “the average life expectancy of men in Korea is 70 years old”, and there is a claim that “the average life expectancy of men in Korea has recently increased to over 70 years”, we can consider the following null and alternative hypotheses.

The Null Hypothesis: The average life expectancy of men in Korea is 70 years old.

The Alternative Hypothesis: The average life expectancy of men in Korea is not 70 years old.

Based on the above two hypotheses, the hypothesis is adopted or rejected through statistical hypothesis testing. In the example above, if the null hypothesis is rejected and the alternative hypothesis is adopted, the average life expectancy is not 70 years old.

3 Source: Wikipedia (<https://ko.wikipedia.org/wiki/연역>)

4 Source: Wikipedia (<https://ko.wikipedia.org/wiki/귀납법>)



II. Business Problem Solving Techniques

▶▶▶ Learning Objectives

1. To be able to identify the definition and types of business problems.
2. To be able to describe the business problem solving process.
3. To be able to apply problem-solving techniques appropriate to your situation.

+ Preview for practical business

K System decided to enter the online bank business centering on payment and settlement services of the FinTech industry.

However, in order to start the online bank business, you must submit a business plan to the Financial Services Commission and obtain approval after being reviewed through presentation.

Director Kim in charge the business decided to conduct an analysis of the current situation of K System and the external environment of the online bank business, and to prepare a business plan including strategies to build an online bank.

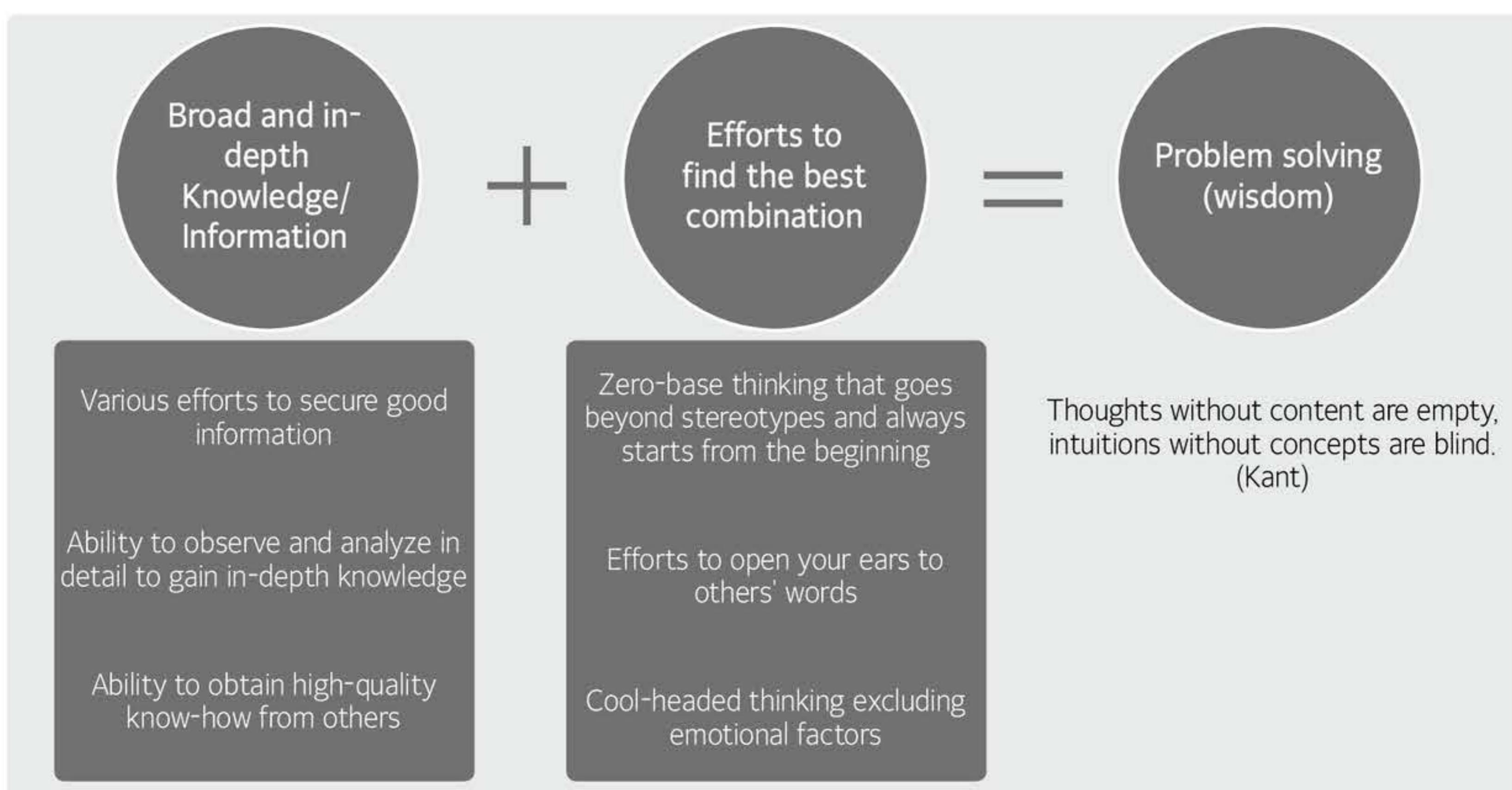
Kim is applying various business problem-solving techniques to accurately grasp the current state of K system and its competitors, in order to determine how to promote the online bank business.

For successful business execution, it is very important to analyze information about consumers, competitors, and industry trends in a timely manner, and utilize it for strategy establishment and product development through creative ideas.

01 Business Problem Solving Techniques

A) Concept of business problem solving

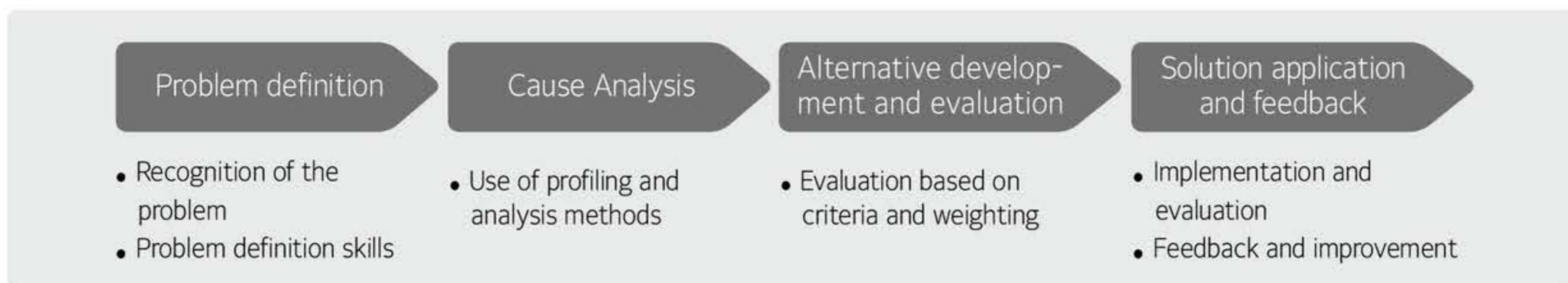
In a business environment, problems can be broadly divided into two: planning that creates new opportunities; and improvement of internal processes. Planning can be said to be the process of finding the “blue ocean”, which is a business opportunity, and it is the process of creating a new market through a solution that can address the current problems. Improving internal processes is a task to more efficiently execute a current market opportunity. When those two elements are accurately recognized, defined and resolved, it is possible to ensure stable business continuity and to create new opportunities. Therefore, it is most important to solve business problems through optimal problem-solving processes and business thinking.



[Figure 5] Problem Solving Process through Efforts of Knowledge/Information and Optimal Combination

B) Business problem solving process

The business problem solving process is to recognize various types of problems that occur in the process of performing work, understand the process from analyzing and addressing the problems, and propose new solutions by appropriately applying the existing problem solving methods based on reasonable grounds. Problem solving techniques are generally presented as follows.



[Figure 6] Detailed General Problem Solving Process

① Step 1: Problem Definition

In the problem definition stage, you decide what problem you want to solve. It is necessary to organize the problem to grasp its essence, and whether the problem can be fundamentally resolved by writing the problem description. For more accurate problem definition, it is helpful to apply the MECE framework to break the problem into subproblems, rather than defining it as a single problem.

② Step 2: Cause Analysis

In the stage of cause analysis, a defined problem is classified according to logical criteria and structured step by step. In order to analyze the cause of a structured problem in detail, an issue tree is used to dissect the largest problem into smaller components in a logical order and organize it in a tree form. From the bottom of the organized problem, profiling and various analysis methods are used to find the root cause of the problem. In addition, it is necessary to prioritize the finally identified causes of the problem, and remove the ones that are not essential for fundamental problem solving.

③ Step 3: Alternative Development and Evaluation

In the alternative development and evaluation stage, various alternatives are developed to address the cause of the problem finally derived in the cause analysis stage. Alternatives developed by establishing various hypotheses from the root cause of the problem and comparing with the facts found through profiling are evaluated through evaluation criteria and weighting for each criterion, and one or more alternatives are finally selected.

④ Step 4: Solution Application and Feedback

In the solution application and feedback stage, the final selected alternative is verified. It is important to find a test bed to verify the established alternative the most efficiently, and prepare for its execution. The alternative is executed based on a detailed workplan and quantitative feedback on its effectiveness is provided, to verify the validity of the alternative and provide feedback.

C) Creative thinking techniques

It is important to clearly define everyday problems found in the course of job performance and to derive solutions or processes to address them through various ideas. To this end, it is necessary to consciously guide the flow of thinking through appropriate techniques. There are the following ways of thinking techniques that creatively solve problems through this horizontal process.

① Brainstorming

In the 1940s, American advertiser Alex Osborn invented brainstorming as a kind of meeting method to come up with ideas. The original meaning of the term brainstorming refers to the mental derangement of a mentally ill patient. In other words, abnormal phenomena, like a storm in the brain, are used as a way of thinking of ideas at meetings. It can be used in the entire process of problem solving, such as analyzing the cause of the problem, deriving a solution, developing evaluation criteria and establishing an action plan.



[Figure 7] Flow of Brainstorming

② Six Thinking Hats

The Six Thinking Hats is a simple yet effective way to think, developed by Edward de Bono. In other words, it is a method of a group of six people taking different roles and present ideas that fit their roles, to approach an issue from various perspectives and derive the optimal decision-making.

<Table 3> Composition of Six Thinking Hats

Type of Hat	Role
White	The role of Explain objective facts or data in a neutral manner
Red	Emotional thinking
Black	Negative or critical thinking
Yellow	Positive and optimistic thinking
Green	Be creative and generate new ideas
Blue	Organize results in a cool-headed and objective manner

③ Random Word

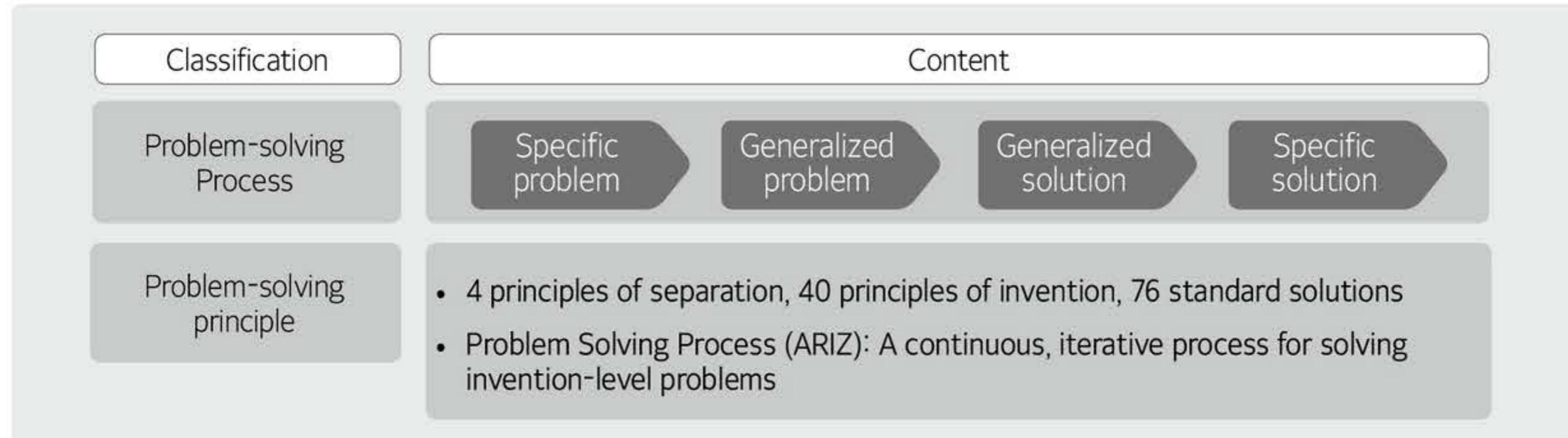
Random Word is a thinking technique devised by Professor Edward de Bono. Various words are presented until a unique idea comes out, and words are selected and combined at random to create new connections.

④ SCAMPER

SCAMPER is an analysis method derived from the checklist of Osborn, the originator of ideation method brainstorming, and revised by Bob Eberle. The term SCAMPER is an acronym formed from the abbreviation of: "Substitute", "Combine", "Adapt", "Modify" or "Magnify", "Put To Other Uses", "Eliminate", "Rearrange" or "Reverse". It is an ideation method similar to brainstorming that draws out ideas at random, but it differs in that ideas are generated from a list prepared in advance.

⑤ TRIZ(Theory Of Inventive Problem Solving)

It is a problem-solving and ideation technique created by Russian inventor Dr. Altshuller through analysis of tens of thousands of existing inventions. TRIZ models a specific problem into a generalized issue through abstraction, then finds a general solution model and derives a solution. Rapid and accurate decision-making is the most important for corporate survival amidst the rapid changing business environment. TRIZ objectifies various problems and contradictions arising in the business process, and presents innovative solutions by applying proven principles and solutions.



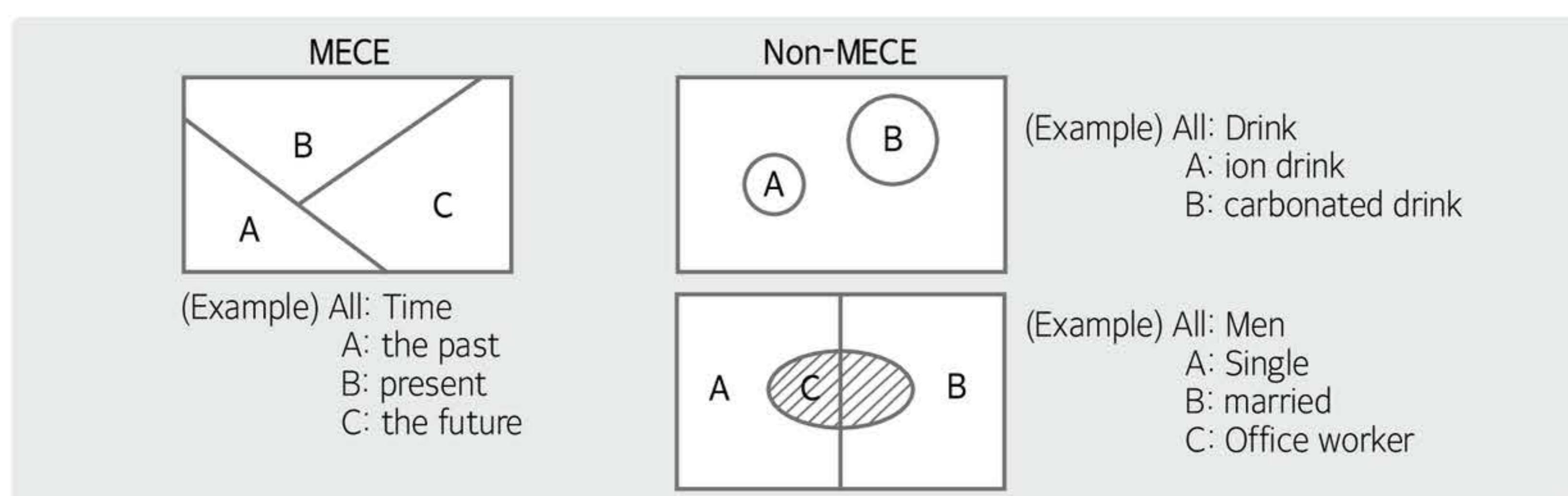
[Figure 8] Problem Solving through the TRIZ theory

D) Logical thinking technique

Unlike creative problem solving, it is often necessary to classify problems according to their root cause and solve problems based on facts. In other words, a logical thinking technique is needed to predict the future through the facts discovered up to now and data based on objective indicators. Techniques for clearly defining everyday problems found in job performance and deriving solutions to address them through a vertical process are as follows.

① MECE(Mutually Exclusive and Collectively Exhaustive)

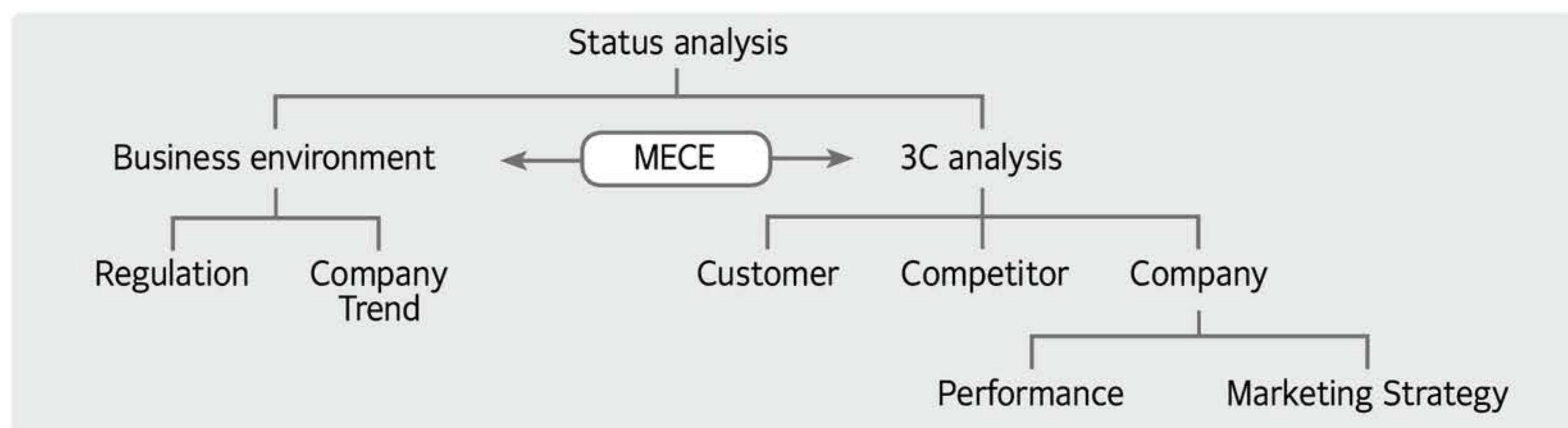
As implied from its term, MECE is to compose any information or message in a state of “without duplication and no omission as a whole.” That is, in order to analyze the problem, each item is divided so that there are no omissions or duplicates, and the total sum is processed to include the number of all cases. For example, if you group the whole of “time” into the past, present, and future, it can be said that the principle of Mutually (mutually) / Exclusive (without redundancy), Collectively (as a whole) / Exhaustive (without omission) is met. However, if the whole beverage is divided into ionized beverages and carbonated beverages, it satisfies the elements of Mutually (mutually) / Exclusive (without duplication), but because other components that can be called beverages such as mineral water are omitted, the elements of Collectively (as a whole) / Exhaustive cannot be said to be fulfilled.



[Figure 9] Example of the MECE principle

② The Logic Tree

The Logic Tree is a breakdown of key items in a tree form according to the MECE principle, and it can promote logical thinking, create a wide range of ideas, and ensure that there is no omission, thereby serving as a checklist for strategy establishment and problem-solving.



[Figure 10] Example of structuring through the logic tree

For example, “Status Analysis” can be decomposed into business environment and the 3C analysis according to the MECE principle and if each component of the next step is decomposed into a tree form according to the MECE principle, the given key content can be checked.

③ The 80-20 rule

The 80-20 rule was discovered by an Italian economist named Pareto who found out that the top 20% of people have 80% of their total wealth, while analyzing the distribution of income in Europe. The 80-20 rule is found in many cases, meaning that the top 20% of customers generate 80% of sales, and solving the core 20% of problems tend to solve 80% of all problems.

Strategies and Pareto's rule are very well matched. As shown in the figure below, it can be understood that if resources are concentrated on solving the causal variable that is the essence of the problem, more than 80% of the problem can be solved as a result.

E) Rational decision-making techniques

Rational thinking is a technique for making the most efficient and effective decisions, although it cannot accurately verify truth/falsehood. In other words, it can be said that it is a thinking technique for decision-making that best suits the purpose among many alternatives. There are the following techniques for making this rational decision.

① Multi-Criteria Decision Making(MADM)

The Multi-Criteria Decision Making is a technique that considers the criteria of various factors rather than one criterion in the process of selecting the best alternative. The factors to be considered refer to the attributes that are characteristic of the object, and the degree to which each factor meets the purpose is evaluated and reflected in the final decision-making.

② Analytic Hierarchy Process (AHP)

The AHP technique is a technique that leads to the final decision by arranging the information of the situation in hierarchical tree for decision-making and analyzing it in stages. This technique proceeds by segmenting complex and non-quantifiable problems for easier analysis and evaluating the segmented problems through pairwise comparisons. Through segmentation, the problem is divided into a more understandable form, and decision makers can easily compare and judge the elements of each class.

F) Problem-solving skills

Recently, companies are emphasizing problem-solving skills as a common competency. Problem awareness is necessary to solve real problems. In simple terms, problem-solving can be described as “an activity that recognizes the gap between the desired level and the current level and improves it”. In other words, since it is difficult to solve practical problems if you are complacent with the current level or simply follow the existing method, efforts to continuously raise the desired level (quality threshold) through various information collection and experiences are required. There are three main factors that increase the level of problem solving.

① Always ask “why”

Above all, trying to recognize the problem by questing “why” is the essence of problem- solving. Of course, if you do not recognize the problem itself, you cannot solve the problem, so you must always have a sense of

problem awareness of asking “why” to enhance problem-solving skills.

② Develop an active attitude to solve problems.

Since there are many variables in every problem, a solution may not come out from a momentary thought. Therefore, positive thinking about problem-solving and the ability to transform ideas are important. This is because there are many cases where things that are completely irrelevant are linked together and new alternatives are proposed.

③ Take ownership of your problems.

Ownership that sees a problem as yours and accountability that strives to resolve it are the most important. When problem-solving is difficult, we often pass the buck, saying “because of what” or “because of whom”, etc. But in this way, you cannot solve problems or become a professional employee.



III. Business Document Writing Technique

►►► Recent Trends and Major Issues

Most of the business activities are done through documentation. A variety of business and development activities can be successful only when oral communication skills are supported by document writing skills. In particular, as the business environment is becoming more complex in recent years, the ability to write business documents concisely and clearly is very important.

►►► Learning Objectives

1. To be able to understand and explain the core principles and methods of writing business documents.
2. To be able to understand and explain how to write business documents such as e-mails, meeting minutes, one-page report, and official letters for various business situations.

+ Preview for practical business

Employee P met a very tough manager on his first project. The manager rarely approved a report from not just Employee P, but anyone else. The manager would quibble about "Why is this like this?", "What evidence is this supported by?" Or yell "Why is it so complicated?", "What on earth are you doing?"

Of course, reports written by Employee P would always be marked with the color red meaning errors. Employee P, who was wondering "Do I lack skills?" or "What is the problem?" got to realize, "Oh, I didn't think that the ultimate recipient of my report was the CEO, not my manager!" In other words, he realized that the final reporter of the report made by Mr. P was not himself, but his manager.

From then on, Employee P set the standards for making reports like this. He first thought, "How much does the CEO know?" and "Will the manager be able to understand this document easily?", and he started creating the document, imagining the manager reporting to the CEO. In particular, when reporting to the manager, he prepared the grounds or materials for the questions the CEO would be curious about. In other words, keeping in mind thought that the CEO is not an expert in the field, he picked out the questions that those with general knowledge might ask and the corresponding answers, and submitted them with the report to the manager. Since then, Employee P received compliment and better evaluation on his work.

In IT business practice, communication means the beginning and end. Define business communication, find out techniques to solve business problems, and how to write documents necessary for business communication.

01 Concept and Types of Business Documents

A) Concept of business documents

Business documents refer to all types of documents necessary for business activities such as process planning documents, business reports, meeting minutes, results and status reports. Unlike general documents, these business documents must be accurately described in a standardized form so that they are not misleading. In addition, it should be written with concise phrases and objective expressions, excluding lengthy phrases and emotional expressions, so that the person who receives the report can understand it intuitively.

B) Types of business documents

① Types of Business Documents

The types of business documents vary according to the content of work as follows, and reports, proposals, and business plans are used the most.

- Report: A document to be prepared for reporting on the business feasibility of a product or idea or business environment related to it.
- Letter: A document used to evaluate the value of a product or idea
- Proposal: A document to obtain approval for business promotion of a product or idea
- Plan: A document to prepare a commercialization plan after approval of a product or idea
- Manual: A document explaining the details of the plan/product

② Types of Report

A report refers to a document to logically explain or persuade a business plan and progress. Depending on the nature of the report, the report can be divided into a report that describes the situation and a report that seeks judgment. The former develops an idea based on the 5W1H principle from an objective standpoint, and prioritizes speed and accuracy (e.g., status report, situation report, etc.) In the latter case, it is important to develop an idea according to a logical table of contents from the perspective of the person being reported to, and to clearly present the logic and reason (e.g., plan report, countermeasure report, etc.).

In addition, it can be classified according to the purpose. Reports made during the planning process, such as planning reports, are called information reports, and reports made during the control process, such as inspection results reports, are called management reports.

02 Principles of Writing Business Documents

① Easy to understand from the perspective of the end consumer

When creating a business document, make it understandable and relatable, not from your own standpoint, but from the standpoint of the reader or final decision maker. Documents should be prepared in a way that the end-user can understand and relate to it by comprehensively considering the knowledge level, experience, and needs of the end-user. The end consumer may be the management or the ordinary member of an organization.

It should be written differently for each target. In other words, you have to write the document while imagining how the viewer might feel.

② Write concisely and clearly

People reading documents in a business environment don't have much time. Therefore, documents should be written concisely and clearly so that anyone can identify key points. A business document is different from an academic or general document in that it is necessary to write the conclusion first to grasp the rest of the content quickly.

③ Reflect clear evidence

It should be prepared based on accurate information and facts, and vague guesses should be avoided. Regulations, policies, and sources of information or data must be clearly stated.

④ Logical writing

The purpose, background, current situation, cause, alternative, etc. should be logically structured in terms of why this document is needed, what is the cause, and how to do it.

03 Methods of Writing Business Documents

A) Methods of writing business documents

The most used document in a business environment is a one-page report. If you can write a one-page report well, you will be able to apply it to various documents such as plans, business plans, and proposals. The principle of writing is the same. Focusing on how to write a one-page report, the method of writing a specific business document is as follows.

① Deliver the key message on the first page, and attach materials for additional explanation

Key opinions are described on the first page of the report, and other supplementary explanations or supporting data are made as attached documents. Of course, the more data there are to support the report, the better, but those who receive the report or hold a meeting do not have time to review the 20-30 pages of a lengthy report. There is also an advantage in that the time required to complete all 20-30 pages is drastically reduced by summarizing the core content on one page.

② Write according to the table of contents, and itemize sentences focused on keywords

First, create a table of contents and then describe the details. It might be too much to compress all messages into one page from the start. First, for the content you want to explain, create the table of contents in order of "1. Purpose, 2. Current status/issue, 3. Direction or improvement plan, 4. Budget, 5. Decision-making, etc.", and describe the content like brainstorming ideas and summarize it focused on keywords.

When creating a table of contents, many beginners often skip the contents. The 5W1H1T principle below, which is used a lot for designing a table of contents, is a set of basic questions to be asked when writing most reports. If you write a report in a way to answer those questions and summarize the report based on keywords, you can create a report with all the important points.

- 5W2H1T

- Why: Why are you planning this project? (Reason, significance, background)
- What: What are you going to do with this project? (Content of the plan)
- Target: With what goals are you implementing this project? (Subject, target of planning)
- How: How are you going to promote this project? (Method, means)
- When: When and on what schedule? (Time and period of implementation)
- Who: Who promotes it? (Executioner, person concerned)
- Where: Where do you perform it? (Target area, place)
- How much: What about the costs and benefits? (Budget, profit plan)

After that, the contents naturally described according to the table of contents are summarized focused on keywords. A one-page report is completed by subtracting elaborate words and putting only the keywords in a concise and clear manner.

As in the example in the table below, the work of the organization cannot be exaggerated with flowery language, so it should be described based on the fact itself. As shown in the example below, just [Beautiful Night] is enough to convey the meaning of [It's a very wonderful and beautiful night.]. Also, as in the example below, if the phrase [spent a lot of money] can be substituted with [excessive spending], to deliver the meaning more clearly.

<Table 4> Example of Removing Unnecessary Words

General Sentence	Sentence for reporting
It's a very wonderful and beautiful night.	Beautiful night, or night
Company XX spent a lot of money and did not achieve what it wanted as a result of the project implementation.	Company XX failed to achieve its goals despite excessive spending

③ Clarify the conclusion

While most of the poorly written reports have a description of current status and analysis, they are often not clear what they want to assert or what conclusions they want to draw. It is very important to clarify the thesis and draw conclusions in order to make a one-page report. In particular, there should be an answer to the question of "How are you going to do it?" asked by a manager or a stakeholder.

④ Effective Use of Tables

Since summarization is important for a one-page report, narration alone is not enough. Therefore, proper use of narrative sentences and tables help to summarize and describe a large amount of content on one page.

⑤ Methods of Writing the Title of the Report

The title should be written in a way that the content of the document can be immediately identified. Especially for busy managers and executives, it is very important to write the title well so that the content can be immediately grasped just by looking at the title. It is better to condense the content within 20 characters so that anyone can identify the whole content, purpose, and nature of the report even by reading the title. If you look at the examples below, well-written titles imply the year, the nature of the document, etc., while poorly written titles are not specific and ambiguous. It is necessary to describe the title of the document in a

way that the character of the document can be immediately understood by using words like review, improvement (proposal), status, and minutes. If the title seems to be too long, it is also effective to add subtitles using punctuations like -, (), etc. to describe the content more specifically.

- Well-written Report Title (example)

2009 Evaluation System Improvement Plan (Focusing on Improvement of Performance Evaluation System)

Status of Introduction of Enterprise Architecture (EA) by High Performing Companies

Minutes of related departments for ERP introduction (1st)

- Poorly written Report Title (example)

Evaluation/Compensation System Improvement Plan

Department Meeting Minutes

EA (Enterprise Architecture) introduction status

⑥ Date and Organizer (author) of Report

The date and organizer (author) of a report should be indicated at the right bottom of the title. This is important because it provides a basis for identifying the document later and prevents confusion with older versions. Beginners often make the mistake of omitting this part.

⑦ Numbering

If you like or have decided on any specific numbering method, use it. Here, what is set by the organization should be prioritized, and if there is none, choose what you use the most. The following numbering system is used a lot for general plans.

As shown in the example below, two main numbering methods are used the most: using numbers for headings and figures for subheadings; and numbering with figures.

Code formulas such as <Type 1> and <Type 2> are mainly used in documents such as regulations and policies, and <Type 3> and <Type 4> of the mixed use of numbers and letters are mainly used for official letters and poems.

- Numbering Examples of General Reports

<Type 1>

- 1.
-
-
-

<Type 2>

-
-
- ▷
-

<Type 3>

- 1.
- 1.1
- 1.1.1.
- 1.1.1.1

<Type 4>

- 1,
- A.
- 1)
- A)
- (1)
- (A)
- ①

⑧ Detailed Method of Writing by Item

- Purpose: It should be well described in one or two sentences about why this work is done and why this proposal is made.
- Status/Issue: Since general plans are for improvement purposes, in order to achieve the purpose, the current situation and the issue/cause should be well described.
- Improvement plan: Describe the solution to the problem raised in the current situation/issue. In this case, it is good to use a table. In particular, depending on the nature of the document, there are many cases where the manager chooses between <Plan 1> and <Plan 2> based on the strengths and weaknesses. In this case, it is good to use a table to describe the contents, strengths, and weaknesses of each section.
- Schedule: Organized to describe schedule and major issues for each item
- Attachment: If there are attachments, number them as 1, 2, etc. E.g. 1. One copy of Reward Recipient List, 2. One copy of Public Record
- End: The word “End” indicates that the document is over. If there is no attachment, you can mark the end two spaces apart from the last letter of the document, and if the table is the last part of the document, mark it at the bottom left of the table. If there is an attachment, you can mark it two spaces apart from the last letter of the attachment.

- Example of one-page report

Title	Knowledge History management system establishment plan
Reporting Department	Human Resources/e-Management Team
Related Department	Technology Strategy Team
Date	YY-MM-DD

1. Purpose

- Maximize the efficient use of human resources by systematically managing the knowledge/technology history of members
- Optimal decision-making support for various personnel affairs such as recruitment/location/career development

2. Status/Issue

- General history of members is managed, but detailed management of knowledge history such as project performance experience (inside and outside the company) and possessed technologies is insufficient.
- In-house experts in the relevant field or the system for support are insufficient.
- Difficult to find relevant experienced persons to form an effective PJT organization when performing major projects

3. System Construction Plan

- Overview: Establish a knowledge history database that combines personal histories such as job/skills/key experiences
- Main functions

Classification	Content
Knowledge history management/ Talent search function	<ul style="list-style-type: none"> • Input/management of knowledge history in which personal histories such as job/skills/key experiences are integrated • Assign various conditions (job/experience/skill/role/desired job, etc.) to search for talents that meet the conditions
Career/Skill analysis and statistics	<ul style="list-style-type: none"> • Derive various HR analysis statistics (retention status by job/skill, etc.) required for personnel affairs and strategy establishment
Experience sharing marketplace	<ul style="list-style-type: none"> • Establish a space where members can share questions-and-answer for various knowledge

Career goal and desired job management	• Career development support through individual career goal and desired job management
--	--

4. Establishment Process

Job/Skill Classification System establishment	System design	System development	Experience/skill research of the entire workforce	System Initiation
10/3 ~ 28	10/3 ~ 10/15	10/17 ~ 11/30	12/1~12/15	12.15

5. Expected Benefit

Classification	Content
Strengthening strategic support	<ul style="list-style-type: none"> Support decision-making data when promoting various projects based on company-wide technical competency data Can grasp the core competency level of enterprise-wide human resources
Effective reinforcement of manpower utilization	<ul style="list-style-type: none"> Use key data to arrange the right resources for the right organizations Provide occasional support for manpower with various skills required for PJT promotion
Knowledge exchange/ Business promotion support	<ul style="list-style-type: none"> Support organization of learning by establishing a system that enables exchange of knowledge among members Identify demand for nurturing technical competence and provide development support

End.

[Figure 11] Example of One-Page Report

B) Principles and methods of official letters

The document conveyed to clearly express the intent of an organization in business settings, in the name of the head of the organization, is called the official letter and it's officially called the draft/execution text. A draft text is a document created to receive approval from the head of the organization. It is preserved after the approval, and then the approval section is deleted to create an execution text and deliver to the receiving organization. Here, we will look at the principles and methods necessary for writing official letters.

① Approval

This document becomes effective with the signature of the approving authority. Signatures include electronic image signatures, electronic text signatures, and administrative electronic signatures.

Approval refers to the act of a person who has the correct authority to decide his or her decision, and the types include regular approval, discretionary approval, substitute approval, and cooperation.

- Regular approval: Approval made by the head of the organization. For example, approval by the head of an institution or the CEO of a company
- Discretionary approval: Refers to the fact that the head of the organization has delegated the approval authority to the leader of the sub-organization according to the delegation regulation. In the case of approval made through proper delegation, it has the same effect as regular approval.
- Substitute approval: Refers to a case where the approver temporarily delegates the approval authority to a subordinate member when the person is absent for an extended period of time.

② Methods of Writing Official Letters

Official letters have been evolved from government official documents, how to write them is based on the

following methods in accordance with government regulations.

- Numbers: Arabic numerals are the default. In the case of currency or the amount of money, a comma (,) is used to mark off units of thousands, and no comma is used for the year (e.g., T113,560 won (1,113,500 won for today))
- Date: Marked as numbers, omitting letters such as year, month, and day, and each unit is separated with a dot (ex: 2011.12.12)
- Time: Hours and minutes are expressed as numbers based on 24 hours, and the letters of hour and minute are omitted and a colon (:) is inserted between them (ex: 5:30 pm (x) → 17: 30 (O))
- Subdivision: The method of subdivision of a draft is clearly presented in <Regulations on the Efficient Operation of Administrative Affairs>. Write according to the following subdivision rule.

<Methods of Writing Official Letters>

- 1.
- A.
 - 1)
 - A)
 - (1)
 - (A)
 - ①
 - ②

③ Method of Writing Official Letters by Item

- Sender: Write the name of the organization that sends out the letter at the top center of the document. For example, OOO Co., Ltd.
- Recipient: Write the head of the organization which the letter is sent to. (e.g. Mayor of Seoul, CEO of OOO Co., Ltd.). If there are multiple organizations to receive the document, write “Refer to the list of recipients” and put a comma at the bottom and mark multiple organizations (e.g. Seoul Metropolitan City Mayor, Uiwang City Mayor, Gwangju Metropolitan City Mayor)
- Reference: In the reference section, write the organization responsible for handling this document. For example, the head of the organization in charge such as the head of the general affairs department, the head of the personnel department, etc. If you are not sure of the organization in charge, write “the person in charge of OO”
- Title: Write a title that can encompass the contents of the document, just as in the method of writing the title for a general one-page report or statement.
- Greeting: Include a greeting at the very beginning of an official letter. (E.g.: 1. We wish all the best to your company.)
- Relevant evidence: It is to clearly state the grounds for sending the document. If there is no relevant evidence, you can omit it. Relevant grounds are usually indicated as “document number (effective date), document title”, etc. If it is too long, the title of the document may be omitted (e.g., Seoul Metropolitan City Public Notice No. 20XX-326 (20XX.11.30) 20XX Request for Recommendation of Social Contribution Award Recipient)
- Content: Write opening statements summarizing the core contents of the official letter, and fill out detailed items to support them. (E.g.: 3. Based on the above-related grounds, I would like to apply for access to

computer data as follows.

- Attachment: It is called “attachment” in public institutions. The way to record the attachment is as follows. The attachment is marked at the beginning of the document right below the reference, title, etc., if there is only one attachment, the number 1, 2, etc. is not assigned, and if there are multiple ones, the number is assigned for each.

Recipient:

Reference:

Title:

Attachment: 1. One copy of OOO
2. One copy of XXX. End.

[Figure 12] Example

- “End” mark: The end of the document should be marked with the word “End”, with one space separated from the last letter. If the document ends with a table, the “end” is marked at the bottom left of the table.
- Sender: Write the name of the head of the organization sending the letter at the lower center of the document. For example, it is Seoul City Mayor for Seoul, Minister of Justice for the Ministry of Justice, etc. In case of a general company, it goes like OOO Co., Ltd. CEO, or the actual name is cited like CEO OOO of O O Co., Ltd.
- Contact information for the person in charge: Finally, write the address, email address, and contact information of the person in charge at the bottom of the document, for any inquiries about the document and response letters.
- Document numbering: Write in accordance with the organization's document numbering rules. It is usually composed of abbreviation of the organization, year, and serial number. It is located at the top or bottom of the document depending on the type of document by organization. Recently, in case of public organizations, it is placed at the bottom of the document.

C) Method of writing meeting minutes

① Significance and Importance of Meetings

In definition, a meeting refers to an act of a group of people to discuss or a place thereof, and synonyms include discussion and consultation. Generally, in business, a meeting can be defined as a process in which the moderator presents a certain topic and the relevant stakeholders gather at a set time to discuss and reach an agreement.

As the various viewpoints of meeting participants collide and converge, creative ideas can be derived and unexpected risks can be reduced. Meetings are the most effective way to use collective intelligence.

In order to take advantage of these meetings more systematically, efforts should be made to take minutes as much as possible. As the Annals of the Joseon Dynasty, the UNESCO World Heritage, retain various minutes of state management for more than 500 years, helping to study the history, organizations can accurately understand the history of work and various decisions through meeting minutes.

② Methods of Writing Meeting Minutes

In other words, meeting minutes are documents that clarify communication by organizing meeting results. In case of collaboration, it is very important to organize meeting minutes because the content of communication may be subtly changed later due to differing interests. The specific method of writing the minutes is as follows.

Record the date and time, place, theme of the meeting, participants, discussions, and decisions. If the meeting lasts for a long time, you can use an electronic recorder.

Minutes are basically written in accordance with the 5W1H principle: When, where, who, what, how, and why.

It is of utmost importance to record the summarized opinions presented at the meeting. As described above, minutes serve a role as the official letter that prevents you from overturning what was previously agreed.

The completed minutes are circulated via e-mail to the attendees of the meeting, and opinions are received or signed after public disclosure. The minutes of the meeting must be confirmed as it will become an important document to record business process in the future. Nowadays, meeting minutes are usually shared by e-mail, so it is good to ask stakeholders for opinions after writing in the e-mail, "I have organized the minutes as above, and please review them and offer us your opinion.", adding "If there is no special opinion, I will share them or proceed as they are."

Meeting Minutes of Technology History Management System Establishment

Date: 20XX.12.5(Wed) 14:00

Place: Conference Room 1 on the 3rd floor

Attendees: Gil-dong Hong, Gil-san Jang, Kek-jeong Lim, Woo-chi Jeon (4 people)

1. Main agenda

- Discuss how to build a technology history management system

2. Detailed discussion

- The technology classification needs to be reflected in the form of code in the technology history management system.
- It would be nice if the details of the project execution experience are reflected in the technology history management system.
- ... (omitted)

3. Decisions

- Agree with the information system team to reflect the technology and project execution experience in the technology history system

4. Items to be discussed later

- The technology classification code is decided to be reflected in the system. When a specific classification (draft) comes out, we will discuss it once more.

Kil-dong Hong (Signature), Gilsan Jang (Signature), Kek-Jung Lim (Signature), Woochi Jeon (Signature)

[Figure 13] Example of Meeting Minutes

D) Methods of writing e-mail

① Importance of E-mail

Email is one of the communication techniques that have been widely adopted with the invention of the Internet and it has become the most popular and frequently used in recent years. In particular, in the field of software development, it is a highly utilized means of communication and often serves as an official letter, so it must be written clearly and carefully. There are various techniques for writing e-mails, but in general, the techniques to refer to in business settings are as follows.

- Write a title in a way that the purpose of writing is clearly revealed.
- Write the content in a way that the purpose of writing is effectively revealed.
- Designate recipient/reference person in consideration of the scope of work.
- Write the content concisely and clearly, and describe the main content first (the main clause followed by the subordinate clause, deductive writing)

② Methods of Writing Effective E-mail

- Subject line: Anyone would be able to guess what the e-mail is about simply by reading the subject line. The subject of the email should be a itemized sentence that concisely expresses only the core of the email. It is effective to add a heading such as [Report], [Share], [Notice], and [Reference] in front of the title.
- Greeting: Must include a greeting to induce mutually positive communication
- Heading: Place important information at the beginning so that you can understand it quickly. The structure of the email is divided into 4 parts: greeting, headings, numbered details, and final thank-you message. The headings serve to help you quickly understand the contents of the entire mail. Therefore, it is better to organize the contents of the mail in one sentence so that the recipient can quickly understand the contents.
- Numbering: The key tip for writing an email is to add numbers such as 1, 2, and 3 to the email content so that you can understand the email content faster. It is important to always number the content of the email. The good thing about numbering is that you can quickly understand the contents firstly, and secondly, it is convenient because you can send a reply to each numbered item when the other party responds.
- Clearly distinguish To and CC. The “To (recipient)” column indicates the person who will read the email and give an opinion, and the “Cc (reference)” column reflects the person who will refer to the email.
- Reply to all: If multiple people collaborate at the same time, a full reply is sent with all relevant stakeholders included for effective information sharing. However, if special security is required, use a single (general) reply.
- Confirm the recipient: Make sure to double-check the “recipient” before sending an email to reduce security and sending errors

From: Kim Kyung Hee
Sent: Tuesday, October 14, 2018 1:38 PM
To: Hong Gil Dong
Cc: Banchang-go; Kimchi0guk
Subject: [Review request] Confirmation of participants in XXX conference

Good morning, manager! How are you?

The '2018 XXX Conference' is scheduled to be held next week, and we have decided to notify the attendees list by today. Please give us your opinion on the participants of your organization.

1. Date: 20XX.10.16(Thu) 10:00~16:45
2. Place: Millennium Hilton Seoul Hotel, Grand Volume AB (B1)
3. Participants per organization are limited to 4 people. Please reply with the list of attendees by e-mail.
4. We are sharing the list of participating companies this year as an attached file, so please refer to it for business purposes.

Attachment: A copy of the list of participating companies in 20XX. End.

Thank you. Have a nice day.

Regards,
Kim Kyung-hee

[Figure 14] Example of E-mail

E) Business documents

The nature of the document is important in communication, but it plays an important role in transcending the limits of oblivion and transforming an "instantaneous moment" into a "permanent record", and in business, the clear basis for decision-making is all made up of documents. Therefore, since documents are written to logically explain or persuade the plan or progress of work, it is important to structure the logic to be explained well (table of contents) and describe each of them, as the phrase "Simple is Best" implies. In terms of project management, it is safe to assume that the success and failure of project management depends on document management, and documentation is a prerequisite for productivity improvement such as recycling, not just coding as a developer. The high productivity of European and American countries such as the U.S. (US productivity is three times that of Korea) is largely driven by document management, and document management is very important in quality management, and document management has a significant share in assessing the maturity levels of organizations as defined in ISO, SPICE, and CMMI models, etc.

① Types of Business Documents

- Report: A document to be prepared for reporting on the business feasibility of a product or idea or business environment related to it.
- Letter: A document used to evaluate the value of a product or idea
- Proposal: A document to obtain approval of business promotion for a product or idea
- Plan: A document to prepare a commercialization plan after approval of a product or idea

- Manual: A document explaining the details of the plan/product

F) Checklist for business documents

Good quality business documents cannot be produced unless the final inspection procedure for business documents is conducted from the objective perspective of a third party. To do this, it is necessary to compare and review whether your document conforms to the requirements described in the checklist below after writing the document.

<Table 5> Checklist for Business Documents

No.	Inspection Criteria	Confirmed
1	Is there a description of why this report or proposal is needed?	
2	Is it easy to understand from the perspective of the person who will ultimately read the report?	
3	Is there an answer to the question "Why should I do this?" for the proposed plan?	
4	Are the possible alternatives and their pros and cons well described?	
5	Are there any alternatives missing? Are the answers prepared verbally?	
6	Are the sentences concise and clear? Aren't there any lengthy ones?	
7	Does the title of the report well represent its content?	
8	Are there any logical errors in the table of contents?	
9	"Are you prepared for answering the question "what are you going to do specifically?"?	
10	Is it easy enough to understand without explanation?	
11	Is it visually appealing? Is there the beauty of white space?	
12	Is there any concrete, intuitive, and logical gap?	
13	Aren't there too many colors? Is the color conspicuous?	
14	Is the evidence clear? Has the source of the supporting data been examined and described?	

G) Use of business documentation tools

Commonly used commercial tools for writing business documents include word processors (HWP, MS Word), presentation tools (MS PowerPoint, Prezi), and spreadsheets (MS Excel, Google Spreadsheet). These tools support many functions that can meet the requirements of business documents, so knowing how to use them well comes in handy.

① Word Processor

It is a tool that is commonly used to create relatively lengthy documents such as outputs of specific work, minutes, and manuals. It has a standardized structure of table of contents, and each table of contents has a tree structure for each level. The main functions are the insertion of tables and pictures, and maintenance of the layout structure.

② Presentation Tools

Presentation tools are mainly used for materials supporting presentations or for creating reports with visual aids. The table of contents and texts are visually created on the standardized master layout, and there are functions that support the diverse composition of presentation effects.

③ Spreadsheets

Spreadsheets are widely used for expressing a variety of quantitative information, such as documents requiring formula-based calculation, tabular documents, and reporting of numerical contents. The entire document is divided into a number of cells in a spreadsheet, and you can enter text or numbers in each cell, and you can write a predefined function or a macro for repetitive work.



IV. How to Write Technical Documents

▶▶▶ Recent Trends and Major Issues

As we enter the information society, document exchange using e-mail and decision making using electronic approval systems are spreading. As various project proposals, reports, and work performance plans are prepared frequently, the ability to write logical and convincing technical documents has become a decisive factor in determining success and failure in one's work.

▶▶▶ Learning Objectives

1. To be able to explain the concepts and types of technical documents.
2. To be able to clearly write technical documents that fit the purpose.

• Preview for practical business

Director Kim of K System's Online Bank Team decided to develop an information system for the Online Bank business. For the development of the information system, he decided to select an IT system developer by preparing a request for proposal as an ordering agency for the development of the Internet bank system.

IT service company P selected Mr. Hwang as a Project Manager (PM) of proposal and business to win the order for the K-system's online bank business, and prepared and offered a proposal. PM Whang prepared a proposal presentation to appeal that Company P is qualified for the implementation of the project.

Company P obtained the order for the online bank business, prepared a project business plan for its implementation, prepared the required documents, and negotiated and reached agreements with Director Kim and the Online Bank Team.

PM Hwang prepared technical documents for the operation of the online bank system in a way that the reader, K system, could clearly understand them.

In the IT business, the creation and presentation of technical documents is an important part of customer activity along with system development. Let's take a look at the creation, characteristics, types of technical documents, and presentation techniques and methods.

01 Concept and Types of Technical Documents

A) Definition of technical documents

Technical documents are documents that record the description of reference documents or product handling, function and architecture development/use, and provide sufficient information so that not only end users but also administrators and service/maintenance technicians can understand the interior/exterior of the product. Therefore, it can be defined as a document written by using a lot of terminology according to the communication method of specialized fields such as engineering, technology, and science.

In other words, a technical document contains content such as explaining a specific fact, persuading the other party, or instructing certain actions. In recent years, the concept has been expanded to technical communication, meaning "any writing and communication for business performance regardless of business, industry, or specialized field".

B) Features of technical documents

① Clarity

The meaning of a word or sentence should not be interpreted or distorted differently by readers. In particular, abstract and metaphorical rhetoric should be avoided in that it may cause confusion and in order to convey accurate content.

② Accuracy

Technical documents should be written with accurate content to conform to objective facts based on various materials or data. In addition, the process of developing the logic using the materials or data given based on rational thinking must remain accurate and consistent.

③ Structuredness

As seen in reports, manuals, and proposals, technical documents often have a certain format. The elements (introduction, body, conclusion, etc.) that make up the form of the text should be structured and written so as to achieve overall unity.

C) Types of technical documents

Technical documents serve to provide readers with information or to solve specific problems. Technical documents that are commonly used in relation to SW development are closely related to the SW development project and can be classified as follows.

<Table 6> Types of Technical Documents

Classification	Types of Technical Documents
Project management	<ul style="list-style-type: none"> • Business plan • Information request form • Request for Proposal • Proposal • Project management plan • Requirement Traceability Matrix • Project completion report
Project development	<ul style="list-style-type: none"> • Analysis • Design brief • Development document • Testing document • Manual

02 Principles and Methods of Writing Technical Documents

A) Expression and description methods of writing technical documents

Technical documents are documents that must have accuracy and logical validity, and they emphasize strict logic and format compared to other documents. Therefore, it is important to be faithful to the rules of language and formal logic, to make sure there are no errors. You should pay attention to the following numbering system, commonly misspelled foreign words, and Korean spelling.

<Table 7> Examples of Document Numbering System

Classification	Numbering
- First level	• I. II. III. IV. V. . . .
- Second level	• 1. 2. 3. 4. 5. . . .
- Third level	• 1) 2) 3) 4) 5)
- Fourth level	• (1)(2)(3)(4)(5)
- Fifth level	• ①②③④⑤

B) Precautions for writing technical documents

- ① It should be written in a way that is easy to understand from the perspective of the person reading the document (the reader), and it should be able to help the readers to make accurate judgments of the technical document. For the reader's accurate judgment, the author of technical documents should refrain from using terminology and involving the personal feelings and considering personal relationships.
- ② It should be written in a way that readers can understand it without referring to other documents. There should be no questions or confusion while reading the technical documentation.
- ③ Technical documents must be created according to the predefined template.

C) Writing articulate technical documents

Since it is not possible to invest indefinitely the cost and time for writing the document, proofreading and review should be conducted while writing the text. This can increase the completeness of the document by improving the accuracy and logic.

<Table 8> Consistency and Relevance

Relevancy	<ul style="list-style-type: none"> There must be a logical causal relationship between the main requirements of the document and the core contents, the selected core contents and the written contents.
Consistency	<ul style="list-style-type: none"> One method or point of view, etc. must have the consistent nature from start to finish. It means that the presentation of the main content described in the document should be similar. E.g.) Formally, the font, color, and descriptive technique should be constant, and in terms of substance, if it is about a means of transportation, it should be arranged by train, bus, taxi, etc.
Accuracy	<ul style="list-style-type: none"> When writing SW technical documents, you must write them accurately. The stated structure and algorithm should be described to show that they accurately perform the functions required by the software.
Suitability	<ul style="list-style-type: none"> Technical documents must be properly described to suit the purpose of the document. The purpose of the document should be clearly stated to suit the purpose of use of the user who uses the technical document.

03 Writing Technical Documents

A) Business plan (plan)

The business plan is a guideline that includes business-related details such as the content of the project, the characteristics of the target market, and the possibility of success in the market so that the business plan can review the feasibility of the project and prepare for possible future risks.

<Table 9> Composition of Business Plan

Classification	Content
1. General Status	<ul style="list-style-type: none"> Overview of the project
2. Goals	<ul style="list-style-type: none"> Describe the goals you are trying to achieve through the project
3. Content	<ul style="list-style-type: none"> Content of the project
4. Business Method	<ul style="list-style-type: none"> Method of conducting the project
5. Finance	<ul style="list-style-type: none"> Promotion cost Promotion personnel
6. Expected Effects	<ul style="list-style-type: none"> Expected effects that can be obtained through the project

<Table 10> Principles of Writing business plan

Classification	Content
Easy to understand	<ul style="list-style-type: none"> The business plan should be written in an easy-to-understand way to convince third parties such as investors and customers In particular, product and technical analysis should avoid using technical terms as much as possible, and should be composed of simple and universal content.
Feasibility	<ul style="list-style-type: none"> If it is judged that it is not feasible in the view of a third party, reliability may be severely damaged. Therefore, it is recommended to write the document based on evidence from public or professional organizations.
Highlight the core content	<ul style="list-style-type: none"> If the business plan is mediocre, it cannot appeal to a third party. It is necessary to explain the product focusing on the characteristics of the product with the expectation that the planned product will be more appealing to the consumer than the competitor product.
Consistency and accuracy	<ul style="list-style-type: none"> If arguments and viewpoints do not match, it lowers the credibility of the entire business plan. Therefore, it is necessary to unify and express numbers and units, and to write with a consistent flow and theme.
In-depth analysis of problems and risk factors	<ul style="list-style-type: none"> In-depth analysis of potential problems in the planned project and possible risk factors in the future, and inspections from various angles are required to ensure that the project is not delayed or made impossible due to unexpected circumstances.

B) Request for Information (RFI)

Since it can be viewed as a process to determine who is an external company that can solve the problem facing the company, the information that is usually requested is a brief introduction to the external company, credit-related information, and experience in performing related services. If necessary, it also inquires of the scope of the project budget.

<Table 11> Composition of Request for Information

Classification	Content
1. Business overview	<ul style="list-style-type: none"> Project name, background and purpose, scope of business, RFI submission method, etc.
2. Information about ordering company	<ul style="list-style-type: none"> Business status (business goal/direction, etc.), informationization status, improvement
3. Key requirements	<ul style="list-style-type: none"> Business and technical requirements, implementation, training, project management, project budget, etc.

C) Request for proposal (RFP)

This is a document that informs bidders of the ordering agency's system and business status, problems, and requirements so that the ordering agency can successfully carry out projects such as information system establishment and describe in detail the matters necessary for the proposal. This is an official document that allows the proposer to clearly propose the matters the ordering agency needs.

<Table 12> Composition of Request for Proposal

Classification	Explanation
1. Business overview	<ul style="list-style-type: none"> Background and necessity of implementation, service content, business scope, and expected effects
2. Status and problems	<ul style="list-style-type: none"> Business status, informatization status, problems and improvement directions

3. Direction of business promotion	<ul style="list-style-type: none"> • goals, strategies, systems, schedules of business promotion
4. Request for Proposal Content	<ul style="list-style-type: none"> • RFP overview, target system overview, details and configuration requirements of the development target, and the target equipment to be introduced, initial data construction requirements, standardization requirements, system operating conditions, training support requirements, technical support requirements, maintenance requirements, etc.

D) Proposal

A proposal is a document that provides detailed analysis of the company's experience, capabilities, and business in order to win an order for the business ordered by the proposer. The ordering company selects a company based on the proposal.

<Table 13 Composition of Proposal

Classification	Content
1. Proposal overview	<ul style="list-style-type: none"> • Background, purpose, scope, prerequisites, and expected effects of the proposal
2. General information about proposer	<ul style="list-style-type: none"> • General status, organization and personnel, major business details, major business performance
3. Technology	<ul style="list-style-type: none"> • System configuration diagram, system construction plan (system specifications and functions, configuration device details and detailed specifications, system delivery and installation plan, etc.), software development plan (development methodology utilization plan, business development plan, initial data construction plan, system integration plan), etc.
4. Business Management	<ul style="list-style-type: none"> • Quality assurance plan, risk management plan, implementation schedule plan, work report and review plan, performance organization and work division, input manpower and history, etc.
5. Support	<ul style="list-style-type: none"> • Education and training plan, maintenance plan, technology transfer plan, other support matters
6. Others	<ul style="list-style-type: none"> • Attachment: Basis for price calculation

E) Requirement traceability matrix

The Requirement Traceability Matrix is a document that tracks the process of the user's requirements to be reflected in the final deliverable. Through this document, it is possible to trace how the user's requirements are reflected in the product, and trace back to what requirements the implemented product is based on.

In the document, WBS, design, developed product, test scenario, etc. are mapped and managed with user requirements.

<Table 14> Composition of Requirement Traceability Matrix

Classification	Content
1. User requirements	RFP requirements and requirements collected
2. Analysis output	<p>Analysis contents mapped to user requirements</p> <ul style="list-style-type: none"> • Use case, requirements analysis, etc.
3. Design output	<p>Design content mapped with user requirements</p> <ul style="list-style-type: none"> • Architecture • Screen design brief • Module design brief • Interface design brief • DB design brief

4. Implementation and test output	Implementation output <ul style="list-style-type: none"> • Implementation function Source • Manual Test Output <ul style="list-style-type: none"> • Integrated test case • User test case • System test case
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F) Analysis

Analysis is a document specifying detailed conditions required when designing or manufacturing SW products. In other words, it is a document to be made to understand the requirements for SW in order to develop SW. It can be said to be a document that understands the nature and scope of the requirements for software and clearly describes the constraints.

The analysis document should include the overall details of the implemented SW including the items to be referenced in the design.

<Table 15> Composition of Analysis (example)

Classification	Content
1. General information	<ul style="list-style-type: none"> • Definition and overview
2. General technical information	<ul style="list-style-type: none"> • Product features • User characteristics • Assumptions and dependencies
3. Detailed information	Functional requirements <ul style="list-style-type: none"> • Input • Processing • Output • Performance requirements • Design limitations External interface requirements <ul style="list-style-type: none"> • User interface • Hardware interface • Software interface

<Table 16> Principles for writing analysis

Classification	Content
Clarity	<ul style="list-style-type: none"> • Clearly describe all the functions the system will perform and the constraints that will affect the system.
Conciseness	<ul style="list-style-type: none"> • Specifications are written concisely and easy to understand for both customers and developers.
Verifiability	<ul style="list-style-type: none"> • All the stated requirements are verifiable, so the desired system quality, relative importance, quality measurement and verification methods and standards are specified.
Universality	<ul style="list-style-type: none"> • The requirements specification describes the external behavior of the system and should not be designed using a specific structure or algorithm.
Modifiability	<ul style="list-style-type: none"> • It is organized hierarchically for participants to understand the function of the system or to analyze the impact of changes.
Availability	<ul style="list-style-type: none"> • Requirements are numbered with a unique identifier for easy reference and prioritized as not all requirements are equivalent.

G) Design brief

The design brief is a document that implements the requirements described based on the analysis specifying detailed requirements for designing or manufacturing a SW product. Therefore, it includes structural design to understand the configuration of SW and the relationship between programs, interface design between modules or systems, design of data storage to store data, design of program algorithm, and design of user interface.

<Table 17> Composition of Design Brief (example)

Classification	Content
1. General information	<ul style="list-style-type: none"> • Definition and overview
2. Structure design	<ul style="list-style-type: none"> • SW components • Relationship between SW components
3. Program design	<ul style="list-style-type: none"> • Algorithm design of SW components • Input and output design of SW components
4. Interface design	<ul style="list-style-type: none"> • Overview of related SW components • Interface between SW components
5. Material design	<ul style="list-style-type: none"> • Data storage overview • Data storage design

H) Test design brief

In order to test an implemented product, it is necessary to define test targets and clearly understand the result values such as normal results and exception results during the test.

The test design brief is a document created to be used for testing by defining test objects, test cases, and test data.

<Table 18> Composition of Test Design Brief (example)

Classification	Content
1. Test item	<p>Types of test</p> <ul style="list-style-type: none"> • Functionality, performance, usability, etc. <p>Test ID</p> <ul style="list-style-type: none"> • Uniquely define test items <p>Test item</p> <ul style="list-style-type: none"> • Define the item to be tested
2. Test cases and data	<p>Types of test</p> <ul style="list-style-type: none"> • Functionality, performance, usability, etc. <p>Test ID</p> <ul style="list-style-type: none"> • Uniquely define test items <p>Input</p> <ul style="list-style-type: none"> • Content and data to be entered for testing <p>Expected output</p> <ul style="list-style-type: none"> • Expected results and data according to the contents put in for the test

I) Manual

In order to use a new product (or technology) well, the user needs to know the principle, features, and operation methods of the product. It is a document written in an easy-to-understand manner for customers who do

not know about the product so that readers can accurately and easily understand the object by interpreting the principle, phenomenon, knowledge or information of the product

<Table 19> Composition of Manual (example)

Classification	Content
1. General information	<ul style="list-style-type: none"> Product name, overview, characteristics, strengths and weaknesses of important functions, etc.
2. How to use and install/check	<ul style="list-style-type: none"> Precautions for use Precautions for installation How to use and install Inspection method, etc.
3. Maintenance and problem-solving	<ul style="list-style-type: none"> How to manage, symptoms and solutions of problems, etc.
4. Others	<ul style="list-style-type: none"> Index, warranty, A/S procedure, etc.

J) Project completion report

It is a document that summarizes project performance results and confirms project completion to users, including actual performance against goals, lessons learned, and summary of statistical items for future project estimates.

<Table 20> Example of Composition of Project Completion Report

Classification	Content
1. Summary of project results	<p>System function Profit assessment Actual performance against plan Satisfaction evaluation Future support plan Follow-up project plan</p> <p>System functions, list of deliverables, system installation status, etc. Qualitative, quantitative evaluation, etc. Budget, input labor, period, etc. Satisfaction level of requirements, user evaluation, etc. Maintenance, customer support plan, etc. Future plans</p>
2. Lessons learned	Lessons learned, causes/problems, project results, improvement plans, etc.
3. Statistics	Item type, statistical item, estimates, performance results, evaluation, etc.

04 Writing Technical Documents that Fit the Purpose

The important thing in writing a technical document is that the expert or scientist who writes it effectively communicates his or her ideas and research results to readers (the general public). The content must be communicated clearly and efficiently, and since the time and effort invested in writing these documents is very important and valuable, effective writing skills for research, performance and achievements in one's professional field are required.

A) Key checklist for writing technical documents

<Table 21> Key checklist for writing technical documents

Classification	Content
What is the main point of the author trying to tell the reader?	The core content of the target technology, which guides the direction and content of the technical document, should be provided.
What are the features and differentiating factors of the technology covered in the document?	Highlight the advantages of the technology compared to existing technology or competing technology and underscore the disadvantages so that the differentiated features of the technology can be well communicated.
How to communicate effectively to your readers?	Express in a way that the readers feel that the technology has a better value than the existing technology or competitive technology under the same conditions (budget, requirements, schedule, etc.).

B) Key checklist for reviewing technical documents

<Table 22> Key checklist for reviewing technical documents

Classification	Content
Is the development of the core logic consistent?	Check whether the logical development of the technical document content is consistent, and whether facts and grounds to support the logic are well presented.
Is the content of the written document easy to understand and intuitive?	Check whether the length of the sentences constituting the document is adequate and easy to understand.
Are appropriate cases and examples, figures and diagrams provided?	Make sure that examples, pictures, tables, and diagrams are provided in the right place to help readers to understand easily and prevent any misunderstanding.



VI. Presentation

►►► Recent trends and major issues

Presentations have the most important influence on winning development projects, attracting investment in new product development, securing decision-making within the organization, and project termination. In many cases, success or failure depends on the presentation. Along with writing skills, presentation skills are very important in securing decision-making and support for projects.

►►► Learning Objectives

1. To be able to understand and explain necessary matters when preparing a presentation.
2. To be able to understand and explain the core principles and methods of writing presentation materials.
3. To be able to understand and explain presentation methods to effectively perform actual presentations.

01 Presentation Design and Preparation Process

Presentation is a series of processes in which the presenter induces changes in the audience's consciousness or behavior in the direction the presenter desires by conveying and persuading the audience with certain facts, information, and opinions within a set time period to achieve the desired goal.

A) Purpose of presentation

<Table 23> Purpose of Presentation

To inform	<ul style="list-style-type: none"> Basics of all communication Sufficient delivery of information through presentation of evidence and detailed description
To persuade	<ul style="list-style-type: none"> Share the speaker's perspective with the audience The audience does not always understand the speaker's point of view or draw conclusions like the speaker.
To provoke action	<ul style="list-style-type: none"> The final stage of the entire document preparation, including briefing sessions. The "action" means selection, order, adoption, and acceptance.

B) Presentation process

① Goal/topic setting

Goals and topics should be defined in one sentence to make them clear. If the goal is unclear, the presentation is more likely to fail.

② 3P analysis

Person (audience), Purpose (purpose), and Place (place/environment) are called 3P. The presentation needs to be analyzed by comprehensively considering the audience's situation (time, interest, etc.), the purpose/goal of the presentation, and the place and environment of presentation.

③ Content composition/design

It's the step in determining the theme of what to tell to achieve the desired goal. It is important to write sentences in a narrative manner like brainstorming, and to make a compelling message by appropriately trimming it.

④ Data collection/analysis

Collect and cite data that can effectively support the previously constructed message.

⑤ Delivery format

Prepare data in a format that can effectively deliver a message to the other party based on the items analyzed by 3P analysis

⑥ Rehearsal

It is a stage of rehearsal practice based on the written data. It takes a lot of practice to avoid being nervous in practice.

⑦ Presentation

As with the rehearsal, be confident and concise and clear in accordance with the presentation technique.

⑧ Post processing (Q&A, feedback)

It is a step to answer questions about the issues presented, receive feedback on the results of the presentation, and check items to be improved. If you prepare expected questions in advance, you can answer them without being nervous, and you should be able to listen carefully to the other person's questions and explain them in a humble and calm manner.

C) Scenario creation

When preparing a presentation, the most important thing is the scenario. Novice presenters often make the mistake of not writing presentation materials and writing scenarios. Since the presentation can be nerve-wracking, creating a separate scenario in advance and bringing it with you will greatly ease the tension during the presentation.

① Content Composition of Scenario

Scenarios derive and reflect important presentation points from presentation materials. Because of the time constraints, the order of the points should be decided in a way that the presentation becomes suitable for the audience, purpose (expectation), and place. You need to write and check to make sure a lot of content can be communicated efficiently, by seeing whether the big flow of the story and keywords are clearly identified.

② Length of Scenario

Usually, it takes about 3 minutes for each A4 sheet. Therefore, it is necessary to write a scenario for the amount of presentation time given. Exceeding the set time schedule is what should be avoided the most, and scenario should be structured in a way that the presentation can be finished within the set timeframe, and receive questions and offer answers.

02 Writing Techniques of Presentation Material

A) Overall material composition

The entire material is generally organized in the order of opening → table of contents → main text → closing.

- The opening is the time to show the presenter's first impression, and the success or failure of PT is determined within 30 seconds of the start, and failure to build a positive impression and trust becomes difficult to reverse.
- The table of contents should be structured in consideration of the length of the briefing session, and the complexity of the content. Generally, PTs within 30 minutes use a two-tiered structure, and a three-tiered structure for more than one hour.
- The main text can be divided into the following.

- Requested Order Type
 - (Strength) Easy to write as requested and can contain all the contents
 - (Weakness) Too much content may fail to deliver the key message
 - Key Issue Type
 - (Strength) Logical and easy to structure and connect presentation strategies and key issues
 - (Weakness) Although not a core issue, essential parts for presentation may be omitted
 - Presentation Evaluation Form Type
 - (Strength) If there is a presentation evaluator, it is organized around the evaluation form (interested matters of the evaluator)
 - (Weakness) The composition of the presentation is not natural
- Closing is the step of summarizing the key content. It is good to express feelings or use quotes to deliver a message that will leave a deep impression, but you should not bring up new stories.

B) Presentation scenario creation

① Logic development suitable for purpose, target audience, and place

Depending on the purpose, subject, audience, and location of the presentation, use techniques for developing logic, such as placing the key message first or last. If the purpose of the presentation is to present a solution or if the target audience is a high-ranking person, telling the key message first is preferable. By presenting the conclusion quickly, it has the advantage of inducing interest and retaining the audience's attention. On the other hand, when a dramatic story development is necessary or when the audience is the subject of training, conveying the key message later is desirable. It has the advantage of being able to slowly build a connection with the audience and make the conclusion fully understandable.

② Structure table of contents

Once the logic development method has been decided, build a table of contents to maintain the flow. First create first-level heading and then detailed subsections.

③ Check the logic flow

Check the logic flow based on the prepared table of contents. While simulating the presentation, check whether there is any disturbance in the flow.

④ Define conclusion

Summarize the contents of the presentation and organize arguments or suggestions to be presented as the final conclusion. It is important to define it so that the audience can relate to the natural flow of the logic development.

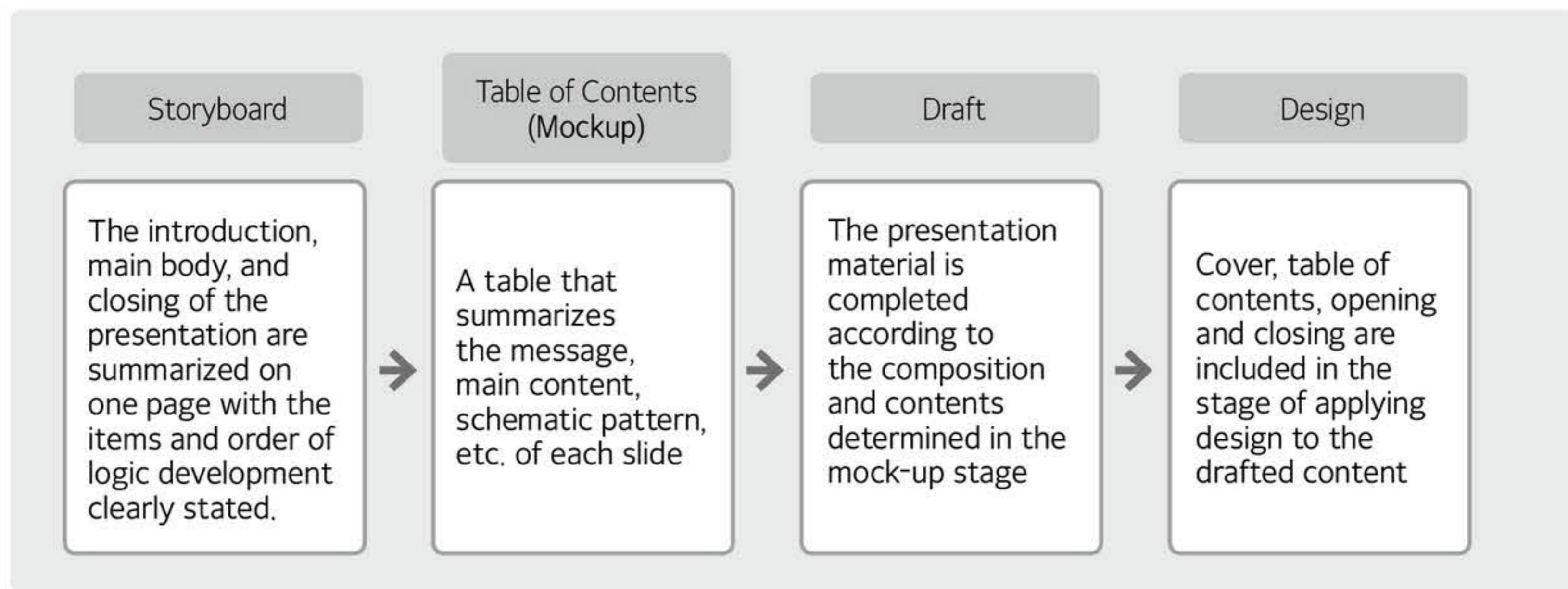
C) Presentation material creation

① Things to Consider beforehand

To make a presentation material, you must first organize the storyboard of the overall presentation. The overall flow and table of contents should be determined, and the content to be presented as a conclusion should be clearly defined. In addition to the story, visual factors must also be considered. These are as follows.

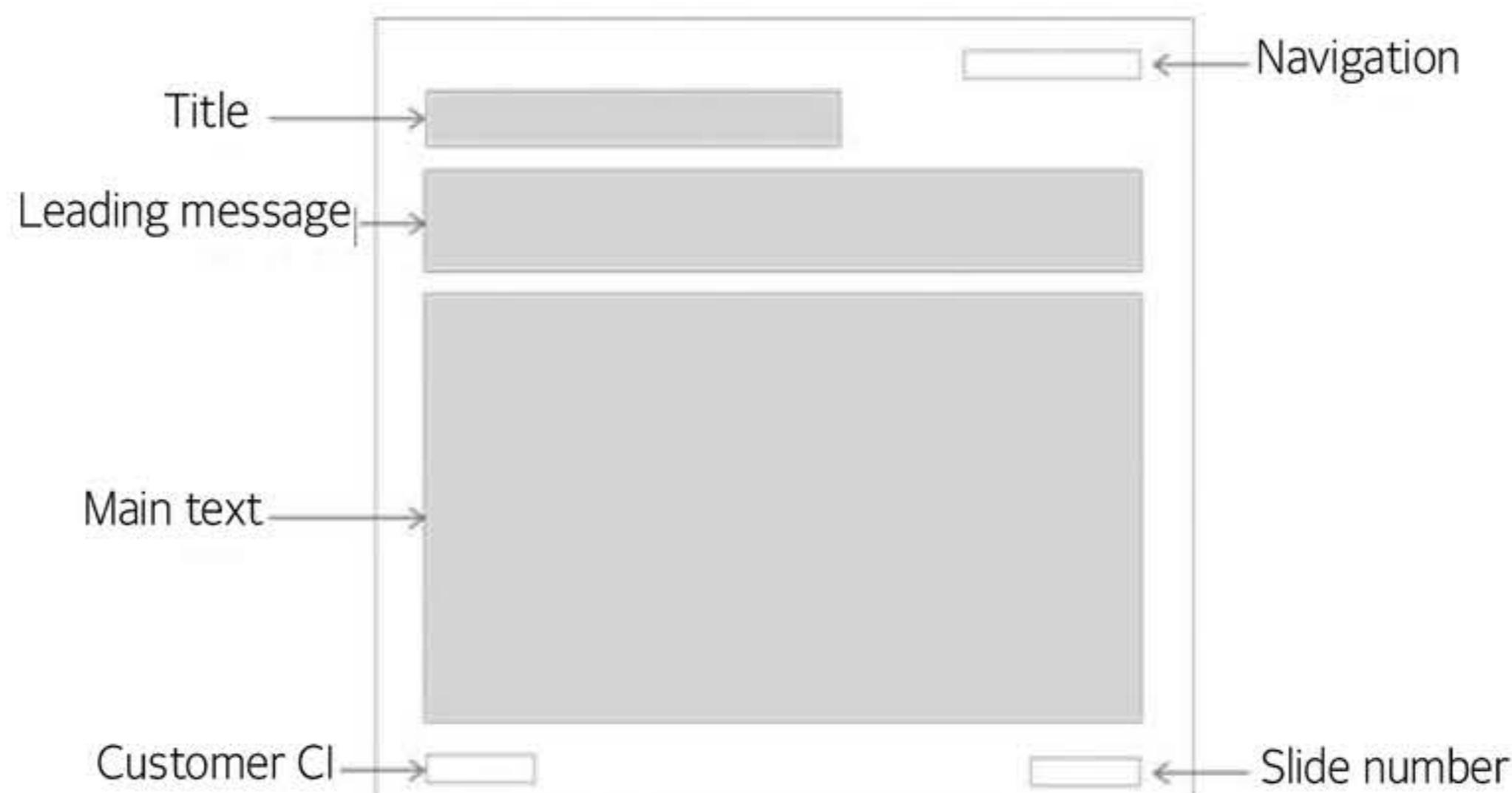
- Color: The color is selected in consideration of the audience. When presenting to a specific company or organization, select a representative color by referring to the vision, CI, and BI displayed on its website, and choose a method to highlight the color according to the level of brightness of the presentation venue.
- Font: Use Gothic font without serif, preferably 20~24pt for the title and 14pt for the body.
- Others: The presentation material is easy to be printed in A4 paper, and the presentation tools include PowerPoint, Keynote, Prezi, etc. Be sure to check the presentation environment when selecting a tool.

<Table 24> Presentation Material Preparation Procedure



② Template Selection

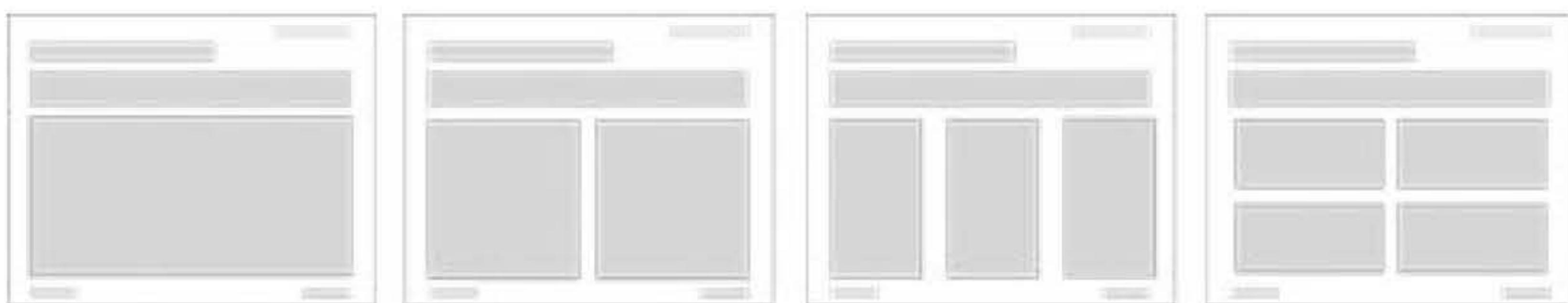
You must prepare a template to write your presentation material on. It should not be too complex and flashy, and be able to visually present the subject. In general, it is composed by the title, heading (leading message), body, navigation, CI, etc. as shown in the figure below.



[Figure 15] Slide layout (example)

③ Layout Selection

Various layouts provided by presentation tools such as PowerPoint can also be used, and users can create their own. Layouts can be classified into the cover, section, and body, according to the nature of the material to be designed, and the commonly used body layout is as follows.



[Figure 16] The commonly used layout of the body

④ Things to consider for the body

When designing the main body, be aware of the following matters.

- Contain the content targeted at the audience (readers, reviewers, etc.)
- Schematic writing and simplifying expression
- Use commonly used schematics
- Use original images
- Use proper fonts and colors
- Utilize the message (or feeling) that colors convey

⑤ How to write headings (leading message)

The heading (leading message) plays a very important role in the preparation of presentation material. This is because the key message is determined first and the materials that can further explain the message are placed at the bottom. The key tips for writing the heading are as follows.

- One message per page: The heading should contain only one topic explaining the rest of the contents below. More than one topic in a single heading sentence can be distracting.
- It shouldn't be too short to understand what it's about, and too long to read. It should be written in an appropriate length. The length of the heading is usually one or two sentences. More than two sentences undermine readability.
- The content to be included in the heading is what to do (What) or why, summary of the conclusion, description of key points, and the facts of information or data.
- Avoid ambiguous content that is not specific. It is necessary to reflect specific content as much as possible.

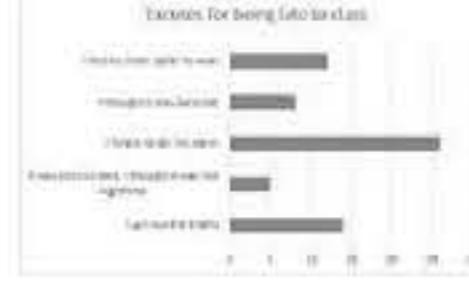
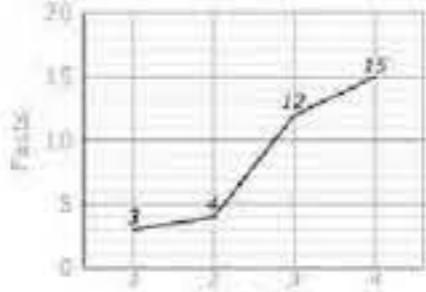
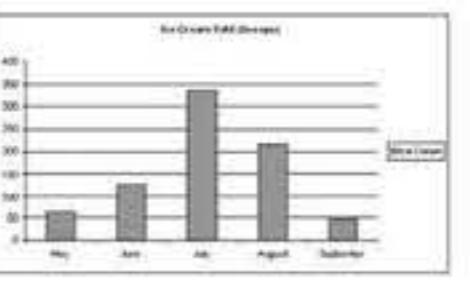
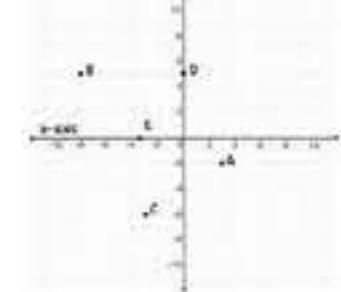
⑥ Use of charts

When preparing a presentation, it is important to have a variety of charts to present as the basis for your argument. Charts are a very important element in the presentation, as the appropriate form must be selected according to the characteristics of the item to be displayed to make the audience understood and convinced of your argument.

Most of the charts fall into the five types below. You should use the chart well according to your message.

<Table 25> Types of Charts

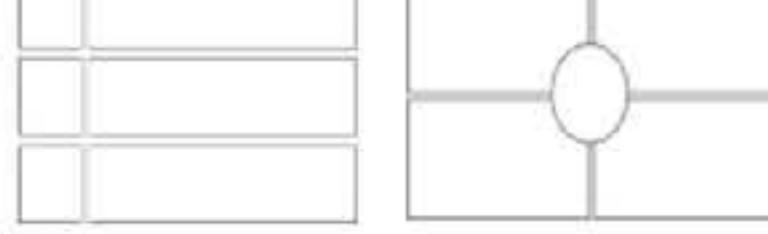
Classification	Comparison of Composition	Comparison of Items	Comparison of Time series	Comparison of Distribution	Comparison of Correlation
Content	Percentage of the whole	Ranking	Change over time	The number of items in the range	Relationship between variables

Effective chart types	Pie chart Bar graph by percentage	Horizontal bar graph	Vertical bar graph Line graph	Vertical bar graph	Dot graph Line graph
Example					

⑦ Basic Patterns of Visualization

Visualization is a way of using schematics to better understand the subject, and using appropriate schematics is much more effective than writing verbosely. For visualization, the items go through the process of structuring the message using the following pattern.

<Table 26> Basic Patterns of Visualization

Classification	Content	Example of Visualization
Method/Factor	Useful for listing different items and describe specific details for each item	
Trend/Stage	Used when the meaning cannot be conveyed clearly if the specified order is violated.	
Table/Correlation	Used to describe items in parallel relationship. Explain the causal relationship of what is the cause and what is the effect	

⑧ Three Principles of Visualization

- First Principle: With a suitable structure-Selection of shape types according to the description method of keywords
- Second Principle: Easy to understand-structured logic for intuitive understanding
- Third Principle: Highlight points-Highlight points to be emphasized with color or other shapes

D) Presentation material Review

It is good to have a third party review the contents after completing all the materials for the briefing session from an objective perspective.

<Table 27> Review of Briefing Session Materials

Key Items	Review Content
Are there differentiated materials suitable for the subject?	<ul style="list-style-type: none"> • Was there a clear answer to the audience's needs? • Is the content to be emphasized properly expressed?
Is the content of the text logically structured?	<ul style="list-style-type: none"> • Argument (keyword)-Is the logic of the basis valid? • Is the priority of content (contribution to achievement of purpose) organized?

Is the key message expressed in each chapter?	<ul style="list-style-type: none"> • Can the keywords identifiable in the difficult and complex content? • Is there any difficulty in using or expressing the diagram?
---	--

E) Presentation tools

Tools that are often used to create technical documents include PowerPoint, Keynote, and Prezi, and the features and strengths and weaknesses of each are as follows.

<Table 28> Presentation Tools

Classification		Explanation
Power Point	Characteristics	<ul style="list-style-type: none"> • Commercial presentation tool made by Microsoft
	Strengths	<ul style="list-style-type: none"> • Sold as part of the MS Office suite of software and has the biggest user base • Various templates and multimedia objects can be edited and utilized • Advantageous for formal reporting and presentation
	Weaknesses	<ul style="list-style-type: none"> • Limited in terms of design or use of external objects
Keynote	Characteristics	<ul style="list-style-type: none"> • Began as a computer program for Apple CEO Steve Jobs to use in creating the presentations
	Strengths	<ul style="list-style-type: none"> • Easy to use in terms of design or user interface • Advantageous in importing, sorting, and editing external objects, videos or music • Easy for professional graphic design • Excellent transitions, animation effects
	Weaknesses	<ul style="list-style-type: none"> • Fatally disadvantageous in that it is only available for Apple Mac • There are many things to learn for beginners to use
PREZI	Characteristics	<ul style="list-style-type: none"> • Web-based presentation tool. It can also be installed for desktop application.
	Strengths	<ul style="list-style-type: none"> • Web-based(desktop application available, charged) • Can be used with an Internet connection, not restricted by OS • There are many templates, and the functions are well organized, so it is easy for beginners to make a presentation. • Advantageous for story-based presentation
	Weaknesses	<ul style="list-style-type: none"> • Presentations made by PREZI may look alike to one another • You must be connected to the Internet at least once to check and download the presentation • Basic shapes or templates provided are limited • Limited for professional graphic design

03 Methods of Executing Presentation

So far, we have looked at various processes and key techniques for preparing the presentation. Here we will look at some of the important things to consider when executing your presentation.

A) Checklist for inspection before on-site presentation

On the actual presentation site, such as a proposal briefing session, a business briefing session, and a presentation within the organization, the presentation material has an effect, but the presenter's presentation ability has a more significant effect. Even if the presentation material is insufficient, if the presenter responds well, it will be finished well. Even if the presentation material is well-designed, if the presenter cannot answer an im-

portant question, it may lead to poor outcomes. Likewise, the important points for on-site presentation are as follows.

- Preliminary Inspection of the Presentation Venue

It is necessary to look around the presentation venue in advance, visualize a scene in which the audience is seated, and simulate the range of motion, gestures, and a simple practice of presentation.

- Be familiar with the order of presentation material

Check whether you are familiar with the sequence and flow of the presentation material. Glancing over at the material while speaking may often make you look less confident because you do not make eye contact with the audience, which may undermine credibility in what you say, and make the presentation itself boring. Therefore, you should always be familiar with the order of the presentation material and maintain a natural flow so that you can continue your presentation even without reading the material.

- Appropriate and Interesting Opening Comments

You should start your presentation with a story that can relate to topics such as simple weather, current status, and recent issues, and that can arouse the audience's interest. If you go straight into the topic from the beginning, the atmosphere may become rigid and the relationship between the presenter and the audience may become awkward. It's okay to talk lightly, so prepare a comment that can help create a comfortable atmosphere of the first encounter with the audience.

- Presentation Material Review

Check the prepared presentation material for any errors. Since the style in which the prepared material is displayed may vary depending on the version or font of the presentation tool software, it is recommended to bring with a laptop, etc. to be ready for an unexpected situation.

- Key points of each sheet and appropriate examples to promote understanding

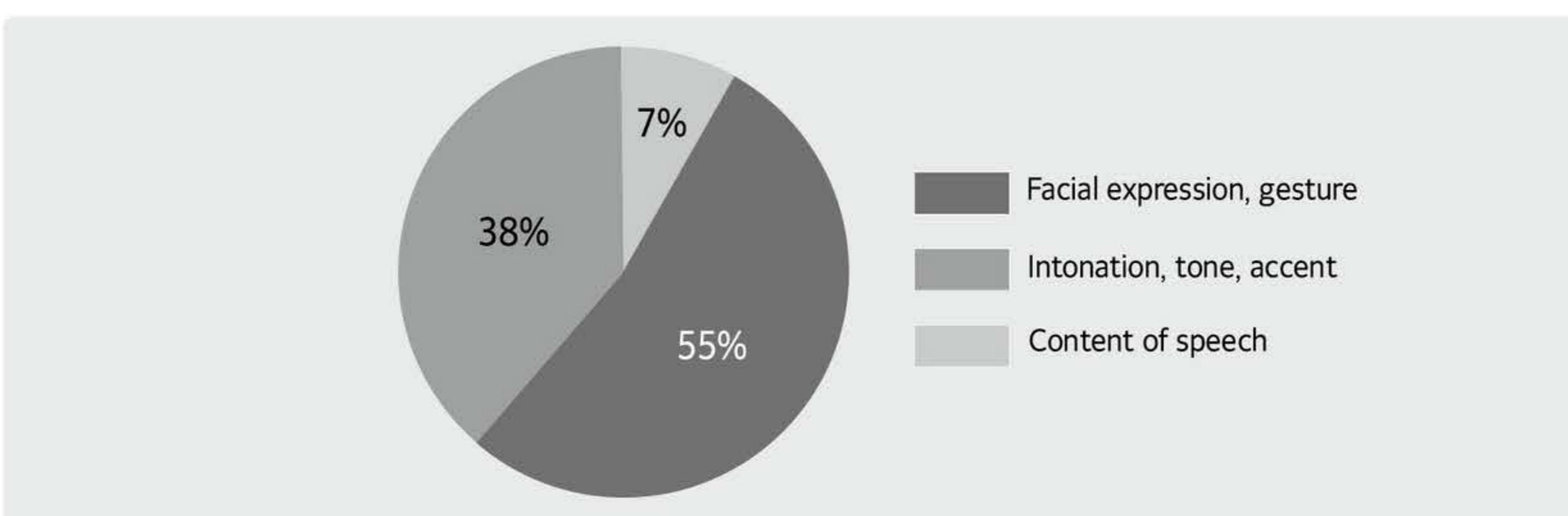
Check the key points to be presented for each sheet once again, and whether the cases prepared to promote better understanding are well connected. It is also good to make good use of presentation tools or prepare a simple cue sheet.

- Impressive closing comments

At the end of the presentation, prepare a closing comment so that you can leave an impressive message to your audience. It is also good to use aphorisms or quotes related to the contents of the presentation, or to convey impressively the good words you saw in the book. The important point is that the closing comment is well linked to the subject so that the subject content can be more deeply relatable.

B) Effective use of body language

According to The Law of Mehrabian, 93% of non-verbal body language such as gestures and tone of voice is used to persuade the other person in actual communication. The logical explanation occupies only 7%. Here, body language includes voice.



[Figure 17]

For example, we think that an actor with good voice is good at acting. No matter how well you act, if you cannot speak well, you may be seen as if you are not good at acting. How to effectively use body language in your presentation is as follows.

① Personal Appearance and Image

Your appearance and image is also very important factor to win the audience's trust. In order to make a good impression, you need to have a neat appearance, hairstyle, and attire. It is difficult to make a good impression and look trustworthy when you look messy. And you should have a smiling face. If you are gloomy or stiff, you may present a negative image.

② Eye-contact

You must keep your eyes clear and bright. Insecure eye gaze cannot make you look confident or trustworthy. Eye contact is a very effective way to make a presentation successful. When giving a presentation, it is most important to make eye contact with the key people who make decisions. Look at one person at a time, but distribute your visual attention about 60% to the decision maker and 40% to the rest of the audience. It is necessary to observe the other person's reaction and develop a connection through "eye contact".

③ Voice

You must explain with correct pronunciation and appropriate speed, and presenting with a resonant voice helps to enhance delivery. Rather than keeping the speed of voice constant, you should immerse the audience by controlling the speed such as making it slow, fast, or a pause, etc.

④ Use appropriate motion

Body language is effective to use when emphasizing important points. If you take too much exaggerated motion, you can make a negative impression. It's a good idea to use the proper hand movements at the right timing.

⑤ Use gestures for emphasis

If you emphasize something with your voice, and make a gesture afterwards, it may not be effective. It is effective to make a gesture at the same time or slightly ahead of an utterance. Make eye contact and use your hand gestures together while vocalizing as if pressing the voice slowly.

C) Conduct scenarios and rehearsals (practice)

Scenario is a kind of simulation of using a given time in a certain way. No matter how good the presentation material is, if you aren't prepared to when to throw a certain message, the presentation is highly likely to fail.

Therefore, it is good to write a message to explain in a slide note and print it out for rehearsal. Rehearsal is good to practice once or twice by imaging as if there is an audience to hear you.

D) Relaxing tension before starting

Tension is the greatest enemy of the presentation, and lowering tension is a very important factor in an actual presentation. An example of how to reduce tension before a presentation is below.

- Clench and unclench your fist repetitively.
- Do a belly breathing. Repeat inhaling deeply and exhaling long.
- Go to the presentation venue early to get ready.
- Do more rehearsals to enhance confidence.
- Having a chat with a colleague before the start can reduce the tension
- Encourage yourself by saying "It's okay to make a mistake." and "Right now! I'm okay." in your mind.

E) First greeting

Most novice presenters are not good at first greeting. That's why you may feel nervous throughout the entire presentation, as if the first button was misplaced. For example, let's say you made your first greeting as follows.

"Good morning. I'm A from OO department at OO Company. (Greeting at the same time)

"Good morning." (Greeting), "I'm A from OO department at OO Company. It's nice to see you."

Which would be better? In the first case, there are too many words to say before bowing. The timing to make a bow may not coincide with the applause of the audience.

As in the second example, if you greet the audience with a short greeting message to the audience, and after receiving applause, look around and introduce yourself, you will be able to give a more relaxed presentation.

F) Responding to the audience's reaction

The presentation is present. You make a connection with others and communicate with them, and the purpose is to draw empathy and make the other person make decisions.

You should be able to think about the voice tone, speed, content, emphasis, and story transition from various angles while monitoring the reaction of the other person. The positive and negative reactions of the audience are as follows.

<Table 29> Response of the presentation

Positive Response	Negative Response
<ul style="list-style-type: none">• Make eye contact• Nod one's head• Lean forward• Smile• Look focused	<ul style="list-style-type: none">• Folded arms• Distracted gaze• Slouch• Just read the handout• Look distracted

When negative reactions appear, you need to quickly judge and transition the story, or use humor for a moment, or adjust the tone and speed of your speech to retain the audience's attention. Be aware of the above reactions as it is very important to keep track of and control the situation in the middle of the presentation.



VII. Understanding of Project

►►► Recent Trends and Major Issues

It is important to understand the concept and characteristics of project, organizational structure for project execution, and the areas of activities of project managers and participants, for the successful execution of a project, given that all business activities including software development are operational and project-based.

►►► Learning Objectives

1. To be able to explain the concept of project.
 2. To be able to describe the organizational structure and roles of participants for project execution.
-

►►► Concept summary

- Project characteristics: temporary effort, provision of a unique product or service, purpose, progressive elaboration
- Similar concepts: program, portfolio
- Organizational structure: functional organization, matrix organization, projectized organization
- Project Roles: Project Manager, Project Leader, Quality Assurance Team, Architect Team, Development Team, Support Team, Sponsor

Corporate projects are increasingly operated through PMO organizations or similar organizations that manage enterprise-wide projects and portfolios. Projects are activities to achieve organizational requirements, and PMOs prioritize projects and programs that become the organization's strategy, and supply and manage necessary resources.

⊕ Preview for practical business

As all projects are original without being uniquely the same, and the environment in which they are conducted is all different, project management techniques cannot be applied in a uniform manner. Still, it is necessary to know what standards and guidance exist in the project knowledge, skills, techniques, and tools, and which situation they are applicable, in order to make the project successful. Representative knowledge systems and standards of projects are as follows:

PMP is a professional qualification for project management supervised by the PMI (Project Management Institute). It has a project management knowledge system called PMBOK, consisting of 5 process groups, 49 processes and 10 knowledge areas. PRINCE2 is a project management method based on project management qualifications and procedures created in the UK. ISO 21500 was developed by the International Organization for Standardization (ISO) in 2012, from the existing private project management into a global project management standard system, consisting of 11 important cases of project management, 5 process groups, 10 subject groups, and 39 processes.

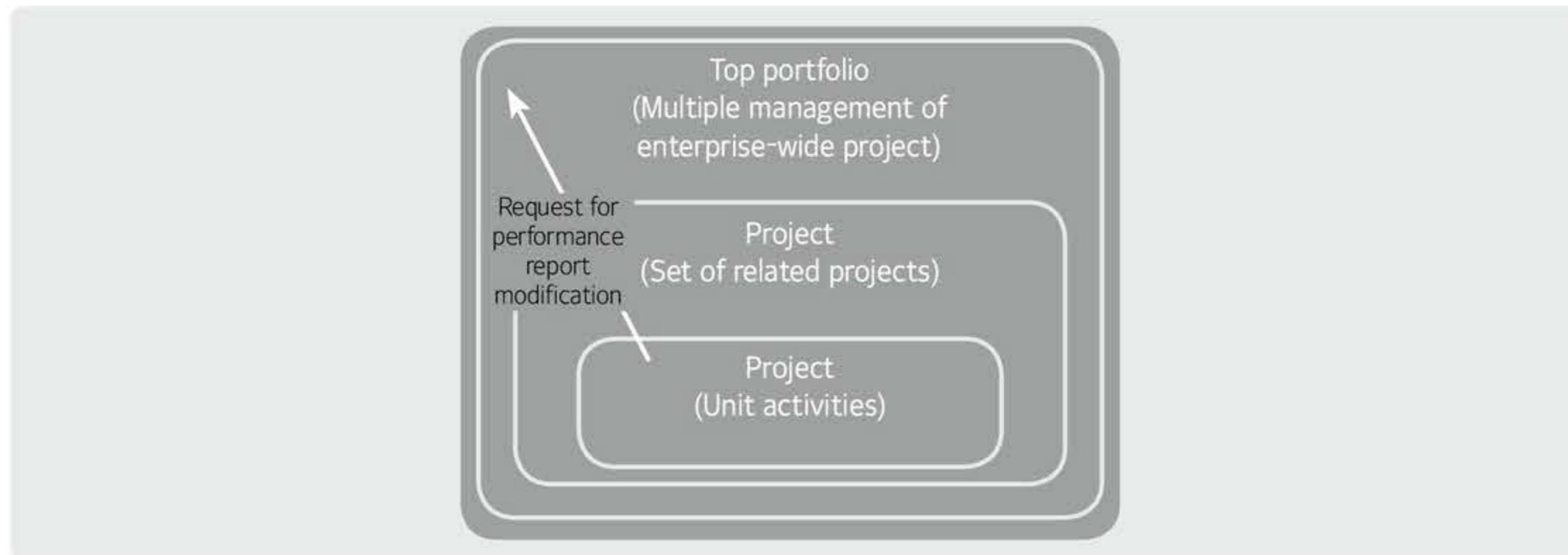
01 Concept of Project

A) Definition of project

According to The Mythical Man-Month by Frederick Brooks, the Tower of Babel was man's first project and Noah's Ark was the first successful one. As such, a project refers to a sum of efforts to mobilize resources to achieve a specific goal. Recently, projects are being carried out for the purpose of developing various products or services by investing limited resources within a predefined period, both inside and outside the company. As such, a project refers to any activity in which limited human and physical resources and efforts are put into place at a set (temporary) time to create a unique product or service, or for a specific purpose.

Similar terms to the project include program and portfolio. A program is a set of interrelated projects. It aims to integrate multiple projects into a single program in order to achieve a common goal in consideration of correlations between projects, and to manage individual projects in an effective manner.

A portfolio is a set of programs and projects undertaken to achieve an organization's strategic goals. Portfolio management is carried out from the strategic perspective of the organization, including prioritizing programs and projects and providing appropriate resources.



[Figure 18] Relationship between project, program, and portfolio

These terms have the following commonalities and differences, depending on the size, relevance, and the profits of the project in the business organization. The comparison of project, program, and portfolio is as follows.

<Table 30> Comparison of project, program, and portfolio

Type	Project	Program	Portfolio
Scope	Aim to achieve the project's goals throughout the project lifecycle	A project group that has a greater scope and relatively more significant interests than the project	A set of projects and programs with strategic organizational objectives and organizational scope
Modification	Project managers monitor and control through the modification management process	Program managers manage all changes in- and outside the program	Portfolio managers continuously monitor and control the internal and external environment

B) Features of Project

- Temporary: A temporary activity that has a specific beginning and end.
- Uniqueness: Every project is unique, offering a unique service to the customer.
- Progressive elaboration: An activity to specify the product or service to be created from constructing the general meaning at the beginning
- Constraint of scope, cost and time: The most common constraints are scope, cost, and schedule.
- Resource and quality: A service that provides quality through resources to customers and stakeholders.

C) Examples of practical project

In business, projects are being planned or undertaken even today by countless organizations with a wide variety of goals and objectives. I would like to briefly examine the purpose of projects in practice, taking examples of several projects that are being actively carried out these days.

<Table 31> Examples of Practical Project⁵⁶

Type	E-government project	Smart factory project	Next Generation Finance Project
Purpose	A project to establish public informatization using a framework for efficient e-government services to the public	A project to establish factory automation and digitalization by using IT systems such as IoT, MES, PLM, and SCM to improve the competitiveness of manufacturers	A project to construct an ideal integrated system of business and IT to effectively reflect and support enterprise-wide strategies of financial institutions
Application	A total of 756 public and private informatization projects, including Korean Statistical Information Service(KOSIS) and Corporate Competitiveness Support System (as of March 2018) ⁵	Built 5,003 smart factories as of the end of 2017 with the goal of reaching 20,000 by 2022 ⁶	The system has already been built or under construction among most commercial banks and local banks in Korea since 2000
Practical Example	<ul style="list-style-type: none"> • Customer-specific administrative information sharing system • Resident service integrated system • Urban railway system • 911 reporting service expansion • Health insurance fee portal 	<ul style="list-style-type: none"> • Build customized MES system • MES/POP for inventory, process management, and defect rate reduction • Customized ERP/web control system for special manufacturing process • Real-time facility monitoring 	<ul style="list-style-type: none"> • Next-generation systems of such as Shinhan Bank, Hana Bank, Daegu Bank, JB Jeonbuk Bank, and Kyungnam Bank • To be developed by KB Kookmin Bank, Bank of Korea, Korea Postbank, Hanwha Life Insurance, etc.

Numerous projects are planned or conducted with their own goals and objectives. This is a natural response of organizations or companies to survive in the business ecosystem as the existing business environment, customers, and markets change from moment to moment.

02 Project Organizational Structures and Roles

A) Project organizational structures

Organizational structures related to project execution can be divided into functional organization, matrix organization, and project-oriented organization.

- Functional Organization: It is a conventional corporate structure in which an organization is divided into smaller groups based on each task or function, and the project of a group is conducted independently from other groups. In a functional organization, there is no separate project manager, but the manager of each functional group performs responsibilities and roles. If there is a project manager in the functional organization,

5 Source: eGovernment Standard Framework (<https://www.egovframe.go.kr>)

6 Source: Smart factory expansion and advancement strategy, jointly with related ministries, led by the Presidential Committee on the 4th industrial revolution, 2018-03-08

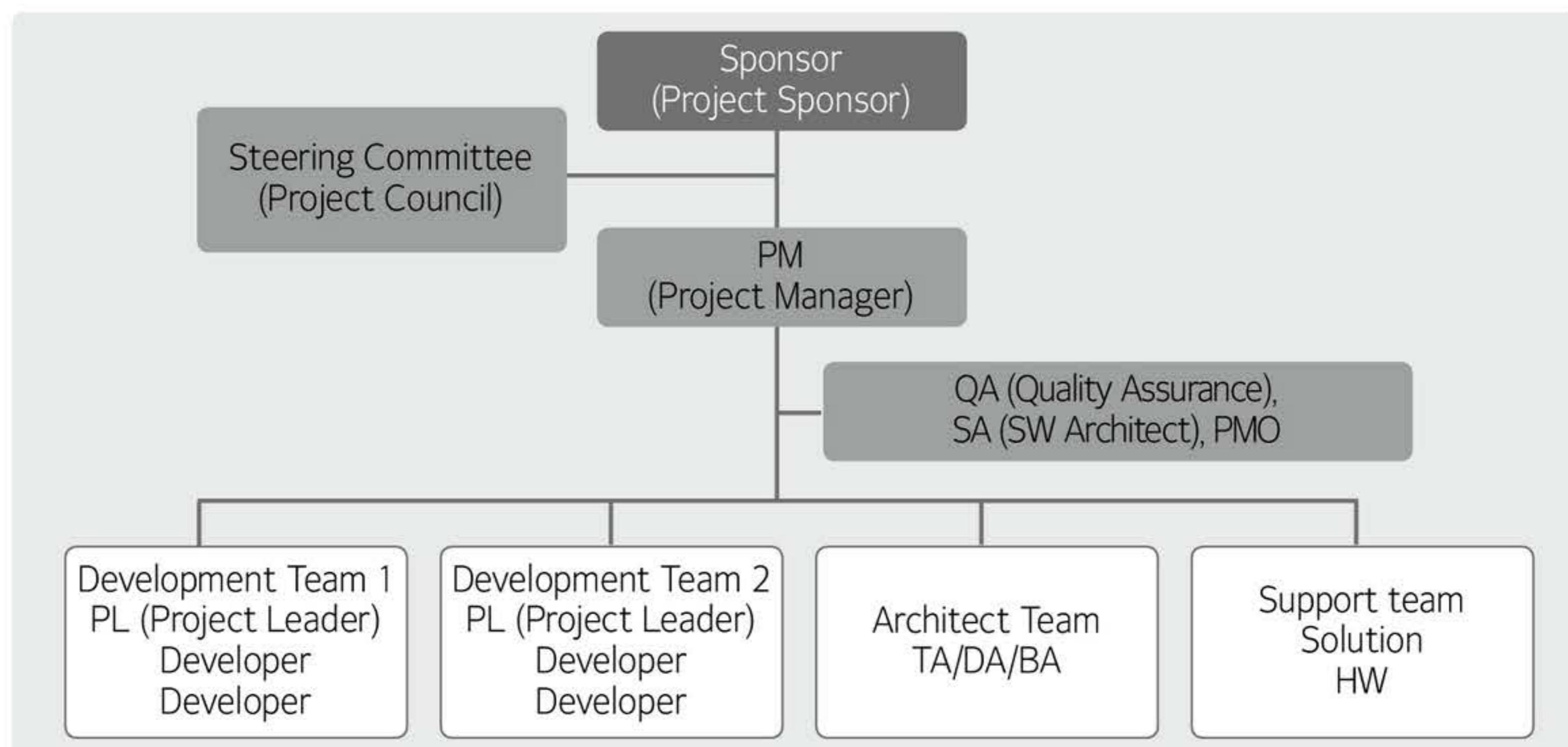
he or she does not have decision-making authority in the project and plays a facilitating role.

- Projectized Organization: It is an organizational structure in which the project manager is responsible for decision-making and has total authority for project execution. It shares the same physical space by project, allowing prompt communication and decision-making.
- Matrix Organization: Matrix organization is a complex form of functional organization and project-oriented organization, and can be divided into weak, balanced matrix, and strong matrix structure. The weak matrix organization is similar to the functional organization, and the project manager acts as a facilitator. The balanced matrix organization is a structure in which members of the functional organization play the role of project managers. The project manager acts as a coordinator with the right to decision-making and partial authority. The strong matrix organization is similar to the projectized organization, and a separate project manager apart from the functional organization focuses on project management and is responsible for much decision-making and authority.

<Table 32> Project Organizational Structure

Type	Functional Organization	Weak Matrix	Balanced Matrix	Strong Matrix	Projectized Organization
Level of Authority	Close to none	Minimum	Minimum to medium	Medium to strong	Total authority
Time Horizon	Part-time	Part-time	Full-time	Full-time	Full-time
Role	Facilitator	Facilitator	Coordinator	Manager	Manager

In general, when a project for software development or system construction is undertaken, project managers of the client company and staff of the IT development company are combined to form a project organization.



[Figure 19] Project Organizational Chart

The project organization consists of project managers (PM), project leaders (PL) who lead each development team, developers, quality assurance (QA) staff under the direct control of PMs, SA (software architect) for architect support, PMO (Project Management Office) for project management support, project support groups (UI design, testing, etc.), architect team, PM, etc., as well as steering committees and sponsors who support higher-level decisions, such as changes in the scope and schedule of the project. Of course, the project organization may vary depending on the goals and characteristics of each individual project.

B) Responsibilities and roles of project manager

“Who is the project manager, and what does the person do on the project?”

“The project manager is the person responsible for the entire scope and schedule of the project. In other words, the person oversees and communicates the progress of the project, as well as resolving issues and risks to quality and stakeholders from the initial stage to the end of the project.” Project managers need to understand and be able to exert the following three distinct competencies in order to carry out a project.

<Table 33> Classification of PM's Competencies

Classification	Type	Detailed Area
Project management knowledge competency	Knowledge of project management tools	<ul style="list-style-type: none"> Basic knowledge of the use of project management process, templates and tools Provide a framework for project activities Track project progress against the plan
	Knowledge of the project area	<ul style="list-style-type: none"> Knowledge of scope, schedule, cost, quality, human resources, communication, risk, purchase management and integrated management, configuration change and contract management
	Problem-solving skill	<ul style="list-style-type: none"> Ability to resolve project issues
	Management Experience	<ul style="list-style-type: none"> Experience in the job and project management
Technical competency	Technical knowledge related to the project	<ul style="list-style-type: none"> Understanding of practical work and processes related to the project, practical experience and knowledge thereto
	Information technology trends	<ul style="list-style-type: none"> Comprehensive knowledge of information technology, market trends of information industry Trends in information technology products, systems related to information industry Legal and compliance knowledge
Communication competency	Negotiating skill	<ul style="list-style-type: none"> Dispute resolution and conflict arbitration Negotiating skills with project approver or senior authority
	Communication	<ul style="list-style-type: none"> Exhibit leadership skills to effectively lead the team and communicate with team members, stakeholders and customers
	Human resource management	<ul style="list-style-type: none"> Effective management of team members

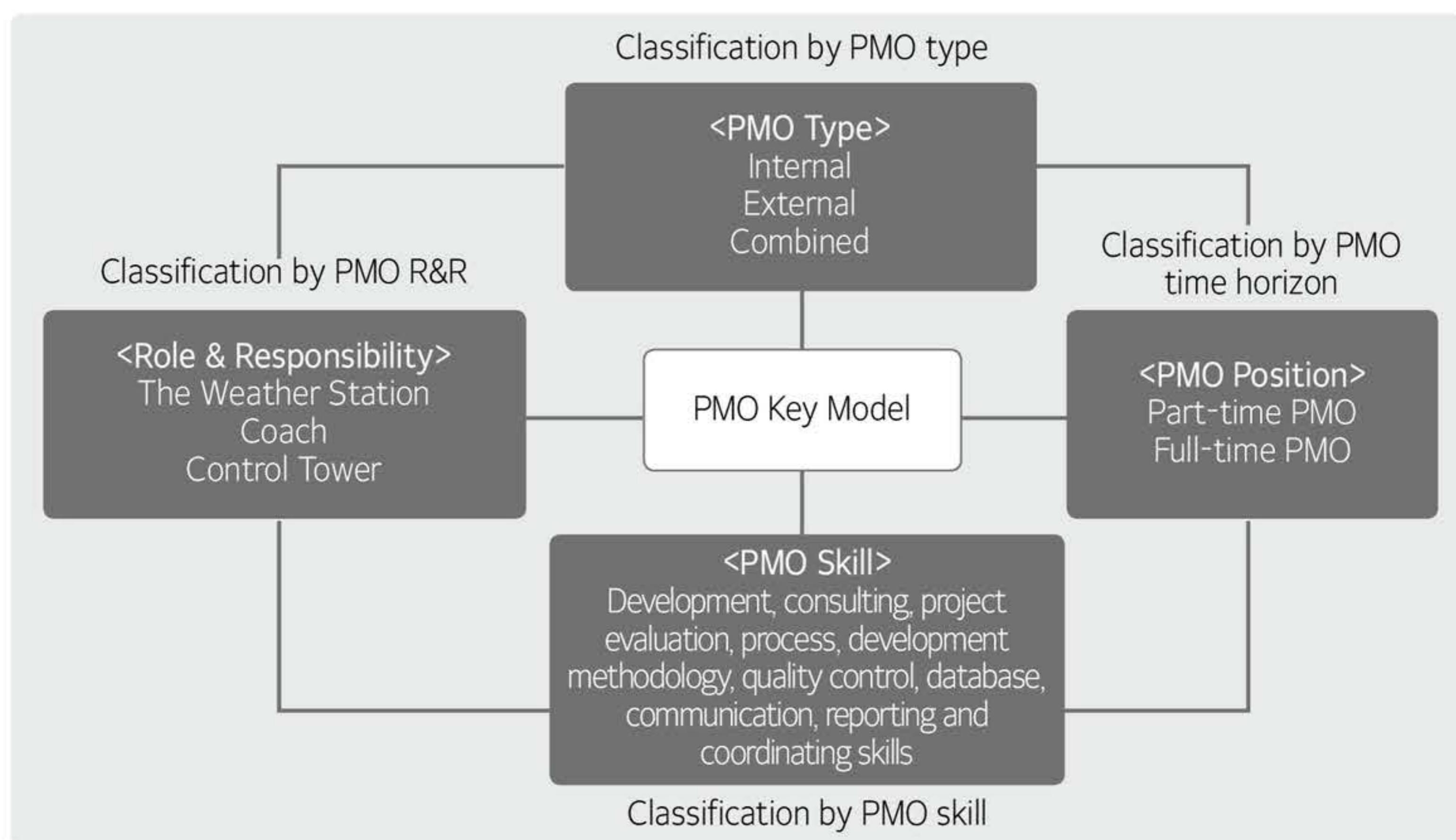
C) Project management office (PMO)

Many companies have thought about how to conduct an effective enterprise-wide project management for several decades. As a result, an organization dedicated to the project called the Project Management Office (PMO) has come into being.

In Korea, PMO functions as a system that entrusts persons with professional knowledge and technical skills to efficiently perform e-government projects in accordance with Article 64-2 “Entrustment of Management of

Electronic Government Projects" of Electronic Government Act. It plays the role of overseeing and the entire project, mediating issues, and consulting, from the standpoint of complementing the client's expertise. In the case of intangible informatization projects requiring a high level of credibility, PMO is needed for pre-diagnosis, thorough planning for each stage of the project, quantitative process management, periodic communication and quality assurance of outputs.

PMO can be classified according to the type, responsibility, and role of PMO, time horizon of the project, and skill division of PMs, into 4 types as follows.



[Figure 20] PMO Classification

① PMO Type

When the PMO organization is composed of internal project managers, it becomes an internal organization, an external organization if composed of external project managers, and a mixed type in case of skill mix.

② PMO Role & Responsibility (R&R)

As the PMO is affected by the corporate structure, it is classified into the weather station model that acts as a facilitator according to the roles and responsibilities of the project manager, the coach model that is responsible for guides and processes, and the control tower model that has a great influence on the overall responsibility and process for the project.

- Weather Station Model: Operated by a small number of professionals, secure and provide information only on progress, distribute project management knowledge, develop and disseminate methodology
- Coach Model: An extended concept of the weather station model, distribute the use of common methodologies and software tools within the organization, operate a community to relay communication between the project team, recording and monitoring project performance, and supplying project management experts
- Control Tower Model: Involved in all projects, deeply engaged in decision-making, the same methodology applied to all projects, centralized management, coordinate and determine resources to be put into the project

③ PMO Position

A project manager may be in charge of one project and manage it intensively, but one project manager may be in charge of two or three projects at the same time. If the person has full control, it is classified as a full-time type, and if multiple projects are managed together, it is classified as a part-time type.

④ PMO Skill

PMO is an organization made up of project managers, and individual project managers are experts in fields such as development, consulting, project evaluation, database, quality management, and development methodology. The technical type of the PMO organization is determined by the specialty of the project manager.



VIII. Project Process and Management

►►► Recent Trends and Major Issues

Project management process cannot be applied to all projects in a uniform manner. Appropriate project lifecycle and management processes should be applied according to the environment and conditions of the project. It is important to develop the ability to understand and apply agile processes that are actively applied recently.

►►► Learning Objectives

1. To be able to explain the life cycle of a project through project preparation and initiation.
 2. To be able to explain project management methodology.
 3. To be able to explain the concept of agile process and how to perform it.
-

►►► Concept summary

- Project life cycle: predictive life cycle, iterative life cycle, adaptive life cycle
- Project management process groups: initiating process group, planning process group, executing process group, monitoring and controlling process group, closing process group
- Project management methodology: PMBOK, ISO21500, PRINCE2
- Agile process types: Scrum, XP (eXtreme Programming), Kanban, Lean
- Agile process execution methods: Backlog, Burndown Chart, Scrum Master, Sprint, Retrospective, Daily Meeting

+ Preview for practical business

Project management methodologies and processes are influenced by the organizational structure or application method of the company.

The Waterfall methodology is a classical model to perform a project with one single sequence and can develop into an iterative or adaptive life cycle through overlapping or repetition of the sequence.

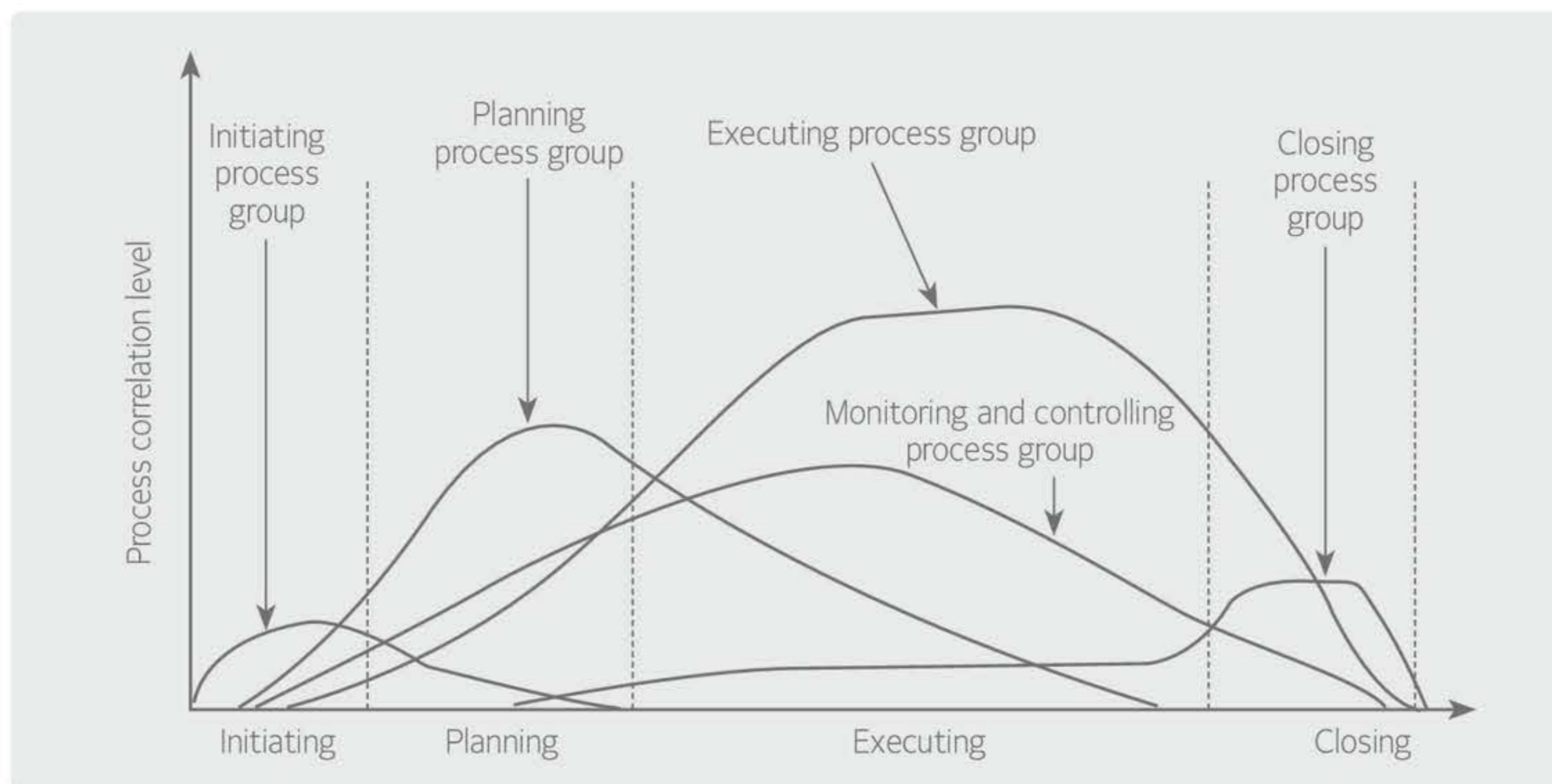
If the Waterfall methodology is based on planning, Agile is a value-oriented methodology. Scrum improves project productivity through active cooperation and communication between people rather than formalities.

In the domestic development environment, there are cases where it is difficult to apply Agile methodology in a vertical structure or a power imbalanced relationship between the acquirer and the supplier.

01 Project Life Cycle

A) Project life cycle

A project has a certain cycle, which is generally composed of five processes: initiating, planning, executing, monitoring and controlling, and closing, and if the project is stopped in the middle, the closing process is immediately executed.



[Figure 21] Correlation between Project Management Process Groups

The initiating, planning, executing, and closing process usually proceeds at each relevant stage, whereas the monitoring and controlling process is evenly conducted throughout the life cycle.

<Table 34> Project Management Process Groups

Process Group	Explanation
Initiating process	Formal project initiation, stakeholder identification, project manager appointment, project charter development
Planning process	All planning activities to achieve project goals and create outputs
Executing process	A process to complete the tasks defined in the project management plan.
Monitoring and controlling process	A process of tracking project performance and progress, and making adjustments
Closing process	A process to complete all activities including contractual obligations

The life cycle is the period from when a service or product is released until it is no longer used or retired from the market. The life cycle of a project refers to the period from initiating, planning, executing, monitoring and controlling, and closing of the project.

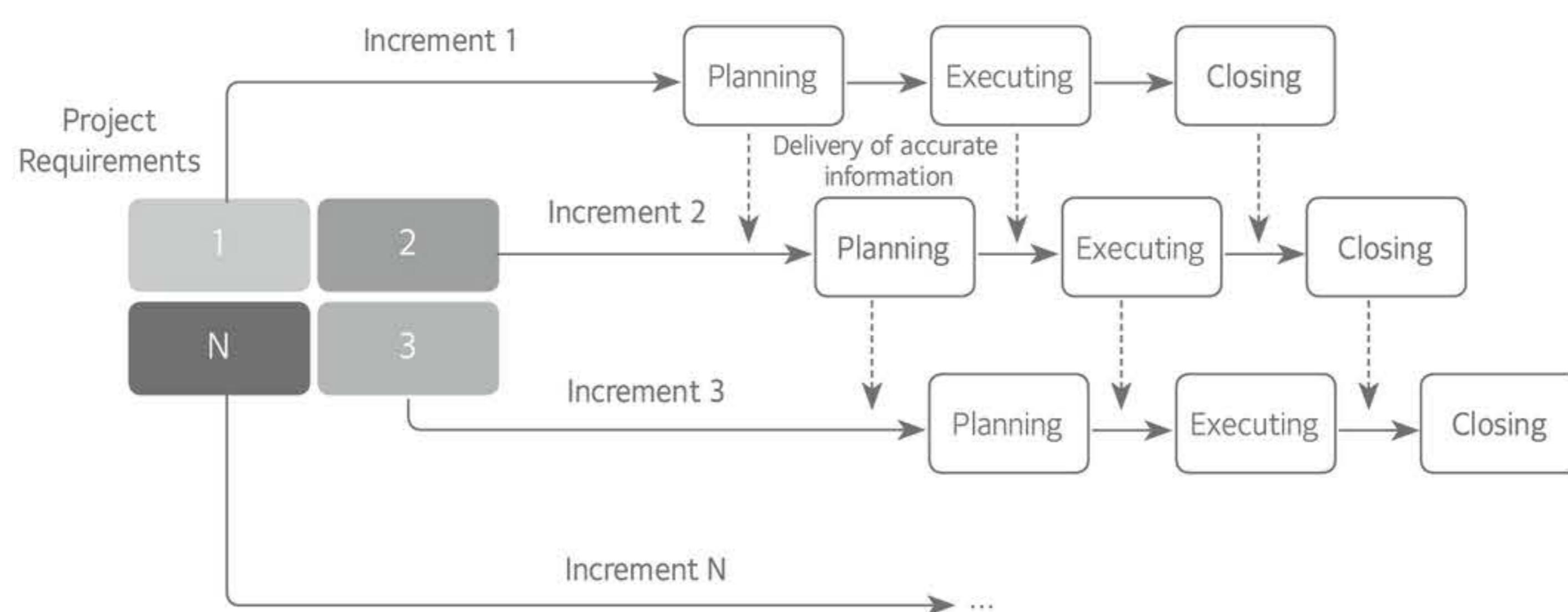
Project life cycle management is to approach project management in the systems engineering model. It is to facilitate the management of the entire project by dividing the life cycle into detailed stages, and systematically managing inputs, technologies, tools, and outputs for each stage. The life cycle simply describes the whole process by each step to prepare the basis for the systems engineering approach, and the methodology is a concrete specification of inputs, technologies, tools and outputs for each step.

The predictive life cycle is a planning-focused life cycle, and it is determined at the beginning of the project as knowledge about the project scope, schedule, and cost is accumulated empirically. It is mainly applied to

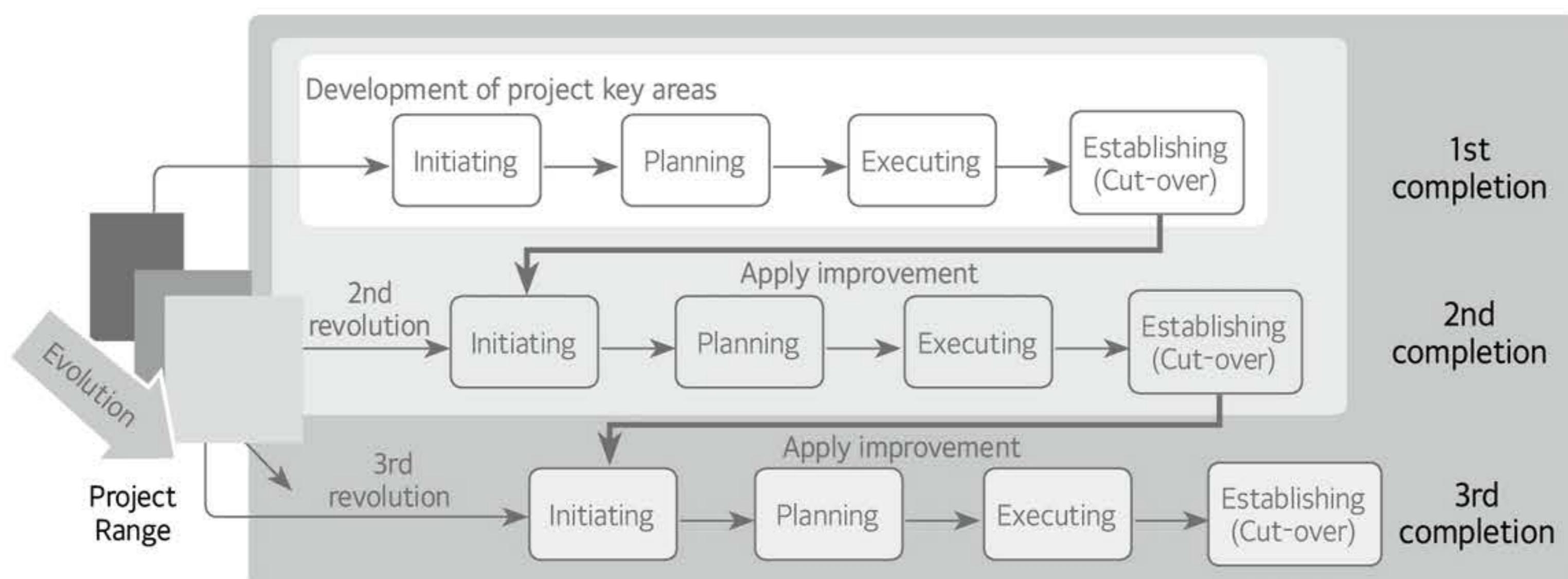
product development and architectural projects with much accumulated technology or experience. It is a cycle in which the entire scope of the project is defined at the initiating stage and the schedule and cost are carried out according to the plan.

The iterative life cycle is a model in which a product is divided into parts that are developed repeatedly to complete a final product. Iterative life cycles can be divided into incremental and evolutionary types.

- Incremental life cycle: The scope of the project is divided into multiple phases in which the activities of the project are run in parallel and overlapped gradually and repeatedly.
- Evolutionary life cycle: The project is divided into several phases, and the iteration itself proceeds sequentially.



[Figure 22] Incremental Life Cycle



[Figure 23] Evolutionary Life Cycle

The adaptive life cycle refers to an agile process that reacts promptly to external changes, and its purpose is to flexibly respond to changing requirements to fulfill the value of the project.

B) Project planning and executing

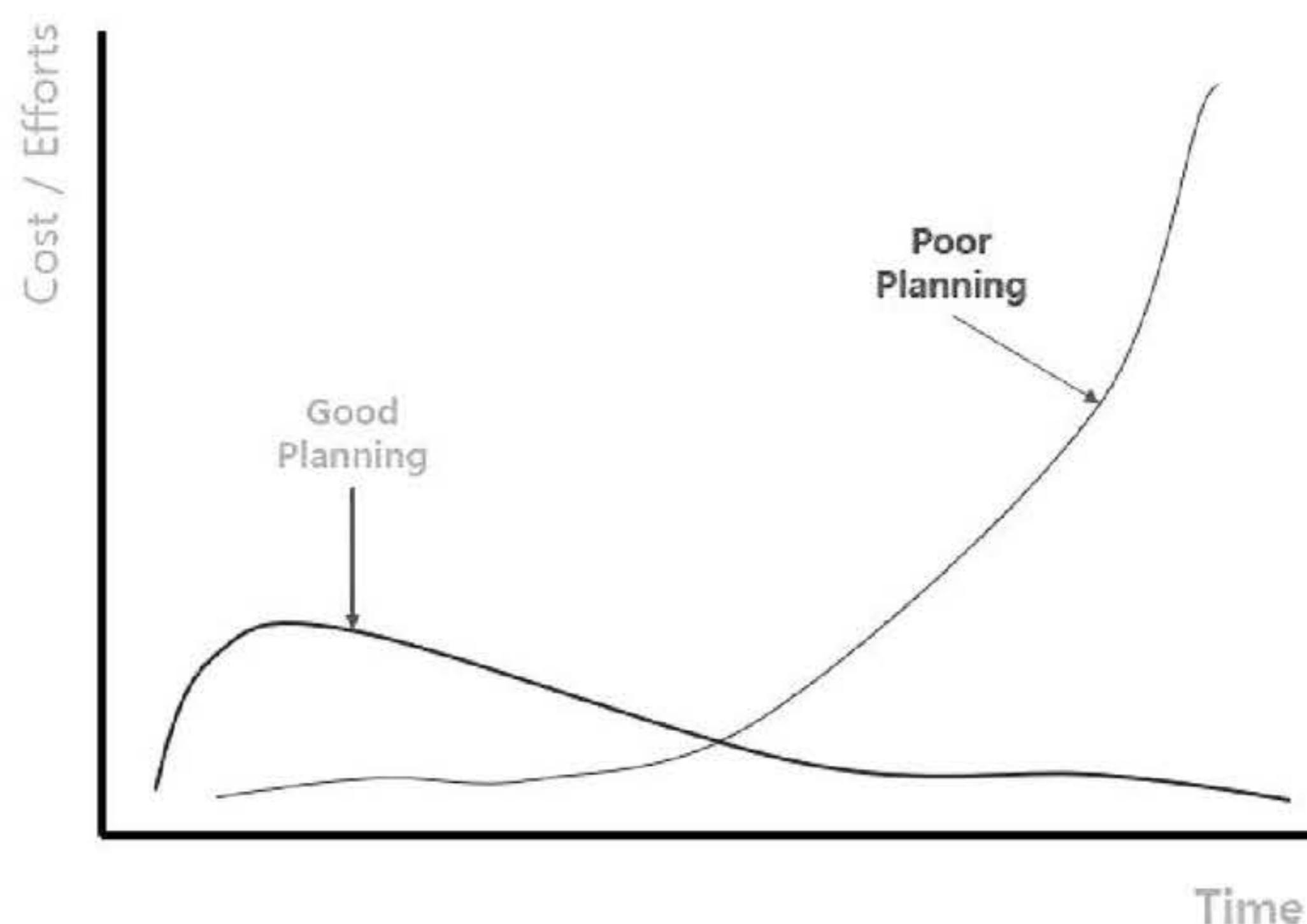
To briefly look at the stages before the project is contracted and commenced, it largely goes through the

planning, acquisition, and contracting stage.

In the planning stage, preliminary work such as feasibility analysis and budget planning of the project is carried out. In the acquisition stage, scope definition and Request For Proposal (RFP) are carried out, and if necessary, a RFP briefing can be held. Subsequently, in the contracting phase, the proposal submitted to select a business operator is evaluated, and the final business operator selection and contracting are conducted through technical negotiations.

When planning a new project, it is necessary to approve the unit project or program according to the portfolio under management to achieve the organization's enterprise-wide strategic goals. In addition, a high-level plan for the project should be reviewed by considering whether there is an integrated management program for relevant projects.

There is a Project Cost/Efforts Curve as shown below that demonstrates the importance of the initial project planning stage. If enough time is spent on planning in the early stages, unnecessary confusion can be avoided in the latter stages. This is because, if you predict various risks or issues that may occur during initial planning, and establish a response plan in advance, or a process for handling unexpected problems, you can respond effectively in case of various risks or issues that may arise in the project process. On the other hand, if the initial plan is poorly formulated and executed right away, the project may seem to be progressing quickly at first yet cause confusion at an exponential rate as it moves through the latter stages. Many projects neglect the initial planning stage and jump directly to the executing stage, resulting in a failure of the entire project.



[Figure 24] Project Cost/Efforts Curve

From the developer's point of view, a proposal is made in advance to initiate a project. A proposal is the act of writing and submitting a document to the acquirer to win the order based on the RFP from the acquirer. It contains the proposal outline, introduction of the proposing company, project execution and management. After the evaluation of the submitted proposal, if it is selected as the preferred bidder, the contract is concluded through technical negotiation, and the project begins.

02 Project Management Methodology

A) Project management methodology

Typical project management methodologies include PMBOK, ISO 21500, and PRINCE2.

The most representative PMBOK (Project Management Body of Knowledge) is a project management knowledge system published by the PMI (Project Management Institute), a non-profit project management organization in the United States. In September 2017, the 6th edition of PMBOK was released, which consists of five process groups: initiating, planning, executing, monitoring and controlling, and closing; 10 knowledge areas: scope, cost, schedule, quality, risk, communication, resources, procurement, and stakeholder management; and a total of 49 processes. In the 6th edition of PMBOK, the project manager's Talent Triangle (Technical Project Management, Leadership, Strategic and Business Management) was added. PMI operates the PMP (Project Management Professional) qualification system as the license of project management experts.

ISO 21500 is a project management standard established by ISO (International Standard Organization), an international organization for standardization. The overall content is similar to that of PMBOK.

Unlike PMBOK, PRINCE2 (PRojects IN Controlled Environments) is a structured project management methodology developed in the UK and mainly used in Europe and Australia, and a project management professional license. It consists of Seven Principles (Continued Business Justification, Learn From Experience, Defined Roles and Responsibilities, Manage by Stages, Manage by Exception, Focus on Products, Tailor to Suit Project Environment); Seven Themes (Business Case, Organization, Quality, Plans, Risk, Change, Progress); and Seven Processes (Starting Up A Project, Initiating A Project, Directing A Project, Controlling A Stage, Managing Product Delivery, Managing Stage Boundaries, Closing A Project). While PMBOK describes project management centered on the project manager, PRINCE2 deals with project management more practically, focusing on various participants and outputs in addition to the project manager.

The project management methodology defines the project life cycle and clarifies and manages inputs, tools and technologies, and outputs in detail through the systems engineering approach at each stage, to support the achievement of project goals using limited resources. Recently, Agile methodology as a flexible and practical approach to project management is garnering a lot of attention.

B) Agile methodology

Agile methodology is an adaptive model that continuously creates prototypes at regular intervals, adds and modifies requirements in a timely manner, compared to existing traditional methodologies based on thorough planning and explicit outputs.

The purpose and spirit of Agile methodology is well represented in the Agile Manifesto.

① Manifesto for Agile Software Development

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation

- Customer collaboration over contract negotiation
- Responding to change over following a plan

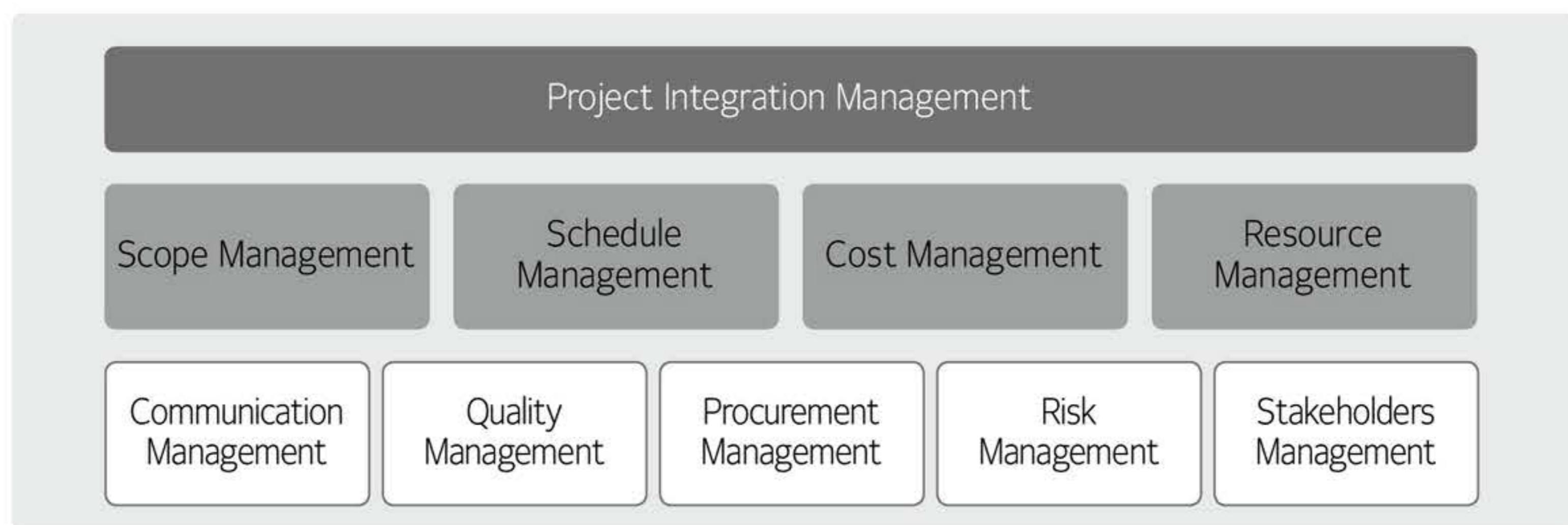
According to this agile spirit, various methodologies such as Scrum, XP, and Kanban emerged. Scrum, the most representative agile method, first appeared in 1995 when it was adopted in software development by Ken Schwaber and Jeff Sutherland. It is a mutually progressive development methodology for project management.

The Scrum process consists of sprint planning, daily scrum, sprint review, and sprint retrospective, and the main deliverables include product backlog, sprint backlog, and burndown charts.

Daily scrum meetings or sprint-level reviews are held to manage project quality through repetitive reviews. One of the most common deliverables is burndown charts.

C) Project management area

The PMBOK and ISO 21500 methodology is a framework of project management, which is divided into five process groups, 10 knowledge areas, and 49 detailed processes. The ten knowledge areas are shown in the figure below.



[Figure 25] Project Knowledge Areas

In addition to brief explanations for each knowledge area, the main knowledge areas such as scope management, schedule management, cost management, quality management, and risk management will be examined in detail from the next chapter.

<Table 35> Description of Knowledge Areas

Knowledge Area	Description
Project Integration Management	A key knowledge area that manages the processes and activities necessary to identify, define, and coordinate the processes and management activities within the project management process group.
Scope Management	A key knowledge area that manages the initiation activities of project planning and controlling, such as defining customer requirements with the sum of products and services provided through the project and designing WBS (Work Breakdown Structure)

Knowledge Area	Description
Schedule Management	A key knowledge area that develops a schedule by understanding the relationship between each activity, such as efficiently allocating resources and deriving project activities with the goal of completing the project within the time agreed with the customer
Cost Management	A key knowledge area that manages cost planning, calculation, budgeting, and controlling activities to complete a project within the approved budget.
Resource Management	A knowledge area that manages a series of activities performed in order to properly secure the resources available to the project and put them to use in a timely manner
Communication Management	A knowledge area that manages a series of activities performed to create, collect, store, distribute, control, and monitor project information requirements to stakeholders
Quality Management	A knowledge area that manages a series of activities related to quality planning, quality assurance, and quality control to meet the requirements of the project in progress
Procurement Management	A knowledge area that manages a series of activities including procurement contract, change control, and contract closing for products and services procured from outside for a project
Risk Management	A knowledge area that manages a series of activities that identify, analyze and respond to possible risks in the project and increase the likelihood of success of the project
Stakeholder Management	A knowledge area that manages a set of activities that identify all people or organizations that influence the project and develops strategies to effectively manage their expectations or interests.



IX. Scope Management

►►► Recent Trends and Major Issues

The biggest cause of project failure is scope change caused by repetitive requirements changes. Frequent scope change in and after mid-project delays the schedule, which in turn leads to higher costs such as hiring or paying overtime. For the successful execution of a project, it is necessary to understand the scope management process that collects requirements and defines, verifies and controls scope.

►►► Learning Objectives

1. To be able to explain the concept and process of scope management.
 2. To be able to explain the concept of Work Breakdown Structure (WBS).
-

►►► Keywords

- Scope management process: Scope management plan formation, requirements collection, scope definition, work breakdown system creation, scope validation, scope control
- WBS techniques: Segmented, integrated planning
- WBS components: Work Package, Code of Account, WBS Dictionary

⊕ Preview for practical business

Often, the work breakdown structure (WBS) is misunderstood as a schedule management output or tool. This is because it is used to track progress of a project as the start and end dates are specified in the work package (the lowest unit of work), which is a component of the WBS. Moreover, it is not unusual to think that WBS exists for schedule management as the commonly used schedule management tool of Microsoft has a structure that manages the schedule with WBS uploaded in the form of a file.

However, it is clear that WBS is a deliverable of scope management because it is included as “Create WBS” in PMBOK (Project Management Body of Knowledge) of PMI (Project Management Institute).

Then, why is it important to distinguish “whether WBS is a deliverable of scope management or schedule management.” This is because WBS plays a very important role in scope management. When scope changes in a project, i.e. when requirements change or are added, the first thing to look at is the WBS. If you are aware that WBS is used for managing changes, you can manage any related elements from schedule, cost, and to quality all at once.

From now on, let's use WBS as a tool for scope management rather than schedule management!

01 Concept and Process of Scope Management

A) Concept of scope management

The first of the three important knowledge areas in project management is scope management. Since a project is a unique, temporary, and goal-driven activity, it is important to have a clear goal and scope to make it successful.

In a project, it is necessary to do what needs to be done and exclude anything that is unnecessary, even if demanded by the client. As a project manager, the first thing to do is to clarify and define the scope of his or her work.

The scope is “the sum of products and services provided through the project” and means the range of work or the work itself required to successfully complete the project. The scope is divided into project scope and product scope.

- Scope = project scope + product scope

Project scope refers to all the work required to create products, services, and outputs of specified features and functions. The product range refers to the features and functions of the product distinguished from other products, services, and outputs. The project scope is about how products and services are provided, that is, the HOW aspect, and the product range is about the product and service itself, that is, the WHAT aspect. The criteria for determining whether the scope is complete differs for each project scope and product scope. The completion of the project scope is measured based on the project plan, and the completion of the product scope is measured based on the product requirements.

B) Scope management process

The scope management process proceeds in the order of scope management planning, requirements collection, scope definition, work breakdown system (WBS) formation, scope validation, and scope control.

① Scope Management Planning

- Concept of Scope Management Planning

Project scope refers to tasks necessary for project execution in order to deliver products and services, which are the final products of the project, to customers, and project scope management is a process to develop a project scope management plan to define, confirm, and control the project scope.

- Project Scope Management Plan

The project scope management plan defines the process to be carried out by the project stage and the level of execution of each process. The main items of the project scope management plan are as follows, and the scope plan should be shared between the client and the service provider.

- A procedure to describe project scope
- How to formulate Work Breakdown System(WBS)
- Verification and validation criteria for outputs to be delivered to customers
- Explanation on the format and procedure to request for scope change

② Collect Requirements

In a project on the ground, it is important to find out what the customer needs and why they think they need it. The following is an example of the development of an F-16 fighter jet in the 1970s on why collecting requirements is so important.

At the time, the F-16 fighter aircraft was required to fly at a speed of Mach 2.5. However, the fighter jet, by design, was not able to reach the speed above Mach 2. The designer of the fighter jet asked the U.S. Air Force to clarify the speed requirement as to why and received a response from the U.S. Air Force that it was to improve engagement capabilities. The designer thought that it would be possible to improve maneuverability rather than speed to enhance engagement capabilities, and applied fly-by-wire, integrated canopy, digital avionics, etc., ultimately meeting the requirement of “improving engagement capabilities”.

On the other hand, there were cases of Soviet military aircraft at the time. Soviet fighter jets were required to be the fastest in the world. The fighter aircraft built to fly at a speed of Mach 3.25 was too fast to be shot down from outside, but as being too expensive, short-lived and poorly suited for combat, it was retired early in 1980.

The Collect Requirements process focuses on what needs to be developed. Of course, "What" is important, but understanding the "Why it needs to be developed" is more important. That way, you can avoid unnecessary development and focus more on what's important.

③ Scope Definition

Scope definition is a process of identifying the key scope of the project after requirements collection and defining the scope based on a common understanding of the business functions to be included in the project. Scope definition is a process of formulating detailed scope statements for projects and products. The scope statement specifies the criteria for outputs and delivery, and includes characteristics such as exclusions, constraints, and assumptions. In other words, it is an activity that clearly distinguishes the boundaries of the project scope from others.

The requirements for scope definition are as follows:

- Clear Scope: The project scope must be clearly defined. Being clear means that it is not interpreted differently from person to person. Clarity is fundamental to other requirements: being complete, agreed-upon, and manageable.
- Complete Scope: Being complete means that there should be no missing, excessive, or overlapping parts.
- Agreed-upon Scope: Opinions on the scope often vary depending on the stakeholder. The problem is that if there is a disagreement of stakeholders on the scope of the project during project execution, the process of coordinating it causes various side effects. Therefore, the entire scope of the project must go through a process of collecting opinions of all stakeholders and reaching a consensus before execution.
- Manageable Scope: WBS provides a basic framework for other plans. Therefore, if the scope is not defined to be manageable, it becomes difficult to incorporate plans from other areas such as schedule, budget, etc. The term "manageable" specifically means the following:
 - Duration and cost are accurately estimated.
 - The person in charge is designated.
 - Performance is evaluated realistically.

④ Work Breakdown Structure Formulation

WBS is an output created by decomposing deliverables and the entire scope of the project into manageable components. WBS creation can be regarded as the most important not only for scope management, but also among the entire project activities. By breaking down the tasks to be accomplished by the project team and defining the deliverables for each stage of execution, it is possible to prevent missing tasks, identify the relationship between tasks, and consistently communicate with stakeholders and sponsors.

⑤ Scope Identification

Scope identification is the process of confirming approval with the client or the project leader for deliverables to be handed over to the client. For official validation of the project scope, inspection and technical review by the project team are conducted to identify defective products, specifications and standards and the confirmed results are derived as outputs.

- Inspection

It is an act to measure, examine, and confirm performance to check whether the tasks and deliverables meet

the requirements and criteria for delivery. Examples of official inspection include Review and Walkthrough.

⑥ Scope Controlling

It is the process of monitoring project status and product range and managing them according to formal procedures.

It makes sure that requested changes, recommended corrective actions, and preventive actions are processed throughout the project. Requests for changes to the baseline scope made through scope definition in the project design and analysis stage are frequent in practice. Since scope changes are closely related to schedule and cost, they should be reported to the Project Change Control Board (CCB), reviewed for their impacts throughout the project, and approved and processed according to formal procedures.

02 Scope Management Technique

A) Work breakdown structure (WBS)

A work breakdown system is created, in general, for scope management. In order to design work breakdown system, customer requirements must be collected, and the requirements definition document must be prepared.

Requirements are generally gathered in the following ways.

<Table 36> Scope Management Techniques

Technique	Explanation
Interview	<ul style="list-style-type: none"> A systematic approach to derive requirements through an oral interview with individuals and groups
Prototyping	<ul style="list-style-type: none"> A technique to promptly and schematically build a system to be developed in full or part Prototyping is better than specification to enhance the understanding of and feedback from users
Moderator meeting	<ul style="list-style-type: none"> A technique to generate ideas for specific products, services and opportunities for improvement The moderator ensures to achieve intended goals by faithfully implementing the pre-defined contents for specific issues when conducting group discussions
Document analysis	<ul style="list-style-type: none"> A technique to derive system requirements by examining documents and related data on the existing system Analysis of business plans, market research results, contract details, RFP, SOW, related records, existing business guides/procedures, training materials, documents related to similar products, problem reports, customer proposal records, and existing system design documents

① Concept of Work Breakdown Structure (WBS)

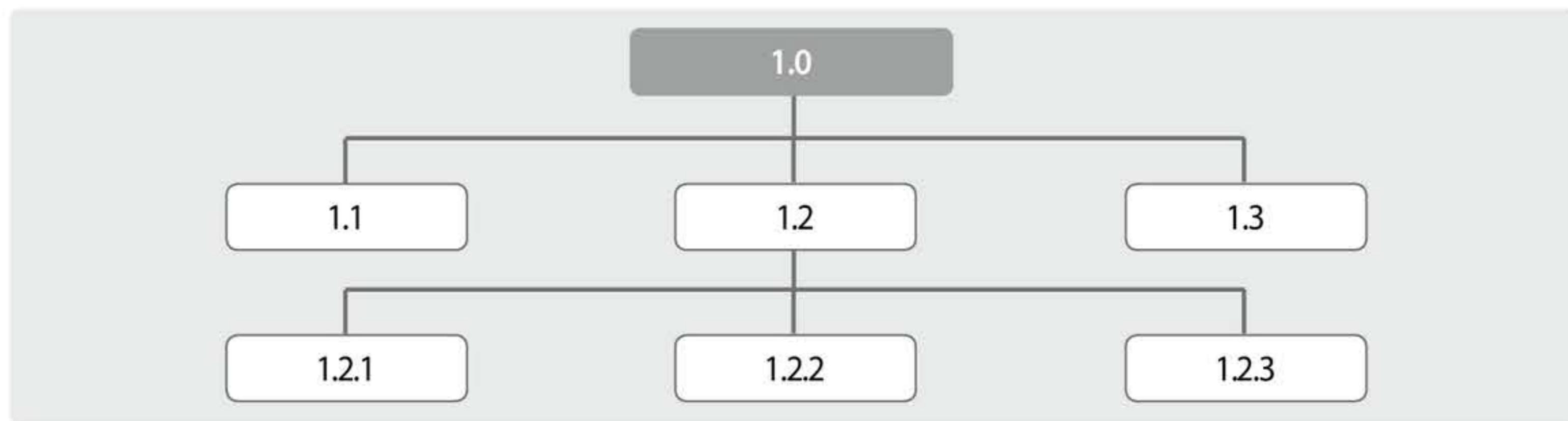
The work breakdown system is a hierarchical structure of tasks that are classified based on project deliverables and broken down into manageable packages. Each subtask item in the work breakdown system is called a work package. For example, a project that creates an online bulletin board can be divided into work packages of “Writing”, “Deleting”, “Editing”, and “Uploading”. The following is an example of WBS created by Microsoft Project.

Hierarchical Classification						
Work mode	Work name	Period	Starting date	Finish date	Preceding work	Resource name
	The Bulletin Board for IT Competency Index Project	19 days	13/07/25 (Thurs.)	13/08/20 (Tues.)		
	Create a bulletin board	19 days	13/07/25 (Thurs.)	13/08/20 (Tues.)		
	Write text	5 days	13/07/25 (Thurs.)	13/07/31 (Wed.)		Kim Jisim
	Delete text	2 days	13/08/01 (Thurs.)	13/08/02 (Fri.)	3	Kang Jeongbae
	Modify text	2 days	13/08/05 (Mon.)	13/08/06 (Tues.)	4	Kim Seonhwa
	File upload	10 days	13/08/07 (Wed.)	13/08/20 (Tues.)	5	Lee Hongcheol

[Figure 26] Example of WBS (building an online bulletin board)

② Structure of Work Breakdown Structure (WBS)

A tree diagram is the most common structure of WBS. It arranges components in a parent-to-child relationship, which facilitates an intuitive understanding of the hierarchy.



[Figure 27] Structure of Work Breakdown Structure (WBS)

③ Components of Work Breakdown Structure (WBS)

The elements of the work breakdown system include Work Package, Code of Account, WBS dictionary, and RAM, and their explanations are as follows:

<Table 37> Components of Work Breakdown Structure (WBS)

Component	Explanation
Work Package	<ul style="list-style-type: none"> The lowest-level unit of the work breakdown structure for which cost and duration can be planned, estimated, monitored and controlled
Code of Account	<ul style="list-style-type: none"> A unique identification or numbering system in which unique numbers are assigned to each unique work package of the work breakdown structure
WBS Dictionary	<ul style="list-style-type: none"> A detailed description of each work package (outline, schedule, person in charge, budget)
RAM(Responsibility Assignment Matrix)	<ul style="list-style-type: none"> It serves as a standard for who is responsible for each element, such as the approver at each stage, quality reviewer, and input manager

④ How to Create a Work Breakdown Structure (WBS)

The work breakdown structure is broken down into small, manageable work packages to identify key deliverables and tasks described in the scope statement.

<Table 38> How to Create a Work Breakdown Structure (WBS)

Principle	Explanation
Deliverable-based	<ul style="list-style-type: none">• Focused on tangible deliverables in order to control and manage the scope of work
Manageable	<ul style="list-style-type: none">• The lowest unit of WBS is usually divided into a duration of around 80 hours (2 weeks) in order to facilitate the control of work performance.
Detailed segmentation	<ul style="list-style-type: none">• Subdivided into units that can be processed usually within 1-2 weeks by project members
Hierarchical representation	<ul style="list-style-type: none">• Defined in a way to understand sequential relationships or correlations of each WBS



X. Schedule Management

►►► Recent Trends and Major Issues

If you are overconfident about resource capacity for scheduling, it is difficult to comply with the delivery date of the project, if the schedule is delayed in the latter half of the project. Therefore, the product schedule should be based on the scope of requirements and the capacity of resources.

►►► Learning Objectives

1. To be able to explain the concept and process of schedule management.
 2. To be able to explain schedule management techniques.
 3. To be able to explain schedule compression techniques.
-

►►► Keywords

- Schedule management process: schedule management planning, activity definition, activity sequencing, activity resource estimation, activity duration estimation, schedule development, schedule control
- Activity duration estimation techniques: one-point estimating, three-point estimating, analogous estimating, parametric estimating, expert judgment
- Schedule management techniques: Critical Path Method (CPM), Critical Chain Method (CCM)
- Compression Techniques: Crashing, Fast Tracking

+ Preview for practical business

One of the characteristics of the project is that “it has the beginning and the end”, which means that “there is a fixed timeline” or “a delivery date”. In other words, as time precisely heads toward the delivery date, it is necessary not only to work efficiently work in the project execution process, but also to minimize errors or unnecessary work.

Nevertheless, there are cases in which the delivery date of the project is delayed, resulting in a “project failure”.

Accordingly, an approach to systematically manage the schedule is being adopted, and one is to break down the project schedule into smaller units and repeat them to fulfill the schedule. In other words, you adjust the schedule according to the situation while estimating the future schedule based on the tasks already completed. This concept is nothing new but has become more necessary as market competition intensifies or technical development diversifies.

One example is the Agile Process, which is based on rapid and iterative development through XP (eXtreme Programming) or Scrum. In other words, a short schedule of developing part of the whole is called a “sprint”, and these sprints are performed several times to increase the degree of completion. At the end of the sprint, there is a procedure called “retrospective” to allow participants to communicate in a free atmosphere and to realistically adjust future plans.

01 Concept and Process of Schedule Management

A) Concept of schedule management

① Schedule

A schedule is a display of the start and finish dates of each of the activities that make up the project and can be expressed in various formats such as tables, graphs, and network diagrams.

However, the date information displayed in the schedule is determined based on a comprehensive analysis of the duration, sequential relationships, human and physical resources required of the activities, input costs, the uncertainty of the project progress, and the working conditions. It is distinct from the timetable for a simple goal.

② Importance of Schedule

The schedule is distinguished from the timetable as it describes in a logical manner the factors that affect the overall project execution time and cost, such as the dependency between activities and the type and quantity of resources required for each activity, in addition to the arbitrary relationship between work and time. Writing a schedule is important as it functions as follows:

- Useful planning: you can set a feasible timeline by reasonably estimating the duration of the project.
- A bird's eye view of the project: you can get a full understanding of what the project is and how it is executed. In addition, the completed schedule is a good tool to explain the project team's plans to stakeholders such as clients and the management.
- Effective control: resources can be concentrated by identifying areas that need intensive management through schedule analysis.
- Effective communication: the schedule itself expresses a lot of information about the project. Thus, a well-written schedule allows for effective communication.

③ Format of Schedule

Schedules can take many formats. The most common schedule formats in project management are as follows.

<Table 39> Pros and Cons of Each Type of Schedules

Schedule Format	Pros and Cons
Network schedule	<ul style="list-style-type: none"> • Illustrate the relationship between activities. • Used for project planning.
Gantt chart	<ul style="list-style-type: none"> • Effective representation of the progress of each activity • Mainly used for reporting to management
Milestone chart	<ul style="list-style-type: none"> • Describe merely whether and when milestones are executed • A milestone is an important checkpoint of a project with zero duration. • The most simplified form of schedule • Suitable for summary-level reporting to clients and management.

④ Definition of Schedule Management

Schedule management is the process of efficiently allocating resources, defining project activities, identifying

the relationship between each activity to develop a schedule, with the goal of completing the project within the time agreed with the client.

If the finish date has already been specified, the schedule management process is ignored, and the schedule is planned in a top-down manner, the activities to be performed will be determined based on the project timeline. The schedule may get tight as the correlation between each activity is neglected and it is divided by weighting each stage of the project, which can eventually fall into a vicious cycle. Project schedule should be feasible and planned in consideration of scale and resource capacity.

B) Schedule management process

The schedule management process includes project schedule management planning, activity definition, activity sequencing, activity duration estimation, schedule development, and schedule control. The existing activity resource estimation process has been moved to the knowledge area of resource management in the PMBOK 6th edition.

① Schedule Management Planning

For schedule management planning, a project schedule management plan is formulated. A detailed plan is made by sharing the project management plan, project approval, and rules for measuring the project schedule with the team members.

In addition, as the project schedule management plan is an important deliverable for quality control or supervision, any change in the confirmed schedule requires an approval from the project steering committee and the plan must be updated and kept in a record.

② Definition of Activity

It is a process of identifying and documenting the relevant activities to be performed to produce the project deliverables. The project teams define the activities based on the project scope and requirements statement. Since it is difficult to define all activities at the beginning of the project, the project activities are elaborated in a repetitive and incremental manner through division and Rolling Wave Planning based on the work breakdown system (WBS).

③ Sequencing of Activity

It is a process of identifying the relationship between subdivided activities and connecting them in a logical order.

The logical relationship between activities is divided into the following types:

<Table 40> Logical Relationship between Activities

Item	Content	Case
Finish-to-Start Relationship	<ul style="list-style-type: none"> A Successor Activity cannot start until a Predecessor Activity has finished. The most commonly used 	<ul style="list-style-type: none"> Develop a product after screen design
Finish-to-Finish Relationship	<ul style="list-style-type: none"> A Successor Activity cannot finish until a Predecessor Activity has finished 	<ul style="list-style-type: none"> Analysis is completed only when writing and deletion of a text are completed
Start-to-Start Relationship	<ul style="list-style-type: none"> A Successor Activity cannot start until a Predecessor Activity has started. 	<ul style="list-style-type: none"> Development activities can be initiated only when planning begins

Start-to-Finish Relationship	<ul style="list-style-type: none"> A Successor Activity cannot finish until a Predecessor Activity has started 	<ul style="list-style-type: none"> In case of three-shift work, B (successor activity) can take turns and leave work only when A (preceding activity) comes to work
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④ Estimation of Activity Duration

Activity duration estimation is a process of estimating the time it will take to perform each activity with the allocated resources. The estimation method is as follows:

<Table 41> Characteristics of Activity Duration Estimation Methods

Estimation Method	Characteristics and Explanation
Expert Judgment	<ul style="list-style-type: none"> A method that a resource estimation expert uses internal or external resources with similar experience to calculate the resources to be put into the activity.
Analogous Estimating	<ul style="list-style-type: none"> A method of estimation by referring to similar projects performed in the past
Three-point Estimating	<ul style="list-style-type: none"> Risk-based estimation technique Estimate the beta average of Optimistic value, Most Likely value, Pessimistic value Commonly used in case of lack of experience

Expert Judgment and Analogous Estimating are common methods used by practitioners and those with extensive experience in the field. Three-point Estimating is a method of measuring the optimistic, pessimistic, and most likely values for each activity in consideration of risks, which allows more accurate estimation. The term “Three-point” has the following meanings:

- Optimistic, O: the best-case estimate, the shortest duration
- Most likely, M: the most likely estimate, the average duration
- Pessimistic, P: the worst-case estimate, the longest duration

In the three-point estimation method, the most likely estimate receives a multiplier of 4 to come up with the final estimate of an activity. If an activity takes 4 days to be optimistic, 10 days to be pessimistic, and 6 days to be the most likely, the duration of the activity using the three-point estimation method is calculated as $(4+4*6+10)/6 = 6.3$ days.

$$\text{Average} = \frac{(P + 4M + O)}{6}$$

The three-point calculation formula is derived from the existing PERT (Program Evaluation and Review Technique) technique. PERT is a technique developed by Booz Allen Hamilton in 1958 for the U.S. Navy Special Projects Office to track and manage the progress of the Polaris nuclear submarine project. It is widely used in new projects and is an analytic technique that supports predicting the project schedule in consideration of various risk factors and fluctuations.

⑤ Schedule Development

Schedule development is a process of creating a project schedule by analyzing the sequence of activities, the estimated duration, resource requirements, and schedule constraints.

Work name	Period	Starting date	Finish date	Completion rate	Preceding work	Resource name
The Bulletin Board for IT Competency Index Project	24 days	13/07/25 (Thurs.)	13/08/27 (Tues.)	15%		
Create a bulletin board	24 days	13/07/25 (Thurs.)	13/08/27 (Tues.)	15%		
Analysis	19 days	13/07/25 (Thurs.)	13/08/20 (Tues.)	24%		
Write text	5 days	13/07/25 (Thurs.)	13/07/31 (Wed.)	90%		Kim Jisim
Delete text	2 days	13/08/01 (Thurs.)	13/08/02 (Fri.)	0%	4	Kang Jeongbae
Modify text	2 days	13/08/05 (Mon.)	13/08/06 (Tues.)	0%	5	Kim Seonhwa
File upload	10 days	13/08/07 (Wed.)	13/08/20 (Tues.)	0%	6	
Design	19 days	13/08/01 (Thurs.)	13/08/27 (Tues.)	0%		
Writing screen design	2 days	13/08/01 (Thurs.)	13/08/02 (Fri.)	0%	4	Kim Jisim
Delete text	1 days	13/08/05 (Mon.)	13/08/05 (Mon.)	0%	5	Kang Jeongbae
Modify text	1 days	13/08/07 (Wed.)	13/08/07 (Wed.)	0%	6	Kim Seonhwa
File upload	5 days	13/08/07 (Wed.)	13/08/27 (Tues.)	0%	7	Lee Hongcheol
Coding				0%		Park Jieon
Test				0%		Park Jieon
Release				0%		Park Jieon

	13/07/28	13/08/04		13/08/11	13/08/18	
Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	
	Manual work			Period	10d	Kim Jisim
	Work	File upload				Kang Jeongbae
	Start work	13/08/07(Wed.)				Kim Seonhwa
	Finish work	13/08/25(Tues.)				Lee Hongcheol

[Figure 28] Example of Project Schedule (Gantt chart)

⑥ Schedule Control

Schedule control is a process of changing and managing the schedule of a project while monitoring the status of project activities to accomplish the plan.

Schedule control focuses on the following:

- Determine the current status of the project schedule
- Adjustment of factors causing schedule change
- Determine whether the project schedule has changed
- Management of changes that actually occur

In an agile project methodology, schedule control focuses on the following:

- Determine the current status of the project schedule by comparing the total amount of work received and delivered with the estimated work completed in the elapsed time period
- Perform a retrospective review to correct the process (review scheduled to record lessons) and make an

improvement if necessary

- Reprioritization of remaining tasks (backlog). Determining the rate at which deliverables are produced, verified, and accepted at a given time per iteration (pre-agreed work cycle, typically two weeks or one month).
- Determine whether the project schedule has changed
- Management of changes that actually happen

02 Schedule Management Technique

A) Schedule development technique - critical path method (CPM)

The critical path method is a network analysis technique used to determine the minimum duration of a project. It is a technique of finding the path that determines the minimum duration of the project among many, that is, the critical path. The critical path technique is known as Critical Path Method.

The critical path is the minimum path connecting activities with “Zero” float. Using a Project Schedule Network Diagram as an input, you take into account the sequence of activities, duration, dependency, lead, and delay and conduct Forward Pass and Backward Pass analysis to calculate Early Start(ES), Early Finish(EF), Late Start(LS) and Late Finish(LF).

<Table 42> Components of Critical Path Method

Component	Characteristics and Explanation
Forward Pass	<ul style="list-style-type: none"> • A method of deriving the expected finish date based on the project start date from duration of and the relationship between tasks • Calculate Early Start (ES), Early Finish (EF)
Backward Pass	<ul style="list-style-type: none"> • A method of deriving the start date based on the project finish date from duration of and the relationship between tasks • Calculate Late Start (LS), Late Finish (LF)
Early Start	<ul style="list-style-type: none"> • ES, Early Start • The earliest date an activity can possibly begin
Early Finish	<ul style="list-style-type: none"> • EF, Early Finish • The earliest date an activity can possibly finish
Late Start	<ul style="list-style-type: none"> • LS, Late Start • The latest date an activity can start, without delaying the finish of the project.
Late Finish	<ul style="list-style-type: none"> • LF, Late Finish • The latest date an activity can finish, without delaying the finish of the project.
Total Float	<ul style="list-style-type: none"> • Total Float • The amount of time that an activity can be delayed or extended without delaying the project finish date • $\text{Total Float} = \text{Late Finish (LF)} - \text{Early Finish (EF)} = \text{Late Start (LS)} - \text{Early Start (ES)}$

In order to calculate the schedule by hand using the critical path method, the activity is expressed as follows.

ES	Duration	EF
Activity Name		
LS	Float	LF

[Figure 29] Expression of an Activity

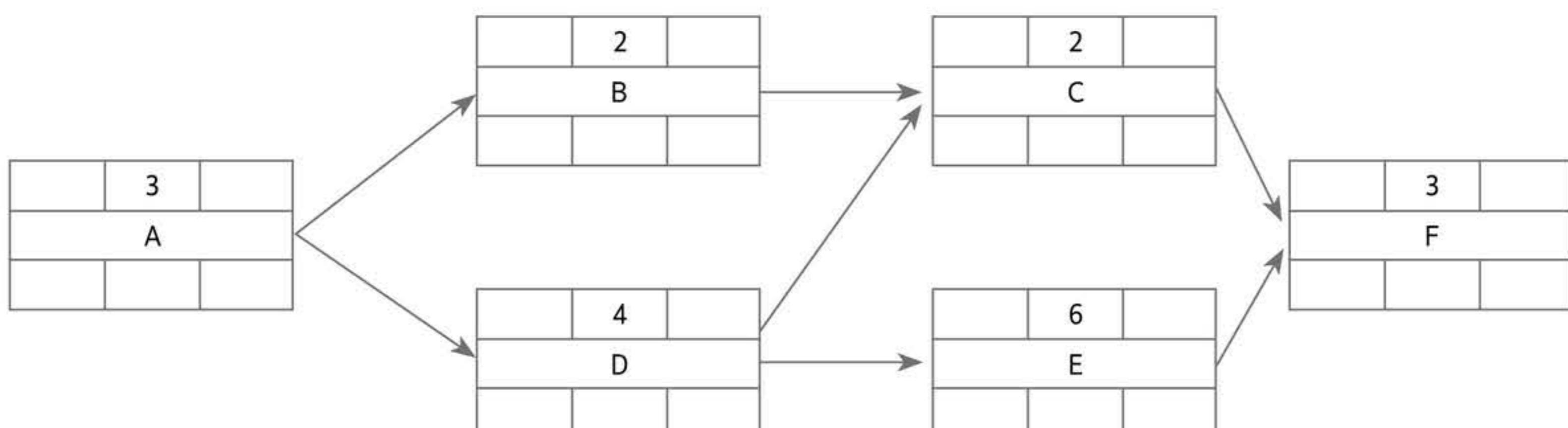
The following is an example of calculating a schedule using the critical path method. The critical path method will be described in detail through the example below.

<Table 43> Critical Path Method (Example)

Activity Name	Duration	Predecessor Activity
A	3 days	
B	2 days	A
C	2 days	B, D
D	4 days	A
E	6 days	D
F	3 days	C, E

① Activity Definition, Duration Estimation

If the activities of the project are defined and the duration of each activity is estimated, the activities are linked according to the sequential relationship as follows. Arrange the identified activities according to the sequential relationship and enter the activity name and duration.



[Figure 30] Critical Path Method① (Example)

In the case of the activity name "B", it is placed after the activity "A" because the Predecessor Activity is "A", and the duration of the activity "B" is 2 days, so enter 2 in the "Duration". Likewise, for all other activities, predecessor activities are identified and arranged in order, and the duration of the activity is written at the top of the activity name.

② Forward Scheduling

The Early Start (ES) and Early Finish (EF) of each activity are calculated, and the formula is as follows:

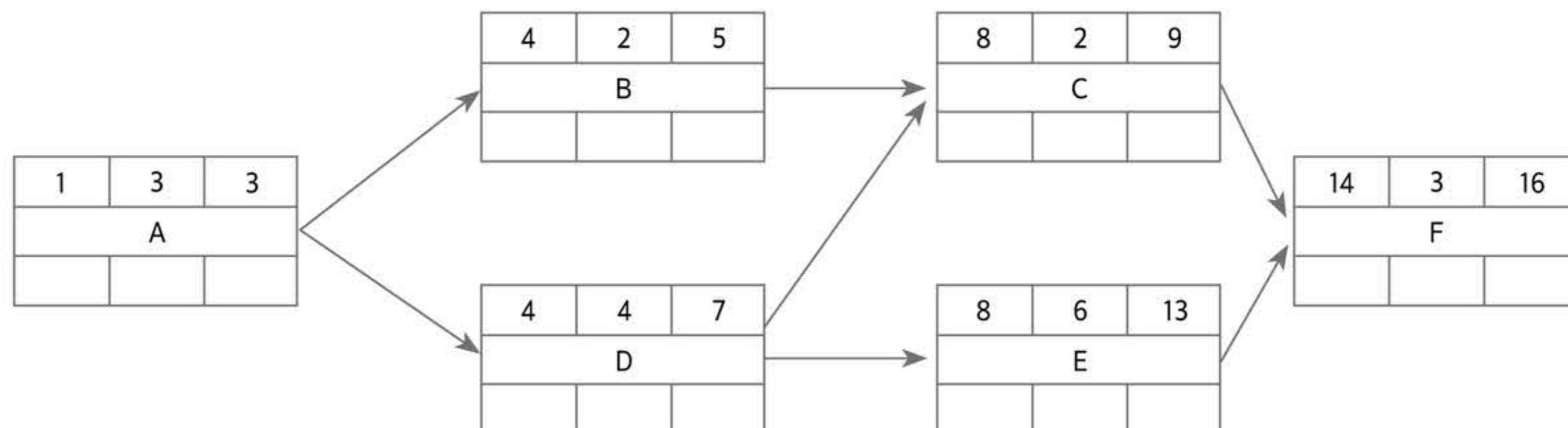
- $ES = EF \text{ of immediate predecessor activity} + 1$
- $EF = ES \text{ of activity} + \text{activity duration} - 1$

<Table 44> Result of Forward Scheduling by Activity

Activity Name	ES (Early Start)	Duration	EF (Early Finish)
A	1	3	3(1 + 3-1)
B	4(3 + 1)	2	5(4 + 2-1)
C	6(5 + 1) 8(7 + 1)	2	9(8 + 2-1)
D	4(3 + 1)	4	7(4 + 4-1)
E	8(7 + 1)	6	13(8 + 6-1)
F	14(13 + 1)	3	16(14 + 3-1)

For Activity “A”, there is no EF of predecessor activity, so ES starts with 1.

In the case of Activity “C”, there are two predecessor activities: “B” and “D”. In this case, as Activity “C” can be started after both “B” and “D” activities are finished, the EF of the immediate predecessor activity used in the ES calculation is 7, which is the EF of Activity “D”, which is then added with one to become eight ($7 + 1 = 8$). After calculating all ES and EF for each activity, fill in as shown in the figure below.



[Figure 31] Critical Path Method② (Example)

③ Backward Scheduling

The Late Start (LS) and Late Finish (LF) of each activity are calculated, and the formula is as follows:

- $LS = LF \text{ of activity} - \text{activity duration} + 1$
- $LF = LS \text{ of successor activity} - 1$

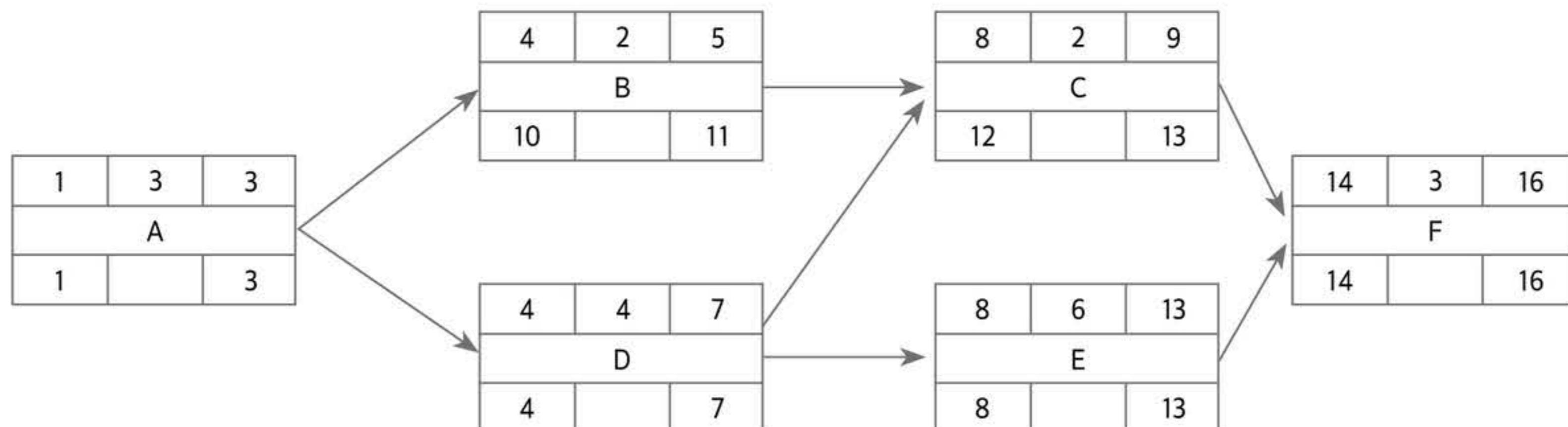
<Table 45> Result of Backward Scheduling by Activity

Activity Name	LS (Late Start)	Duration	LF (Late Finish)
A	1(3-3 + 1)	3	9(10-1) 3(4-1)
B	10(11-2 + 1)	2	11(12-1)
C	12(13-2 + 1)	2	13(14-1)
D	4(7-4 + 1)	4	11(12-1) 7(8-1)
E	8(13-6 + 1)	6	13(14-1)
F	14(16-3 + 1)	3	16

For Activity "F", there is no LS of successor activity, so LF starts with 16.

In the case of Activity "D", there are two successor activities: "C" and "E". In this case, the "C" and "E" activities can start only after the "D" activity ends. The "C" activity must start on the 12th at the latest (LS, Late Start), and the "E" activity must start on the 8th at the latest.

Therefore, Activity "D" must finish on the 7th at the latest (Late Finish), and the faster "E" of the two activities can start normally on the 8th. So, the LF of Activity "D" becomes 8 (LS of Activity "E") - 1 = 7. Subsequently, the LS of Activity "D" also becomes 7 - 4 + 1 = 4. After calculating both the LS and LF of the individual activities, write them as shown in the figure below.



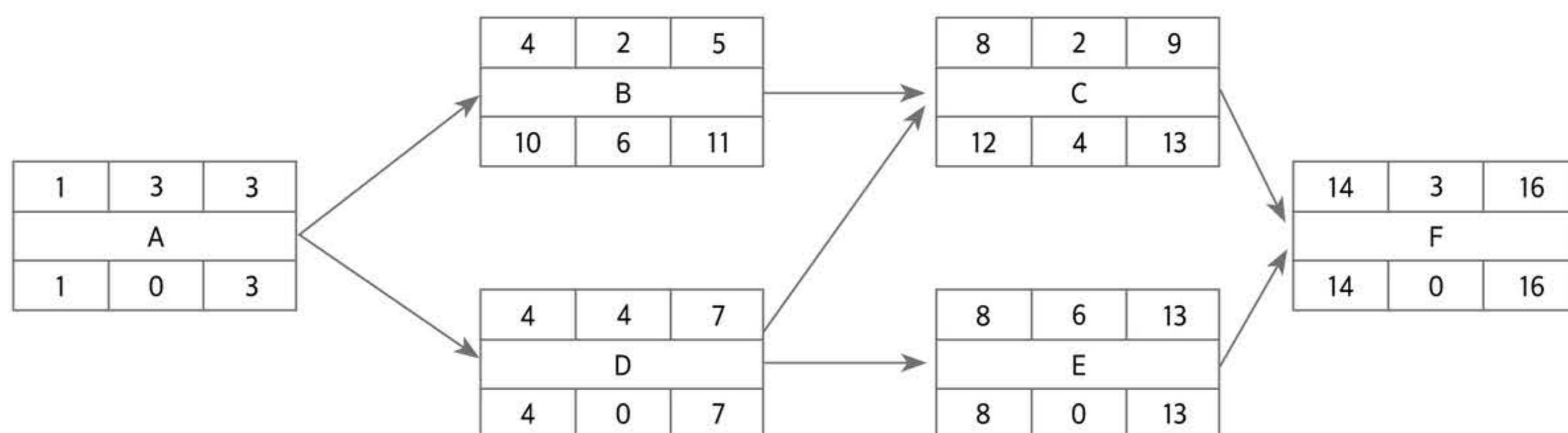
[Figure 32] Critical Path Method③ (Example)

④ Total Float, Critical Path Calculation

The formula for calculating Total Float for each activity is as follows:

- $TF = LF - EF$ or
- $TF = LS - ES$

The reason for calculating Total Float is to determine the critical path. In other words, the critical path is a path that connects activities whose Total Float is "zero". Therefore, the critical path in this example becomes "A-D-E-F" indicated in red as shown in the figure below.



[Figure 33] Critical Path Method④ (Example)

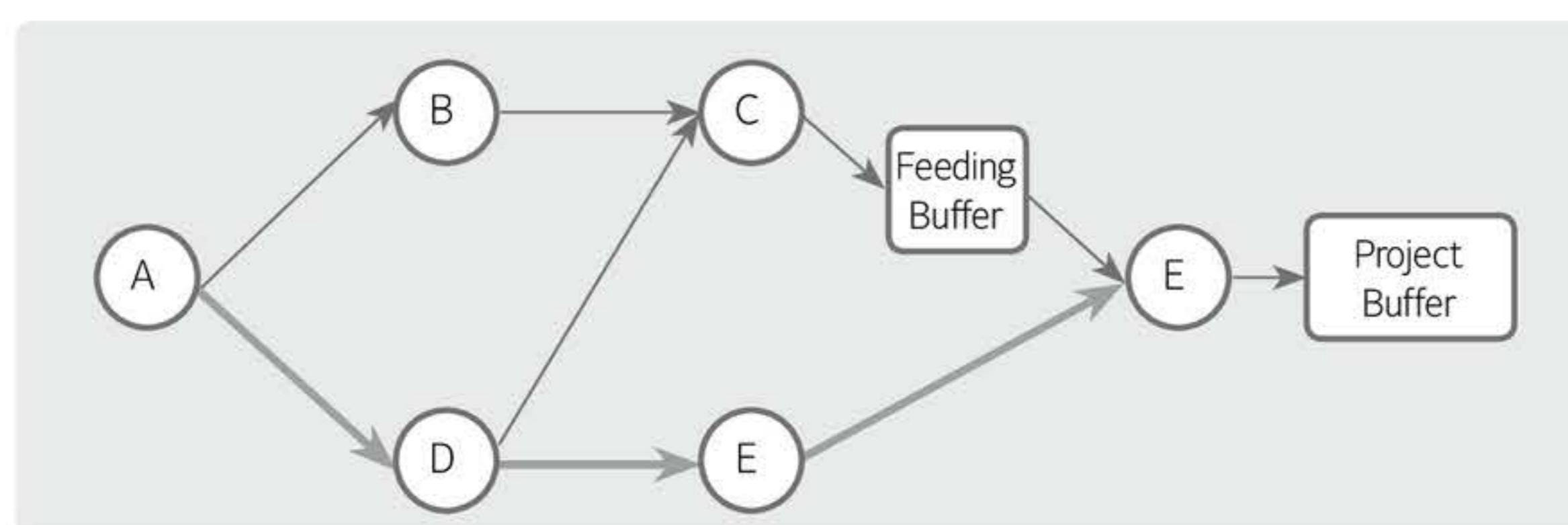
Any delay in activities on the critical path will result in a delay in the overall project schedule. Hence, activities on the critical path become intensive targets of schedule management.

B) Schedule development technique - critical chain method (CCM)

Critical Chain Technique or Critical Chain Method is a scheduling method that allows the project team to buffer the project schedule in consideration of limited resources and uncertainty.

In order to consider the effects of resource allocation, optimization and leveling, and activity duration uncertainty on the critical path determined by the Critical Path Method, the concept of buffering and buffering management is added to the CPM.

The figure below shows how Buffer is added to the example of the CPM assuming the uncertainty of the duration of the activities.



[Figure 34] Critical Chain Method (Example)

The buffer added at the end of the critical chain is called Project Buffer, and it its to prevent the target finish date from slippage along the critical chain.

An additional buffer, called Feeding Buffer, is placed at each point at which non-critical activities which don't belong to the critical chain (red line in the figure) merges into the critical chain. The size of the feeding buffer should be determined by taking into account the uncertainty over the duration of the feeding chain linked up to that buffer.

After determining the buffer schedule, the activities scheduled for the latest possible start and finish dates should be scheduled. As a result, the critical chain method focuses on managing remaining buffer durations against the remaining durations of chains of activities, instead of the total float of network paths.

C) Schedule compression technique - crashing and fast tracking

The most common cause of schedule compression in a typical project is requirements change. Despite frequent changes in the requirements, the project finish date cannot be changed in reality, so there are many cases where it is necessary to shorten the development schedule or test schedule at the end of the project. Here are some typical schedule compression techniques.

① Crashing

Crashing is a technique that compresses the schedule by adding extra resources at minimum cost. Examples of crashing include approval of overtime work, replenishment of resources, and payment for activities in the critical path. Crashing is effective only for activities of which duration is shortened by replenishing resources in the critical path. However, crashing may lead to an increase in cost. It can also lead to an increase in the risk due to sharing the contents of an existing project for new human resources or many communication channels.

② Fast Tracking

Fast Tracking is a method of shortening a certain period of time in which activities or steps that are performed sequentially are conducted simultaneously in a specific section of a certain duration. For example, it is the case where the foundations are built before all architectural drawings are completed. Fast tracking can lead to rework or an increase in the risk. Fast tracking is effective only when activities can be overlapped to shorten the project duration.



XI. Cost Management

►►► Recent Trends and Major Issues

Cost management is the process of planning, estimating, budgeting, and controlling cost to complete a project within the approved budget. Project cost management is an important factor because projects are performed with limited resources.

►►► Learning Objectives

1. To be able to explain the concept and process of cost management.
2. To be able to explain cost estimation techniques.
3. To be able to explain cost identification according to project progress.

►►► Keywords

- Cost management process: Cost management planning, cost estimation, budgeting, cost control
- Cost estimation technique: one-point estimating, three-point estimating, analogous estimating, parametric estimating, expert judgment, M/M (Man/Month), Function Point
- Earned Value Management (EVM), project progress
- Measurement: BAC: Budget At Completion, Planned Value, Earned Value, Actual Cost
- Analysis: Schedule Variance, Cost Variance, Schedule Performance Index, Cost Performance Index
- Estimation: EAC: Estimate At Completion, ETC: Estimate To Complete

+ Preview for practical business

How much SW engineers in Korea be paid?

Korea Software Industry Association surveys the actual wages of working SW engineers in order to identify the wage trends of SW engineers and use them as basic data for policy making, or provide them to the relevant companies and related organizations so that they can be applied as the unit of wages of the engineers mobilized in software projects.

The information can be found in the notification section of the Korea Software Industry Association website (www.sw.or.kr), and the following is a breakdown of the recently announced average wage for SW engineers.

Average Software Engineer Salary (daily, monthly, hourly) in the 「2015 SW Engineer Salary Survey (Statistics Approval No.37501)」 pursuant to Article 27 (Announcement of Statistics) of the Statistical Act.

【Unit: No. of people, KRW, %】

Classification	Number	Average monthly wage (M/D)			Average monthly wage (M/M)	Average hourly wage (M/H)
		2017	2018	(% change)		
Engineer	295	452,611	462,072	(2.1)	9,611,098	57,759
Principal Engineer	15,526	391,068	406,342	(3.9)	8,451,914	50,793
Senior Engineer	8,742	305,353	305,433	(0.0)	6,353,006	38,179
Intermediate Engineer	9,104	239,506	239,748	(0.1)	4,986,758	29,969
Junior Engineer	11,363	191,320	215,681	(12.7)	4,042,272	29,960
Senior Technician	99	191,177	194,340	(1.7)	3,298,818	24,293
Intermediate Technician	200	158,490	158,597	(0.1)	2,515,718	19,825
Junior Technician	233	114,914	120,948	(5.3)	2,436,616	15,119
Date Entry Operator	204	113,959	117,145	(2.8)	2,436,616	14,643
Total/Average	45,766	289,473	302,665	(4.6)	6,295,432	37,833

<Notes for the utilization of the survey in SW project cost estimation>

The results of this survey are not mandatory for software business.

The average wages by rank will not be announced in 2019, but the average wages by IT profession will be announced.

* The average wages of software engineers refer to the “unit wages of software engineers” under Article 22 (Payment for Software Business) (4) of the Software Industry Promotion Act.

* The average wages of software engineers include base pay, allowance, bonus, allowance for severance and retirement benefits, and corporate contribution.

* The average monthly wage is calculated as the daily average * working days (20.8 days), and hourly average wage is calculated as the daily average ÷ 8 hours.

* The average number of working days per month is the average of the reported working days of the company, not including holidays and legal holidays, as well as vacation.

* The average wages of software engineers increased by 4.6% compared to 2017.

* The base pay of the average wages of data entry operators, referenced in the Guidance of Cost Estimation Model for the Digital Document Database Construction Project, is KRW 93,287 in 2018.

[Enforcement date] Effective from September 1, 2018 to August 31, 2019

01 Concept of Cost Management

A) Concept of cost

Price is the amount of money the client pays in exchange for the supplier's provision of a product or service in a business relationship and is determined by business judgment between the client and the supplier. On the other hand, cost is the monetary value of resources invested in the production of a product or service and is determined by the production capacity of the supplier.

For reference, cost is often translated as expense. In other words, they can be distinguished by how the loss and profit from the project execution are measured. Cost is mainly used when the profit and loss measurement is based on an individual product or service, while expense is based on the period. (Example: Product Cost, Period Cost)

B) Importance of cost management

A project undergoes formal approval and allocation of planned resources and budget. If the budget is exceeded due to poor cost management, it must be reported to the project approver (sponsor) or the management board. The cause of cost overrun is due to mismanagement of the scope or schedule. If the scope is expanded or the schedule is delayed, the cost is exceeded because resources must be put in to comply with the schedule. In other words, good cost management means that appropriate project costs are estimated at the beginning and scope and schedule management are performed well throughout the project.

C) Concept of cost management

Project cost management is a set of activities to plan, calculate, procure, manage, and control the budget so that the project can eventually be completed within the approved budget.

02 Concept of Cost Management

Cost management process includes project cost management planning, cost estimation, budgeting, and cost control.

A) Cost management planning

Cost management planning is a task of establishing and determining cost management methods during the life cycle of a project. It is a process that includes various cost estimation techniques from estimating the budget required to complete the project, identifying responsibilities for each person in charge of cost management, to predicting costs based on all information related to the project at a given point in time.

B) Cost estimation

Project cost estimation is a process for developing an estimate of the monetary resources required to complete the project. Cost estimation methods are as follows:

<Table 46> Cost Estimation Method

Cost Estimation Technique	Characteristics and Explanation
Analogous Estimating	<ul style="list-style-type: none"> A method of estimating the cost of the current project based on the scope, cost, budget, and duration of similar projects in the past
Bottom-up Estimating	<ul style="list-style-type: none"> A method of estimating the sum of the lowest-level work packages to come up with upper-level cost It is affected by the size and complexity of an individual activity or work package and time-consuming but enables accurate cost estimation.
Expert Judgment	<ul style="list-style-type: none"> A method of presenting information about the project including labor costs, raw materials costs, inflation and risk factors, based on the surrounding environment and information about previous similar projects
Three-point Estimating	<ul style="list-style-type: none"> A method of estimating project cost using the most likely, optimistic, and pessimistic values. It takes into account uncertainty and risk in cost estimation.

C) Budgeting

It is a process⁷ of creating an approved cost baseline by collecting individual activities and work packages of cost estimation, or estimated costs, in order to manage all costs in an integrated manner. The cost baseline is the approved version of the project budget, excluding management reserves. After all, the project budget is the sum of the management reserves and the cost baseline.

Contingency reserves, used in case of contingencies other than planned activities by project managers, are included in the cost baseline. However, management reserves are an expense that can be enforced by the Chief Technical Officer (CTO), sponsor, or CEO.

D) Cost control

Project cost control is a process of monitoring the status of project cost management and baseline changes.

Work name	Period	Starting date	Finish date	Completion rate	Preceding work	Resource name
The Bulletin Board for IT Competency Index Project	24 days	13/07/25 (Thurs.)	13/08/27 (Tues.)	16%		
Create a bulletin board	24 days	13/07/25 (Thurs.)	13/08/27 (Tues.)	16%		
Analysis	19 days	13/07/25 (Thurs.)	13/08/20 (Tues.)	24%		
Write text	5 days	13/07/25 (Thurs.)	13/07/31 (Wed.)	90%		Kim Jisim
Delete text	2 days	13/08/01 (Thurs.)	13/08/02 (Fri.)	0%	4	Kang Jeongbae
Modify text	2 days	13/08/05 (Mon.)	13/08/06 (Tues.)	0%	5	Kim Seonhwa
File upload	10 days	13/08/07 (Wed.)	13/08/20 (Tues.)	0%	6	Lee Hongcheol
Design	19 days	13/08/01 (Thurs.)	13/08/27 (Tues.)	0%		

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Writing screen design	2 days	13/08/01 (Thurs.)	13/08/02 (Fri.)	0%	4	Kim Jisim
Delete text	1 days	13/08/05 (Mon.)	13/08/05 (Mon.)	0%	5	Kang Jeongbae
Modify text	1 days	13/08/07 (Wed.)	13/08/07 (Wed.)	0%	6	Kim Seonhwa
File upload	5 days	13/08/21 (Wed.)	13/08/27 (Tues.)	0%	7	Lee Hongcheol

[Figure 35] Cost Control Screen (Example)

In the example above, the duration of the [Writing] activity was calculated as five days, and it was planned to be completed by July 31st. As of August 1st, the five days of planning have not been completed. If the activity is calculated as the cost (assuming KRW 300,000 per day), it is $5 \text{ (days)} \times 0.9 \text{ (completion rate)} \times \text{KRW } 300,000 = \text{KRW } 1,350,000$. In addition, if the activity had been completed as scheduled, it would be, if calculated as a cost, KRW 1,500,000. In other words, as of August 1st, $1,500,000 - 1,350,000 = \text{KRW } 150,000$ of work has not been completed, meaning the cost of KRW 150,000 has been excessively spent.

The above cost control management method is called Earned Value Method, and cost control management applying EVM is called Earned Value Management.

03 Cost Estimation Technique

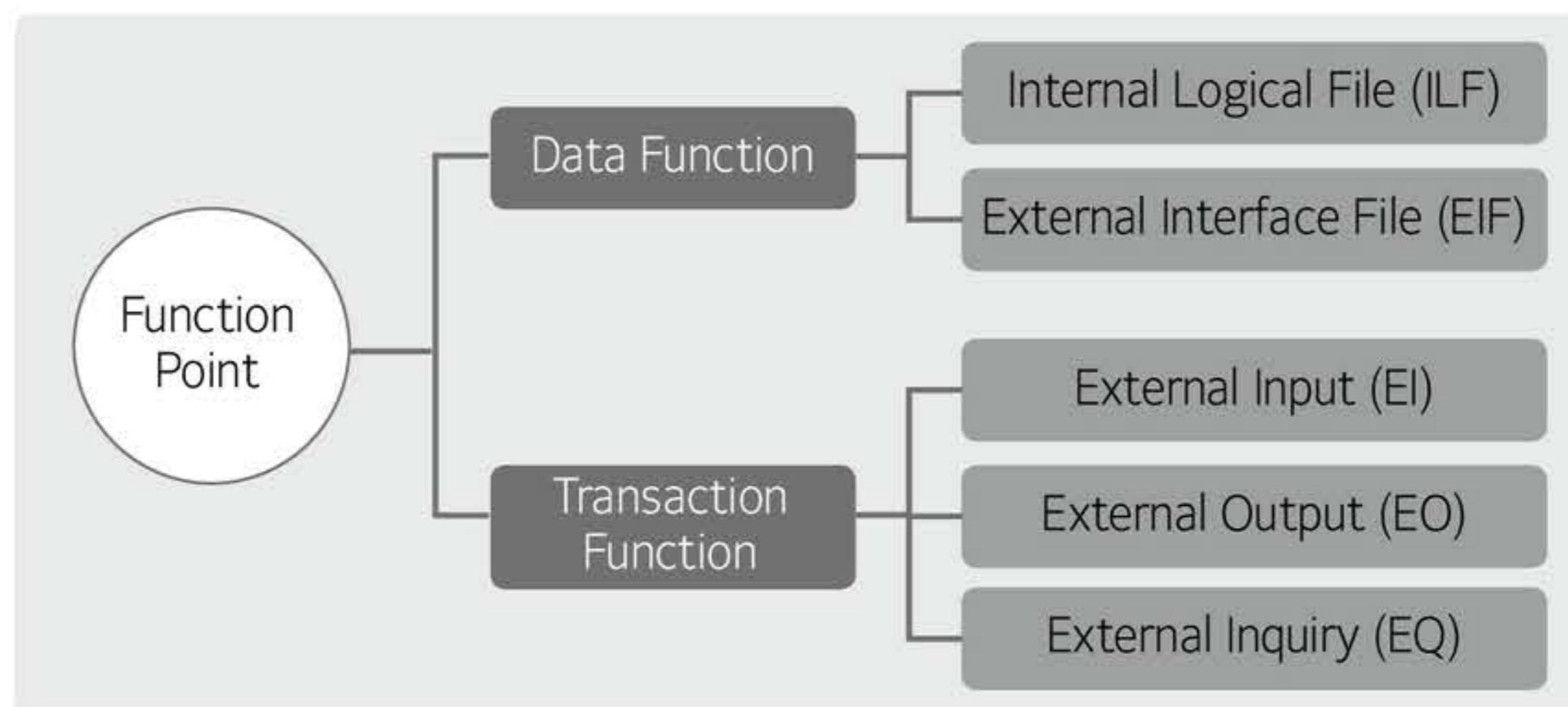
The most common project cost estimation techniques include Function Point (FP), Man/Month (M/M), and COCOMO.

A) Function point (FP)

Function Point is a method of estimating the cost by measuring the scale of software development as a Function Point (FP) and multiplying the unit price per function point. It is an international standard (ISO/IEC 14143) that quantitatively calculates functions requested by and delivered to users from a user's point of view, and is a cost calculation method for software development, maintenance and operation.

Compared to the LOC (Line Of Code)-based COCOMO method or the Man/Month (M/M) method, it has the characteristic of grasping the size of the development project before initiation by identifying the required function of the user.

Software functions are divided into Data Functions and Transaction Functions, and more specifically, data functions are subdivided into Internal Logical Files and External Interface Files, and transaction functions are subdivided into three types: External Inputs, External Outputs, and External Inquiries.



[Figure 36] Types of Functions

The calculation process of the function point method is as follows:

① Determine the Type of Count

- Choose among Development Project / Enhancement Project/ Application FP count

② Identify Scope and Boundary of the Count

- Determine the full scope of software
- Separate the boundaries of individual applications

③ Measure Data Functions

- Identify the internal logical files (ILF) and the external interface files (EIF), determine complexity and contribution, respectively, to derive data function points
- Complexity and contribution are determined by dividing into Data Element Types (DET) and Record Element Types (RET). DET is calculated as the number of attributes and RET is calculated as the number of subgroups.

④ Transaction function measurement

- Identify units of activity, separate EI (External Input), EO (External Output), and EQ (External Query) for each unit of activity, and then determine the complexity and contribution, respectively, to derive transaction function points
- Complexity and contribution are determined by dividing into data element types (DET) and file transfer reference types (FTR).

⑤ Determination of Unadjusted Function Points

- Unadjusted function points are the sum of data function points and transaction function points.

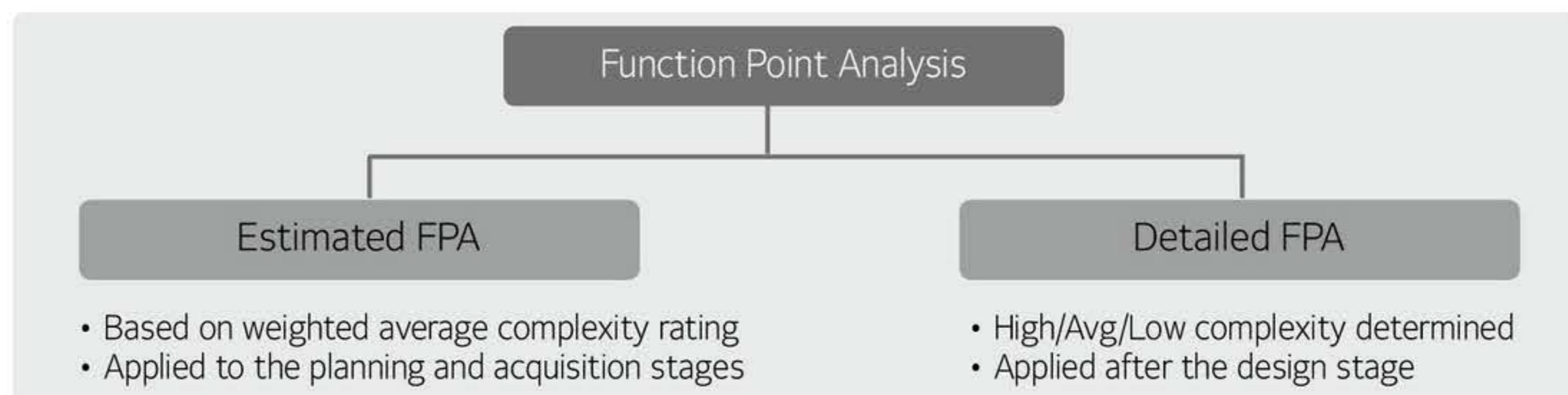
⑥ Determination of Value Adjustment Factor

- Total Degree of Influence (TDI) is calculated by determining and summing the values of 14 General System Characteristics (GSCs) weighted on a scale from 0 to 5
- The 14 GSCs are: Data communications, Distributed data processing, Performance, Heavily used configuration, Transaction rate, On-Line data entry, End-user efficiency, On-Line update, Complex processing, Reusability, Installation ease, Operational ease, Multiple sites, Facilitate change.
- Value Adjustment Factor (VAF) = $(TDI * 0.01) + 0.65$

⑦ Determination of Adjusted Function Points

- When the value adjustment factor (VAF) is determined, the final adjusted FP is calculated by reflecting the VAF according to the development/enhance /application type
- Adjusted FP Count = Unadjusted FP Count × VAF

Function Point Analysis (FPA) is largely divided into Estimated FPA and Detailed FPA. In the development proposal stage, cost is calculated using the average values of EI/EO/EQ and ILF/EIF, while the cost is calculated using the traditional method after the stage of demand analysis and design.



[Figure 37] Function Point Analysis Method

In recent practice, in the case of public projects, cost estimation is carried out focusing on user's functional requirements by utilizing the FPA.

B) Man/Month (MM)

Man/Month is a method of measuring how much labor is consumed in a project based on previous experience in similar projects, and calculating the cost based on the manpower put into the project.

Project development cost = direct labor cost + overhead cost + Royalty+ direct cost

Generally, required manpower resources are allocated for each work package, the lowest unit of the WBS derived from scope management.

① Direct Labor Cost

When the required labor is allocated for each work package, the unit price per labor must be determined. In the case of Korea, the average wage of a software engineer published by Korea Software Industry Association is applied, which is determined by referring to the table below.

<Table 47> Average Wage for SW Engineers in 2017

Classification	Average Wage (M/M)	Average Wage (M/H)
Engineer	9,414,309	56,576
Principal Engineer	8,134,214	48,884
Senior Engineer	6,351,342	38,169
Intermediate Engineer	4,981,725	29,938

Junior Engineer	3,979,456	23,915
Senior Technician	3,976,482	23,897
Intermediate Technician	3,296,592	19,811
Junior Technician	2,390,211	14,364
Date Entry Operator	2,370,347	14,245

② Overhead Cost and Royalty

Overhead cost is indirect expenses⁸ incurred in the areas of planning, management, and general affairs for the administrative operation of the software developer. Usually, it is calculated as 110 to 120% of the direct labor cost. Royalty is an amount paid in exchange for the use and accumulation of technology developed and owned by the software developer, and it is calculated as 20 to 40% of the sum of direct labor cost plus overhead cost.⁹

③ Direct Cost

Direct cost refers to expenses directly required for software development, such as royalties for computer system or software tools, software, professional expenses, travel expenses, and materials costs, etc. directly incurred for the software development project.

In the field of private projects, the man month calculation is used to calculate project development cost, and also for mutual verification interchangeably with the function point analysis, which has recently become mandatory in public projects.

C) COCOMO(Constructive Cost Model)

COCOMO is one of the estimation methods of the cost of a software development project. It calculates the cost by using a regression formula with parameters such as development period, man per month, and maintenance costs that are put into the modules and subsystems that make up the system.

COCOMO is divided into three types: Basic, Intermediate, and Detailed, depending on the complexity of the calculation model. In addition, it is divided into three types: Organic Mode, Semi-Detached Mode, and Embedded Mode, according to the type of applied project. Each is calculated by taking into account the effort, development time, average staff size and productivity.

A brief look at the COCOMO calculation method is as follows:

Case of the Basic COCOMO model

① Effort Applied) $E = a * (\text{KLOC})^b$

- a and b are coefficients by project type (see table below)
- KLOC (Kilo Line Of Code) is the estimated number of delivered lines of code in thousands

8 출처 SW사업 대가산정 가이드 2017년 개정판

9 출처 SW사업 대가산정 가이드 2017년 개정판

- ② Development Time) $D = c * (\text{Effort Applied})^d$
 • c and d are coefficients by project type (see table below)

③ People Required) $P = \text{Effort Applied} / \text{Development Time}$

<Table 48> Coefficients by Project Type

Project Type	a	b	c	d
Organic	2.4	1.05	2.5	0.38
Semi-Detached	3.0	1.12	2.5	0.35
Embedded	3.6	1.2	2.5	0.32

The Intermediate, and Detailed COCOMO models are calculated by changing the coefficient values in the table above.

D) COCOMO 2(Constructive Cost Model 2)

COCOMO 2 is a method of estimating software development costs by improving the existing COCOMO model through such as code reusability, off-the-shelf component, design and development management, etc. in accordance with the changing development environment.

COCOMO 2 has three sub-models: Application Composition Model, Early Design Model, and Post-Architecture Model.

<Table 49> Sub-Models of COCOMO 2

Type	Explanation
Application Composition Model	<ul style="list-style-type: none"> Applied to projects using GUI Tool and CASE Tool for S/W prototyping Use component count, complexity, object points, etc.
Early Design Model	<ul style="list-style-type: none"> Applied to estimate approximate cost and schedule at the design stage Used when there is insufficient information on details of scale, environment, manpower, and process in the early stages of development
Post-Architecture Model	<ul style="list-style-type: none"> Applied to projects in which sufficient data have been prepared after architecture establishment Use unadjusted function points and SLOC (Source Line Of Code) after the establishment of the software life cycle

04 Cost Management Technique – Earned Value Management

A) Concept of earned value

“Value” means how much something is “worth”. In earned value management, value means how much the work done so far is worth, and the budget allocated becomes the value of the work.

- Value = Monetary value of work = Budgeted Cost of Work Performed

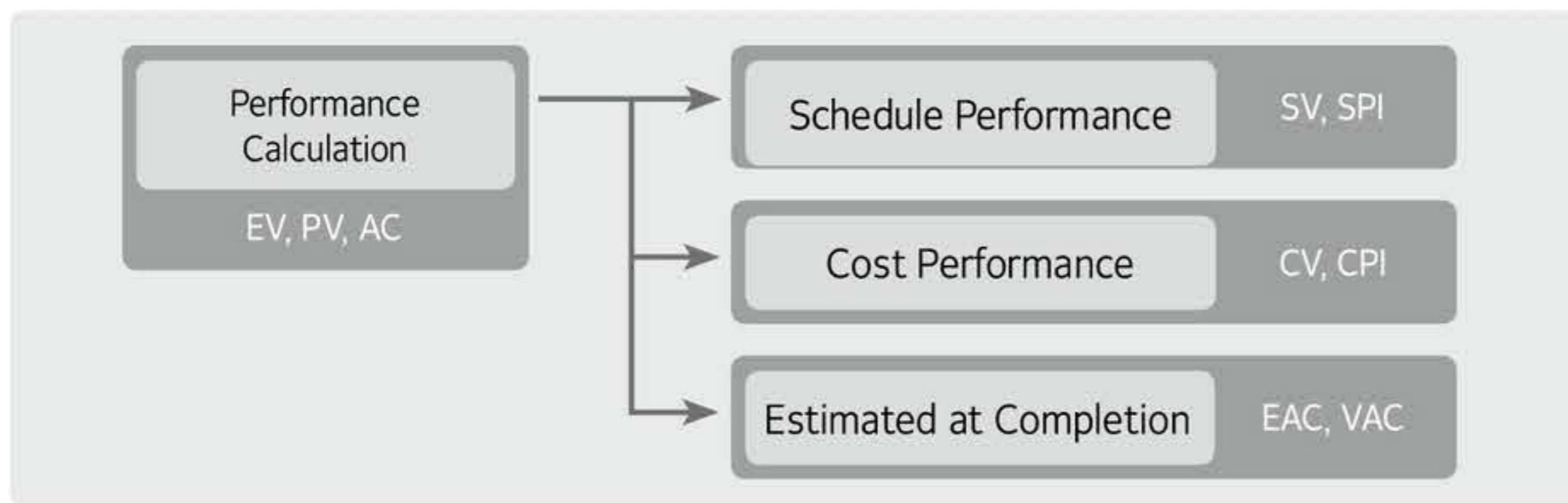
“Earned Value” means the value of the work actually done at the point of measuring performance. Earned val-

ue is the budgeted cost of work that has actually been performed. Earned value is also called BCWP (Budgeted Cost of Work Performed).

- EV, Earned Value = Value of work performed = Budgeted Cost of Work Performed

B) Earned value management

Earned Value Management (EVM) is a project performance management technique that analyzes performance through integrated management of project schedule and cost, and predicts the cost and schedule of the final project at the present time.



[Figure 38] Composition of Earned Value Management (EVM)

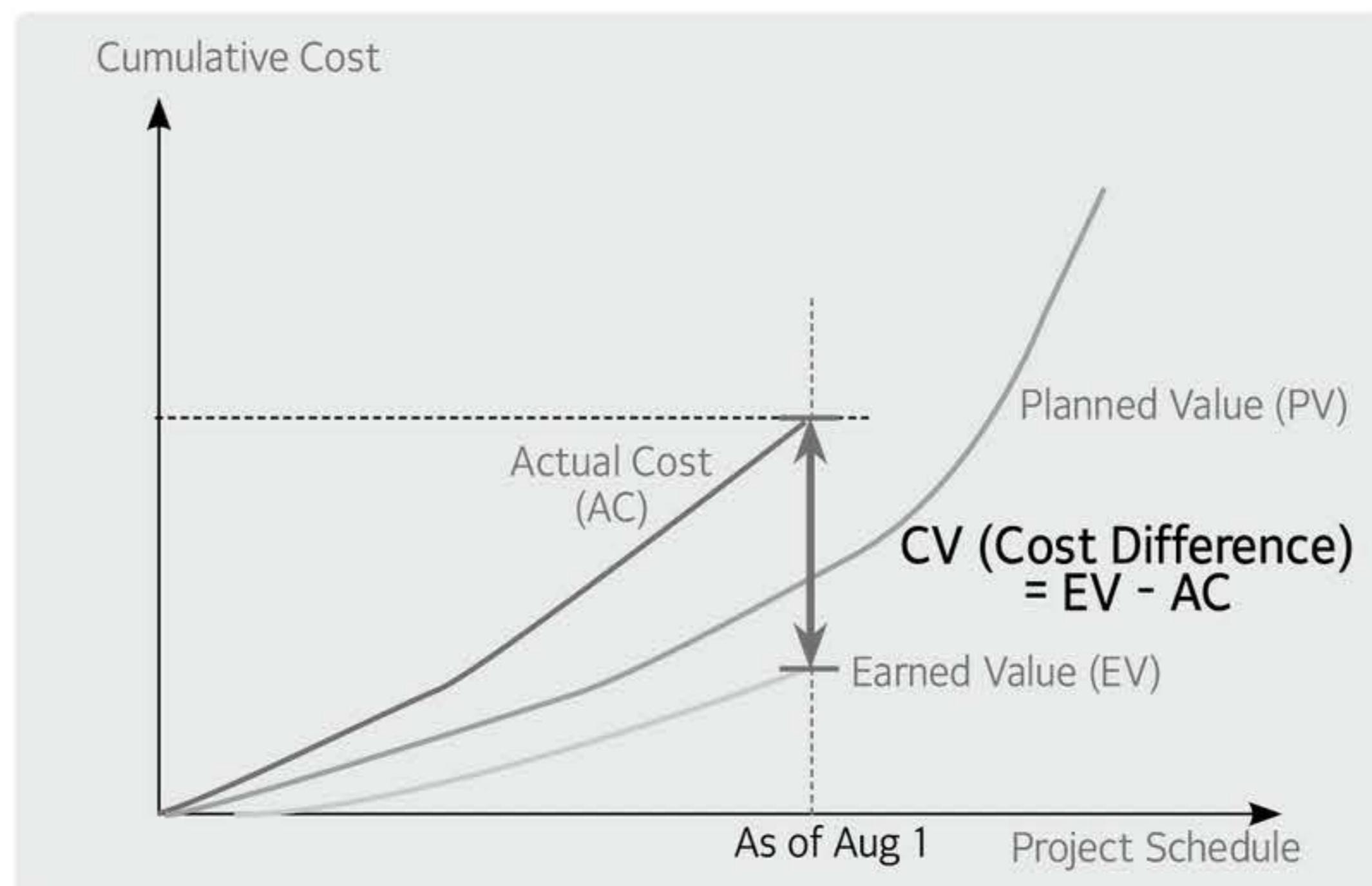
EVM is a technique to control project performance by integrating cost and schedule. The related terms are as follows:

<Table 50> Key Terms of EVM

Key Terms	Explanation
EV: Earned Value	<ul style="list-style-type: none"> The allocated budget for the work performed to date (Example) 5 days 80% (progress rate) = $5 \times 0.8 = 4$ days
PV: Planned Value	<ul style="list-style-type: none"> The approved (planned) budget for the work performed to complete an activity or component in the WBS (Example) 5 days
AC: Actual Cost	<ul style="list-style-type: none"> The costs actually incurred for the work completed (Example) Add 1 person and 1 day to the 5-day activity = $5 \text{ days} \times 1 \text{ person} + 1 \text{ day} \times 1 = 6 \text{ days}$
SV: Schedule Variance	<ul style="list-style-type: none"> A measure of actual progress against expected progress SV > 0: ahead of schedule, SV < 0: behind schedule SV = EV - PV, $4-5 = -1$ day, 1 day behind schedule
SPI: Schedule Performance Index	<ul style="list-style-type: none"> A measure of actual progress against expected progress SPI = EV / PV SPI > 1: on or ahead of schedule, SPI < 1: behind schedule
CV: Cost Variance	<ul style="list-style-type: none"> A measure of actual cost against the budgeted cost CV > 0: under budget, CV < 0: over budget CV = EV - AC, $4-6 = -2$, 2 days over budget
CPI: Cost Performance Index	<ul style="list-style-type: none"> A measure of actual cost against the budgeted cost CPI = EV / AC CPI > 1: on or under budget, CPI < 1: over budget

The following graph is an example of earned value management. As of August 1, the planned value (PV), actual cost (AC), and earned value (EV) are measured, and schedule variance (SV) and cost variance (CV) are analyzed, for project value estimation. The AC, which is costs actually incurred, was spent more than the PV, and the EV, which indicates the actual amount of work completed, was less than the PV.

To analyze the project cost, schedule variance (SV) = earned value (EV) - planned value (PV) is negative, meaning behind schedule, and cost difference (CV) = earned value (EV) - actual cost (AC) is also negative, meaning over budget.



[Figure 39] Graph of Earned Value Management (EVM) (Example)

Estimate At Completion (EAC) is “estimated total cost at project completion”. An important advantage of the EVM is that the total cost of the project can be estimated reasonably. EAC is calculated as the sum of the actual cost (AC) incurred from work completed up to the point of performance measurement and the estimated cost of the remaining work, or Estimate To Completion (ETC). Since the actual cost (AC) can be known as the result of the performance measurement, only the Estimate to Complete (ETC) is calculated to come up with the EAC.

There are three methods to calculate the ETC according to the results of performance analysis.

How to apply the previously approved budget for the remaining work divided by the cost performance index (CPI)

- Estimate to Complete (ETC) = (Budget at Completion (BAC) - Earned Value (EV)) / Cost Performance Index (CPI)

How to apply the previously approved budget for the remaining work without change

- Estimate to Complete (ETC) = (Budget at Completion (BAC) - Earned Value (EV))

How to create a new budget overriding the previously approved budget for the remaining work

- Estimate to Complete (ETC)= New estimate for the remaining work

By adding the ETC calculated as above with the AC, the EAC can be estimated as follows:

- Estimate At Completion (EAC) = Actual Cost (AC) + Estimate to Complete (ETC)

It is difficult to judge the value of work that has already been completed or has not begun at the time of performance measurement. However, measuring the value of work in progress may be less inaccurate depending on the criteria. The value of the work in progress can be measured by choosing one of the following methods:

- Percent Complete

The amount of completed work against the planned budget at completion

Example) 40% Complete → 40% of the budget claimed as EV

- 50/50 Rule

A task is considered 50% complete when it starts. The remaining 50% credit is given when the task is completed.

Example) The work in progress → 50% of the allocated budget claimed as EV

- 20/80 Rule

A task is considered 20% complete when it starts. The remaining 80% credit is given when the task is completed.

Example) The work in progress → 20% of the budget claimed as EV

- 0/100 Rule

A task obtains 0% credit when the activity begins and 100% credit when the task is completed.

Example) The work in progress → No EV claimed



XII. Quality Management

►►► Recent Trends and Major Issues

Software is getting more complex due to the construction of a large and highly functional system. Along with problems such as delays in delivery of software construction projects, lower customer satisfaction, and excessive cost for system operation/maintenance, awareness of quality is becoming more important.

►►► Learning Objectives

1. To be able to explain the concept and process of quality management.
 2. To be able to describe quality standards and evaluation perspectives.
 3. To be able to explain quality assurance and quality control.
-

►►► Keywords

- Quality management process: quality management planning, quality assurance, quality control, PDCA
- Quality standards: ISO/IEC 9126, ISO/IEC 12207, CMMI, 6 Sigma, ISO 9000
- Quality evaluation perspective: product quality perspective, process quality perspective, project quality perspective

+ Preview for practical business

Just as you frequently checks for any abnormalities in a car while driving a long distance, a series of quality control activities are needed to ensure that the quality target is achieved by checking the project quality level even when implementing a project.

In general, quality management consists of quality planning, quality control, and quality assurance. There is no significant difference in the overall composition, but the quality management of the actual project is somewhat different from that of the manufacturing industry. For example, if quality control in manufacturing is about product quality, quality control of project can be seen as process quality. This is due to the fact that the working method differs depending on the process in which the result is generated. If the quality control of the manufacturing industry is to manage the defects of a number of products produced, the quality control of the project is to manage one or a few outputs (e.g., system) without errors. Defect management for many products can be viewed as product quality management, and error management for a few outputs can be viewed as process quality management. In particular, in an IT project, as the output is intangible, quality control for intermediate outputs should be carried out at each project stage (eg, analysis, design, execution, testing, deployment stage, etc.).

Quality management activities for each project stage are carried out through techniques such as review, inspection, and walk-through, which are performed based on guidance from specialized quality management organizations (e.g., quality management team, quality assurance team, etc.).

In particular, if enterprise-wide quality control is to lead to the quality control of individual projects, the company can receive guidance on enterprise quality standards through the PMO (Project Management Office) or check the quality level.

If such diverse quality management is meticulously carried out according to a systematic procedure, quality cost can be minimized by satisfying the quality targets requested by customers (eg, the acquirer) at the end of the project. Another advantage is that Validation and Verification of requirements can reduce Rework through clarification. This helps scope management by preventing omission of requirements, and schedule management by reducing wasted time.

01 Concept of Quality Control

A) Concept of software quality

① Software Quality

It refers to the characteristics and productivity of a software product that meets a given requirement.

② Characteristics of Software Quality

Software quality is a relative concept, and it is difficult to measure quantitatively, dependent on several resources such as cost, time, manpower, and tools, and correlated with each other.

In order to measure and evaluate software quality, a quality model that can first define elements and characteristics representing the quality of software and quantify quality in an objective aspect in the development process is required. In general, such quality model is represented in a hierarchical structure. The first layer is composed of quality targets from the user's point of view, the second layer is composed of high-level Quality Characteristics that can achieve the quality targets, and the third layer is composed of specific Subcharacteristics.

<Table 51> ISO/IEC 9126-1 Quality Characteristics

Quality Characteristics	Subcharacteristics
Functionality	Suitability, Accurateness, Interoperability, Compliance, Security
Reliability	Maturity, Fault tolerance, Recoverability
Usability	Understandability, Learnability, Operability
Effectiveness	Time behavior, Resource behavior
Maintainability	Analyzability, Changeability, Stability, Testability
Portability	Adaptability, Installability, Conformance, Replaceability

③ Major Standards Related to Software Quality

There are ISO/IEC 9126, ISO/IEC 12207, CMMI, 6 Sigma, ISO 9000, etc.

④ Perspective of Software Quality Evaluation

- Product: Quality itself (measurement, verification, validation, evaluation)
- Process: Process improvement and audit

B) Concept of quality control

① Definition of Quality Control

It refers to all techniques and activities performed to preserve the quality of a product or service that satisfies the user's requirements.

② Quality Control Process

It refers to the activities and processes performed to establish quality policies, set quality goals, and determine quality-related responsibilities in order to meet user requirements (Fitness for use) in a project.

<Table 52> Three elements of Project Quality Management

Classification	Concept	Case
Quality Plan	Activities to identify activities necessary to achieve the quality targets given in the project and to plan decisions on how to perform them	Quality Planning
Quality Assurance	Activities to review from the point of view of a third party whether the user requirements and the results performed by the project team are consistent (Review, Inspection, Walk-through)	Design review meeting for wireframe
Quality Control	Activities to find and resolve the cause when the project team's results do not meet the quality targets or conform to the standards	Debugging software errors

02 Quality Management Process



The quality management process can be largely divided into three stages: quality planning, quality assurance, and quality control. In other words, the quality planning stage establishes an overall process and plan for quality management. Quality assurance is the process of managing quality in the process throughout the business or manufacturing process. Quality control is the stage of checking the quality before the final product or service is delivered to the customer. Let's look at more details one by one below.

A) Quality plan

① Quality Planning

Quality planning is the task of documenting a plan that identifies the activities the project team must perform to achieve a given quality target, and determines how to perform it. The quality of the project should be planned in advance rather than inspected afterwards, so a quality plan should be prepared early in the project.

② Cost of Quality

Cost of Quality is a concept of calculating the cost of all activities of the project team to achieve a predetermined quality target. The purpose of quality cost management is to reduce Failure cost of a project, and accordingly, the cost (Prevention cost) for activities to prevent defects and the cost (Appraisal cost) for activities to check/verify the quality of the product relatively get higher.

<Table 53> Type of Cost of Quality

Classification	Concept		Case
Cost of Conformance	Prevention Costs	Cost to prevent defects	Education, training, documentation, equipment, improvement schedule
	Appraisal Costs	Cost for product quality validation/verification	Test, inspection and destruction test cost
Cost of Nonconformance	Internal Failure Costs	Cost of correcting defects before product delivery	Rework Wasted materials (Waste, waste treatment)
	External Failure Costs	Cost of correcting defects found after delivery products and services to external customers	Liability, defect repair, business loss

③ Quality Plan

Quality Plan is one of the project management plans prepared at the beginning of the project to ensure the quality of the result (system) built by the project team while complying with the schedule (project duration) at a set cost.

<Sample quality control plan>

Overview	Objective
Objective	Quality requirement specification
Role and Responsibility	Quality objective setting
Organizational chart	Measurement and evaluation
Responsibility and role	Verification and confirmation activity
Quality objective	Quality assurance activity
Quality assurance orientation	Quality evaluation
Quality activity	Corrective action activity
Quality activity reporting	Attachment

<Sample quality control plan>

Quality feature	Quality requirement	Measurement methodology	Target	Measurement date
Functionality	Accuracy of function implementation	Measurement items of accurate function reflection A: No. of function design reflection (Requirements Traceability Matrix) B: No. of requirements on function for task comparison matrix	100%	At the point of the design stage completed
		Measurement formula for accurate function reflection		
	Measurement items of function implementation A: No. of inaccurate functionality requirements B: No. of requirements		0%	At the point of delivery test completed
		Measurement formula for inaccurate function implementation		

Portability	Portability	Replace with service accessibility compliance in accordance with the user's internet environment	-	-
Understandability	Understandability	Measurement items of understandability A: No. of screens with user guidelines accurately described B: No. of screens with UI design(menu) Measurement formula for understandability	100%	At the point of delivery test completed
Credibility	System availability	Measurement items of system availability A: No. of message notification in the event of errors B: No. of message notification test case in the event of errors Measurement formula for system availability	100%	At the point of integrated test
Compliance	Web cross browsing	Measurement items of Web cross browsing Use inspection tools of web cross browsing	95%	At the point of unit test completed
	Web accessibility	Measurement items of web accessibility Names of inspection tools for web accessibility	95%	At the point of unit test completed
Others	Corrective action progress rate	Measurement items of corrective action progress rate A: No. of corrective action completed B: No. of corrective action Measurement formula for progress rate	100%	At the point of quality activity

[Figure 41] Quality Plan of the Actual Project (example)

B) Quality assurance

① Concept of Quality Assurance

It refers to a technique and activity that monitors quality requirements and measurement results of quality control and checks whether the quality standards are applied. Quality control is classified as follows.

<Table 54> Comparison of Quality Control and Quality Assurance

Classification	Quality Control	Quality Assurance
Key Activity	• Inspection	• Quality Audits
Target	• The result of work (Product, process, performance)	• Project organization • Overall quality management activities
Subject	• Project team members	• Professional review agency outside the organization • Professional reviewer inside the organization
Result	• Pass/failure of product • Process adjustment	• Lessons applicable throughout the organization • Customer trust or authentication
Commonality	Quality improvement	

② Types of Quality Assurance Technique

Quality assurance techniques can be classified into Prevention¹⁰ and Inspection¹¹ depending on the timing of quality assurance activities, and can be divided into Review, Inspection, and Walkthrough as follows depending on the purpose of quality assurance.

<Table 55> Quality Assurance Technique

Classification	Technical Review	Software Inspection	Walkthrough
Purpose	Assess conformity to specifications and plans and ensure the integrity of changes	Find defects and verify solutions	Find defects, verify alternatives, utilize learning tools
Participant	Developer	Formally documented participant	Developer
Leadership	Senior engineer	Moderator	Developer
Data Volume	Big depending on purpose	Relatively small	Relatively small
Deliverable	Technology Review	Inspection Report & Defects List	Review Report

③ Case of Project Quality Assurance Activity

In a project, the following activities for software quality assurance are performed.

<Table 56> Case of Project Quality Assurance Activity

Project Quality Assurance Activity	Detail
Configuration management	Management activities for configuration items such as configuration item identification, control, audit, and record ⇒ Project site sketch It mainly performs configuration management for program sources and deliverables and starts with setting a baseline for management.
Document management	Document management procedure establishment, document creation, document storage, document disposal ⇒ Project site sketch It distinguishes deliverables officially offered to the client from work products required for project execution after the project is completed.
Quality record	Establishing, executing, and recording the results of quality assurance plan ⇒ Project site sketch Test results such as unit tests for unit program modules, integrated tests for systems, and system tests must be provided to customers.
Joint review	Joint review of project progress according to milestones ⇒ Project site sketch Performed through weekly work report, monthly work report, and occasional report

10 Prevention: Inspection performed to prevent errors in intermediate deliverables

11 Inspection: Inspection for errors before delivery of project deliverables to the customer

Project Quality Assurance Activity	Detail
Verification and validation	<p>Verification and validation activities by project stage</p> <p>⇒ Project site sketch Performed at the end of each of the analysis, design, development, and testing stage of the project on the regular basis, and performed when major events occur on a non-regular basis</p>
Corrective action	<p>Establishing a solution and taking action</p> <p>⇒ Project site sketch As a feedback on quality assurance results, supplementary activities performed on errors and improvements in quality assurance results</p>
Risk management	<p>Project risk identification/qualitative evaluation/quantitative evaluation/response</p> <p>⇒ Project site sketch Initial risk items are identified at the start of the project, and through continuous monitoring, activities are performed to avoid occurrence of risks or to minimize damage.</p>
Issue management	<p>Analysis of issues such as changes in customer requirements, alternative development and response</p> <p>⇒ Project site sketch Conduct activities to resolve realistic risks or restrictions on the performance of project activities</p>

C) Quality control

① Concept of Quality Control

Quality control refers to activities and procedures that record and monitor the results of quality activities to achieve quality targets.

In order to verify that the project result satisfies the quality standard requirements, performance, schedule and cost variance are measured, and quality nonconformity factors are analyzed, and corrective actions are suggested.

② Quality Control Tools and Techniques

Quality control validation (inspection) uses the concept of statistical information extraction such as Pareto Chart, Cause and Effect Diagram, Control Chart, and Scatter Diagram as shown in the table below. Added with Flowchart, Check sheet, and Histogram, they comprise of the 7 Basic Quality Tools.

- The 7 Basic Quality Tools: The seven basic quality tools, also known as 7QC tools, are used to solve quality-related problems within the PDCA (Plan-Do-Check-Action) cycle.

<Table 57> Quality Control Technique

Classification	Explanation												
Pareto Chart	<ul style="list-style-type: none"> • Histogram sorted by frequency of occurrence to prioritize a problem • It is based on the principle that relatively frequent causes generally lead to most of the problems or defects. • It displays the cause, frequency, and share of the problem <table border="1"> <thead> <tr> <th>Item</th> <th>Defect Frequency</th> </tr> </thead> <tbody> <tr> <td>Item 1</td> <td>12</td> </tr> <tr> <td>Item 2</td> <td>10</td> </tr> <tr> <td>Item 3</td> <td>5</td> </tr> <tr> <td>Item 4</td> <td>2</td> </tr> <tr> <td>Item 5</td> <td>1</td> </tr> </tbody> </table>	Item	Defect Frequency	Item 1	12	Item 2	10	Item 3	5	Item 4	2	Item 5	1
Item	Defect Frequency												
Item 1	12												
Item 2	10												
Item 3	5												
Item 4	2												
Item 5	1												
Cause and Effect Diagram	<ul style="list-style-type: none"> • Diagram designed to represent how the cause and effect relate to and affect each other • Known as Cause and Effect Diagram, Fishbone Diagram, and Ishikawa diagram, it is generally used for preventing defects in product design and quality to identify possible causes for an effect. 												
Control Chart	<ul style="list-style-type: none"> • As a tool to determine whether a process maintains a certain level of quality, it is judged to be in an unstable state when the number of defects exceeds the control limit. 												
Scatter Diagram	<ul style="list-style-type: none"> • As a tool used to identify the impact between two variables, it is used to identify the cause (factor) and effect (characteristic) relationship between the two variables and visually express the relationship. 												

03 Quality Evaluation Perspective and Quality Standard

A) Quality evaluation perspective

Quality evaluation perspective can be divided into product quality and process quality.

① Product Quality

It is a technique that evaluates the functionality and reliability of a product made by a project, and ISO/IEC 9126 and 6 Sigma are the most common quality standards.

② Process Quality

It is a technique that evaluates whether a process is defined and properly operated from the viewpoint that a good product comes from a good process, and ISO 9000, ISO/IEC 12207, and CMMI are widely used quality standards.

B) Quality standard

① ISO/IEC 9126 (currently known as ISO/IEC 25000-2)

It is a quality model created through standardization on software quality characteristics from the user's point of view by ISO (International Organization for Standardization), an international standardization organization, as a specific definition for standardization and quality assurance of quality characteristics and metrics is required.

<Table 58> ISO/IEC 9126 (currently known as ISO/IEC 25000-2)

Classification	Content
ISO 9126-1	[Consists of 6 quality characteristics and 21 subcharacteristics] Enable those involved in purchasing, requirements, development, use, evaluation, support, maintenance, quality assurance, and software auditing to define and evaluate the quality of software products from different perspectives.
ISO 9126-2	[External metrics] It refers to the external properties that appear while in use, and measures the final product, which is the closing stage of software, from the user's and manager's point of view
ISO 9126-3	[Internal metrics] Interim products are measured by creating a measurement table for each evaluation factor by development stage based on internal software properties
ISO 9126-4	It measures whether the goals for efficiency, productivity, safety and satisfaction are met when using the finished software

② ISO 12207

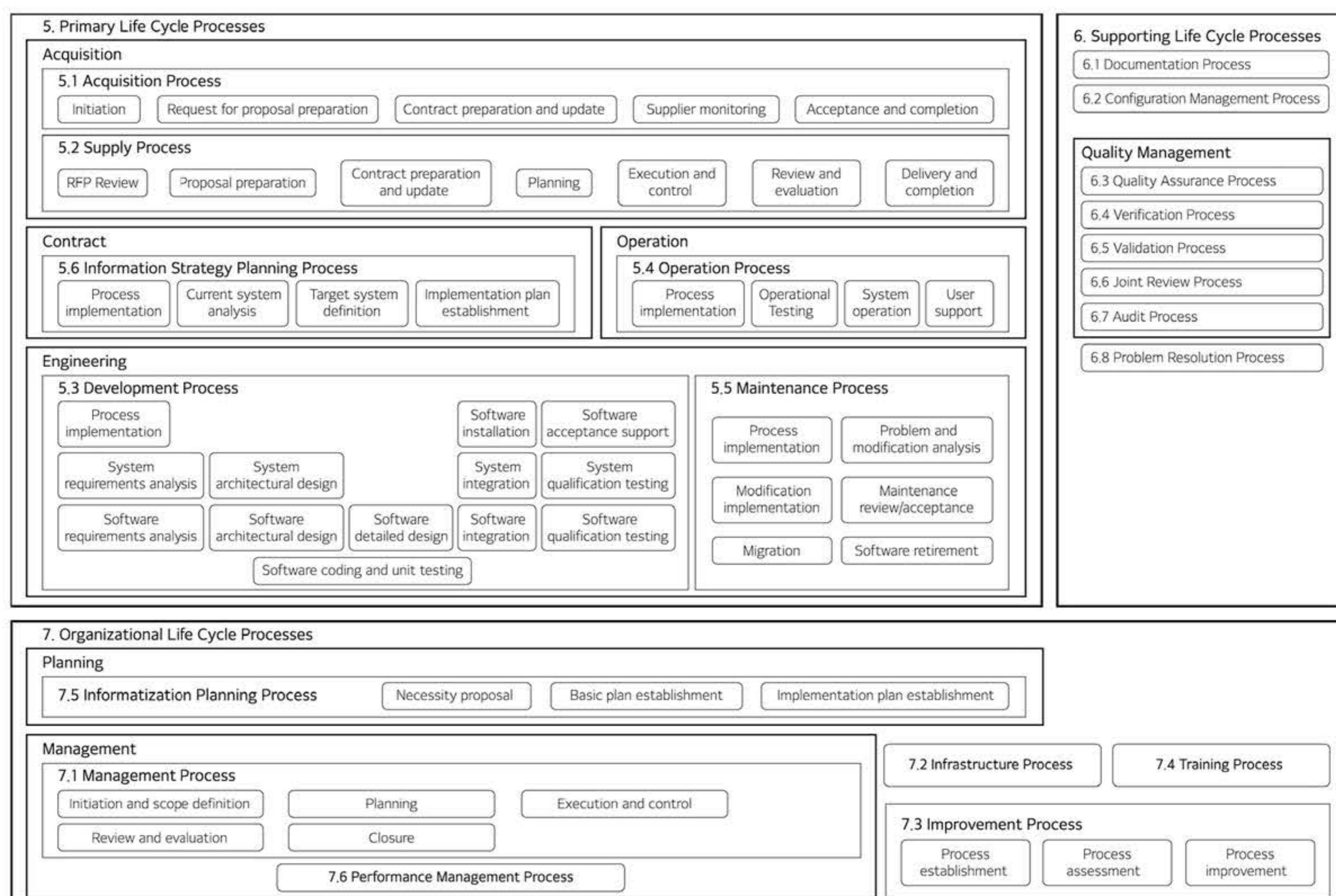
As a standardization for software process, it is a quality model that provides standards across the Software Development Life Cycle (SDLC) for systematic software acquisition, supply, development, operation, and maintenance.

The basic framework for communication by software practitioners in development and management was defined and presented at a high level.

<Table 59> ISO 12207 Life Cycle Process

Classification	Content
Acquisition	Define the activities to be performed by organizations that acquire systems, software products, or software services
Supply	Define the activities to be performed by organizations that supply systems, software products or software services
Development	Define the activities to be performed by development organizations that define and build software products
Operation	Define the activities to be performed by organizations that provide information system operation services in an actual environment (product environment) for users
Maintenance	Define the activities to be performed by organizations that provide maintenance services for software products

The following is an acquisition/management process framework among SW standard processes for acquisition and managing public projects based on ISO/IEC 12207. The acquisition/management process framework is a system that defines basic activities in the entire life cycle for software introduction, and procedures and activities for performing basic activities from a managerial and engineering perspective. The framework consists of three life cycle processes: primary; supporting and organizational, and 20 subprocesses.



[Figure 42] ISO 12207 Framework

③ Iso 25000

ISO25000 is an integrated software quality evaluation model established by International Organization for Standardization. Each division consists of the integration of existing quality standards such as ISO14598 and 9126 and the development of new standards referring to ISO/IEC 15288.



[Figure 43] ISO 25000

④ CMMI(Capability Maturity Model Integration)

CMMI is designed to provide guidance to improve the processes and capabilities of an organization that develops, acquires, and maintains software products or services. It is a standard to measure the maturity of a software development organization developed by Software Engineering Research Institute of Carnegie Mellon University.

<Table 60> CMMI Maturity Levels

Classification	Content
Level 1	[Initial] Organization where it is difficult to predict performance results because there is no standardized process
Level 2	[Managed] Organization in which the project is managed by building a basic process
Level 3	[Defined] Organization in which the project is controlled with detailed standard processes
Level 4	[Quantitatively Managed] Organization capable of predicting performance by quantitatively managing and controlling project performance activities
Level 5	[Optimizing] Organization in which continuous improvement activities are established and projects are carried out with optimal management

The following is a table comparing software process audit and certification systems: Software Process (SP) certification of Korea, international standard (ISO/IEC 15504) SPICE (Software Process Improvement and Capability Determination), and CMMI of the US.

<Table 61> Comparison of Domestic and Overseas Software Process Audit and Certification Systems

Classification		SP Certification (Korea)	CMMI (Overseas)	SPICE (Overseas)
Certification Institute	Organizer	Ministry of Science and ICT	Software Engineering Institute (CMU/SEI)	ISO/IEC
	Operation and Management	NIPA SW Engineering Center	SEI, CMMI Institute	ISO/IEC JTC1 SC7 WG10
	Characteristic	Domestic standard	Market standard (US)	International standard
		Organizational maturity assessment	Organizational maturity assessment	Process maturity assessment
		Staged model	Staged, Continuous model	Continuous model
	Rating (level)	Three levels (Level 1-3)	Five levels (Level 1-5)	Six levels (Level 0-5)
	Process Classification	Project management, development, support, organizational management, process improvement	Process Management, Project Management, Engineering, Support	Depends on the Process Reference Model (PRM)
Certification Method	Appraisal Method	SW process quality certification	SCAMPI A	SPICE compatibility
	Appraisal Target (Type of evidence)	Document and interview	Document and interview	Document and interview
	Validity Period	Three years	Three years	Unlimited
Certification Subject	Auditor	Senior auditor (internal/external)+auditor(external)	Senior auditor (internal/external) + auditor (mostly internal)	Senior auditor (internal/external)+auditor(external)
	Audit and Certification	Certification institution	Companies that have secured senior auditors	LTC
	Training and Management of Senior Auditor	Specialized institution (NIPA SW Engineering Center)	Software Engineering Institute (CMU/SEI)	LTC, iNTACS, IntRSA

⑤ SPICE(ISO15504)

It is a model that evaluates the software life cycle in two dimensions as a measure of the organization's software process maturity and improvement capability.

<Table 62> Characteristics of SPICE

Process	Group	Explanation
Primary Process	CUS(Customer-Supplier)	Acquisition, supply, demand creation, and operation between customers and suppliers
	ENG(Engineering)	System and software development, maintenance, etc.
Supporting Process	SUP(Support)	Documentation, configuration management, quality assurance, verification and validation, audit
Organizational Process	MAN(Management)	Project management, risk management
	ORG(Organization)	Organizational improvement activities, organizational manpower management, measurement tools and reuse



XIII. Risk Management

►►► Recent Trends and Major Issues

Amidst the changing business environment, systematic risk management and effective risk management capability is a new buzzword in business management. The level of expectations and demands for risk management is on the rise, and it must be managed in an integrated manner for sustainable business growth. At the project level, it is essential to preemptively identify and respond to any risk that could have an impact on the project for its successful completion.

►►► Learning Objectives

1. To be able to describe the concept of risk and risk management process.
 2. To be able to describe risk management process using risk response strategies.
-

►►► Concept summary

- Risk management process: risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, risk control
- Negative risk response strategy: Avoid, Transfer, Mitigate, Acceptance
- Positive risk response strategy: Exploit, Share, Enhance, Acceptance

✚ Preview for practical business

Risk management is a very attractive business management technique considering that the very survival of a company depends on potential large losses caused by unexpected risks. For the activation and effective application of risk management, an execution guideline that reflects the characteristics of the company must be established, and its effectiveness must be continuously measured to manage performance, and risk management process must be established at the enterprise level, rather than at the individual department level.

It must not be a one-time project and should be done organically in consideration of policies, management processes, definition of related roles and responsibilities, support systems and culture, etc.

01 Concept of Risk Management

Project risk refers to a situation in which uncertain events or conditions occur that negatively or positively affect project goals, such as scope, schedule, cost, and quality.

Risk management is a process that defines how to manage risks occurring in such a project, is an activity in which the level and type of risk management, and risks and their impacts are identified by the project organization. The types of risk are as follows:

<Table 63> Type of Risks

Classification	Known Risk	Unknown Risk
Concept	Risks that can be identified in advance	Risks that cannot be identified in advance
Contingency Reserve Allocation	Contingency Reserve is allocated to each work package and managed About 10% of total project cost	Management Reserve separately managed by management outside the project

Contingency Reserve Calculation	Calculated as expected value of probability and impact	Calculated as a percentage of the total budget
Countermeasure	Establish and execute a risk response plan	On an ad-hoc basis

02 Risk Management Process

Risk management is generally carried out over the following four stages:



[Figure 44] Risk Management Process

A) Risk identification

It is important to find the risks in the right time as possible. Risk identification involves identifying and documenting risks that may affect the project. A commonly used risk identification method is documentation review. The scope and schedule of tasks specified in the contract are legally valid and should be prioritized. The contract, proposal, and project execution plan should be cross-checked and double-checked for any omission. If something omitted from the project execution plan is specified in the contract or proposal, even if it is not actually implemented, it violates the acceptance criteria.

<Table 64> Risk Identification Method

Risk Identification Method	Explanation
Documentation Reviews	Review plans, assumptions, previous related project files, contracts and project documents
Information Gathering Techniques	Use techniques such as brainstorming, Delphi Technique, interviews, and root cause analysis to identify risks.
Checklist Analysis	Create a checklist based on precedents and knowledge accumulated in similar projects or other sources of information. The lowest level of RBS (Risk Breakdown Structure) can be used as a risk checklist
Assumption Analysis	Examine the validity of assumptions and identify inaccuracy, instability, inconsistency or incompleteness of assumptions as project risks
Diagramming Techniques	Use diagramming techniques to identify risks, such as a Cause and Effect Diagram, a System or Process Flow Diagram that expresses how various elements of the system are interconnected, an Interrelationship Diagram that depicts the relationship among factors, etc.

Risk Identification Method	Explanation
SWOT Analysis	Investigate the project in terms of SWOT so that the scope of the identified risks can be expanded to include internal risks.
Expert Judgment	Activities in which experts with similar project or business experience directly identify risks

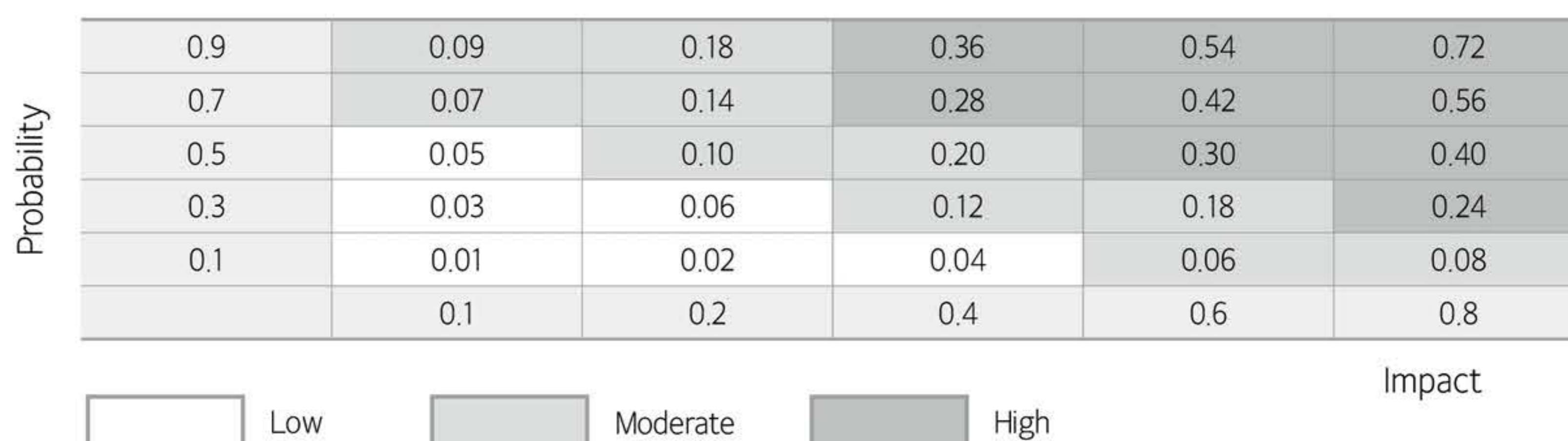
Risk, which is a key output of risk identification, is described as initially identified in the Risk Register. The identified risks are registered in the risk register, and qualitative/quantitative analysis is performed to prioritize the risks for risk response planning. The results of these activities are recorded in the risk register so that risks can be systematically tracked/managed.

<Table 65> Example of Risk Register

ID	Risk Item	Probability	Impact	Exposure	Priority	Countermeasure	Manager
R_001	Unclarified requirements	9	9	81	1	Documentation and periodic management of requirements	Hong Gildong
R_002	Non-verified new software	8	7	56	2	Selection and introduction through BMT	Hong Gilsoon
R_003	Tight schedule	8	6	48	3	Resource leveling for scheduling	Hong Gildong

B) Risk analysis: qualitative risk analysis

Qualitative risk analysis means qualitatively analyzing how much impact the risk has on the project at the beginning. Qualitative risk analysis refers to a method of prioritizing risks by evaluating the probability and impact of risks after risk identification is complete. Probability-Impact Matrix is a technique that qualitatively evaluates the probability of a risk and its impact on the objective and analyzes it in a matrix form.



[Figure 45] Probability-Impact Matrix (Example)

The risk level is “ $F(\text{probability}, \text{impact}) = \text{probability of occurrence} (\text{P}) \times \text{degree of impact} (\text{I})$ ”.

The probability of occurrence ranges from very low (0.1) to very high (0.9).

The impact on the objective ranges from very low (0.1) to very high (0.8).

The risk level is calculated by “probability of occurrence \times impact” and the ratings are ranked as low, moderate, and high for risk prioritization.

C) Risk analysis: quantitative risk analysis

Quantitative risk analysis is a numeric estimate of the overall effect of prioritized risks on the project objectives (cost and schedule objectives) after the qualitative risk analysis is completed.

<Table 66> Risk Analysis Method

Risk Analysis Method	Explanation
Interviewing	<ul style="list-style-type: none"> Rely on experience and precedents to quantify the probability and impact of risk on project objectives
Probability Distributions	<ul style="list-style-type: none"> Widely used in modeling and simulation, Probability Distribution is a measure of uncertainty of values such as the duration of activities, cost components, etc.
Tornado Diagrams	<ul style="list-style-type: none"> Apply the same ratio to input data to explain the amount of change in output, and the result values are displayed in a bar graph in order of sensitivity
Scenario Analysis	<ul style="list-style-type: none"> It describes future situations based on assumptions and used for such as system boundary, allocation method, description, time, space and weighting method. It analyzes the impact of each assumption on each calculated result.
Monte Carlo Simulation	<ul style="list-style-type: none"> The distribution of random variables is calculated by repeatedly substituting a range of values for parameters or variable of the probability model, to predict a specific variable. Statistical analysis that creates a cumulative distribution by generating random numbers according to the probability distribution of input data, and provides a probabilistic model by analyzing the cumulative result.
EMV Analysis	<ul style="list-style-type: none"> Expected monetary value with risks taken into account, expected value for possible occurrence. EMV requires a risk-neutral assumption that neither avoids nor pursues risk, multiplies each result by the probability of occurrence, and then sums the values, which is generally displayed for decision tree analysis.

D) Risk response

Risk response is the process of developing alternatives and actions that can reduce threats and increase opportunities for project objectives. When a risk is about to occur or occurs, a response plan is executed in advance according to the response strategy.

The risk response plan applies the response method according to the positive and negative risks.

Negative risk response strategy is a method to minimize threats or risks that may negatively affect the project objectives and includes Avoid, Transfer, Mitigate and Acceptance.

<Table 67> Negative Risk Response Strategy

Strategy	Explanation
Avoid	<ul style="list-style-type: none"> A method of isolating or changing the project's objectives from the scope of the risk's impact, including changing the project management plan, in order to completely eliminate the risk. For example, it includes actions such as schedule extension, strategy alteration and scope reduction.
Transfer	<ul style="list-style-type: none"> It means to transfer the impact of risk and the subject of response to a third party It simply transfers responsibility and does not eliminate the risk. Responsibility transfer is the most effective in dealing with financial risk exposure. As a transfer tool, there are insurance, performance bonds, various warranties and guarantees.
Mitigate	<p>A method of reducing the likelihood of a risk and its impact on the target up to an acceptable threshold</p> <ul style="list-style-type: none"> Examples include taking initial measures, performing many tests, selecting a simple process, mitigating risk, etc.

Strategy	Explanation
Acceptance	<p>This strategy is adopted when risk elimination is not possible. Passive acceptance and active acceptance are selected when appropriate response strategies cannot be established.</p> <ul style="list-style-type: none"> • Passive acceptance: No action is required other than documenting the strategy and the risk incurred is handled by the project team. • Active acceptance: actively build a contingency reserve, including time, capital, or resources to deal with the risk.

Positive risk response strategy is a method of dealing with risks that can have a positive impact on the project objectives and includes Exploit, Share, Enhance and Acceptance.

<Table 68> Positive Risk Response Strategy

Strategy	Explanation
Exploit	<ul style="list-style-type: none"> • An activity that eliminates uncertainty so that opportunities are evident during the project's execution period, requiring actions such as reducing the cost of provision or dedicating competent resources to shorten the completion time.
Share	<ul style="list-style-type: none"> • If there is a positive impact on the progress of the project, ownership of the opportunity is shared with other organizations to realize opportunities, including establishing partnerships with risk-sharing partners and special-purpose organizations.
Enhance	<ul style="list-style-type: none"> • As a strategy to maximize the probability and impact of an opportunity, it identifies the main causes and take action to maximize effectiveness
Acceptance	<ul style="list-style-type: none"> • Choose to take advantage of opportunities but not actively pursue them so that risks arise

E) Risk Control

Risk control is a process for implementing a risk response plan, tracking and managing identified risks, monitoring residual risks, identifying new risks, and evaluating risk management activities. Assessing the effectiveness of a risk response by monitoring the identified risks and investigating and documenting whether risk management is effective.

<Table 69> Risk Control Method

Method	Explanation
Risk Reassessment	<ul style="list-style-type: none"> • Perform on a regular schedule with activities to identify new risks as a result of risk monitoring and control, reassess current risks, and terminate outdated risks.
Risk Audits	<ul style="list-style-type: none"> • Investigate and document the effectiveness of risk countermeasures addressing the identified risks and root causes, and the effectiveness of risk management processes.
Variance and Trend Analysis	<ul style="list-style-type: none"> • Analyze the difference between planned and actual outputs, and review trends in project execution using performance information for event monitoring and controlling
Technical Performance Measurement	<ul style="list-style-type: none"> • Technical performance during project execution is compared to the technical performance schedule in the project plan, and technical performance is measured by weight, number of transactions, number of defective deliveries, storage capacity, etc.



XIV. Project Tools and Evaluation

►►► Recent Trends and Major Issues

In the past, whether the project was completed on schedule, did not exceed the budget, and achieved the originally planned objective were the criteria for measuring its success and failure. In contrast, today, how much the project contributed quantitatively and qualitatively to achieving the company's management goals and improvement of competitiveness is an evaluating criterion.

►►► Learning Objectives

To be able to explain the concept of project evaluation and step-by-step process

►►► Concept summary

- Evaluation stage: Ex-ante evaluation, interim evaluation, ex-post evaluation
- Evaluation type: IT investment performance management, performance evaluation

+ Preview for practical business

If the project evaluation criteria are successfully met within the planned schedule and budget, the project is evaluated as a success. However, the Sydney Opera House runs counter to such idea. The construction project, which started with the groundbreaking ceremony in 1958, was delayed leading to additional costs increasing exponentially. The duration got 6 years longer than originally planned, and the cost was 15 times higher than the original budget. A project with the construction duration and cost increased significantly compared to the original plan is a failure in terms of project management. But what about now? More than 100 million tourists visit the venue each year, earning several times more profit the total construction cost, and it has even been designated as the World Heritage Site as a modern building.

In business, project performance and evaluation are based on compliance with scope, schedule, and cost, but even if the project fails to accomplish the original plan, it may not be necessarily a failure, given the potential value of the completed project. In other words, it is necessary to make transparent and reliable decisions about changes in range, cost, and schedule.

01 Understanding of Project Management System

A) Project management system, PMS

Management of a large-scale enterprise-wide project requires a lot of human and physical input. The project manager manages the project by connecting it with some practical software for management efficiency. There is software that automatically manages progress for project management. When each project team member puts in their own project activity completion rate, the overall project progress is managed through Excel, Project Management System (PMS), etc. PMS is a system that manages the entire process from project creation to completion, providing efficiency and transparency in project management, removing risk factors, and managing schedule.

The most common open source tools include Redmine, Gantt Project, and Open Project.

Work name	Period	Start date	Finish date	Preceding work	Resource name	Completion rate	Project Process rate
New IPCC establishment	143 days	13/09/23(Mon.)	14/04/11(Fri.)				35%
1. Consultation application establishment	143 days	13/09/23(Mon.)	14/04/11(Fri.)		Lee Hyeonjung, Park Geuncheol		31%
1.1 Requirements specification and scoping	35 days	13/09/23(Mon.)	13/11/08(Fri.)		Lee Hyeonjung, Park Geuncheol		100%
CS(Customer Service)	0 day	13/09/23(Mon.)	13/11/08(Fri.)		Lee Hyeonjung, Park Geuncheol		100%
Public Corporation Plus	0 day	13/09/23(Mon.)	13/11/08(Fri.)		Lee Hyeonjung, Park Geuncheol		100%
Linkage to affiliated company	0 day	13/09/23(Mon.)	13/11/08(Fri.)		Lee Hyeonjung, Park Geuncheol		100%
Product sales operation	0 day	13/09/23(Mon.)	13/11/08(Fri.)		Lee Hyeonjung, Park Geuncheol		100%
Vertical service organization	0 day	13/09/23(Mon.)	13/11/08(Fri.)		Lee Hyeonjung, Park Geuncheol		100%
Membership operation	0 day	13/09/23(Mon.)	13/11/08(Fri.)		Lee Hyeonjung, Park Geuncheol		100%
1.2 Screen design(planning)	25 days	13/10/14(Mon.)	13/11/15(Fri.)		Kim Jihyeon, Lee Hyeonjung, Park Geuncheol		88%
CS(Customer Service)	25 days	13/10/14(Mon.)	13/11/15(Fri.)		Kim Jihyeon, Lee Hyeonjung, Park Geuncheol		100%
Public Corporation Plus	25 days	13/10/14(Mon.)	13/11/15(Fri.)		Kim Jihyeon, Lee Hyeonjung, Park Geuncheol		100%
Partner	25 days	13/10/14(Mon.)	13/11/15(Fri.)		Kim Jihyeon, Lee Hyeonjung, Park Geuncheol		100%
Membership operation	25 days	13/10/14(Mon.)	13/11/15(Fri.)		Kim Jihyeon, Lee Hyeonjung, Park Geuncheol		100%
Manager	25 days	13/10/14(Mon.)	13/11/15(Fri.)		Kim Jihyeon, Lee Hyeonjung, Park Geuncheol		100%
1.3 DB design	25 days	13/10/14(Mon.)	13/11/15(Fri.)		Yun Euisu		100%
IPCC DB design	25 days	13/10/14(Mon.)	13/11/15(Fri.)		Yun Euisu		100%
1.4 Interface design	50 days	13/10/14(Mon.)	13/12/20(Fri.)		Jang Heyonggeun		78%
1.4.1 CTI	1.45 days	13/10/21(Mon.)	13/10/22(Tue.)		Park Jujin Jeong Yeongseon		45%
1.4.2 ARS	29 days	13/10/21(Mon.)	13/11/28(Fri.)		Jang Heyonggeun, Park Jujin		45%
1.4.3 Statistics	20 days	13/10/21(Mon.)	13/12/20(Fri.)		Jang Heyonggeun, Kim Cheoljung		90%
1.4.5 Recording	15 days	13/10/21(Mon.)	13/11/15(Fri.)		Jang Heyonggeun		90%
1.4.6 Legacy/Admin,SF, Settlement)	50 days	13/10/14(Mon.)	13/02/20(Fri.)				90%
1.5 Establishment	98 days	13/11/25(Mon.)	14/04/11(Fri.)				0%
1.5.1 Web Pub membership operation hing	15 days	14/01/17(Fri.)	14/02/10(Mon.)		Lee Yongseok		0%

1.5.2 Interface implementation	13 days	4/01/08(Wed.)	14/01/24(Fri.)		Lee Seonyeong	0%
1.5.3 Consultation screen	86 days	13/11/25(Mon.)	4/03/26(Wed.)		Kim Hyeonhwan	1%

[Figure 46] Project Progress Tracking Management Tool (example)

B) Risk management system, RMS

Project managers must monitor and control the project from initiation to the end of the project for numerous issues and risks. In the same way that requirements are managed using a Requirement Traceability Matrix, issues and risks are also managed using an issue management tool, and the figure below is an issue and requirements management software.

Key	Summary	Status	Processing status	Creation date	Update date	Updated version
SUSRQ-2663	[Local] Improve validity period structure_Sales force	Registered	Unresolved	2013/08/23	2013/08/23	Developed
SUSRQ-2624	Improve commission for the Store Service	Registered	Unresolved	2013/08/19	2013/08/22	To be reviewed
SUSRQ-2580	[CEO work order] Web-related issues of customer center, admin FAQ-related functionality implementation	Registered	Unresolved	2013/08/08	2013/08/23	To be reviewed
SUSRQ-2577	[Store] Feature for buyers related to shipping destination of buyers	In progress	Unresolved	2013/08/08	2013/08/08	Being planned
SUSRQ-2565	Automatic estimation of return shipping cost	Registered	Unresolved	2013/08/07	2013/08/23	To be reviewed
SUSRQ-2552	Automatic reflection into FN of whether actual shipping has been made	Registered	Unresolved	2013/08/06	2013/08/23	Being planned
SUSRQ-2515	Shipping cost promotion system	Registered	Unresolved	2013/07/31	2013/08/07	To be reviewed
SUSRQ-2441	Low price guarantee	In progress	Unresolved	2013/07/22	2013/08/23	QA
SUSRQ-2421	Immediate discount	Registered	Unresolved	2013/07/18	2013/08/19	Waiting
SUSRQ-2389	[Local] Improve validity period structure	In progress	Unresolved	2013/07/16	2013/08/23	Developed
SUSRQ-2358	Road name address conversion	Registered	Unresolved	2013/07/11	2013/08/19	Being planned
SUSRQ-2343	Create icons for cautions for use	Registered	Unresolved	2013/07/09	2013/08/07	Waiting
SUSRQ-2327	Bundle delivery	Registered	Unresolved	2013/07/08	2013/08/23	To be planned

[Figure 47] Project Issue and Risk Management Tool (example)

C) Configuration management system, CMS

Configuration management tool is a management tool that systematically manages source codes or deliverables in an environment where several people work at the same time to prevent duplicate revisions or loss of updated contents. It mainly tracks the history of source codes or deliverables and performs version control. The most popular tools include CVS, Subversion, and Git.

CVS		SVN		GIT	
License	GNU GPL v2.0	License	Apache License v2.0	License	GNU GPL v2.0
Language	Irrelevant	Language	Irrelevant	Language	Irrelevant
OS	Windows/Linux Mac (Third Party Tool)	OS	Windows/Linux/Mac	OS	Windows/Linux/Mac
Runtime Environment	Command Line Interface	Runtime Environment	Command Line Interface	Runtime Environment	Command Line Interface
GUI	Third party tools such as TortoiseCVS, etc.	GUI	Third party tools such as TortoiseCVS, etc.	GUI	Various third-party tools such as SourceTree, GitEye, git-cola, etc. offered in bundle

[Figure 48] Comparison of Configuration Management Tools

D) Advantages of project management system

The following advantages can be obtained by using the project management system.

① Successful project management

You can get full visibility into project progress. In other words, it is possible to see how far the entire project has progressed and what tasks remain in the future. Therefore, there is an advantage of being able to manage the project as planned.

② Effective team management

You can effectively assign each task to team members and manage the schedule. It becomes convenient to assign the subdivided tasks to each team and team member and manage roles, thereby achieving the goal of a large project.

③ Improvement of organizational competence

The history of the entire project in progress is recorded, and the deliverables of each stage are registered, and the organization's assets are managed. This can serve as a reference model when conducting similar projects, thereby improving the overall performance capability of the organization.

02 Concept of Project Monitoring and Evaluation

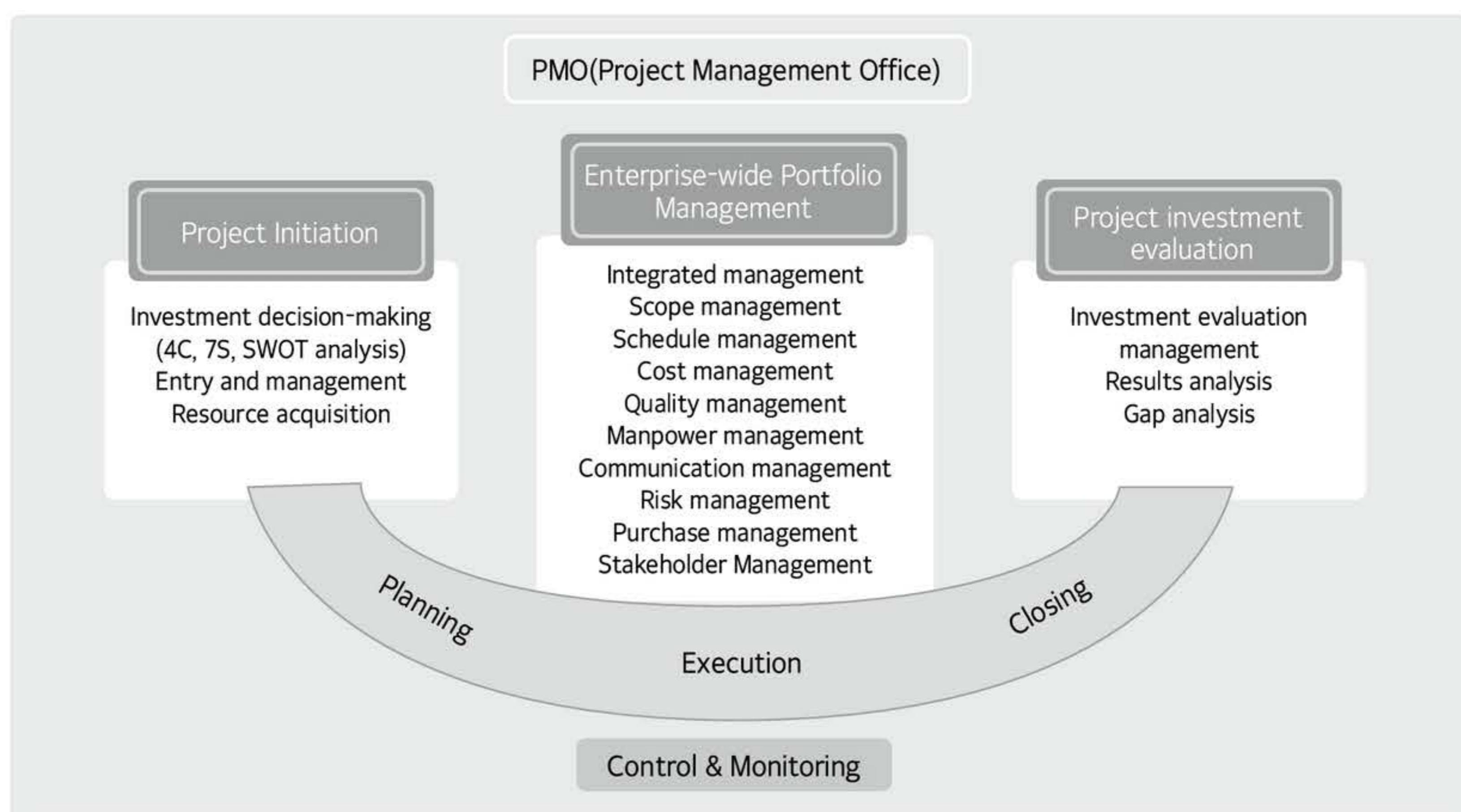
A) Concept of project monitoring and evaluation

Project monitoring and evaluation is the process of evaluating whether the project has completed delivery within the planned time period and whether the cost has excessively exceeded the budget. The reason for such evaluation is: First, it is to evaluate how much IT investment has contributed to the achievement of business goals. Second, a project retrospective helps identify whether there has been any problem in each step or any issue that may be difficult to respond to, reflecting it in future project progress. Therefore, project evaluation is generally conducted in three aspects: first, a financial perspective, second, a management perspective,

and third, a technical perspective. From a financial standpoint, investment and ROI are evaluated. From a management point of view, the process of project progress (schedule, scope, quality, risk management, etc.) is evaluated, and from a technical point of view, it is evaluated from the perspective of technologies and solutions applied to the project.

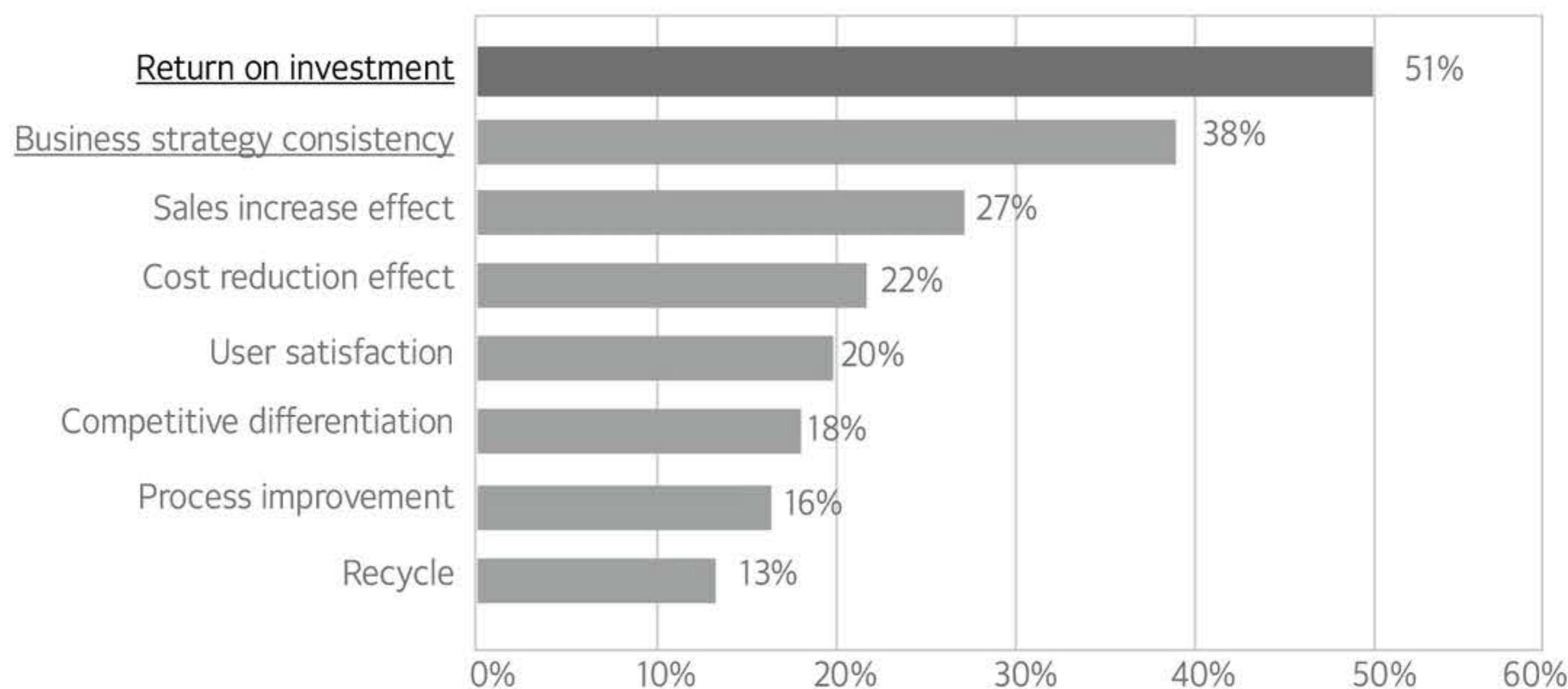
B) Project evaluation

As a project requires a lot of investment management, companies generally run multiple projects and require systematic management. Project evaluation means evaluating everything from the start of the project to the project investment after the end of the project.



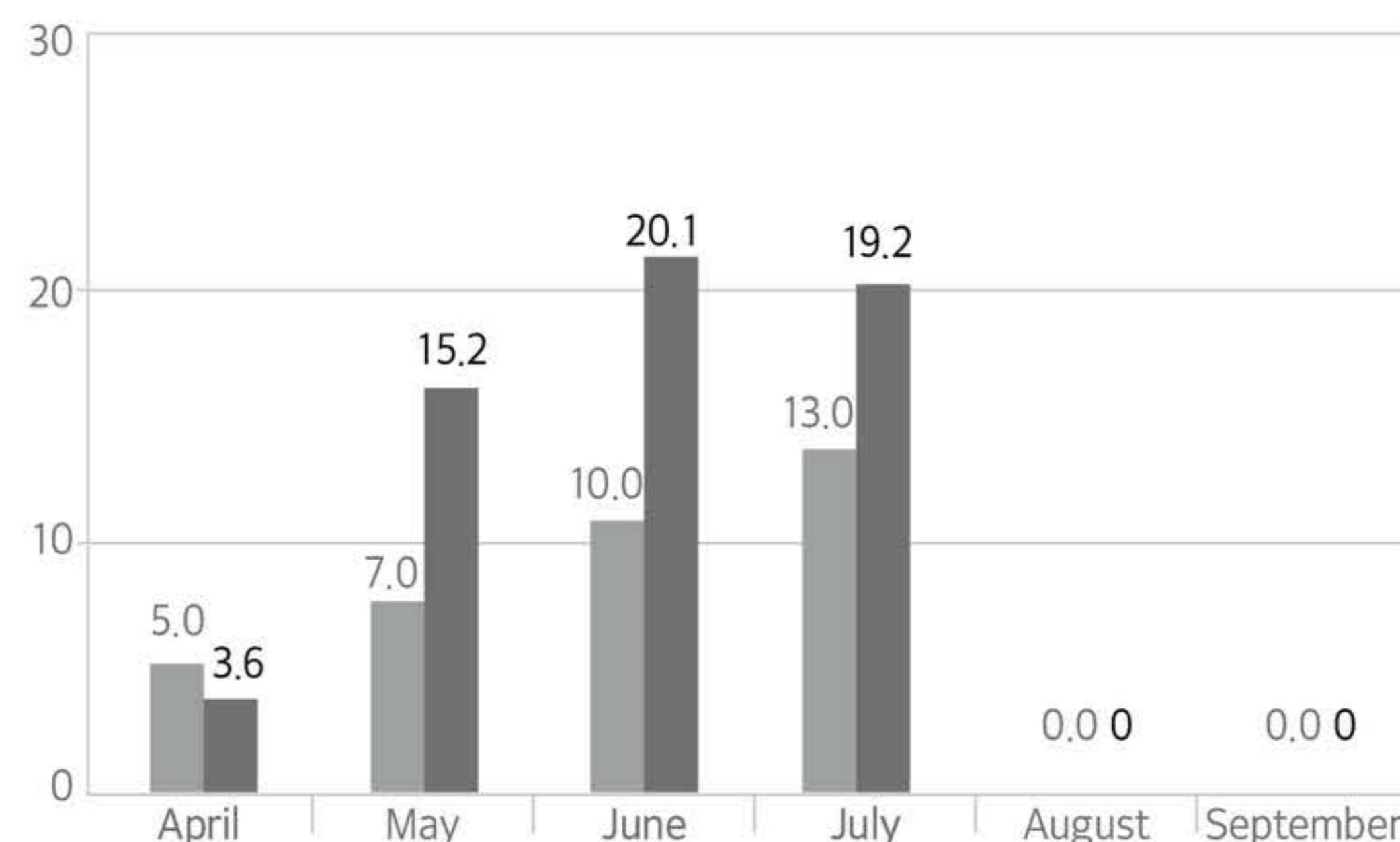
[Figure 49] Project Investment Evaluation Process through PMO

Just because the project is completely finished, it doesn't mean that everything is finished. Since a large number of personnel and costs were invested in one project, it is necessary to carry out a fair ex-post evaluation process. The example below shows evaluation items for the value and perception of the project information system.



[Figure 50] Project Evaluation Items (example)

The result of the project below is an example of evaluating the project goals speculated in the project charter and the actual results after 4 months. This helps to measure monthly project performance based on monthly sales and to derive future operations and improvements along with investment evaluation of the project.



[Figure 51] Four-month Performance Measurement of OO Project (X-axis: period, Y-axis: sales (in billions)) (example)

Project managers should check the project plan and Business Case to determine quantitatively whether the project has reached its goals, through project management tools and evaluation, thereby actively managing and supporting continuous process improvement.

C) Project evaluation stage and focal point

The project evaluation stage is a task that analyzes how much the IT project has contributed to the achievement of business goals from the three points of view previously examined. It can be divided into Ex-ante evaluation, Interim evaluation, and Ex-post evaluation depending on when the project is evaluated.

<Table 70> Project Evaluation Stage

Evaluation Stage	Explanation
Ex-ante Evaluation	<ul style="list-style-type: none"> Analyze the feasibility of the project in advance and support decision-making on IT investments Prioritize multiple projects Evaluation is carried out frequently to decide whether to proceed with the IT project and select alternatives Companies prioritize projects every year to establish the budget for next year
Interim Evaluation	<ul style="list-style-type: none"> Conducted in the form of evaluation, supervision, and inspection during the project IT investment risk management for achieving goals
Ex-post Evaluation	<ul style="list-style-type: none"> Performed in a certain period of time after the project is completed Check whether the company's management goals for IT investment are achieved Confirmation of project effectiveness and investment feasibility Quarterly, semiannual, and annual evaluation Establish future improvement plans and improve IT operation efficiency after evaluation

The following four advantages are obtained through the three-step evaluation process.

- Verifying the effectiveness of IT investment in supporting business goals
- Lessons learned to improve future project performance
- Develop improvement points for project progress and prepare improvement plans
- Progressive, continuous improvement of the project management process