Representative Author: Shignobu Ohara

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Part IV. Domain Management

Chapter 1 Project Strategy Management

Outline

Project strategy management is a framework that clarifies the relation between corporate strategies (including public and non-profit corporations) and projects, and effectively incorporates project activity into corporate value creation. This framework needs two major systems, and formation of such systems will lead to realization of project strategy management. One is a system for companies to select a project and the other is a system to improve project environment for effective achievement of a project.

If a company selects a wrong project, it cannot attain a success as a company even if it successfully achieves a goal for the project. A success in a project could result in destruction of corporate value. Selecting a project is actually investment for companies. Therefore, it is necessary for companies to select a project that creates a value higher than the investment. In order to select a right project, a company vision that shows the direction for corporate value creation and the specific corporate strategy to realize it must be clarified. In other words, a vision and strategy can be a standard for selecting a project.

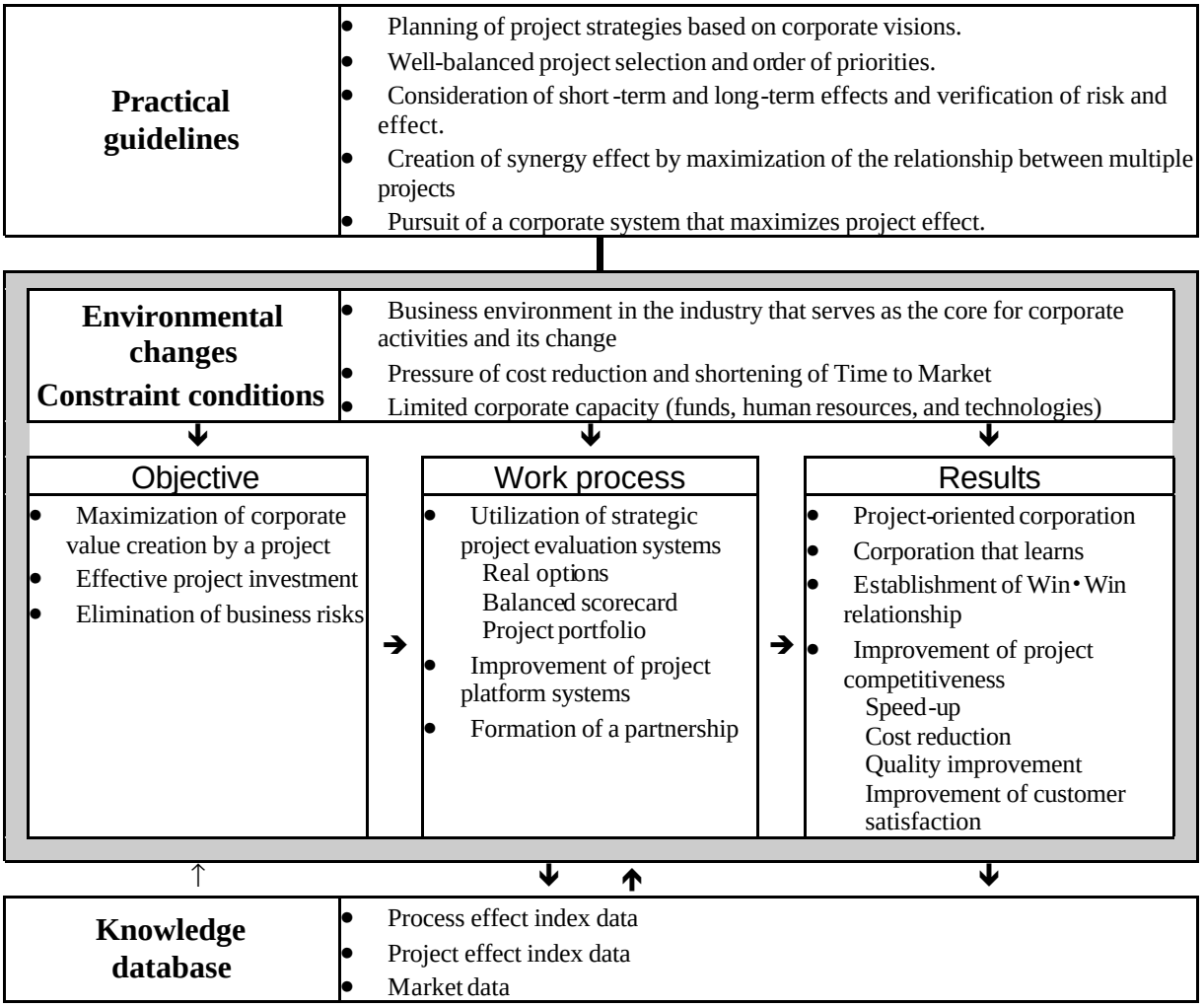


Figure 4-1-1: Overview of Project Strategy Management

Since goals of projects are becoming diversified these days, it is risky to select a project only on a basis of short-term interest. Enterprises also have objectives that contribute to corporate value on a long-term basis such as improvement of technology and reinforcement of relations with customers, so that they need to select a project from both short-term and long-term aspects. In companies, multiple projects proceed concurrently, and the order of priority must be determined for human and financial investments in projects in consideration of respective investment effect. For effective investment, it is significant to determine the order of priorities through relative comparison including close examination of project risks

and values, and to decide investment allocation according to the order of priorities. For such effective selection of projects, methods using the balanced score card or project portfolio are generally used.

The environment of enterprises for implementing a project has potential to seriously affect results of projects. In addition, an environment that supports the generation of project deliverables has potential to positively affect corporate competitiveness Particularly, aspects of corporate domains such as process, organizational structure, finance, and knowledge greatly influence performance of a project. In the project domain, corporate consistency in the relationship between programs positioned higher than projects and lower-positioned tasks will affect project results. Such approaches are expected to become increasingly important, increasing the synergy effect by effectively using project relationships in programs and applying deliverables from one project to others.

When corporate environments are drastically changing, resources needed by enterprises are also greatly changing. Therefore, there is inconsistency between resources held by enterprises and those required thereby. Meanwhile, enterprises have less time to foster these necessary resources by themselves, so this gap continues to increase. In such situations, it is becoming difficult for enterprises to rely on in-house resources only in order to perform projects. Therefore, it is becoming more significant to solicit necessary resources from outside enterprises, rather than being limited to in-house procurement. Hence, alliances with outside enterprises are becoming a critical element for successful projects.

Case ◆ Significance in Project Selection

Top management of a company ordered its development department to reduce software development cost by 10% in a year. The department considered it impossible to reduce the development cost by 10% in a year no matter what kind of improvements they tried to conduct. However, when they closely examined the causes for cost increase, they found that it was attributable to certain problem-causing projects and that the investigation upon receiving those orders was insufficient. Then, they made thorough examination of the risk of accepting orders together with the sales department and reduced the reception of such orders as far as possible. As a result, they reduced software development cost more than 10% in one year.

Case ◆ Difference in Project Performance Environment

In the pharmaceutical industry, the competition for new drug development is intensifying and the average period for developing a new drug is about 5.7 years in major global-scale companies in the U.S. and Europe. However, there is a great difference in development speeds among companies. Some companies develop new drugs in the shortest period of about 4 years. Such difference in development speed is caused by variance in environments for promoting projects. For reference, Japanese pharmaceutical companies generally spend 7 or 8 years for development and have a great difference in development environments.

Case ◆ Value Creation under Favor of Relationship with Higher-level Programs

The automobile industry has achieved speed-up and cost reduction in development of new vehicles by effective application of synergistic relationship between projects . This is seen in development models that incorporate common parts. For instance, sharing of an automobile chassis with a number of models enables not only reduction in development cost but also in development and production time.

1. Evaluation System for Strategic Projects

Choice of projects and investment therein in order to achieve corporate strategies, is a critical issue for enterprises. Generally, enterprises perform activities to enhance corporate value by having a number of ongoing projects. Results of such activities are greatly dependent on how much investment is made in finance and human resources and in which project such investment is made. Evaluation systems for strategic projects play a role similar to risk management in the corporate value creation process. Major items on which strategic projects are evaluated are as follows:

- Degrees of conformity with and contribution to corporate strategies (degree of consistency between projects and corporate strategies)
- Market size (scales of sales and impact concerning products created by projects)
- Market competition power (competitive power of products in the market)
- Financial reward (size of cash flow created by projects)
- Technical innovation (technical novelty and degree of technical contribution to companies)
- Probability of success (probability of success in projects and scale of the risk)
- Development investment cost (scale of investment cost for projects until development of production begins)
- Period until completion (period required for completion)
- Business development cost including marketing.
- Acceptability of environmental and social aspects (whether to generate environmental issues or adverse effect on society)
- Degree of contribution to improvement in in-company business process
- Degree of contribution to human resource development
- Degree of contribution to enhancement of the corporate brand power

● Investment Risk on Projects

Projects intended to improve corporate value require investment . Investments are accompanied by risks, and investments in consideration of risks are required. Conversion of values created by projects into cash value should recognise the time-value of money.

■ Process to Approve Investment Cases

Investment is a critical decision-making issue for enterprises and its process must be streamlined.

Generally, enterprises have investment approval and authorization systems in which investments in excess of a certain amount must be approved by officers at higher positions. However, if lower level of officers are given insufficient discretionary powers to authorize investments, most investments will require approval of top management, which will cause delays in decision-making and complicated in-house procedures, resulting in inefficiency and difficulties to respond quickly.

Meanwhile, if decision-making on all cases are entrusted to lower level officers, it is likely to cause short-term-oriented thinking and uncontrolled flow of funds due to failure to base decisions on strategic investment on a long-term basis. Skills in decision-making process directly affect competitive power of companies. It is important to build up a decision-making process for investment suitable for the business environment of enterprises. In many cases, authority for approving investments is granted to a broader extent when corporate performance is favorable, and when performance becomes unfavorable, authority for approval will be reduced to control internal fund needs.

■ Evaluation of Investment Profitability

As long as projects are investment activity, it should be understood how returns on investments are realized. The following are generally known as methods of evaluating investment profitability:

- Payback Period method or Simple Payback method
- Internal Rate of Return (IRR) method
- Discount Cash Flow Net Present Value method
- Real Option method
- Return on investment (ROI) method
- Return on Equity (ROE) method

■ Investment Types

Investments are closely related to growth of enterprises and maintenance and reinforcement of competitive power. Standards for evaluating individual investments are different according to objectives of investment. Investments are generally classified into the following four categories:

(1)NEW INVESTMENT

New investments create new values and serve as a source of growth in enterprises. Therefore, investments can be evaluated through assessment of sales and profits generated from new values and comparison with investment amounts. Exploitation of new products and development of new stores, etc. belong to this category.

(2)MAINTENANCE AND RENEWAL INVESTMENT

Maintenance and renewal investments are made for maintenance and renewal of equipment and facilities that are needed to keep the present competitive power and to introduce equipment and services similar to those of competitors. The actual investment should be assessed according to the extent to which it is necessary for maintaining competitiveness versus the investment that would be lost opportunity cost due to decreased competitiveness.

(3)FACILITY RESTORATION INVESTMENT

Restoration investment is made to return equipment and facilities that are damaged or broken down for some reason to the original state, so it is difficult to evaluate the collection of investment for this type of investment,.

(4)EFFICIENCY IMPROVEMENT INVESTMENT

Efficiency improvement investment aims at cost reduction through enhancement of efficiency. It aims to reduce cost through improvement in productivity, e.g., large-scale streamlining of work through investment in systems, reduction of maintenance and management cost or production time through introduction of advanced equipment, etc. This type of investment can be evaluated by comparing the cost reduced and the amount invested.

● Project Portfolio Approach

Project portfolio approach reflects the actual state of value creation by enterprises. Since many enterprises achieve their profits through projects, it is significant to know added values and risks of projects held, or to be held by, enterprises for ascertaining the direction of enterprises.

In particular, for enterprises that invest in product development, where to invest their business resources is a critical element for decision making. It affects the future of enterprises and may determine whether they can survive. For pharmaceutical enterprises, e.g., which carry a great number of development projects with high project risk (only 10% of success probability in projects starting with clinical testing), it is a critical item for managerial decision-making to determine those projects in which they should make investment and inject their business resources.

Project portfolio approach identifies relative values and risks of all projects for enterprises. It aims to make choices and decide priorities of projects by determining the order of their significance.

Project portfolio chart for enterprises includes bubbles and plots with success probability of projects as a vertical axis and profitability as a horizontal axis but does not include absolute values (fixed axis). The most general type of project portfolio chart is the bubble chart with axes of risk and profitability. Axes of risk and profitability can be set freely, but a typical chart is Strategic Design Group (SDG) model, which has project success probability from the technical viewpoint as a vertical axis and profitability of project indicated with NPV as a horizontal axis. In some cases, amounts of investment in projects, progress in projects, categories of products, etc. are indicated by the size, color, painting status, etc. of bubbles,

The following bubble chart shows an example of the project portfolio in a pharmaceutical enterprise. In the bubble chart for risk and profitability, projects can be evaluated by classifying projects into the following four zones:

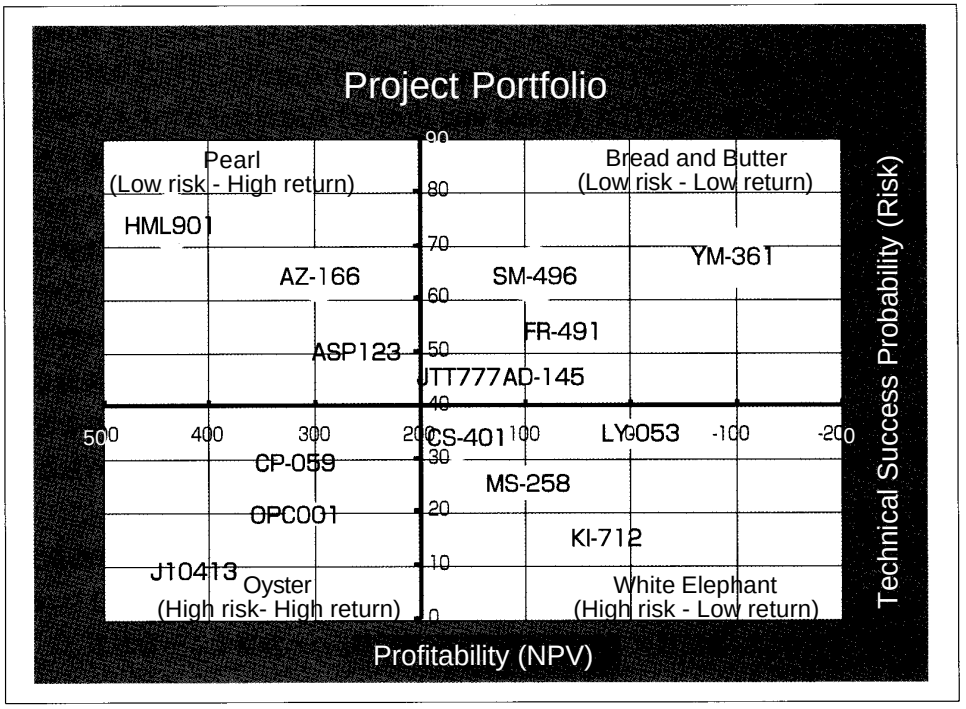


Figure 4-1-2: Project Portfolio

(1) Pearl

A zone of low risk and high return. High value-added projects with low risk belong to this zone. Preferable projects for enterprises belong to this zone, where investment has a top priority.

(2) Bread and Butter

A zone that includes many low-risk and low-return projects that serve as "means of subsistence." This zone includes projects with lower added-values and less technical risk, where functions and purposes for use are enhanced through the use of past technologies and products.

(3) Oyster

A zone of high risk and high return. Projects that have high added-values but high technical risk as well, and need breakthrough belong to this zone. However, such projects will be transferred to the pearl zone if they succeed in technical breakthrough.

(4) White Elephant

A zone of high risk and low return. Burdensome projects belong to this zone. However, if enterprises aim to develop new technologies and convert them to other projects as a strategy, they may intentionally generate projects of this zone.

● Balanced Score Card

Balanced Score Card is designed to link corporate strategies with organization activities by specifying value drivers derived from corporate strategies and developing them into activities of organizations and individuals as a performance evaluation index.

In Balanced Score Card, the following four viewpoints are mainly proposed for achievement of strategies. Goals are established in each viewpoint, and programs and projects for achieving strategies are clarified through step-by-step development, e.g., operation indexes for achieving goals, numerical goals for operation indexes, and action plans for achieving such goals.

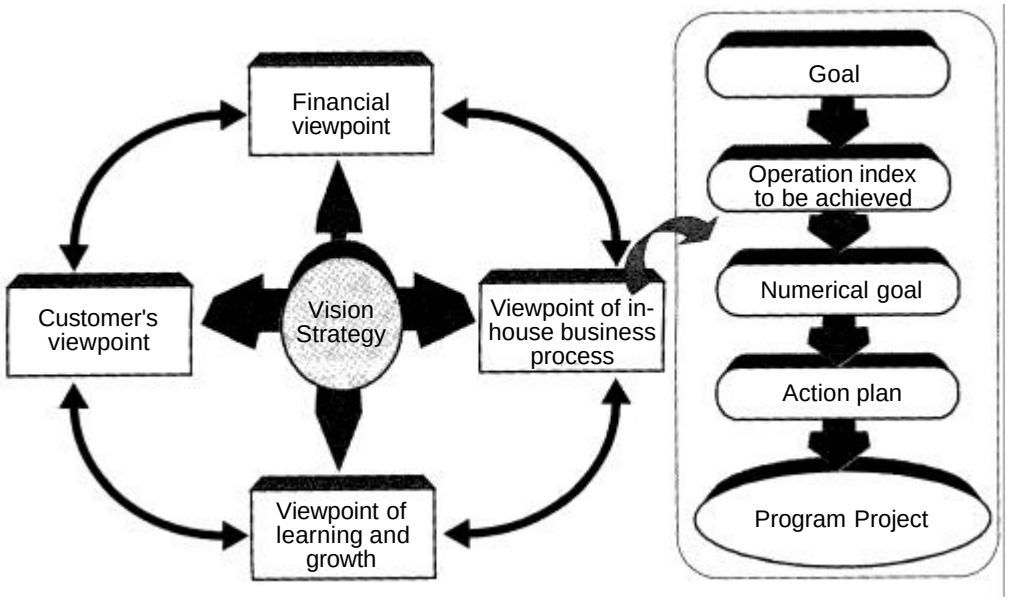


Figure 4-1-3: Viewpoints for Balanced Score Card

- Financial viewpoint
- Customer's viewpoint
- Viewpoint of in-house business process
- Viewpoint of learning and growth

Enterprises have their strategies but also have difficulty in their actual application to business. Therefore, many companies often have such projects that are not aligned with their strategies, which result in deterioration of their competitive power. Given that project activities are the basis for actual activities of enterprises, it is critical for enhancement of corporate competitive power to keep projects consistent with corporate strategies and to implement projects so as to contribute to strategy achievement.

Balanced Score Card satisfies such requirements and works effectively as a critical management index to link corporate strategies with project activities. From the viewpoint of project management, Balanced Score Card has high utility values in terms of the following three points:

(1)USE FOR PRACTICAL PROGRAM SELECTION TO ACHIEVE CORPORATE STRATEGIES

Selection of a good program, which is placed above a project, leads to selection of a project. It enables selection of a practical program to achieve numerical goals derived from strategies and clarifies the scope of program.

(2)USE AS INDEXES FOR DECISION MAKING ON CORPORATE INVESTMENT IN PROJECTS

Investment in projects is also significant for effective use of limited corporate assets.

In this sense, investment should be made not simply by using short-term financial indexes but also by deciding comprehensively including the viewpoint of corporate competitive power on a long-term basis. Balanced Score Card where strategies are developed into practical goals clarifies contribution of projects to strategies and makes it easier to determine the order of priorities of investments.

(3)USE FOR ESTABLISHMENT OF PROJECT GOALS AIMING AT ACHIEVEMENT OF CORPORATE STRATEGIES

Establishment of project goals without control will endanger achievement of strategies. Objectives of projects greatly influence action guidelines and decision-making criteria for people concerned with projects, and policies of projects as well. Project goals developed from strategies serve to closely connect strategies with projects.

2. Evaluation System for Strategic Projects

Project base systems show the framework of new enterprise models needed by projectized enterprises that place projects as a core of corporate activities. Project base systems serve as a system to achieve corporate strategies effectively, and consist of project domain, process domain, organizational domain, financial domain, and knowledge domain. Each domain has a close relationship with and influence on the other domains.

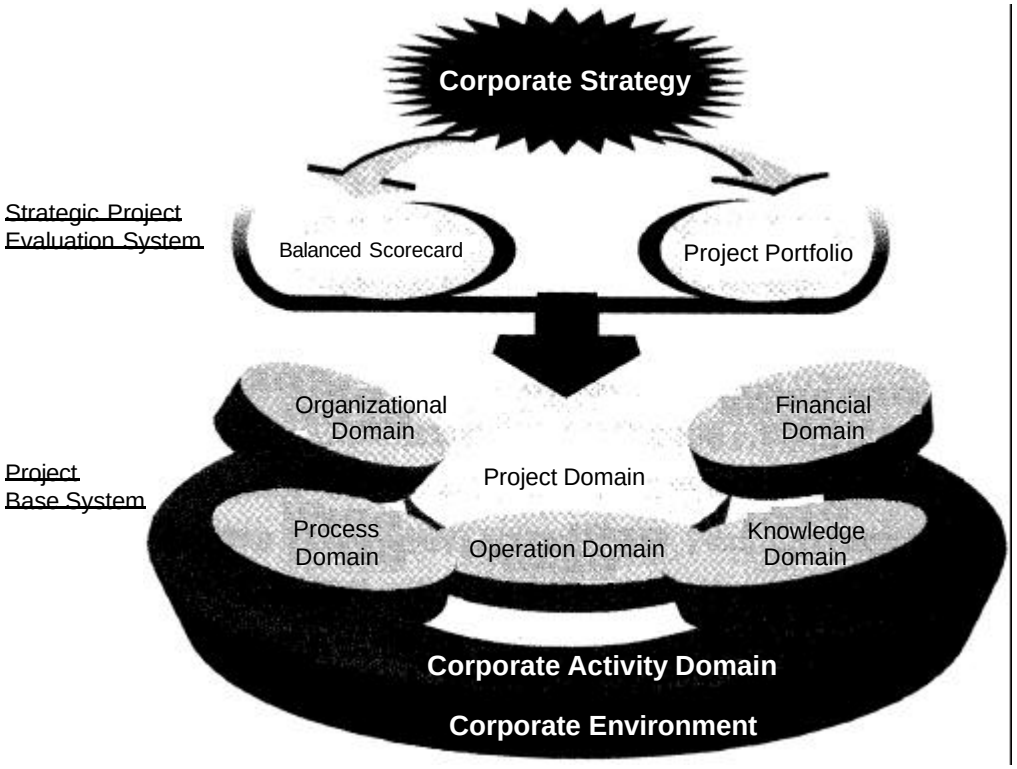


Figure 4-1-4: Project Base System

● Project Domain

Projects have temporariness and originality as features, and they are regarded as unique. Projects in enterprises have similarity and relevancy, and utilization of such features will directly lead to enhancement of corporate competitive power. For example, development projects in the automobile industry focus on deliverables of projects and aim at efficiency improvement by greatly reducing the size of projects through the maximum use of similarity and relevancy. A typical example of such utilization of project features is the trend of strategic sharing of parts, which greatly cuts man-hours for projects, ensures the quality of shared parts and increases their reliability, making a strong contribution to enhancement of corporate competitive power.

The project domain provides frameworks for efficient achievement of corporate strategies by focusing on interrelationship of projects. The project domain consists of programs as activity with a long-term purpose, projects as activity to produce specific deliverables, and tasks that allow clear definition of work.

■ Program

A program is long-term activity to achieve strategies and includes multiple projects. Correct recognition and definition of programs enables effective yield of profits, which would never have been generated if individual projects were operated without interrelationship with each other.

The field of programs is extensive and includes start-up of new business; Business Process Re-engineering (BPR), i.e., an activity to remarkably improve productivity of enterprises; and management of business. However, if a project with a clear objective and scope is divided into multiple sub projects for implementation and management, such projects should not be defined as a program. This is because scopes of programs are hard to be define and objectives of programs are not clear.

Attention has to be paid to how to define the scope of programs. A narrow definition generates multiple programs and causes a problem on interface between programs. In addition, individual programs'

capacities will be limited and measures for achieving strategies are likely to be restricted. Meanwhile, a broad definition will cause a difficulty in controlling programs and may take a great deal of effort and time to achieve effect.

In order to reduce interfaces between programs for easier control thereof, a group of projects that share any of the following items is often defined as the same program.

- Projects that have a common object
- Projects that are likely to share resources or skill types
- Projects that use similar technologies
- Projects that have similar markets or products
- Projects that have the same contractor

The following are examples of programs:

- Shorten the product development period from currently 3 years to 1.5 year through operational innovation.
- Achieve the sales of ¥20 billion within 5 years by releasing multiple new products in target business fields
- Raise the share in the present market to 30% within 3 years by developing a new business model.

The true value of program management rests in how to yield maximum results (profits) from business resources (investment) of enterprises by controlling and managing project activities from the managerial viewpoint. Absence of the viewpoint of program management will result in disordered acceptance (generation) of projects and aimless consumption of business resources, which causes difficulty in achieving corporate goals. Therefore, for organizations holding multiple projects, recognition of program management and its definition are essential to generate maximum results. In implementation of program management, the following matters should be defined.

- Selection of projects
- Determination of the order of priorities among projects
- Coordination between projects
- Integration between projects

■ Project

Projects in this section can be defined as activities to produce specified results that are closely related to programs. Projects should be selected in light of program objectives. Details of the results to be achieved by projects may be identified in some cases through breakdown of program goals, while some of the details are generated from external requirements and are identified after being checked to see if they are consistent with project objectives. Projects can be defined as a component of a program and its relationship with other projects should be specified. Especially, the following items should be confirmed:

- Deliverables shared
- Resources shared (manpower, materials, equipment, and cooperation companies, etc.)
- Information shared
- Technologies shared
- Projects related
- Order of priorities of projects

■ Task

Tasks are broken down and defined by Work Breakdown Structure (WBS). The greatest objective for project domains lies in how to rationalize tasks on a company-wide basis. Therefore, tasks should not be handled individually but as groups from the following viewpoints:

- Is it possible to eliminate tasks?
- Is it possible to achieve commonality of tasks and integrate them?
- Is it possible to standardize tasks?

Tasks are defined in the process of achieving project objectives, but the more tasks a project has, the greater volume of work is needed, and the more risks the project is exposed to. In project management, it is significant to achieve project objectives with as little amount of work as possible. This is because the reduction in workload will bring lower cost, quality improvement, and easier management, and result in contribution to enhancement of competitive power of enterprises.

Meanwhile, mere elimination of tasks causes difficulty in achievement of project objectives. For reducing tasks, reusing what were used in other projects and sharing tasks among multiple projects work effectively. However, tasks cannot be eliminated by chance. Elimination of tasks can be achieved through task sharing across the board. To achieve this, deliverables of projects and structures of work should be broken down and organized to enable systematic undertaking of tasks subject to commonality, sharing and reuse.

This concept can be applied to a single project and reduction and sharing of tasks will result. If tasks that repeatedly occur in a project and deliverables that allow sharing are identified and their reuse becomes possible through some preparatory work then work that would otherwise repeatedly occur will be reduced and efficiency as well as quality will be improved. Recognition of commonality among tasks, and fruitful response to this characteristic, will greatly contribute to the efficiency of projects.

A project has both tasks that should be standardized and tasks that should not, and these two types of tasks should not be handled in the same manner. Tasks to be standardized are those expected to improve in quality or productivity through standardization and rationalization. Tasks that should not be standardized refer to those whose rationalization costs surpass the effect of rationalization, or which need special approaches or ingenuity and greatly contribute to differentiation of projects.

Since enterprises generally do business in a particular industry, they usually practice many similar projects. In such cases, even if details of deliverables are different, there are many tasks that can be standardized. Standardized tasks can be considered highly matured tasks where experiences of past projects are utilized. Therefore, creation of standard tasks on a company-wide basis can result in remarkable improvement in the quality of project deliverables. In standardized tasks, details and work to be done are standardized and quality level can be measured, which works effectively in enhancing communications. In addition, standardized tasks can be easily subjected to comparison, and it provides effective information for task rationalization to compare actual results of similar tasks among projects.

● Process Domain

Each enterprise has its own processes and projects are implemented according to enterprises' own processes. However, whether processes are good or bad affects cost, delivery date, and quality of a project and constitutes a material element that determines whether the project succeeds or fails.

Individual companies have different processes even if they all belong to a certain industry. The reason for this is attributable to differences in corporate history, sense of values, vision, personnel structure, technology, skills, experiences, and corporate environment. There is no process that is best at all times. It is only better than other processes at that moment, and there is no guarantee that it continues to be better in future. This is because business environments of companies are constantly changing and personnel structure, techniques required, necessary skills, etc. also continue to change in line with business environments.

Therefore, to maintain a better process, the optimum process should be designed and built with understanding of business environments. A project domain consists of a project work process where deliverables of a project are identified and procedures for generating deliverables are logically presented, and a management process where deliverables lead to expected costs, delivery term, and qualities without confusion.

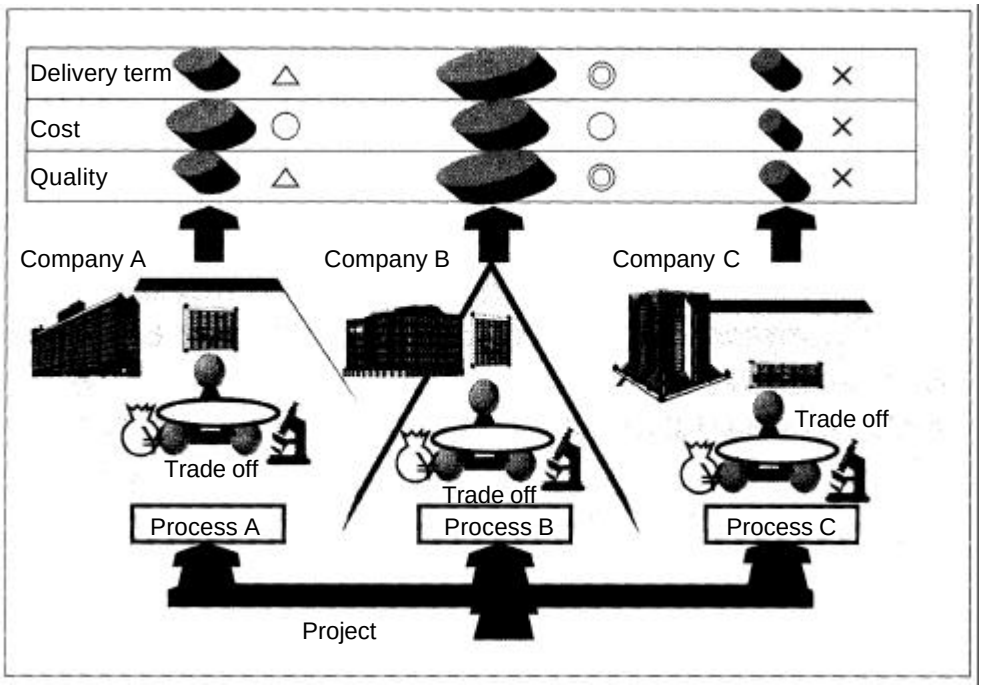


Figure 4-1-5: Results of Corporate Process and Expected Output

■ Project Work Process

Project work processes standardize procedures for creating deliverables from technical viewpoints and vary greatly depending on objects of deliverables. Therefore, details of project work processes differ by industry.

Applicable project work processes are also different depending on which part of the product life cycle companies are engaged in. In addition, details of the project work process become different depending on whether a company holds and invests in a project or receives an order for and contracts to undertake a project. Refer to Chapter 8 "Information Management" (P.224) for project work processes.

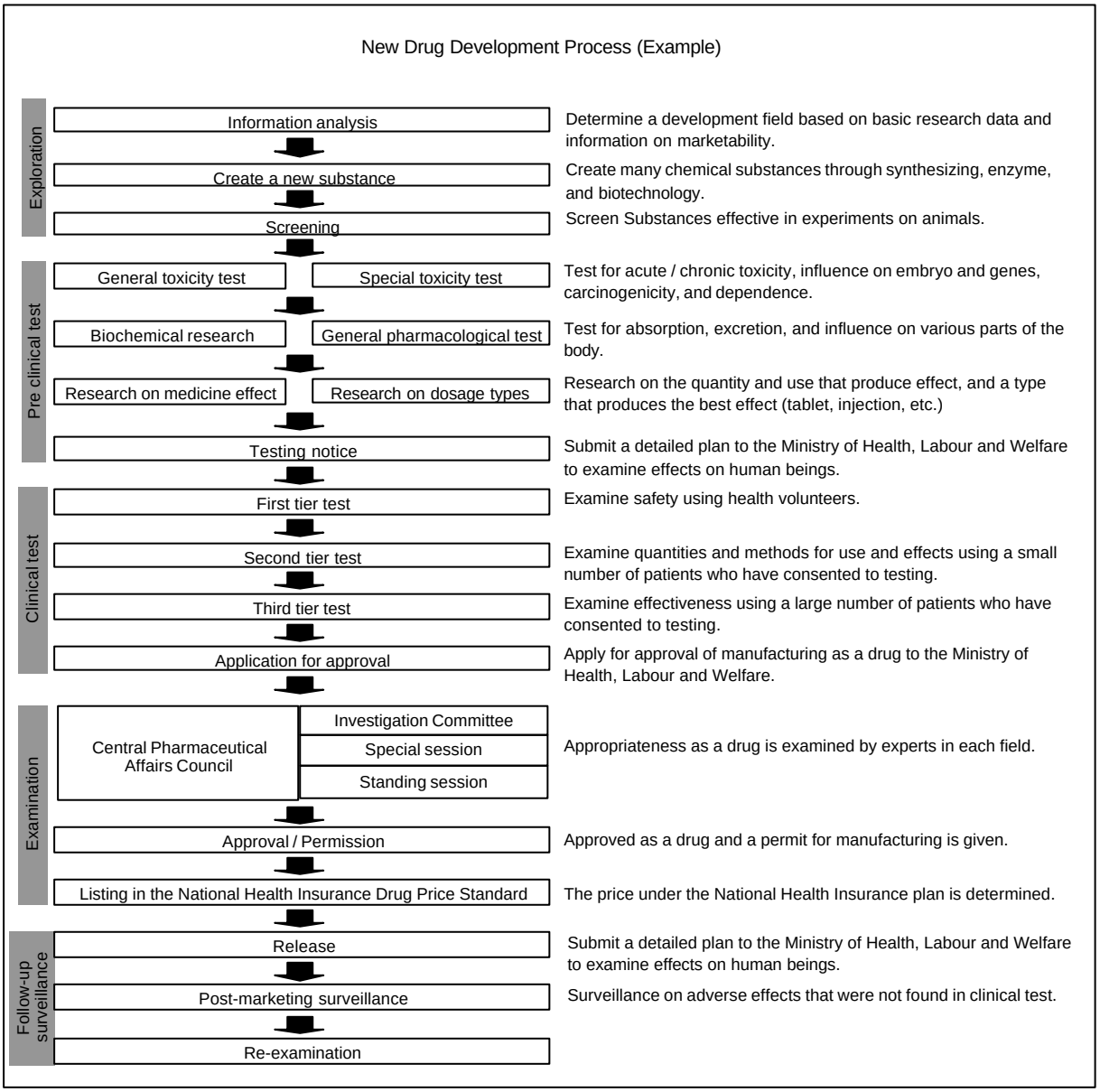


Figure 4-1-6: Example of Project Work Process

■ Management Cycle

Management cycle means a series of processes for coordination and control that are closely related to project work processes. Management cycles should be designed so that project work processes will be accomplished more effectively. In this sense, management cycles should function so that characteristics of project work processes are well understood, and organically incorporated to demonstrate effects.

The objective of management cycle is to achieve smooth accomplishment of projects without trouble. For that purpose, in preparing to advance projects without trouble, coordination and decision making processes to reasonably solve and decide on issues should be defined.

The management cycle includes both program and project management cycles. In enterprises, multiple projects are concurrently running, so their resources are in competition with each other.

Therefore, in management cycles, resource distribution in consideration of optimization of the total enterprise and definition of controllable processes become necessary. Definitions of the following two management cycles in project domains should be specified and the role and responsibility in process should be also clarified:

- Program management cycle
- Project management cycle

As is described in "III.4. Steps of Program Management," the program management cycle means a series of processes for integrated management of multiple projects that are implemented to achieve the same mission. It consists of processes for decision making out of the framework of project such as selection of projects, and determination of order of priorities, such as coordination among projects.

The program management cycle also means a series of processes for managerial operations and decision making to achieve given goals. It is a process to reasonably solve many issues incurred through the life cycle of a project.

● Organizational Domain

The issue of which structure an enterprise adopts is closely related to its strategies. Efficient achievement of a strategy by an enterprise requires an organizational structure fit for the achievement of the strategy. Corporate strategies are accomplished through implementation of multiple projects held by an enterprise, and an organizational structure that enables efficient implementation of projects serves as the one fit for corporate strategies.

An organization should be designed by taking into consideration characteristics and natures of projects, and even skills required by projects. Furthermore, an organization needs a structure with flexibility by taking into account external supplementation for their weak parts instead of completing every part of a project by itself. The organizational domain consists of organizational business structure and function structure to achieve strategies.

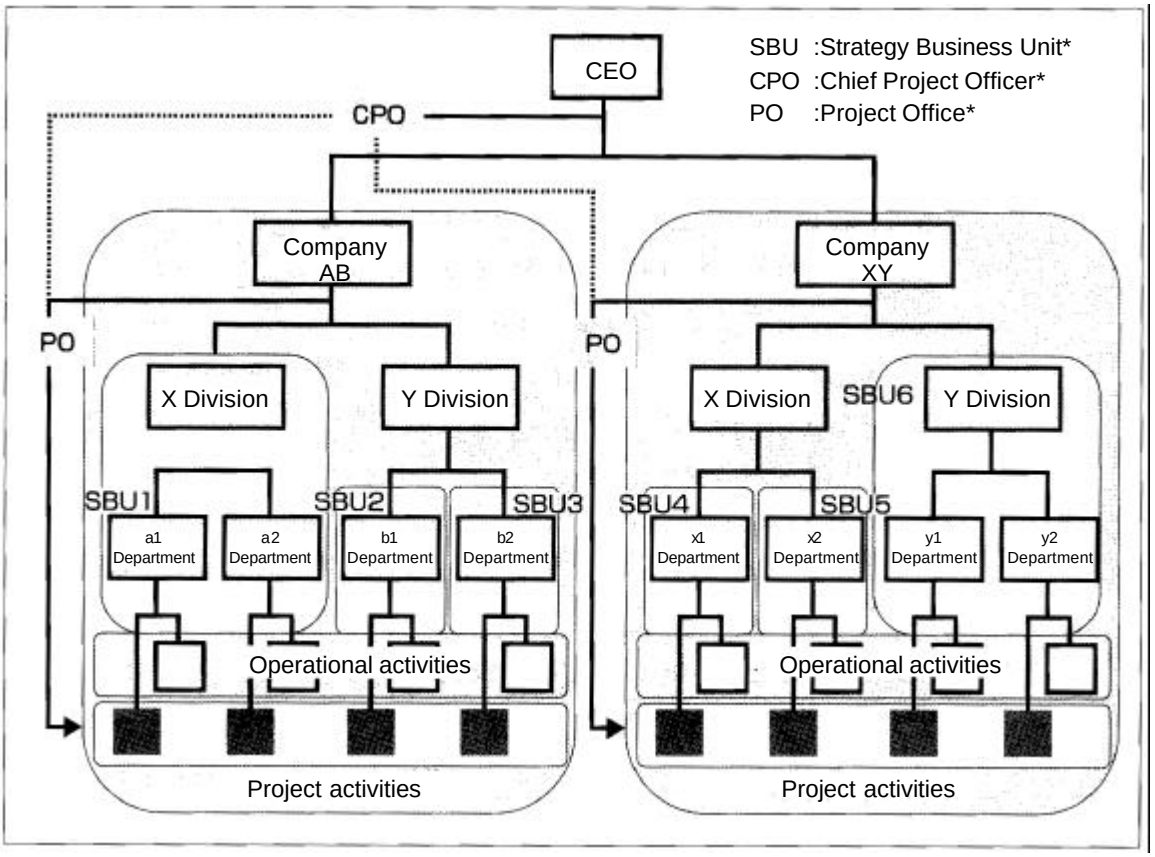


Figure 4-1-7: Organizational Domain

■ Business Composition

Business composition is placed at the top position in organizational domains. Since an organization is comprised as a means to efficiently achieve corporate strategies, it needs to design the composition of organizations to achieve corporate strategies. Frameworks for the composition of organizations are determined by how to separate a corporate strategy and by choice of systems to be used to implement separated strategies.

Enterprises usually form a department organization as a unit of control for efficient operation of business from managerial viewpoints. However, the department organization is not necessarily appropriate as a unit to plan and implement strategies. Ideally speaking, for efficient implementation of strategies, organization groups fit for the contents and size of a strategy should be built and strategies should be implemented by those organization groups. A Strategic Business Unit (SBU) is an organization with a mission to practice given strategic business and is adopted by many enterprises. In SBUs, multiple departments are bundled as a block but are bundled with different hierarchies.

In SBUs, to accomplish business strategies and achieve their objectives, it is desirable to have independent departments of development, manufacturing, sales, planning, etc., and departments that are not so important for a strategy or are suitable to commonality to achieve total advantage for an enterprise are in some cases shared by multiple SBUs. In addition, as an extended type of SBU, there is company system that aims at speed-up in business by spinning off departments by product group or target market and by drastically empowering SBUs by delegation of authority for making decisions on investments and strategies.

Today's organizational domains are strengthening the tendency towards forming strategic organizations centering on projects to aim at more effective achievement of strategies, using a pattern of SBU or department systems. The authority to make decisions on projects is transferred to the project manager who is responsible for a project to take speedy response, and the project manager manages a project with a path (communication means, route) to the top that is close to decision making for the overall organization. In addition, normal operational work and long-term missions of organizations such as human resource development will generally be entrusted to line organizations.

■ Functional Composition

Multiple departments are engaged in business and each department plays a specific role to implement a strategy. Each department has different functions and roles, and the following six elements need to be taken into consideration to determine its functional composition and roles:

(1) Specialization ····· To what extent is a task segmentized and recognized as a job?
(2) Grouping ····· On what basis are jobs assigned?
(3) Chain of order ····· To whom does each employee or group report?
(4) Scope of management ····· How many people can a manager instruct efficiently?
(5) Centralization / decentralization ····· Who makes decisions?
(6) Formulation ····· What extent of rules and regulations should be imposed on employees and managers.

The essence of specialization is to decide a level of division of labor to accomplish an objective and to decide a scope of skills required. It is significant to categorize operations in projects within enterprises to enable organization for specialization.

Advantage in grouping lies in improvement of corporate skill levels by collecting human resources with similar skills and encouraging exchange of their knowledge. Improvement in skill levels can contribute to long-term competitive power of enterprises, while over-grouping promotes the tendency of part optimization and becomes an obstacle to achievement of project goals.

A chain of command clarifies where authority belongs in an organization. A chain of command in hierarchical organizations conflicts with that in projects across organizations. Both types of chain of command exist in matrix organizations, which are placed between these two type of organizations. Output of a project greatly varies depending on how the chain of command is designed.

The scope of management refers to the number of people one person can manage. A narrow scope of management will result in increase in overhead costs, while a broad scope will cause a problem that a manager fails to provide leadership and support to his/her staff , leading to poor performance. These days, the scope of management tends to be extended through information sharing and management education that enable managers to make accurate decisions.

In centralized organizations, many decisions are made by top management, while in decentralized organizations, they are made by management close to the work front. These days, more organizations are improving speed and quality of decisions through decentralization that promotes sharing of missions and strategies of projects.

Formulation in organizations shows extent of rulemaking for jobs. Jobs whose rules are formulated are organized so as to enable predetermined input and output without too much consideration. Excessive rulemaking deprives individuals of freedom and obstructs pro-active behaviors. Disorder bears confusion and remarkably deteriorates productivity of organizations. In order to achieve efficient promotion of projects, it should be decided what should be formulated and to what extent.

● Financial Domain

Creation of profits is a basic issue given to every enterprise. Enterprises must be able to generate profits in order to survive and achieve their ideas. Creation of profits is a minimum hurdle enterprises should clear. Financial domains mean a structure that maximizes corporate values from a monetary viewpoint. For enterprises, finance is likened to a function to activate circulation of blood for human beings. Planning how an enterprise generates business profits in a corporate strategy works as an element to determine what project should be selected and what type of investment should be made. In defining corporate values, financial domains take into consideration the following two elements:

(1)FUTURE CORPORATE VALUE

First of all, future corporate value refers to a value of an enterprise that is computed including not only current corporate profitability and stock prices but also potential values of various projects enterprises have invested in for development. Therefore, it is difficult to read future corporate value simply from financial indexes. It should be computed by taking into account cash flow, capital cost, etc., which an enterprise is expected have in future.

It is an issue how to measure such corporate value. Various indexes have been proposed, such as Profit and Loss Statement (PL), Balance Sheet (BS), Price Book Value Ratio (PBR), Price Earnings Ratio (PER)and Return on Equity (ROE). However, all these indices only measure current or past corporate value and are not appropriate for measurement of the value including future corporate value. In recent years, as the concept of economic value added is expanded, economic value added is being accepted and established as an index for measuring future corporate value.

(2)CORPORATE VALUE INCLUDING INTELLECTUAL ASSETS

Next, intellectual assets refer to a corporate value that cannot be computed on accounting standards but can be recognized as market value, such as "brand power," "global network" and "list of good customers." Intellectual assets are also a source of competitive power of enterprises, a factor of differentiation, and a premium factor that enhances added-value of enterprises. Increase in intellectual assets directly leads to a rise in corporate value. Intellectual assets will be increased by improvement in the knowledge level of employees and growth in the number of employees. However, intellectual assets also have a possibility to turn into an intellectual debt when employees leave or retire from the company.

Corporate value is determined by the sum of intellectual assets and accounting assets. In recent years, value of intellectual assets is being emphasized. On the other hand, however, it is difficult to compute intellectual assets and its trial calculation is not a simple task. To increase assets and draw out a favorable balance sheet, investment is required, and to make investment, fund procurement becomes necessary. As a structure to increase corporate assets, the financial domain is comprised of three elements, i.e., corporate value, investment, and fund procurement.

■ Corporate Value

The dominant concept of financial domains is corporate value. Corporate strategies usually show concrete policies to maximize corporate value, and maximization of corporate value is a common issue in corporate strategies. Corporate value is considered to consist of "going-concern value," which is based on continuance of corporate activities, and "liquidation value" at the time of dissolution of corporation. Financial domains are based on the going-concern value, which is predicated on continuous enhancement of corporate value. Upon this concept, corporate value is considered as the present value of cash flow an enterprise generates in the future, i.e., present value can be regarded as corporate value.

Cash flow shows the amount of cash that actually flows into and out of an enterprise. Even if a profit is accounted for (accounting profit) in the profit and loss calculation, doubtful accounts whose receivable for sales cannot be collected are hardly recognized as cash. Enterprises can generate profits for the first time when they finally change sales to cash. Then, they can use cash for new investments to further enhance corporate value.

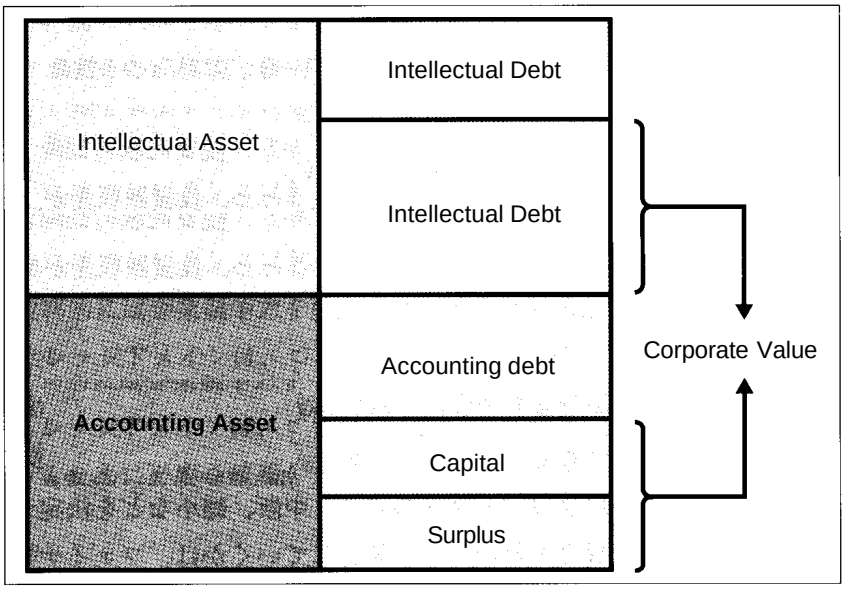


Figure 4-1-8: Corporate Value

■ Project Investment

Investment includes not only monetary investments but also personnel and intellectual investments held by enterprises. Increase in corporate cash flow does not occur spontaneously. No change occurs in cash flow without any investment activity.

Investment is the origin that generates a project. Investment in projects is an act to collect investment by ensuring profits as deliverables of projects. Project investment enables direct or indirect involvement with project activities. It is an investment activity that has an authority to control project activities to some extent.

Concerning how to recognize a project, there are two perspectives: orderer of a project (business investor) and contractor of a project. As shown in Figure 41-9, they are only different in the position from the viewpoint of financial domains, and a project can be seen principally as an object of investment from both sides. They both have periods of investment and collection of investment. They only differ in phases of investment and investment collection and from where investment is collected.

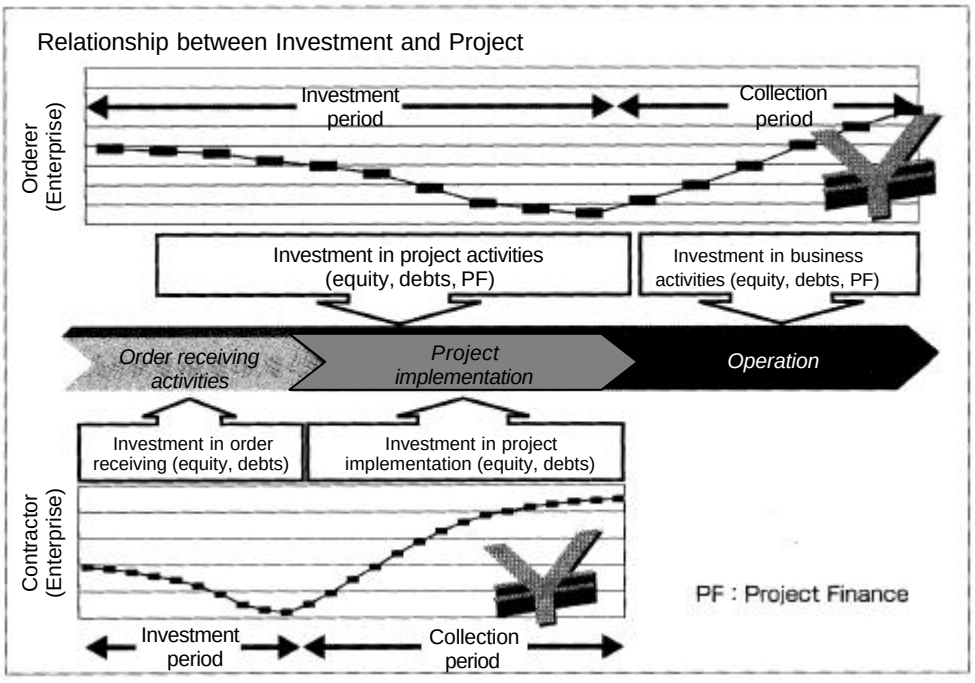


Figure 4-1-9: Project Investment

■ Fund Procurement

Funds are necessary for sound management of enterprises. It is rare for an enterprise to supply abundant funds to all projects. Financial restrictions greatly affect projects and in some cases become an element that determines oblivion, suspension, downsizing, etc. of projects. It is a critical issue in financial strategies for enterprises to be able to procure project funds.

There are generally the following three methods for procuring fund projects.

(1)DEBT

Debt is a generic name of liabilities enterprises owe to outsiders other than the stockholder. Debts are generated from direct finance that procures funds from the market by issuing corporate bonds, Corporate Papers (CPs), etc. and indirect finance that borrows funds from financial institutions. Direct finance is advantageous for enterprises with high credit worthiness because they can procure low-cost funds compared with borrowings from financial institutions. However, the disadvantage of direct finance is that it has a risk on availability of funds. When investors feel that there is a risk on an enterprise, they are unlikely to provide funds to the enterprise, so it cannot secure funds when it needs them.

(2)EQUITY

Equities include capital, legal reserves and surplus (internal reserves), and belongs to shareholders. Once procured, equities will not be returned principally as long as an enterprise survives. If an enterprise goes bankrupt, debts are preferentially repaid. Profits are returned to shareholders as dividends, and enterprises can determine the amount of dividends to shareholders according to their performance, compared with interest rates as consideration of debts.

(3)PROJECT FINANCE

Project finance is a method of finance that uses only cash flow generated from a project as the source of repayment by pledging specific tangible or intangible assets of the project. Refer to Chapter 2 for details of project finance management.

● Knowledge Domain

The use of information technology is changing the styles of projects, organizations and processes, and is creating new environments for projects. Moreover, data accumulated through information technologies is providing significant information for corporate management and greatly contributing to enhancement of corporate value as important knowledge for enterprises. Competitive power of enterprises from now on will be greatly dependent on how to build up knowledge domains, and results of projects will become largely different according to skills to effectively use information technologies.

The ultimate objective of knowledge domains is to enhance the quantity and quality of core competence as enterprise to achieve corporate strategies. This is because services and products provided by enterprises are only generated from a complex combination of core competence that is held by enterprises, and they cannot generate businesses or products for which they do not have core competence. In addition, the more often core competence is used, the more it will improve and grow in quality and contents, and will eventually become an element to enhance corporate competitive power.

In short, knowledge domains consist of connection among knowledge creation to increase core competence, informatization to increase knowledge, and data creation for generating information.

■ Knowledge Creation

Increase in intellectual assets enhances corporate value. When knowledge is informatized through information technology and is specified and provided in a visible manner, it will become quantifiable as an intellectual asset to be shared among organizations, and contribute to stabilization of intellectual assets. In addition, knowledge sharing through information technology generates circumstances where people outside an organization can easily use the knowledge of the organization, and creates a synergy effect that individuals produce new knowledge using existing knowledge. Strategic information technology should be used in the fields concerned with corporate core competence to establish superiority in competition.

■ Informatization

Informatization can be defined as a task to organize and process collected data and convey them as messages in order to achieve a certain purpose. Through informatization, various corporate activities are analyzed and new values are added to data needed for such analyses. Informatization is a means to use data effectively and is an activity to create materials for encouraging decision-making. Quality of materials obtained from information is directly concerned with quality of decision making, and greatly affects the quality of decision made by organizations. Trade off occurs in every aspect of a project, and on each occasion, the project manager is required to make decisions. Aside from managerial quality of the

manager, the manager's ability to make correct decisions is greatly affected by accuracy and quality of information.

- Data Creation

Data is indispensable to perform corporate activities. Corporate activities are made using data recorded for exchange of cash and products. Enterprises handle various and huge amount of data. Knowledge domains are based on creation of data. Without data creations, neither informatization nor knowledge sharing will be achieved. Data creation has structural and an indirect advantage that contributes to improvement of corporate value that is connected with informatization and knowledge creation. As a direct advantage, data creation also contributes to efficiency improvement and speed-up for projects.

For enhancement of data value, work efficiency improvement, and effective speed-up, data models should be established and standardized. Data creation should not be made at random, but tasks should be separated into the ones that are expected to produce effect through data creation and the ones not expected, and focus should be on the former. In addition, data creation should be standardized to the extent possible in consideration of desirable corporate data models so that data can be re-used and that overlap with other tasks will not occur.

3. Alliance

Resources are required in order to implement projects. However, when business environments are drastically changing, it is becoming impossible for enterprises to provide all optimum resources necessary for projects without help. Changes in business environments are also greatly affecting skills and the personnel framework required by projects, and such changes are occurring at a speed that exceeds by far the pace of development of corporate human resources. In such environments, enterprises have no other choice but to pursue resources outside, and it is becoming a serious issue for enterprises how to cooperate and make alliance with outsiders and accomplish projects in a good relationship where both parties enjoy profits.

Project environments today do not necessarily require long-term, fixed transactions or alliance. Instead, attention has to be paid to efficient procurement and utilization of resources for achievement of project objectives. The reason for this is that the speed of technical innovation is so fast that it is quite difficult to foresee what innovative product will appear next and how to catch customer needs. In this respect, R&D type venture businesses in the United States, in some cases, are engaged in creation of an idea of a product, development and acquisition of the patent, and then outsourcing of every phase of application design, trial production, manufacturing, and sales to several to scores of companies.

Thus, alliance in projects is required to develop from a mere relationship of contracting or subcontracting and to build, although temporarily, a relationship of cooperation based on alliance built on mutual trust. Concerning alliance, various frameworks are considered such as decentralization of risk and mutual cooperation between different types of businesses, as well as alliances in each phase of a vertical line including product planning, concept, production and sales.

● Joint Venture

In a single but large-scale project, if risk of contracting the project is too large for a single company, multiple companies of the same industry contract the project and aim to diversify risk and share profit (or loss) from the project. This type of projects is called joint venture (JV). Since there is only one project, its administrative section (staff section) including a finance and accounting system is shared by all companies that join the project.

● Consortium

Consortiums are adopted by large-scale projects such as space development, airport facilities and oil refinery construction, and by complex-type projects that need multiple different types of businesses or technical fields. Since finance types and accounting systems are independent according to projects, each project has its own administrative section.

● Strategic Alliance

There is no guarantee that the present competence in enterprises continues to be a core forever. In other words, the current strength is not guaranteed eternally. To continue to be strong in future, enterprises should make their future position stable by forming alliances with other enterprises that enable their position to remain strategically advantageous.

Strategic alliance aims to reinforce and stabilize the strength of each partner by sharing technologies with competitive power and corporate cultures held by each party. A recent example indicates that major auto manufactures in Japan and the U.S. have conducted joint research to develop pollution-free automobiles using a hydrogen battery by taking out hydrogen from gasoline and methanol with the aim to take the leadership in this field. Thus, significance of alliance in view of future strategies of enterprises is becoming increasingly necessary.

● Outsourcing

A pattern to extract a part of business processes and accomplish the extracted process using external sources is called outsourcing. Outsourcing is often extended to processes where cost reduction is required rather than accumulation of know-how, which is not necessarily important, and when an enterprise does not have enough resources in processes other than the core process.

Outsourced processes become a core process in enterprises that conduct outsourcing, which earn profits by contracting with many enterprises and enhancing efficiency. Today, outsourcing is popular in various industries, such as operation outsourcing to specialized contractors in the construction industry, outsourcing of maintenance in the software industry, outsourcing of manufacture in the manufacturing industry, and outsourcing of clinical test operations in the medical industry.

● Partnering

There is an operation outsourcing contract called partnering, which is more advanced than outsourcing. This is seen in the oil industry and petrochemical industry in the United States and Europe. For instance, a plant owner company and a contractor sign a comprehensive outsourcing contract on a specific operation with a term of 3 to 5 years. The owner guarantees workload, and the contractor sets up a specific department for the client and allocates fixed members there to perform work. This is an alliance with the aim to improve the quality of work performance based on the relationship of trust between the owner and contractor.

● Application Service Provider

There is a great demand for versatile computer software (application) centering on IT-related or IT-oriented enterprises, and development of new software that meets various needs is in some cases necessary. In such cases, it is uneconomical that one enterprise owns many pieces of the same software, while it will need excessive workforce and time if an enterprise develops new software without help.

In order to solve such issues, application service providers (ASP) provide applications and services when necessary. They greatly contribute to enhancement of efficiency in projects by providing software that meets business objectives and that is indispensable for project management methods.

Chapter 2 Project Finance Management

Outline

Project finance management refers to a project control method aimed at building a structure for procuring funds for implementation of a project. A project can be started for the first time when a structure is ready for contribution of funds that are necessary for performing the project. Project finance management is not just a technique for fund procurement, it aims to create a feasible system in consideration of an efficient funds contribution structure in line with the creation of a structure for a project.

To establish such system, a scenario will be considered where funds contribution is mainly supported by a project (business). A sole project entity (project, company, investor, fund lender, etc.) does not guarantee debt repayment on a standalone basis but instead various stakeholders involved with the project and multiple project entities that support the project provide various types of security so that the project itself supports the debt. For this purpose, a concept for a basic structure should be first established, and then optimum factors for giving shape to this concept should be chosen from the market. In consideration of restrictive factors, a feasible structure should be created after adjustment, and through this process, optimization of risk sharing among stakeholders should be examined. With assessment and adjustment of this structure, a final system should be created.

However, concerning the creation of such system, it is desirable to select the best factors through trials and errors and form a total structure. In addition, concerning selection of a particular factor, it is prerequisite above all things that its feasibility and business eligibility are constantly assessed and that its results are expected as a feasible structure. A procedure is adopted by which a concept is planned based on a certain objective and it is completed as a feasible system in consideration of fund procurement for the project.

Incidentally, each factor of the work process has correlations as follows. While each factor goes back and forth along a certain flow, there always exists an assessment axis and decisions are made after obtaining a certain assessment.

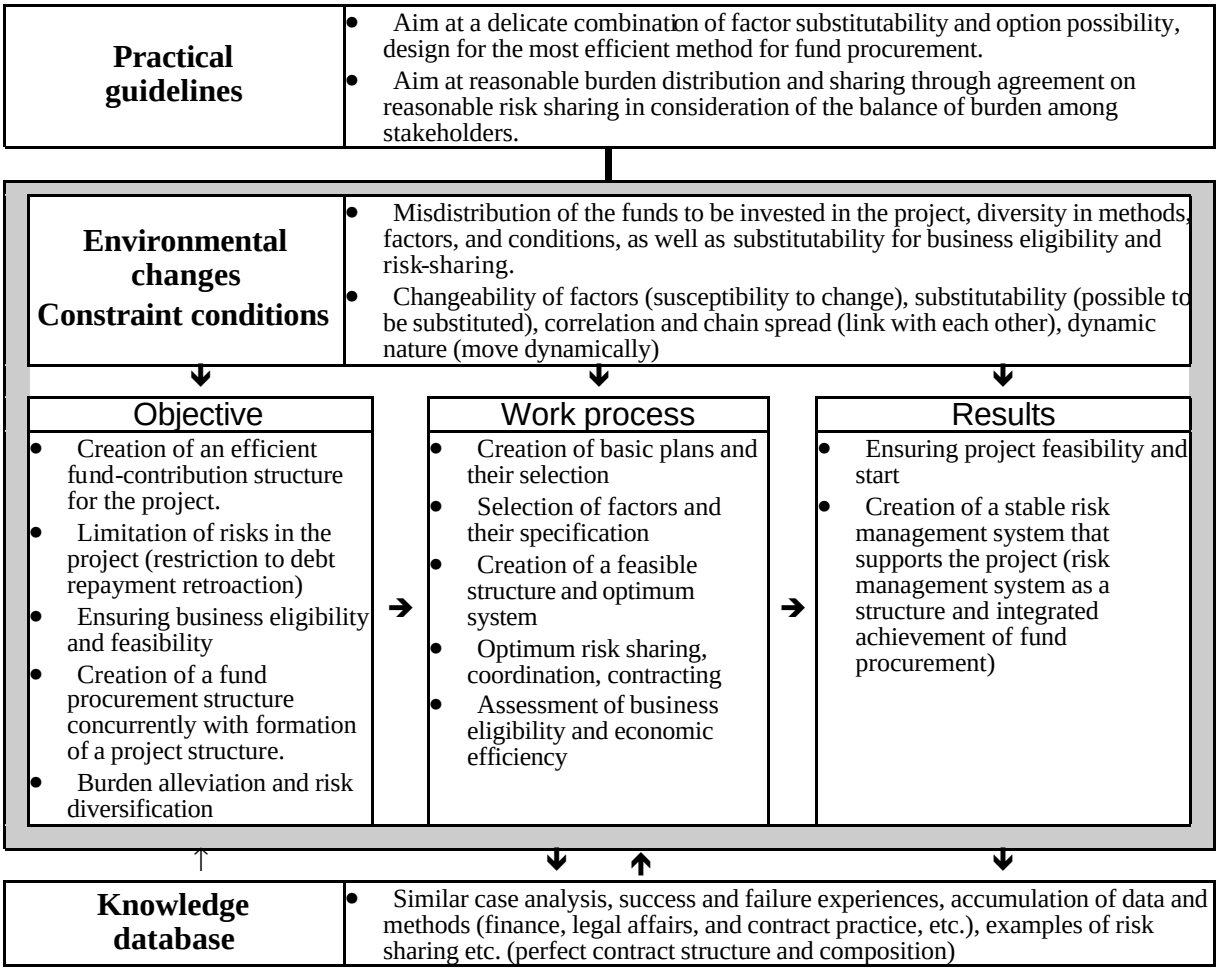


Figure 4-2-1: Overview of Project Finance Management

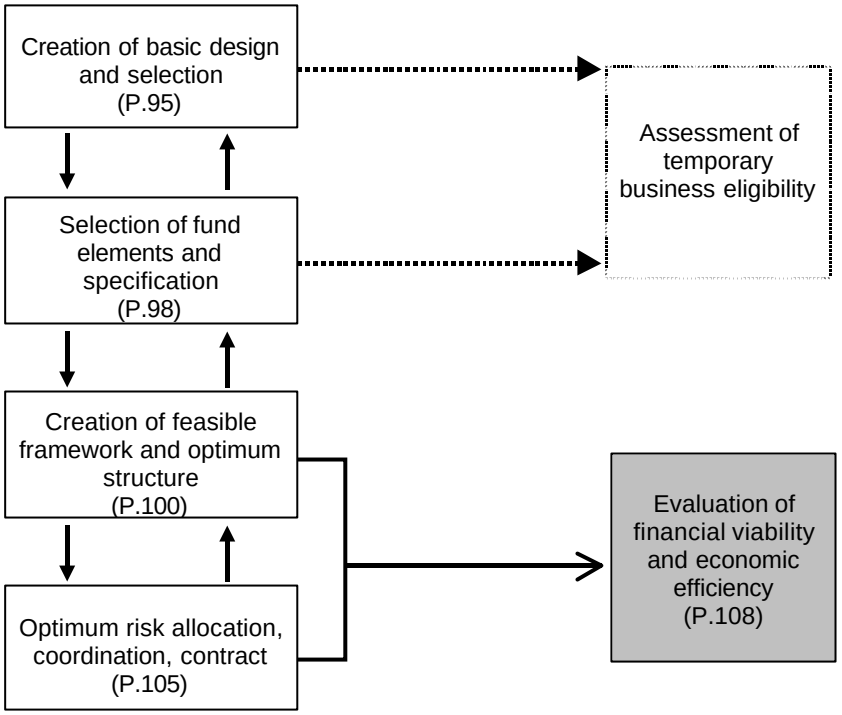


Figure 4-2-2: Correlations among Work Process Elements

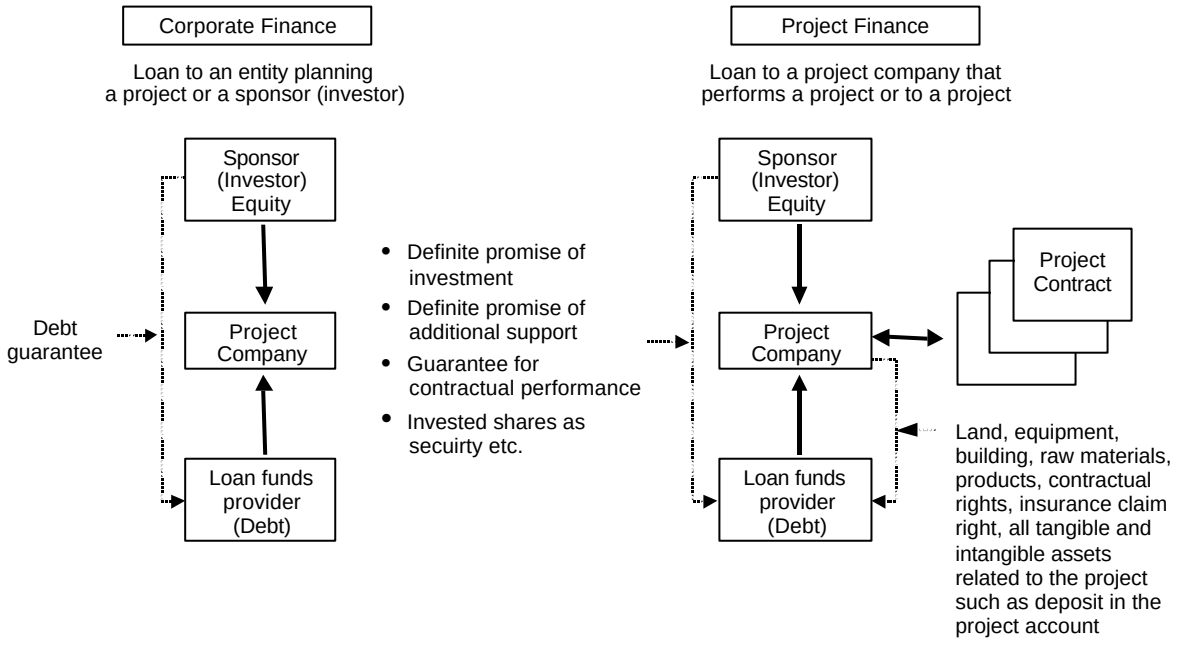
1. Basics of Project Finance Management

In the case where a sponsor (investor) who plans and aims to achieve a project directly or indirectly assumes guarantee for repayment of loan debts for the project, this will be considered as a credit to the investor company (this is called corporate finance), not to the project, because profitability of the overall investor company including said project becomes a resource for debt repayment.

Meanwhile, project finance has a basic structure where a project, not a specific entity, is subject to credit, i.e., multiple entities rather than a sole entity, are involved with a project by bringing in various elements, providing security, and granting credits. Non-guarantee for debts by a sole entity means that a project is supported by a group of elements and such a system for an overall project generates credit.

From the standpoint of a provider of project funds, reasonable expectation for repayment of debts is based on the stability of cash flow generated from the project. Security for repayment is cash flow, or the project's assets or project structures that generate cash flow. To this end, a package comprising various elements, such as performance guarantee, direct guarantee, and indirect guarantee by various entities concerned with a project,constitute part of security, and a combination of such security elements and a system to support them will be created. Through creation of such a system, a project that has not been achieved can be an entity with credit.

Project finance also refers to a system that allows funds to be injected into a project efficiently and effectively. This system supports a project and enables fund procurement. Formation and realization of finances are processed in line with formation of a project structure, and they are integrated in the process where the project is realized.



Corporate Finance	Project Finance
Resource for repayment of loan	Resource for repayment of loan
All business earnings (including those from the project) of the sponsor (investor)	Cash flow arising out of the project (Restriction to debt repayment retroaction toward investors)
Secuirty	Secuirty
Credit of the sponsor (investor) and part of its general properties (land, stock, etc.)	Cash flow of the project, all tangible and intangible assets, contractual right, equity of the sponsor for the project company's stock, etc.
Object of examination of loan eligibility	Object of examination of loan eligibility
Past financial status and performance projection of the sponsor (investor)	Business eligibility of the project, risk factors that prevent smooth operation of the project and their adequate mitigation, or system to prevent manifestation of risks

Figure 4-2-3: Difference between Project Finance and Corporate Finance

Case ◆ Fund procurement secured by earnings from a project

Company A plans to implement a project by investing ¥700 million including construction of facilities. If the Company uses its free cash flow, the project is considered sound as an investment, but the Company A has to use its resources. When sounding out the bank on borrowing funds through its finance department, the bank said that it will require stocks or land as security to guarantee debt repayment. If the Company accepts such requirements, failure in the project may affect the survival of the Company.

In this case, if it is verified that the project surely generates cash flow, since principal and interest on the loan can be paid from earnings from the project, the project can borrow funds from financial institutions using those earnings as security without consuming its resources.

The idea of procuring funds from the market by turning risk into cost is a framework for sharing risk with others, and enables efficient use of in-house resources. Thus, thinking of how to efficiently procure funds for projects is part of the resource management for companies.

(Refer to Chapter 6, Project Resource Management)

2. Creation of Basic Design and Selection (Structure Design)

● Basic Design of the Project (Project Design)

To achieve the objective of the project, a basic framework should be built first, and an outline of the relationships with all stakeholders related to the project should be designed. A basic framework for various issues, e.g., to what extent one's own resources (workforce, funds) should be injected, or whether to procure funds from the market, and how to set the relationship between these issues needs to be established. For this purpose, an optimum structure for realizing a project should be designed by specifying all stakeholders related to the project, and by (1) designing a structure to reasonably share the burden and risk of the project, (2) in this structure, aiming at designing a structure where each stakeholder depends on the project, (3) collecting best elements from the market, and (4) assuming that these elements are substitutable.

Funds needed to implement a project do not exist beforehand. In planning and development phases of a project, fund procurement is planned for its achievement, and at the same time, means and methods for its implementation is designed. Funds in this case include any fund necessary for implementing a project including equity and debts. Both equity and debts serve as a provider of funds to a project but their costs and natures are different. In addition, there are diversified ways of combining funds and this may affect the financial viability of projects. Fund procurement becomes possible for the first time when consistency and loan eligibility of the overall project is approved. Thus, the basics of project design are to design optimum solutions to individual projects and structure a scheme to realize it.

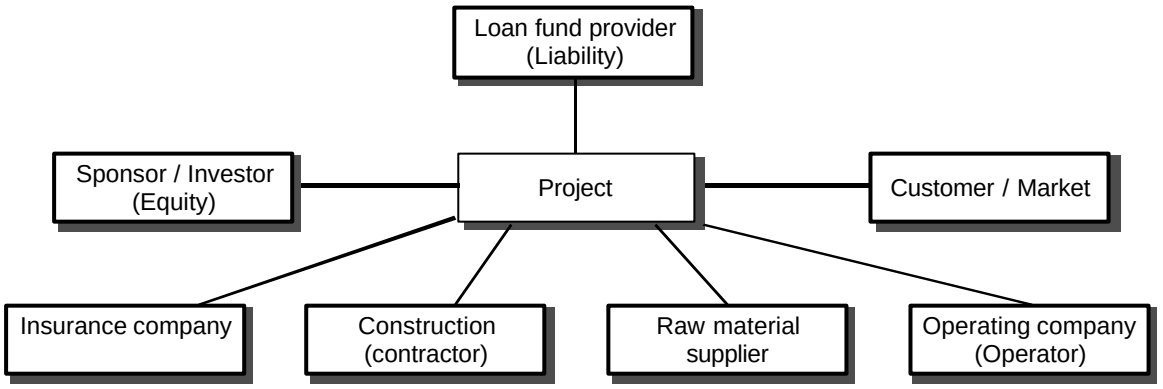


Figure 4-2-4: Project Design (Example)

Case ◆ Internalization and Externalization of Risk

It depends on decisions by enterprises what to incorporate into projects as elements and how to design them. For example, a company may operate a project on its own initiative through a project company, or may supply raw materials, or the project company can receive services or supplies from others through contract-type outsourcing. This will effect decisions such as, whether to internalize or externalize risk, or whether to control and assume risk in the company or consign risk control to a third party on a contractual relationship. This depends on policies on distribution of management resources and the amount of relevant costs. In finance, it is critical whether an entity that assumes risk can reasonably control risk, and that the structure of the overall project supports risk, and how earnings from a project are distributed among stakeholders.

● Funding Design

Funding design means to consider an outline of the structure of fund procurement in accordance with the basic design of a project. Funds needed to achieve a project refer to all funds necessary for construction and improvement of facilities (the sum of originally estimated cost and unexpected extra costs). If a project is defined as an individual entity with one life cycle, from initiation through operation, then repayment of loans, payment of all necessary costs and expenses, should be covered by generation of profits from cash flow of the project itself. In some cases however, unexpected demand for funds such as shortage of operation funds may occur that are needed to continuously perform a project, and this should be taken into consideration.

Project finance is based on prior arrangement of a long-term framework for injection of funds needed for projects. Major components of the funds injected into a project are equity and debts. A

framework for injection of funds into a project is determined on the inter-relationship of these two funds.

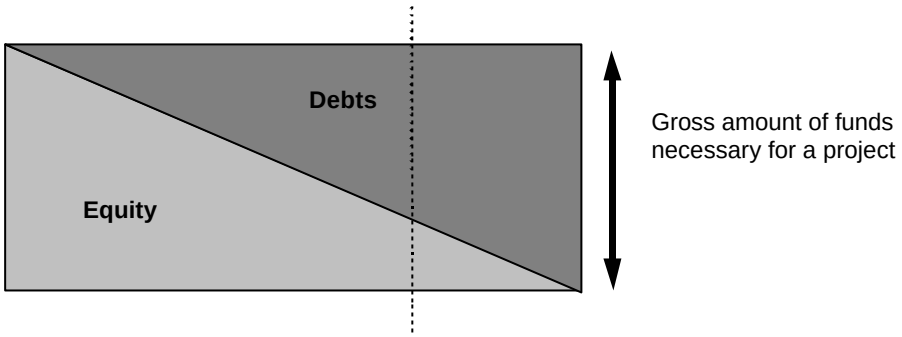


Figure 4-2-5: Relationship between Equity and Debts

(Note) The vertical axis of the above figure is the theoretical gross amount of funds necessary for a project. It is possible to procure 100 percent of the funds necessary for implementing a project from equity, but is impossible to procure them from debts. In projects, funds are procured in an optimum combination of equity and debts. In the above figure, the more Line A moves to the right, the higher leverage of equity and the more risk on debts. When Line A moves to the left, the risk on debts will be lessened. Therefore, equity orients itself to Line A that is set on the right of the figure. On the contrary, debts orient themselves to Line A that is set on the left. They are in the relationship of conflict. In any project, a balance between them is maintained at any point. In project finance, the balance will be kept on the right to the extent possible to aim for enhancement of the leverage of equity, efficiency improvement of equity, non-retroactivity (promotion of off-balance) of debt repayment (for investors). The dotted line of the above figure shows a typical point of balance in project finance. The example of the above figure shows contribution of funds until completion of facilities. When the project enters into a phase where cash flow is generated, an idea that such cash flow is additionally injected becomes possible.

There are many options in the market concerning types and pattern of funds applied to projects and entities that provide funds. Funds for projects are procured by combining such options.

Case ◆ Types, Patterns and Contributors of Funds

Types of funds refer to equity, debts and quasi-equity (funds classified between equity and debts such as subordinated loans contributed by sponsors). Patterns of fund contribution refer to common shares, preferred shares, corporate bonds, convertible bonds, loan money from financial institutions, subordinated loans from sponsors (investors), subsidies contributed by the government, etc.

As an entity that contributes funds, there are sponsors (investors), general investors, institutional investors, commercial banks, institutional financial agencies, international agencies, central and municipal governments, etc.

Since levels of tolerance toward risks are different according to fund contributors, expected costs of each fund are different. Expected cost is determined on the inter-relationship between risk and return. With an eye on this difference and balance, elements of funds for projects are combined to procure funds. Since expected cost of equity is higher than that of debts, the efficiency of equity is enhanced by increasing debt elements to the extent possible (enhance the leverage of equity) and then total cost of funds injected into a project can be reduced.

Risks allowed for debts are limited and debts are originally oriented to repayment of principal and interest. Therefore, the following ideas are adopted: (1) debts require a structure that stabilizes cash flow generated from a project and, at the same time, (2) claim for priority to distribution of cash flow, collateralization of assets, and priorities to receive payment, and (3) responsibility for risk elements that have a negative influence on the generation of stable cash flow from a project is assumed to be taken by major stakeholders. When equity has a high leverage, most of the cash flow generated from a project is appropriated to repayment of principal and interest, because secure repayment of principal and interest will not be expected if this is not stable. Project parties or stakeholders will generally assume project risk, while lenders or banks will assume credit risk

Equity assumes project risks and manages a project on its own initiative. However, if its financial burden is smaller than that of debts (higher leverage of equity), the relationship between risk and financial burdens will become asymmetric and risk of financial hazard will increase. Therefore, structural schemes to deal with financial risks are incorporated into projects. That is to say, (1) various regulations that

secure achievement and stable implementation of a project are imposed on the project and stake-holders, and (2) based on the idea that a project constitutes credit, any status of the risks on the overall project and on the elements of the project is subject to strict investigation when credit is granted by financial institutions, and (3) when a project cannot assume all risks, they are shared by various stakeholders.

As mentioned above, in the case of project finance, which has limited equity contribution and responsibilities, additional contribution lines for equity and debts may be decided within a reasonable scope by assuming cost overruns concerning construction, or a certain line for support by equity may be arranged to prepare for shortage of operation funds in a project company at a running stage.

● Security Design

When a sole entity does not assume guarantee for debts on a project, a reasonable decision on whether debts will be repaid is made based on cash flow generated from the project. Therefore, cash flow of a project itsef is hypothecated as well as the structure and scheme of business assets that produce cash flow. This means that the substitable security is not the value of assets held by a project but business value created by a project.

In this case, the provider of debts to a project requires borrowers or stakeholders of the project to hypothecate various elements on the framework that generates cash flow in order to secure repayment of principal and interest. In other words, when designing a funding framework or project structure, security that is tolerable for the project and stakeholders should be considered concurrently.

Establishment of such security relates to all stakeholders of a project. The level of risk held by a project is in direct proportion to the degree of strictness required for security. In this case, security should be designed on the condition that the cost and tolerance assumed by parties concerned are guaranteed to be limited. Meanwhile, the contents and composition of security may greatly change according to the extent of the involvement and motivation of stakeholders toward the project.

Case ◆ Security Required of Sponsor

Even if a sponsor (investor) is exempt from the obligation of guarantee for debt repayment, financial institutions demand of the sponsor (investor) as security (1) definite promise of injection of predetermined capital fund, (2) definite promise of support for fund contribution to additional and restrictive projects, if necessary, (3) (non-monetary) guarantee for performance of contractual obligations of the project operation company, and (4) hypothecation of stock equity of the project operation company. In this case, the sponsor (investor) makes decisions considering whether no guarantee for debt repayment is required and whether responsibilities and functions as an investor can be minimized.

On the other hand, if the sponsor (investor) intends to assume greater responsibility and greater risk, such security will be unnecessary. In this case however, financial institutions turn their concern to the sponsor (investor) and in some cases may not extend the loan to the project. Diversified securities for debt contributors are presented as a "security package" and an organic status of the whole project also becomes an element that determines loan eligibility.

3. Selection of Fund Elements and Specification (Resourcing)

● Concept of Resourcing

Fund sources are unevenly distributed in the market. A fund provider can provide only a certain amount of funds and cannot necessarily provide the total funds for the overall project by itself. In addition, conditions, expenses and procedures for fund procurement will vary according to situations. Each fund provider has a certain level of tolerance for the amount of funds it injects into a project and risk it assumes on a project. In the event of greater risk, the amount of funds is subject to restriction and expected cost for funds becomes larger, and financial viability may not be established in some cases. In such restricted conditions, in consideration of the fact that fund providers are always substitutable, it is desirable that an optimum combination of funds should be aimed through selection of elements in the market.

● Resourcing Process

Elements of funds are specified among multiple options through the correct recognition of the environment surrounding a project and an accurate understanding of restrictive elements. The basic concept and work flow for this are shown in the figure below.

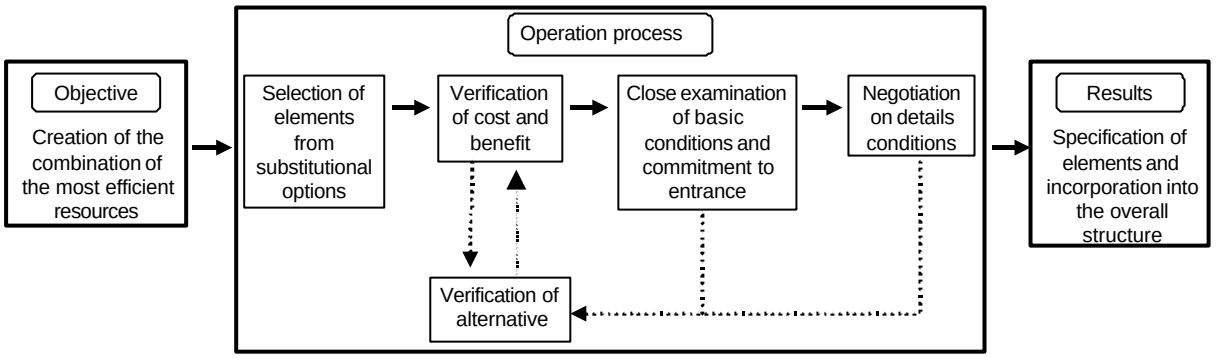


Figure 4-2-6: Basic Concept of Resourcing and Work Flow

Basic selection in resourcing is made concerning (1) fund amount, (2) fund provider, and (3) how to provide funds. Each fund element has its own condition and cost, which are greatly different from others and are not necessarily unified. Loan amount and condition are dependent on the risk held by a project and how to control it. How to set options and combine them determines the structure of fund procurement. In general, intrinsic conditions that are material for a project serve as elements that determines how to procure funds.

Elements for decision from the standpoint of fund providers are (1) the amount that can provided, (2) advantage in conditions (amount of finance cost as life cycle cost recognized from the viewpoint of project) (3) length of the loan period, (4) level of strictness in security restriction condition, and (5) length of the period and level of requirements for necessary procedures and examination.

Therefore, the resourcing process can be summarized as follows.

(1) Select efficient combinations from the options in the market by taking into account the cost of funds injected into the project and restrictions / conditions fund providers can demand.
(2) Verify the cost and benefit concerning the funding for the selected combination. If the cost is high, financial viability will deteriorate. If restrictive elements are strict, possibility and feasibility of the structure become problematic. Verify whether individual funds are an optimum element for the project.
(3) In the above process, cost and restrictive elements / conditions should be considered in parallel. Restrictive conditions, rather than cost, may become an obstruction. Cost should be taken into consideration, if necessary, as a life cycle cost that is adjusted to the present value.
(4) Specify elements as basic selection, and then use the process to ensure their possibility and feasibility.
(5) When resourcing is composed of multiple fund providers, a structure of cooperation and sharing among fund providers as creditors becomes necessary (security and rights / obligations expected by creditors become different among according to different creditors.)

Case ◆ Bond Holders and Financial Institutions

Bond holders are comprised of many unspecified and unsteady creditors who pay the total amount at the same time when purchasing bonds. Their basic concern is stable interest income. They usually hold bonds for a long time but in case a project company falls into default, they rush into selling or collection of bonds. Meanwhile, financial institutions would not provide the funds they are committed to at a single time but they inject funds into the project according to actual demands. Since their loan period is short and they aim to ensure repayment of principal and interest while supporting and managing the project, in case of default by a project company, they act carefully to secure collection of their receivables and consider continuance of the project as long as possible. When the above two participate in the same project as creditors, their ways of decision making and behaviors are fundamentally different.

4. Creation of Feasible Framework and Optimum Structure (Structuring)

● Structuring

Structuring means, summarization of various fund providing entities, fund types, patterns, and conditions, creation of a framework for their organic combination, resultant establishment of loan-eligible conditions of a project, and creation of a structure for achieving a project.

In structuring, assuming that a single entity cannot satisfy all given conditions, a structure of the whole project that meets loan eligibility is designed by combining all elements as a package including performance guarantee, direct guarantee, and indirect guarantee based on an agreement with the various entities concerned with the project. In this case, an overall project is designed so as to create credit in an independent form with a structure where a single entity or element does not support the project.

A process to build an organic body under a certain basic design by assembling and structuring various elements is called restructuring. Structuring a framework for finance refers to building up a framework and structure for procuring the necessary funds so that a project becomes viable. This is done by collecting various elements for achievement of a project and adjusting the interests among them.

● Project Scheme

The basic relationship of functions and responsibilities among stakeholders can be defined by breaking down the basic design of a project and specifying the basic relationships with objects. To this end, elements, framework, and correlations for achievement of a project are organized as a scheme.

A project scheme is a conceptual structure that is reasonably presumed to be viable, where relationships are specified and responsibilities of involvement with a project and functions are clarified. These are depicted as a framework. Details of a scheme may change in the course of structuring.

When viewed from an individual entity, an individual element can be one project, while for a sponsor (investor) who is a promoter, a project means creation and achievement of the framework for the whole project. A project scheme is a bird's-eye view of the framework of the overall project and serves as a road map. Needless to say, it will not necessarily function as the ultimate framework for a project. The concept of structuring refers to planning of the actualization of individual elements and the concurrent realization of the structure and composition of the total project by depicting the whole picture.

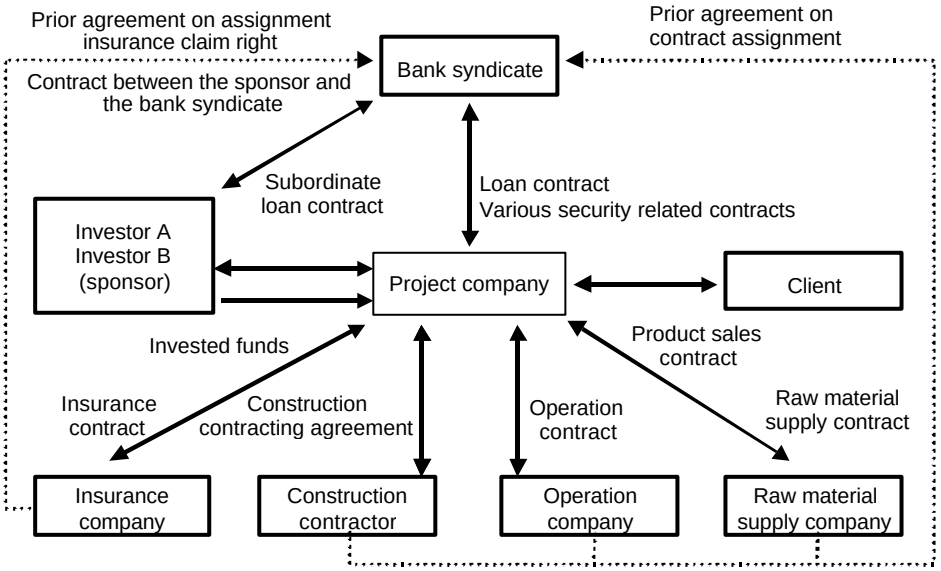


Figure 4-2-7: Project Scheme (Example)

Note: Some projects may not have contracts in part (e.g., product sales contract), or some contract elements will be merged (e.g., the operation company takes charge of supply of raw materials, or the project company itself provides the materials). The above figure only shows an example.

● Finance Scheme

Finance scheme refers to a scheme that shows the relationships between the individual fund providers and a project, and a project and stakeholders, and matters related to fund contribution. It can be referred to as a picture that shows the whole relationship seen from the viewpoint of fund procurement. Finance schemes recognize project elements from the viewpoint of fund procurement for projects and systematize major relationships among them.

The idea that a debt provider can hypothecate the framework that produces cash flow of the project is based on the premise that elements (entities) concerning a project are substitutable in the market and that survival and continuance of projects become possible by substituting elements that have failed or broken down. Therefore, various contracts become necessary between financial institutions and all stakeholders concerned.

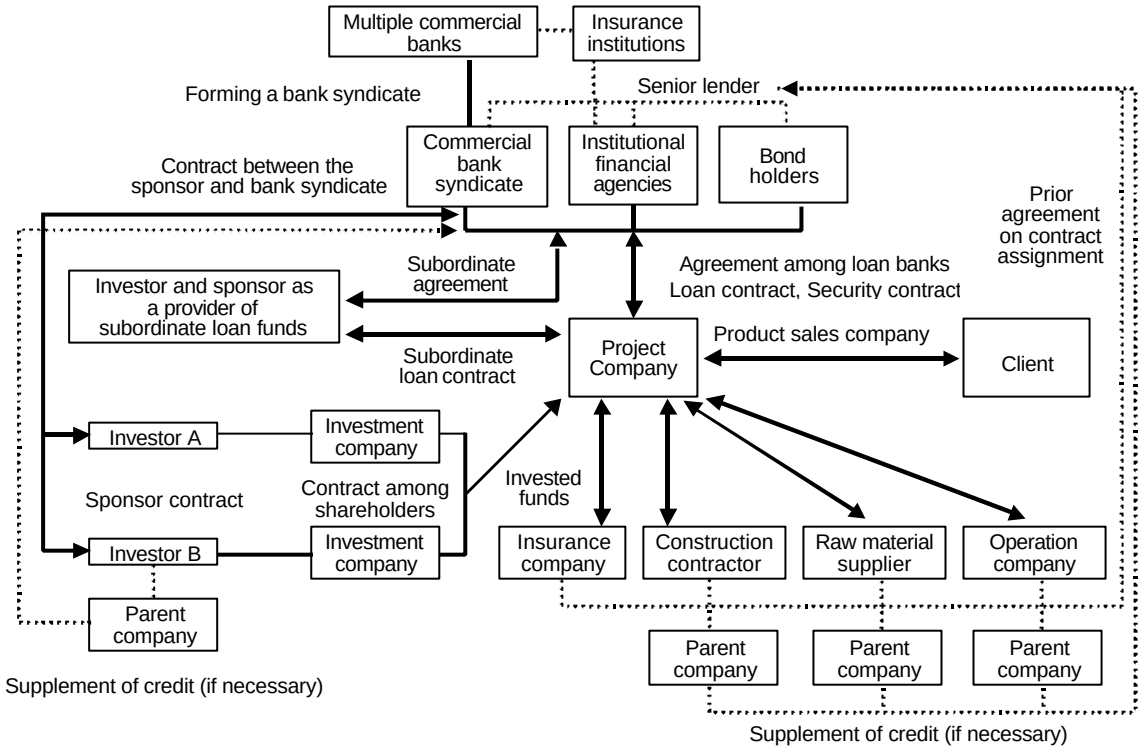


Figure 4-2-8: Finance Scheme (Example)

● Structuring Process

The process to develop a project and the process to build a structure that provides a project with funds are like two sides of the same coin. This results from the following:

(1) Fund providers and stakeholders that assume the risk concerning a project become elements that support the project, and credit is based on this framework. (This is based on the premise that all risks concerning a project and their interrelationships are recognized as a whole picture)

(2) There are various elements that constitute a project as given conditions and the structure of finance is designed premised on them. (Since the framework of fund contribution greatly affects financial viability and feasibility of a project, it will become insignificant unless finance structuring is taken into consideration in parallel when building a structure of the whole project)

(3) In the framework of overall project and its time serial development, a structure that enables reasonable prediction of risk bearers and how to assume risks is established.

(4) Finance is an indispensable element to achieve a project and a project is realized for the first time when the framework of finance is established.

In project schemes, details are examined for each contractual relationship that is assumed to be an element that structures a project, and as a result, a project profitability model is created, and based on this, phased and parallel actualization of each element is designed. Normally, this actualization is processed by controlling funds and costs to be injected within a certain time frame.

Figure 4-2-9 shows a logical process for creation of a project profitability model, designing its optimization and creation of its optimum framework by planning and examining each element that

constitute a project under its basic design. Specifically, as a result of examining the following six elements, a temporary project profitability model is created and its optimization is planned in line with verification of the relationships between the elements and the whole project.

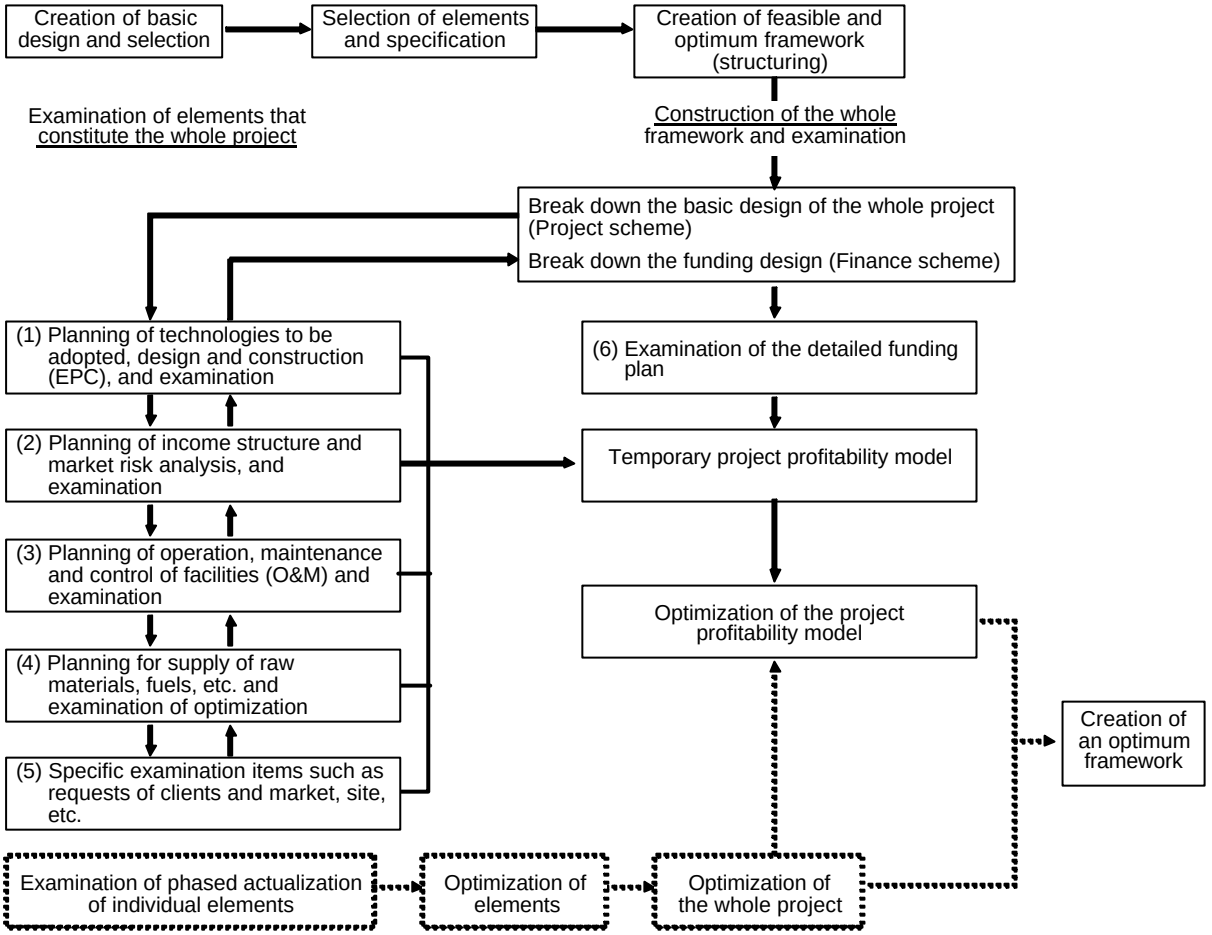


Figure 4-2-9: Elements of Structuring

(1) Examine creation of a framework that generates cash flow. (examination of technologies to be adopted, design and construction of facilities, etc.)
(2) Examine acts to generate cash flow (Examination of marketability of product sales, income structure and risks of the project, etc.)
(3) Examination of acts that make products or provide products and services by using a completed framework (management, maintenance and control of production, operation, and facilities)
(4) Examination of how to supply and procure raw materials and fuels for (management, maintenance and control of facilities and their optimization)
(5) Examination of particular conditions etc. according to cases such as requests from clients and location requirements.
(6) Examination of the basic structure of funding that supports a project based on the above.

With phased actualization of the individual framework that constitutes these elements, the structure of a whole project is being constructed. The framework of funding is actualized for the first time when elements that support a project are established. In consideration of restrictive conditions and elements on finance, a total framework is designed and individual elements are optimized and actualized. As a result, optimization of the whole project and actualization of the finance and project are planned.

Optimization and actualization of individual elements that constitute a project are considered in optimization and actualization of the whole project. Accordingly, it becomes necessary to aim at optimization and actualization of individual elements in line with actualization and optimization of the whole scheme. In addition, regulations on finance apply to the whole project and elements and their investigation is required as a precondition. Without optimization of the whole project, project finance will not be actualized.

Case ◆ Construction and Improvement of Public Facilities etc. by PFI Method

In March 2001, construction and improvement of public facilities etc. by the PFI method was legally approved in Japan. This is a method where design, construction, funding, maintenance and management of public office buildings, schools, hospitals, and basic traffic facilities, etc. are entrusted to private sectors as a package for a long period of time. This is a type of contract that grants a business right to private sectors. In this case, it depends on the types of facilities but all elements mentioned in Figure 4-2-9 at previous page are covered in bidding and contract as a package. BOT or BOO is a pattern of this method, where the life cycle of projects is long and the overall business is considered as a project.

Optimization of the whole project in line with optimization of its parts means that the process is not one-sided but dynamic going back and forth. Figure 4-2-10 below shows the work flow for this.

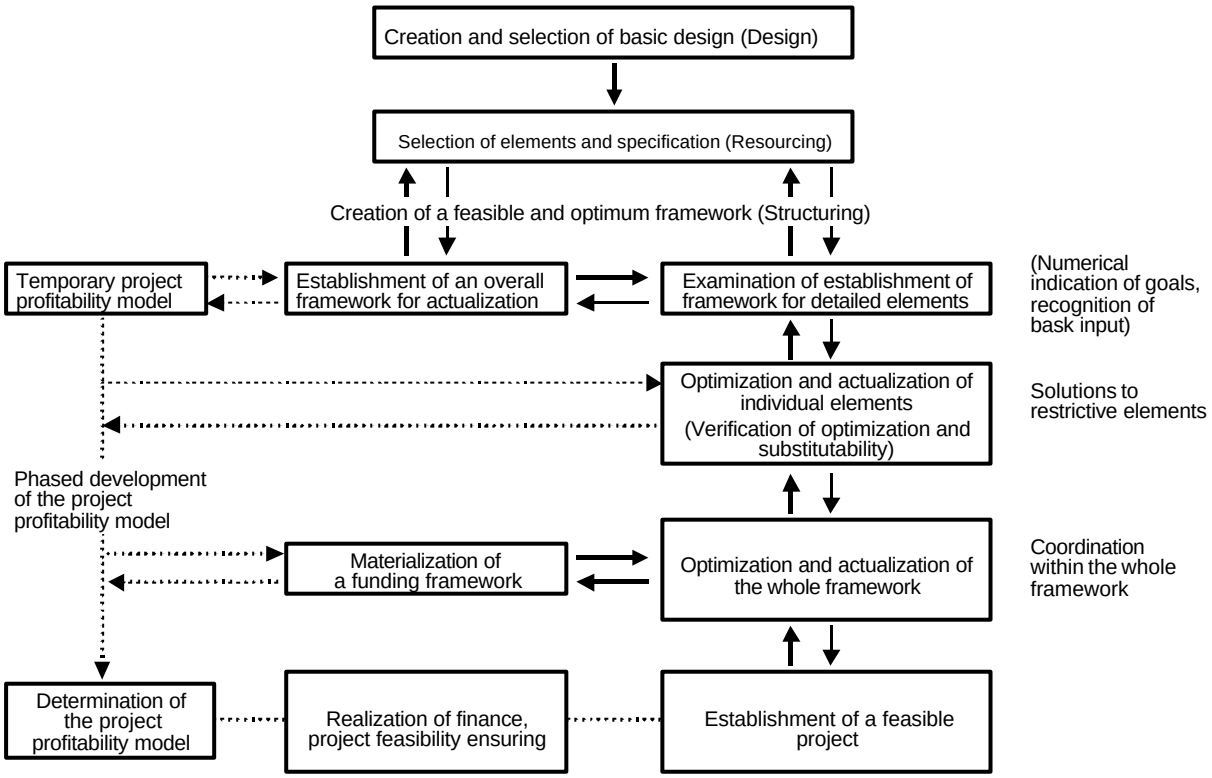


Figure 4-2-10: Interrelationship of Structuring Work Flow

Finance structures and finance schemes vary according to industries, business fields and individual projects. There are also various possibilities for methods of structuring. The following are mentioned as elements for finding the optimum solution:

(1) Originality and device for structure designing
(2) Risk tolerance level by fund providers or risk bearers in the market
(3) Balance among risk, cost, and financial viability

Actual methods of structuring vary widely and this is a part in the course of project creation where originality and device can be demonstrated to the maximum extent.

● Entity, Entrance and Exit

From the view of a sponsor (investor), a project is performed by a newly established project company (special purpose company) and funds are procured also by the company. The sponsor (investor) is characterized by its limited functions and liabilities in spite of the fact that it is a substantial promoter of the project. The sponsor (investor) recognizes the project company as an independent entity and grants it credit and finance. The sponsor (investor) and the project company are thus structured as legally isolated entities, and by separating the legal entities you have additional options for exit.. Such structures where legal responsibilities of sponsors (investors) are limited also mean that debt providers require more strict

regulations of the sponsors (investors).

When a project is structured by multi-layered legal entities as mentioned, rules for entrance / exit and the manner of commitment become significant for the project and finance. In project finance, exit of the sponsor (investor) from a project is taken into consideration in advance and its framework and conditions are established. The exit includes negative and positive exits. Negative exits refer to withdrawal from a project due to failure, succession of the project by financial institutions in charge, change of the project owner, etc. Positive exits include sales or assignment of equity of the project company or economic interest held by the sponsor (investor) to a third party, and acquisition of capital gain from initial public offering.

5. Optimum Risk Allocation, Coordination, Contract

● Concept

Structuring aims at summarization, through agreement, of functions, responsibilities and relationships of rights and obligations between a project and its stakeholders. This is coordination of interests between stakeholders concerned with a project and means to determine risk allocation and risk management on the project. Risk allocation in this case aims at identification of risks and clear agreement by the entities that assume the risks and responsibility. Meanwhile, risk control primarily means to set up a structure and regulations for adequate risk control. If risk allocation is one-sided or unbalanced in view of the whole project, the overall project may have an unstable structure and lose loan eligibility. When risk allocation is determined on a contractual basis, the following reasonable effects can be expected:

(1) Motivate risk bearers to prevent risks becoming evident and they make efforts.
(2) When a risk becomes evident, risk bearers endeavor to mitigate its influence as much as possible.
(3) Risk bearers assume financial consequence when a risk becomes evident.

From the above three, it is known that capability of entities that share risk and a structure that supports the project against risk are critical.

Concept of risk sharing and its work flow are as shown in Figure 4-2-11 below.

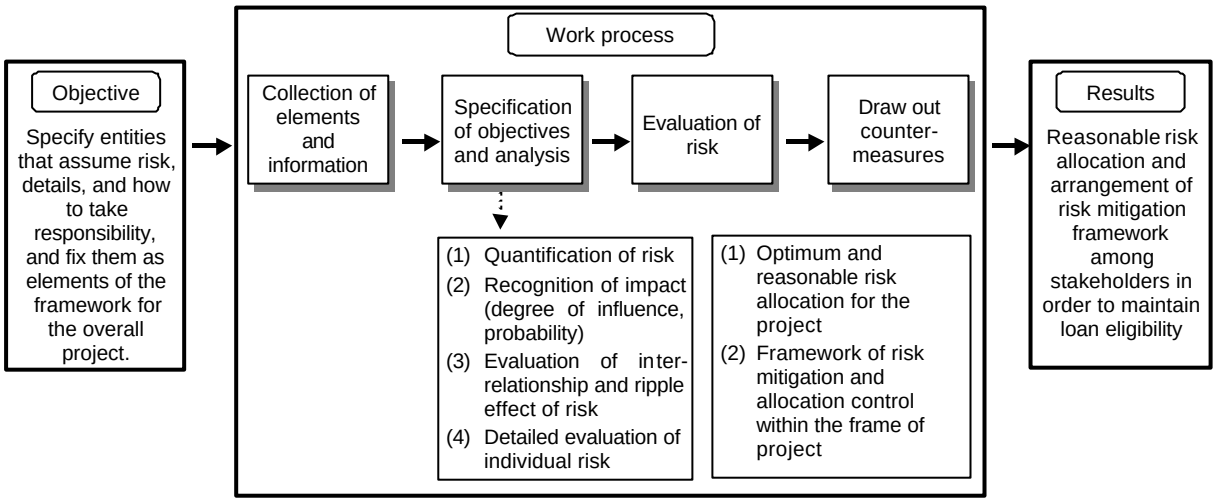


Figure 4-2-11: Concept of Risk Sharing and Work Flow

In the process of structuring, there are not necessarily given conditions that are fixed to the framework for risk allocation and risk control, optimum solution can be optionally pursued in the framework and structure of the overall project. In setting up structures, there is a broad flexibility and structures may change dynamically in the process of building up a structure. In this case, risk and reward become alternative, and entities of allocation or its manner will greatly change depending on the degree of tolerance on the risk among stakeholders concerned with the project. Avoidance, mitigation and acceptance of risks on a project is basically allocated to project stakeholders in the process of risk allocation and are arranged through contract.

Note: The above concept does not necessarily mean that risk is controlled only within the above frameworks. From the financial point of view, a reasonable structure should be built as a framework for the overall project to reasonably control risk. The effectiveness depends on how to practice contractual acts and the concept of risk control becomes necessary for individual elements (refer to Chapter 7, Part IV). When a risk becomes obvious, it is important that "who does what" is arranged in advance and foreseeable.

● Concept of Risk Allocation and Optimum Allocation

The concept of risk allocation and optimum risk allocation should be recognized by the entities that assume the risk and then how to allocate the risk should be discussed. The risk allocation at the stage where all given conditions for a project are not satisfied may be changed in the process of deciding options or negotiation. In this case,

(1) risk allocation is determined based on the relationship among the risk and reward decided by the risk bearer and their degree of tolerance for the risk;
(2) relationship between the project and stakeholders related thereto constitutes all risk allocations;
(3) all various relationships between fund providers (between sponsors [investors] and loan fund providers, between loan fund providers and the project company, between sponsors [investors] and the project company) become risk allocation matters;
(4) risk bearers may be changed in the process where a structure is designed; and attributes of risk may also be converted or substituted.

Case ◆ Changing Risk Attributes

Suppose that a subsidiary that is established to perform a project borrows the necessary funds from a financial institution, and that the institution demands pecuniary guarantee such as a bank guarantee letter of the parent company to ensure the performance of obligations by the subsidiary. In this case, in addition to hypothecation of the subsidiary's assets, negotiation may be possible on the substitution of pecuniary guarantee with non-pecuniary guarantee such as guarantee by the parent company for performance of contractual obligations. In such cases, the essence of risk, i.e., support for the subsidiary, is not changed, but risk attribute is changed from pecuniary obligations to legal obligations.

In the above case, the following should be taken into consideration for optimum risk allocation:

(1) Even if the risk allocation between the parties concerned is optimum in part, but from the project's viewpoint, it may not be necessarily optimum in whole.
(2) If reasonable risk allocation is not designed among the parties concerned, risk allocation and optimum in whole may be contrived by involving stakeholders of other projects.
(3) From the viewpoint of implementing the structure of the overall project, optimum in whole may be given priority rather than optimum in part.

In view of the project, balance of risk allocation in the whole project and its optimality are considered as significant. Risk allocation between parties should be balanced to ensure that risk is allocated to those parties best able to manage and bear the various risks. Optimality in whole greatly relates to the balance of allocation.

● Project Contract, Loan Contract, Various Security-related Contracts

The concept of risk allocation is determined through negotiations among stakeholders and is confirmed in the form of a contract. A means to determine the allocation of risk concerning a project is a contract and various contractual rights and obligations held by the project company serve as security on the loan contract.

Project finance is based on the contractual relationship between the parties concerned and performance of contractual obligations by the entities concerned with the project, and is premised on effectiveness, continuance, feasibility of each contract and each entity's capability of performing the contract. The loan contract in project finance combines all contracts related to a project (various project contracts). All relationships of rights and obligations concerned with the project security are defined in contracts, which are called various security-related contracts (security documents). These contracts are classified into the following types:

(1) Hypothecation concerning real estate, personal property, receivables and any other right on the project company.
(2) Hypothecation concerning bank accounts.
(3) Hypothecation concerning equities of sponsors (investors) in the project company.
(4) Contract for prior assignment of rights concerning the rights and security rights of the project company based on various project contracts among financial institutions, project company, and parties concerned with each project contract.

● Refinance and Decentralization of Small-Lot Finance Risks

A structure of finance that has been designed may not be necessarily fixed but may be re-designed depending on conditions to pursue funds from a fund provider who offers better conditions by repaying all or part of existing finance before maturity. This is called refinance, which is one alternative for efficient management of funds and is effective for improvement of the profitability of projects.

Case ◆ Funding by Issuing Advantageous Bonds

After the middle 1990's, in the private power generation cases (Independent Power Producer=IPP) in United States and some developing countries, there were many cases of refinance in which funds were first procured using equities and short-term loan funds from commercial banks, and, after a project facility is completed, funds were directly procured from the financial market by issuing bonds and repaying all or part of the loans. This is based on the viewpoint that the possibility of elicitation on the risk concerned with projects will change as time passes and on the concept that the structure of debts is redesigned by searching for fund providers who hesitate to assume much risk but offer funds with more advantageous conditions at a stage where the project facility is completed and actual cash flow of the project appears to have become stable. The period of redemption of bonds is longer than that of bank loans and bonds bring more advantageous funding cost and improvement in profitability in view of life cycle cost even if their nominal interest rate is higher.

When there is transparency in the risk and structure of its allocation that supports the project, part of equities and debts may be decentralized in small lots for a few specified or many unspecified investors in the market by means of securitization or bond issuing. Substitution of part of equities by these means after implementation of a project case serves as a means for the exit of equities. Meanwhile, decentralized funds in small lots have different attributes from normal equities or debts. Therefore, when they coexist in a project, relationships of rights and obligations among investors or creditors should be redesigned.

6. Evaluation of Financial Viability and Economic Efficiency

● Evaluation of Financial Viability and Economic Efficiency

Projects are not achieved or their funding framework is not built unless financial viability is confirmed and verified on a reasonable decision. Financial viability evaluation is used as a tool for achieving initial goals by setting up various prerequisites as basic goals in the initial stage of projects, designing a temporary project profitability model, and determining various fluctuation factors and elements in the process of structuring through phased corrections. At an initial stage of projects, prerequisites are merely hypothetic conditions and will change in accordance with phased definition of elements in the process of structuring a project, so they need to be verified constantly. When the overall framework and structure are defined, evaluation of financial viability is established. Process of structuring also serves as a continuous process for evaluation of financial viability.

● Loan Eligibility

A project itself should have loan eligibility to achieve project finance. Verification of this loan eligibility is accountability for results by sponsors (investors) that promote a project toward loan fund providers (risk bearers).

In this case, decisions are made based on the following:

(1) Risks concerned with the project are clearly recognized and grasped, and a structure for adequate protection, mitigation and control concerning risks are designed.
(2) The project has sufficient profitability and debt repayment capability. Elements for profitability fluctuation risk are accurately recognized and an adequate buffer or cushion for fluctuation of the project's cash flow is designed as a structure.
(3) The project's structure is designed so that risks are adequately controlled, and are assumed by proper entities, which have the appropriate capability of performing contractual obligations.
(4) An adequate security framework for loan actions is established and details of the framework have effectiveness.

From the viewpoint of loan eligibility, the following are required: (1) Confirmation of financial viability and economic efficiency (2) Reasonable structure of risk allocation and risk control in the project which support the financial viability and economic efficiency (3) Full consideration of cover and protection in the project's structure when risk becomes obvious in the project.

In terms of these requirements, the following nine items are examined:

(1) Income structure (components that produce income, market risk held by the project and its mitigation)
(2) System, management and actualization concerning adopted technology, design, construction, management, operation, and facility maintenance.
(3) Structure of purchasing costs (raw materials, fuels, etc.) and system, structure, management and actualization concerning purchases.
(4) Financial viability and economic efficiency
(5) Financial prospect of the project
(6) Design of the whole project and each stakeholder's capability and competency
(7) Capability and competency of sponsors (investors)
(8) Stability and strength of the contract structure that supports the project
(9) Effective security framework that supports the framework that produces cash flow.

● Financial Accounting Analysis / Evaluation

Financial accounting analysis brings effective indicators by which the financial viability and profitability of a project are evaluated. Generally, evaluation of investment profitability is a means to evaluate economic efficiency of a project from the viewpoint of sponsors (investors). Safety evaluation brings indicators to verify the safety in repayment of principal and interest from the viewpoint of fund providers that finance funds to a project. In other words, both types of evaluations become necessary from the standpoint of sponsors (investors) as they are the entity to promote the project and plan funding.

There are some methods described in Chapter 1 (p116) for evaluating investment profitability. Meanwhile, safety evaluation brings indicators to assess the capacity of repaying loans, and the following methods are generally known.

(1) Debt Equity Ratio
(2) Loan Life Debt Service Coverage Ratio (LLDSCR)
(3) Yearly Debt Service Coverage Ratio (YDSCR)

Financial accounting analysis and evaluation methods for projects are used by many parties concerned. Their details and viewpoints may be different depending on the relevant parties that provide funds or stakeholders.

Case ◆ Evaluation of Financial Institutions, Sponsors and Institutional Investors

Financial institutions (term lenders) are mainly concerned about cash flow of the project, capital structure of the enterprise, fund source and the purpose of fund use, profitability of the project for a certain period, prediction of future profits, etc. Meanwhile, sponsors (investors) as business investors evaluate projects centering on feasibility (on investment), current and future profitability, and future stability. Institutional investors consider investments as means for acquiring interests, so they focus on ratings and evaluation by third parties such as the debt service coverage ratio (DSCR) and rating institutions. In addition, when contracting constructors (contractors) execute construction contracting agreement with entities that constitute project finance, the framework of funding and its credit risk are mainly investigated and evaluation is made focused on short-term liquidity. Thus, funding financial institutions pay attention to satisfaction of DSCR to some extent and stability of elements that constitute cash flow. As mentioned, financial institutions are not necessarily consistent with sponsors (investors) in evaluation or concept.

● Procedure of Financial Accounting Analysis / Evaluation

Financial accounting analysis and evaluation normally take the following steps:

(1)ESTABLISHMENT OF BASE PROJECT PROFITABILITY CASE (BASE CASE)

Set up a base case on the reasonably feasible premise in consideration of given conditions, and confirm satisfaction of the evaluation of profitability and safety on such premise.

(2)VERIFICATION BY VARIOUS SENSITIVITY ANALYSIS (SENSITIVITY ANALYSIS)

Concerning changes in preconditions (variable values), verify the level and limit of tolerance, and degree of influence on the whole project.

(3)VERIFICATION OF CASES OF DETERIORATION IN FINANCIAL VIABILITY

According to the factors that deteriorate cash flow of a project, consider scenarios of deterioration and verify the level and limit of tolerance for the project and possible development of the scenario (Downside scenario). In addition, if the worst case occurs due to a combination of multiple factors, it is verified to what extent the project is bearable (Worst case scenario)

(4)EXAMINATION OF RESPONSE PLANS (RISK PROTECTION PLAN, CONTINGENCY PLAN)

If the above item (3) is likely to occur, a structure should be planned where an adequate cover is provided even if a deterioration factor appears, in consideration of measures to mitigate the possibility of deterioration in financial viability and influence at the time of occurrence (Risk protection plan), or plans to prepare against deterioration in financial viability (Contingency plan). As a result, risk allocation for the parties concerned is changed, and how to cover risks or set up mitigations measures (protection) are arranged through negotiations.

Case ◆ Concept of Risk Protection

In case a project has a clear risk and the possibility of its occurrence depends on managerial efforts of the project company, the risk cannot be controlled by any party other than this project company. If the project fails to maintain a certain level of DSCR (Debt Service Coverage Ratio), the financial institution decides that the project company falls under the event of default and places it under the control of the funding financial institution as a measure for solution, by directing dividend limitation (to motivate the project company and sponsors to solve the issue), or demanding definite promise for additional fund contribution (Cash deficiency support) of sponsors (investors) when the source for debt repayment becomes short (to have cash-rich stakeholders cover). Thus, "protection" refers to the concept of contractual motivation for risk aversion or restoration and prior determination of response to the occurrence of risk.

Figure 4-2-12 below shows that evaluation of financial viability also has the possibility of exerting influence on the framework of the overall project and negotiations of conditions for risk allocation.

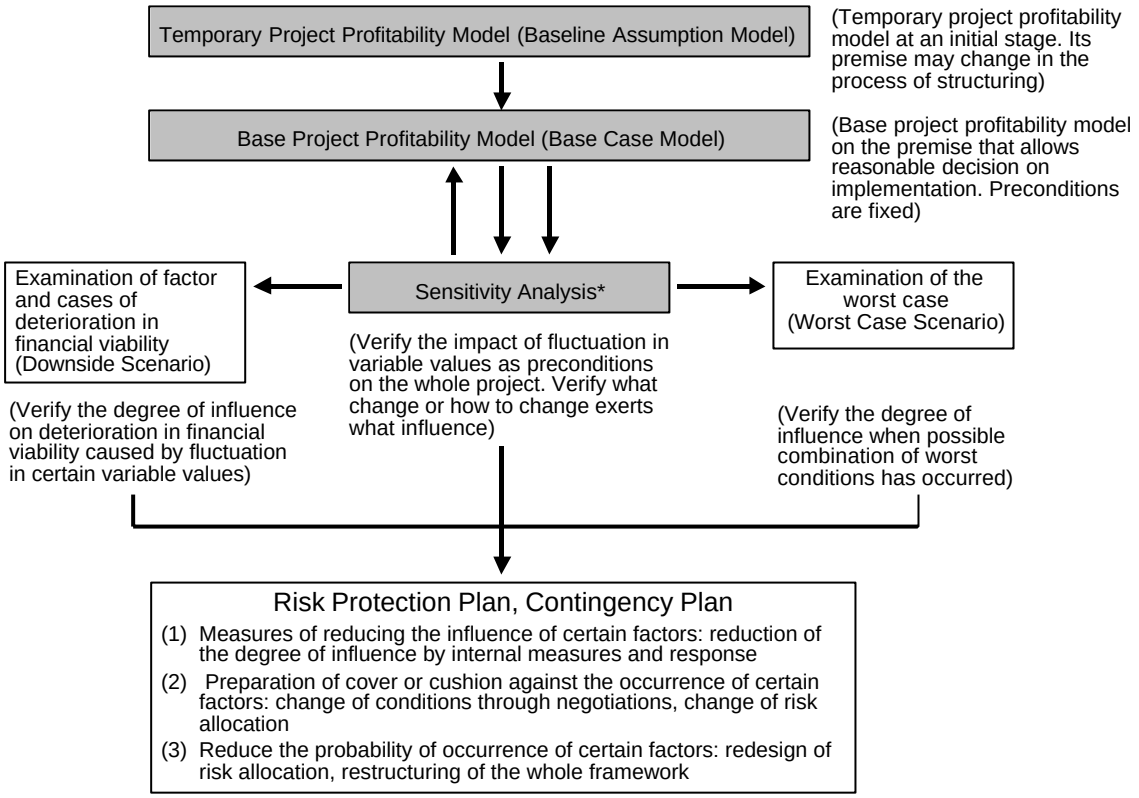


Figure 4-2-12: Work Flow for Verification of Financial Viability

Outline

In planning and/or managing a project, one may encounter things that are uncertain or unexpected situations. Even if you know there are problems to be solved, there are more than a few cases where forming a project, one cannot put a hand on the clue that leads to the solution of the problems. Also, after a project started to move, the job to be carried out become unclear and quite often one may become aware of holding a job which was not initially supposed. As one of thinking processes in order to avoid such a problem as possibly as one can, you have Systems Approach.

This is an approach of problem solving based on the concept of systems and making clear the entire framework, taking things and objectives as a system – conglomeration of various elements having order, and making clear the relationships among its structural elements, a thinking process that examines continually the details of the elements. It is to realize, not only project activities, clarification of the project's assignment and range, planning project activities, and management including results and service mechanism that a project provides.

In view of engineering and management, each is called Systems Engineering and Systems Management. Both try to grasp things in the framework of system. When a project is seen through the concept of Systems Management, outline of project management system is as shown in Table 4-3-1.

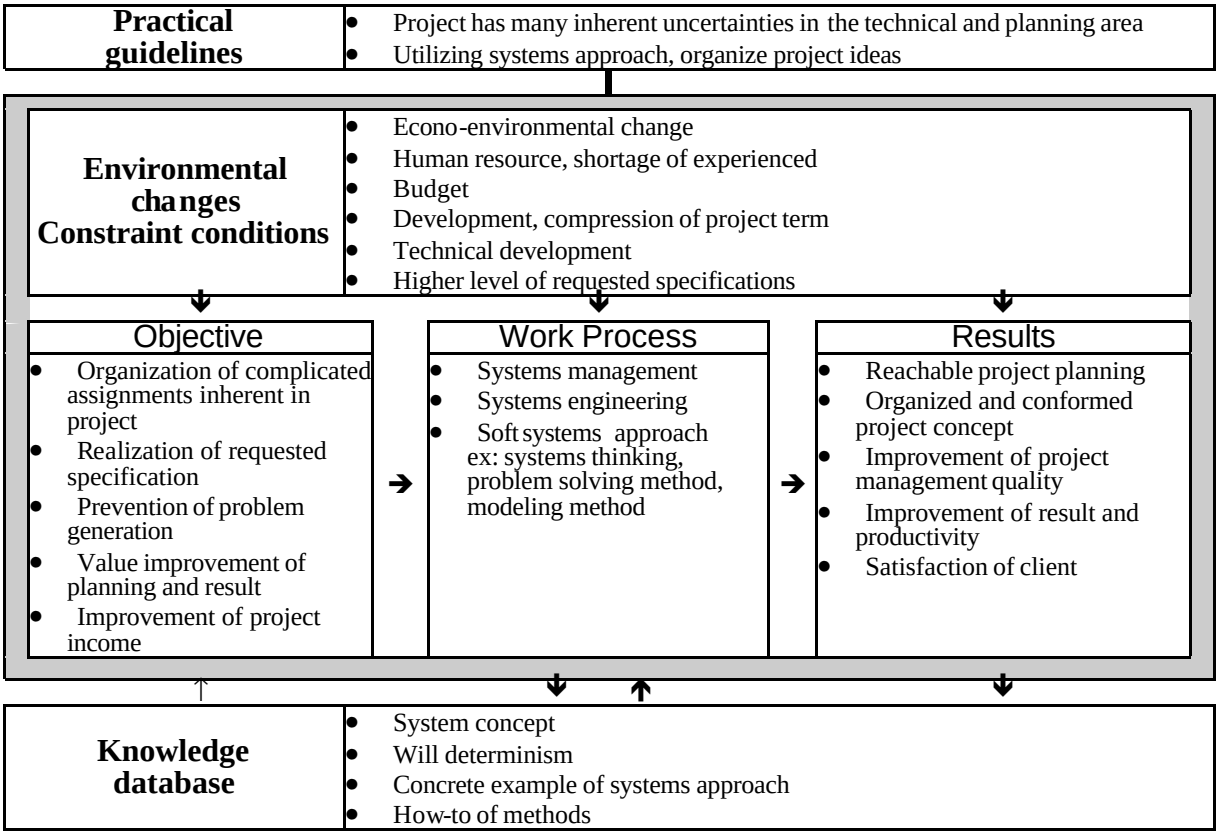


Table 4 -3-1: Overview of Project Systems Management

The most well known applied example of systems approach can be said to be Apollo Mission project. In this, only the mission of "Send human race to the moon within 60's and return them safely" was decided and what needs to be done was discussed in complete darkness and many projects were planned for its realization. Further in individual projects, uncertain elements and objectives were clarified and resolved respectively toward the final goal.

In a concrete form, not only how to launch a large a rocket but human physiology in space and human psychology when a man is trapped in a critical environment were simultaneously researched and studied, a number of projects were each individually resolved and finally in July of the last scheduled year man was successfully sent to the moon. The approach there and its thinking process are valid for not only projects not yet experienced but for sufficient utilization of improvement of result and management qualities in general project.

1. Systems Management

● Project and System

A system is a "conglomeration of various inter-related elements". A system, in this sense, does not exist naturally by itself, but may be considered a result of the finding, defining or creating relationships among elements, so that a system is created.

During the stages of project work process, the approach of considering various objective elements as parts of a system seems helpful. By taking services provided by project results and the products made in the project, then the project itself as a system, assignments and problems become clear and possibility of solution can be probed accurately.

The process in which taking project assignments as part of a system, writing them down, realizing systems relating one element to another, and verifying if the system is as expected is called "Systems Engineering". Further, activity in which looking at objective elements of a project in perspective, defining their interrelationship, and keeping the structure free of contradictions or waste as a whole system is called "Systems Management".

Also, one way of looking at a system is that the system is set up based on the relationship with its environment. An approach that involves clarifying realistically what should be identified as a"Structural Element" of a system, what is looked at as a relationship, and what should be categorized on the environmental side is called a"Systems Approach". Various systems approaches have been suggested but since one specific approach is never adequate for all cases, it is important to comprehend the characteristic of each, grasp the character of the assignment and employ a suitable approach. Table 4-3-2 shows the inter-relationship of Project Management and System, Systems Approach, Systems Engineering, Systems Management.

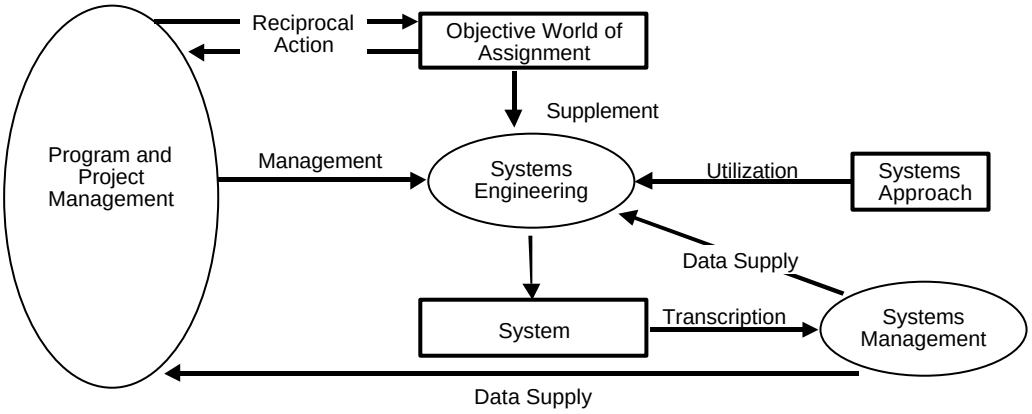


Table 4-3-2: Inter-relationship of Program and Project Management, and Systems Management, Systems Engineering, Systems Approach.

● Perceiving Layers of System and Object

When capturing the project's assignment and clarifying problems to be solved, there is a method which looks at the whole as made of 3 layers, taking each as a system and describing it.

They are categorized thus, the first layer is the client service system layer, the second the product layer, and the third the project system layer.

The first layer should be described as a system which provides services to clients with the project or resulted product, in order to define the project's mission and assignment and requested specification of the product of the project.

The second layer looks at the works of the product and the internal mechanics of it as a system and this is the closest to the general image of a system.

The third layer captures each project itself as a system when there are many projects involved. Time and resources can be saved by making timely supply of the required resources as well as conforming and synchronizing activities among all of the projects.

The view point of each layer is described as follows.

■ View Point of Service Supply – 1st Layer

As one of marketing methodologies, there is an idea to define a business in three planes of client level, client function, and unique technology. In its background, product functions should be specified keeping "Service supply for client functions" in mind for what client and to what operation should it be contributed. It is dangerous to set up the description of the product specification out of the blue for new a product.

For client function, a requested function cannot be met with one product in some cases. For instance, client function may not be satisfied with only the product unless additional services are provided.

Case ◆ Service Supply to Client

As an example of the product with which product alone cannot receive client satisfaction is an automobile. If fuel supply service or maintenance service is not provided, an automobile is not useful for many people. Electric cars are getting attention because of low environmental load but large requirement for its permeation is how to provide fuel supply service, hydrogen for instance, as well as technological skills, such as maintenance capability.

On the other hand, a product may have functions that the client does not want, namely side effects. Either blocking the side effects or service to prevent occurrence of problem needs to be in place for this case. Table 4-3-3 shows relationship of the product (result) and client service.

In some cases "Service" itself may be the project's mission.

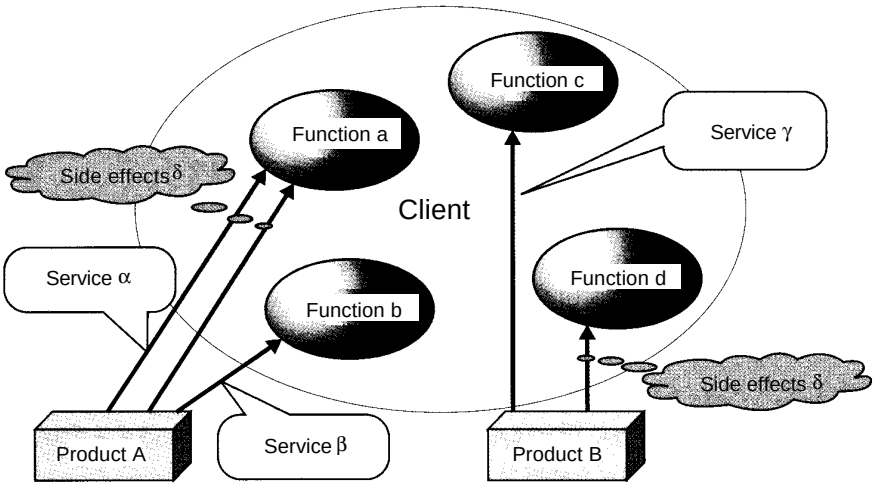


Table 4-3-3: Relationship of Product (result) and Client Service

■ View Point of Defining Project's Result – 2nd Layer

The view point of the second layer is to define the project's result/product itself as a system. In order to describe the system, first describe the relationship between the result's function and side effects, the resources to be consumed and information required and generated. Then describe the relationship between the elements that compose the project's result / product. For capturing product function, a systems approach would be a valid means. The detail of systems approach will be described in "Systems Approach" of this chapter, page 121.

It would be ideal to capture, as soon as possible in the beginning of project activity, the project's result as a system and describe it. Often, a project is unrepeated and is organized to tackle an assignment with many unknown factors, therefore, objective results cannot be defined readily in many instances. Thereby, an approach in which a rough model is drawn in the beginning then refined gradually by evaluating it is quite often taken. The structure of a system of the result is fractionalized according to the project activity's progress and modified. In this approach, since content of discussion changes dynamically, "Management of System Structure", namely systems management would be necessary to a project.

■ View Point of Project's Framework – 3rd Layer

View point of third layer looks at a project as a system generating some result, aiming at "Client Service"

In order to generate some result – or to provide some service, a project performs various activities.

Objective results must be generated by acquiring needed resources and transforming them through manufacturing, transporting, inspecting, and/or educating. If the final result cannot be obtained directly through one activity, an intermediate product is made and by combining a number of projects, the final product is made following procedures. The final objective product is delivered to the client but there are more than a few intermediate products that are not delivered but destroyed. There also could be a danger of making a large number of unwanted intermediate products.

Even though the mission or objective result may be unknown and indefinite, materials, tools, and workers for its realization must be gathered usually from preexisting and available sources. People having unique technology for those resources then would join and figure out a way to generate objective results transforming and manufacturing the preexisting elements.

From these, taking a project itself as a system, to realize the client service which is the final result, management can be considered as overseeing what elements there are, what should be the relationship among each elements, and the presence or not of fault or waste.

In order to make a project adequate, various data should be studied then planned and carried out. If the materials, software, and data for constructing a project system are readied beforehand, project activity can be performed smoothly and effectively. Going further, if the project activity supports the system then project management information system – PMIS can be constructed, it would become more efficient.

When common parts or resources are utilized for products of different projects, by relating projects and carrying out project activity jointly, there is a possibility for saving time and labor. Project management information system, are especially effective, in this case. But care must be taken. There is a danger of distorting assignment or objective results of the project if trying to fit a project into preexisting project activity support systems or project management information systems. Realization of "Service" to "Client Function" is the most important assignment of the project and it should not be forgotten that incorporating preexisting systems is not the goal.

Case ◆ Points to be Careful of When Introducing Preexisting Packages

When trying to make work more efficient and reduce cost with re-engineering of work-flow in an industry, for instance, frequently preexisting package such as ERP is introduced. If the wrong selection made for the needs of the organization and the package cannot be customized, even though a function is required, the function is replaced or merely deleted. The package as a means is given priority in this case and the real objective could not be reached. In carrying out the project, it should be taken to heart that one should not fall for the notion of the preexisting package coming first before anything.

● Role of Systems Management

System management has the part of managing to lead the whole which is composed of various systems looking at a project itself as a system to a final objective. Describing elements and the inter-relationships that construct the system, repetition of maintenance, reference and updating would be its basic tasks. Detailed activities would be as follows.

(1)STRUCTURE MANAGEMENT

The top most part of this is, grasping the relationships among component elements of the system, to take hold of structure of a whole system. Based on this information, duplication or breaks in relationships of component elements can be found. If there is any problem, it should be reported to the project manager and request path correction of project activity.

(2)PROGRESS CONFIRMATION

If status of component elements and their relationships which have been clarified beforehand are recorded, the progress of a project can be found out.

(3)CHANGE MANAGEMENT

During the project's progression, due to environmental change, requests from stakeholders or for technical reasons, the specification of the system may have to be changed frequently. You need to find out how the change affects, which system elements and which it does not. In some cases a change request may affect an entire system negatively and that should not be accepted in these circumstances. To think how to deal with change and providing data for figuring out ideas for coping is the prime job of change management.

When changes take place often, which change one should act according to may become confusing at times on the job site. The second job is project version control in which changes are controlled sequentially.

(4)INTER-SYSTEM ADJUSTMENT

When numerous projects have connections among themselves such as projects handling a number of systems, taking each project itself as a system, taking hold of the relationships among them would be an important part of the systems management function.

For instance, in case resources that project teams use are duplicated and/or delivery recipient of the result by projects are the same, activity schedule of numerous projects needs modifying.

(5)SUGGESTION TO PROGRAM MANAGEMENT

In the first phase of systems engineering, when probing a possibility of problem solution by researching the objective world, the presence of plural systems within a single project and /or assignments which are unsolvable within the project may be encountered. Deciding how to cope with these inside the project would not be proper. The assignments and problems should be reported to program management for adjusting stakeholder's interests and wiping out duplication and contradiction among projects, and the over-all solution should be aimed at.

(6)WORK ENVIRONMENT MAINTENANCE

For smooth operation of project activity, it is effective to provide required resources and mechanical parts in timely manner and maintain a workable environment. With an inferior work environment, project activity can not be started or perhaps would be better not to start in some cases.

There are some tools to support the above activities. They is PDM – Product Data Management, for example, to support design and development of product, Parts Chart and Production Procedure Charts for use in controlling manufacture preparation and production procedure of product, or data dictionary, also called repository, for control of software structure.

● Dealing with Items That Cannot Be Taken as System

With things that can be looked at as system, accumulated technologies and readied tools often can be helpful. Systems management can be mighty in this case. Yet, everything cannot be taken as system in some instances.

Especially, in the real world many items cannot be taken as a system. But even in that case, applying a systems approach as much as possible and transforming formless knowledge into formed, the structure of the objective world of projects needs to be grasped. Parts that cannot be clarified and are indefinite and nontransparent become less and the possibility of realizing the project's mission would become higher. Further, it is desirable to describe as much as possible even items that are indefinite and nontransparent so that items that can be systematized and those that cannot be differentiated clearly for project.

As an example of an item that is difficult for systematization can be seen in chaos, if movement of each element can be formulated, because of minute difference of premise such as initial value, the final action of the system may be completely unexpected. The natural world and human society composed of life form with self-organizing tendency as Green of Chaos have many facets that cannot be systematized. If systematization is forced on those parts, unimaginable side effects may occur. Project managers needs to have an understanding of things that should be systematized and those that should not be.

Things that should not be systematized are better left to people such as clients or operators during the system's operation. By leaving it up to the client the part that must be carried out by the client or operator, or part with room for improvements, which are basically not for systematization, a stronger system can be constructed combining these with the systematized part.

2. Systems Engineering

● What is Systems Engineering

■ Problem Solution with Science and Technology

Problems needing to be solved may be purely technical, those based on passions such as political or human relations, or problems generated by differences in sense of values or emotional conflict. Generally, it seems many problems stand in between and require both solutions. Systems engineering is simply a "Method of Problem Solving with Science and Technology", it approaches problem solving from the side of science and technology.

Ascribing to characteristics of the Japanese language which tend to rear people adept at right brain thinking, Japanese often tackle problem solving based on passions. Maybe because of this, solutions halt as a product of compromise and fresh and satisfactory solution to many does not come out. The concept of Japanese education in learning is mainly copying. Japanese society from now on, somehow, must learn the technique of problem solving with new invention and discovery applying newly learned knowledge.

The objective of systems engineering is, in a situation where not only the solution but the problem itself is vague and obscure, to clarify the problem image and draw out the problem to be solved and its solution with science and technology. According to the solution, action for solving such construction and policy making is taken and when at last the problem is solved, the role of systems engineering is over.

Systems engineering is translated into Japanese as "Shisutemu Kohgaku", but this is literally Kohgaku and is not "Science" such as math or physics. It should be taken as applicable science and not pure science.

■ Relationship of Project Management and Systems Engineering

Assignment of project teams is often a new area for the people concerned. Therefore, more than a few projects seek support from systems engineering. Inversely, with systems engineering applied assignment, the majority get support from project management technology. So project management and systems engineering technologies are spoken often of as twin brothers.

Actually in space travel plan by NASA and defensive missile development plan by the U.S. military force, necessity of systems engineering method and project management technology was recognized and they were developed. These are formed for special purposes, however, and may not be suitable necessarily for assignments of Japanese projects in some parts.

● Phases and Process of Systems Engineering

(1)RESEARCH PHASE – PROGRAM PLANNING

All programs of jobs to be carried out are researched and opinions of all sections should be unified. And necessary information is gathered.

(2)PROBING PLAN PHASE – PROJECT PLAN I

1) Setup of problem
2) Design of value system
3) System composition – create plural ideas
4) System analysis – draw up characteristics of system ideas
5) Selection of best system
6) Outcome report and dissemination

(3)DEVELOPMENT PLAN PHASE – PROJECT PLAN II

1) This phase will be carried out only after execution of development is decided.
2) Create plan for execution of development with its goal and means clarified.
3) The plan to be carried out should be prepared in greater details and man power, cost, schedule and work should be clearly prioritized.

(4)DEVELOPMENT PHASE – EXECUTION PHASE I

This job leaves the hands of the systems engineer and is transferred to the development engineer. The role of systems engineering is to make the requested items more detailed, evaluate and support the execution of development.

(5)CURRENT ENGINEERING PHASE – EXECUTION PHASE II

This starts when the jobs thus far are all completed and as long as the system developed is in use, it will continue. This activity has a goal of elevating capabilities further through use and operation of the

system. As described above, the relationship of project management and systems engineering is very close. These processes will be good reference when planning the process of the project.

● Basic Concept of Systems Engineering

■ System and Structure

A system is a conglomeration of elements and there exists reciprocal relationships among elements and their attributes. Attributes are characteristics that elements posses. The relationship itself between elements may have attributes. Inside the system, there may be a group of elements that have close relationships among themselves. They can be treated as a system within a system, that is a "Subsystem.". A subsystem can be considered one of the component elements of the system. Sometimes, there may be smaller subsystems inside a subsystem and the system may have a "Hierarchical Structure." Relationships between subsystems are not in some cases inclusive, therefore, care must be taken.

■ Environment

Environment is made up of all the elements outside the system. Environmental changes influence the system and the system influences the environment.

Inside the system, a project may have authority to alter its structure in many instances but often does not have authority over environmental changes. That is to say it frequently stays as a limitation to the system.

■ Characteristic of System Macro

The system inter-reacts with its external environment and will have certain characteristics. Mission, Role, Function, and Transformation are stereotype examples.

The internal structure of the system is also one of the characteristics. There are "Dividable" systems and systems that can not be divided. There are systems, where after the system or a part is completed, that gradually get extended or has additions made to it and there are systems that has a firm entire structure from the beginning. Also, there are systems that have an overall control section and the rest following, "Concentrated" systems, and decentralized systems in which each element has autonomic control. Many are in between that employ a mixture of concentrated and decentralized systems.

● Outline of Systems Engineering Process

■ Relationship of 5 Phases

The process of systems engineering and project management is set up to be helpful for the gradual building of plural systems.

(1)RESEARCH PHASE – PROGRAM PLANNING, AND STEERING

The first research phase – program planning makes plans to start a program. Building one system may not be a complete solution to the problem. It is desirable in this case to concentrate on a portion of the problem that requires immediate attention and take the approach to solve one by one. That is, program planning is made for the creation of a scenario for problem solution and the starting of several projects by having them related one to the next.

Somehow, society and industry's environments change and problem status changes, a project may not be allowed to start according to its program planning. Therefore, the person in charge of program planning needs to have the role of "Steering" for problem solution by reevaluating the planning, redirecting project activity as well as modifying its path. That is, the program planning phase does not end at the making of the plan but continues as long as the project operating according to the program is in motion.

(2)PROBING PLAN PHASE – PROJECT PLAN I, AND PROBLEM SOLVING

It is dangerous to pour into a project too many resources which do not have the prospect of problem solution. It is not allowed for a project leader to say defensively "It is thus as a result" after failure occurred. In order to lower the risk, it is desirable to probe the possibility of problem solving beforehand and start a "Research Project" or "Problem Solving Plan Project" for deciding the outline and realization method of the system to be constructed, as a probable solution.

If there can be no possibility of problem solving after particularly studying, moving to the next phase should be avoided. In the case that some system is needed for a solution to the problem is recognized, a move can be made to the development plan phase. However, there are times when plural projects need to be started for problem solving. The project plan has to be fed back to "Program Planning" made in the

previous phase.

(3)DEVELOPMENT PLAN PHASE – PROJECT PLAN II

Various activities in the development phase should be planned according to a clear solution.

(4)DEVELOPMENT PHASE – EXECUTION PHASE I

The real picture of all problems are not necessarily clarified in the previous phase. Many discoveries are made in execution stage and the status of the problem changes. Problems found out should be fed back to the project manager and project plan's path needs to be modified. Plans in the previous phase may need to be rearranged in some cases.

(5)CURRENT ENGINEERING PHASE – EXECUTION PHASE II

The goal of the project is realized in this phase. When a number of projects are involved for problem solution, introduction and setting of results from a single project would not be sufficient. In the development plan phase, considering relationships of systems that are developed by other projects, an adequate introduction plan should be made and connection tools and devices required in execution phase need to be readied.

● Content of Probing Plan Phase – Project Plan I

Today with advances of high technology and the fast pace of business, the importance of activity in this phase is increased. Project managers in the future need to have sufficient comprehension of this phase.

An objective result of this phase is "System Vision" that can solve the problem. Not only simply drawing ideas for the system, but making a number of ideas, evaluating them, and selecting one as the project's recommended idea, it must be submitted to the decision maker including the thinking process along the course.

In this phase, various concepts of objective system should be clarified, or creating new concept, it is important to describe it in the way not to be misunderstood by system users or development division. Since assignment of the project is often unknown to the people concerned, a concept has to be created for the objective system itself. Therefore, "Concept Creation" is the main theme of this phase.

In the method of beginning systems engineering, frequently, concept creation was positioned as one of process – the U.S Military Force, for instance. But concept creation was done in many processes of systems engineering and confusion was generated. From the stand point of cognitive psychology, concept creation is carried out in almost all stages of human activities. To build those without contradictions and keep conformity of the entire system, "Systems Management" becomes a necessity.

Activity of this phase would be carried out giving the importance to "Concept Creation" and its description of "Concept Definition." And detailed activities described below are realized as the joint work of the project manager and the system engineer. The project manager should have sufficient grasp of the discussed content.

■ Setup of Problem

It is important to recognize the problem as a problem and the need for a solution is recognized by stakeholders or the organization and to some extent, also by society. A project cannot be started without someone realizing the existence of the problem and the process of "Problem Recognition and Problem Formulation" where concerned parties recognize the need for a solution. Methods helpful for this problem recognition and problem formulation are numerous – refer to Systems Approach, P.121. "Problem" cited here has a broad meaning. Problem here has a wide meaning that includes not only ideas and needs, but also the potential problems generated by emotional insecurities or frustrations of concerned parties.
These potential problems may be related to the system itself.

To set up the problem, the political, economic, and social "environment" should be clarified, and existing influential regulations and standards need to be researched. Especially, grasping the problem and describing it, and through verifying its meaning, it is important that the project manager and systems engineer are looked at as a "Sensible Partner" by the stakeholders. For this purpose, "Cause Pursuit", "Evaluation", or "Solution Ideas" that make stakeholders suspicious must not be carried out. These actions, before the problem setup is not finished, have a very high risk probability of distorting the project's problem.

■ Design of Value System

Based on researched and the described "Problem", the objective of the project is considered and the goal to be reached by the project is selected.

Behind "Problem" various "Objectives" exist. The project manager and systems engineer should assume those, verify with stakeholders who brought out the problem and get hold of what they really want. Through repeating these activities, recognition as a "Sensible Partner" could be acquired.

Objectives are many, and they are related and as a whole make up the "Value System". In many cases some objectives are contradictory but higher phased objectives are conformed. There are cases where lower phased objectives are in conformity but having many higher phased objectives in opposition and contradiction and these cases are common. In short, making clear value system and introducing new higher phased objective to adjust opposition and contradiction would be desired.

Out of this value system, extract a group of objectives that the system should realize and by relating them, the object for the project should be selected.

■ System Synthesis – Generate Multiple Scenarios

System synthesis is to draw up the system's internal structure, framing with available resources. When "Designing" is mentioned, generally, some people are convinced that the "Realization Method" is not necessary to be aware of. However, if realization is not possible, designed system ideas would be meaningless. To insure the prospect of realization, it is important to start from synthesis.

For system synthesis, whether approached from whole to parts – Top-Down Design, from parts to whole – Bottom-Up Design, or combination of two is employed should be decided according to the characteristics of the problem. With top-down, system ideas become too detailed and contradictions get frequently built-in internally. Also, there is danger of not reaching available resources to be utlized. With bottom-up, the prospect of realization is guaranteed but often it halts at the system idea not conforming to overall objective and causes the phenomenon of "system dissecting organization".

In making system synthesis, taking the "value system" in mind, it is desired to clarify which value component elements – subsystems and parts, contribute to the synthesis. This gets ready for system analysis. And the result of the system synthesis should be described as a model. Modeling will be explained in "Systems Approach", P.121

By the way, since the value system contains contradictions and oppositions, system ideas and its parts ideas often would be plural. Selecting on those right away is not recommended. Plural ideas should be suggested so that decision maker can select what is the best out of many.

Regarding the system's component elements, when it becomes apparent that if available resources are utilized, realization is probable, making more detailed ideas is not recommended. From there on, it should be left to the hands of the development division. For the component elements which can not be insured for realization, detailed ideas should be made until the prospect of realization becomes apparent. By keeping this pointed detailing in mind, the project can save much of its time and labor.

■ System Analysis – Draw Out Characteristic of System Ideas

System analysis is to examine, investigating characteristic of the system and its component elements, whether targeted results can be realized and what unintentional results – side effects may appear.

As a recent tendency, a system analyst often does both system composition and system analysis, thereby, two processes cannot clearly be separated, and on top of this system analysis is often abbreviated. But that causes high risk of project's failure due to faults found in the system test at the closing stage of system development or at the transfer stage. Even though one person handles system composition and system analysis, they should be clearly separated and characteristics of system ideas should be grasped.

For system analysis methods such as OR – Operations Research, Structure analysis and simulation analysis, many tools are in market. It is important to use these properly and get hold of system characteristics. It is not desirable to depend on a particular method or tool. It should be reminded that they deal only with specific side-faces of the system. With assignment of social implications, considering causal relation and interests, grasping of qualitative characteristic is needed. For this, what-if thinking – thinking method of analogizing if this happens, that happens, and past experience would be helpful.

In grasping system characteristics, proper decisions on measuring methods and scales is needed. All things cannot be measured in constants. Combining scales suitable to the objective's character such as simply discernible "Designation Scale – Things", difference apparent "Order Scale – Marks", disparity apparent "Interval Scale – Temperature and Operating Income", and multiplier apparent "Proportion Scale – Distance, Weight and Sales", concentrate on drawing out characteristics of the system and its component elements.

■ Selection of Best System

When there are substitute ideas for the system or component elements, choosing the best out them and deciding on the idea to be recommended, the reason for it should be explained. Designing all the substitute ideas in detail is difficult in many cases in terms of time and energy, it is better to design the system idea in detail during system design while deciding on the idea to be recommended. But for the final decision making, substitute ideas not employed and their reasons for it should be recorded. Decision making should be carried out, as much possible, based on objective data. Also which scales relates to which value and how much it contributes need to be clarified beforehand.

At times, there will be additional measures to cover weak points of recommended ideas after it is decided. It is advised to go back to "System Composition" for the addition and supplement in this case. And, there are times when it becomes clear that system ideas can acquire effects much more than stakeholders; expectation or much less. It should be brought back to "Program Planning" and path modification of the entire problem solution would be preferable in this case.

Whether the system actually realizes the effects as expected is influenced by timing and order of execution. When selecting system ideas, it is desired to clarify adequate order, method, and terms of structuring and make a draft of execution plan. This is one in the chain for realization guarantee.

3. Systems Approach

● Diagram of System Environment

A system is a function for problem solving processes under which a boundary is set between inside and outside of the system and "Input" and "Output" come and go through the boundary.

The work of the system is considered to transform input into output and "origin", where input comes from, and "destination", where output goes to, should be clarified. In recent days, adding to input, output and process, aspects of "Constraint" and "Disturbance" are included and that is becoming popular – refer to diagram 4-3-4.

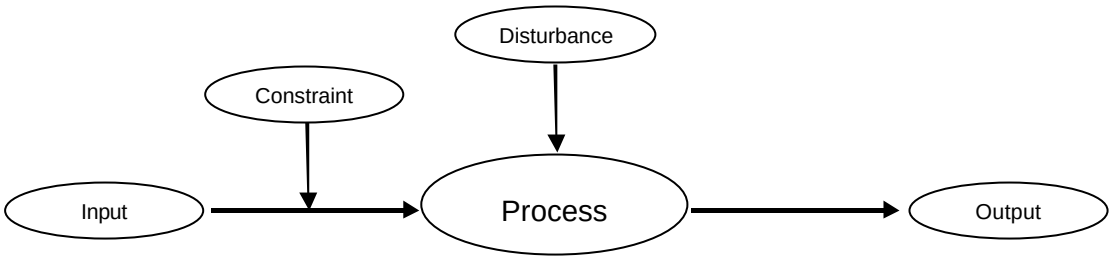


Diagram 4-3-4: Diagram of System Environment

This can be applied to business management too. Abell, for instance, made a suggestion of defining "Client Class" that uses product and service, "Client Function" to which product and service is used and "Unique Technology" for providing product and service. If "resources" such as "things" and "people" can be added to this, it is thought that the range of project activity as well as project results and services can be defined.

Further, if the work of component elements can be represented in detail by input, process, output, constraint, and disturbance and put into an order along the flow of input and output, functional structure can be clearly indicated by using this diagram for "Internal Structure of System".

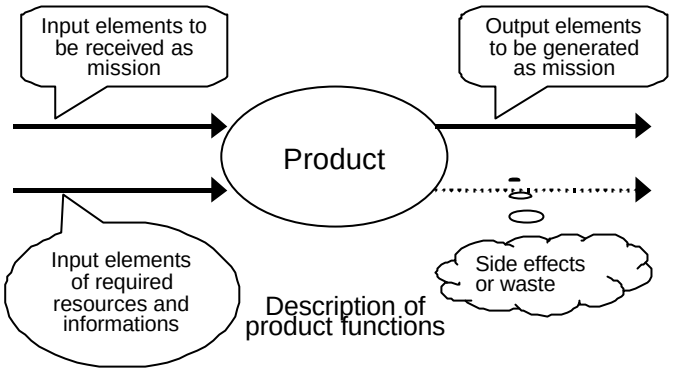
With IDEF – Integrated Definition method of the U.S. Department of Defense, in description of system modeling, in addition to input, process, and output, conditions that limit process – laws, standards, and contract condition and given conditions – regulations and policies of higher organizations in the project, are listed as constraints. Methodology that enables execution of process, resources, and tools are called methods and each is indicated with a relationship of an arrow which comes into a process from above and under. IDEF is used not only for system construction but for description of project industry's project operation process and model – example: PMBOK® Guide of the U.S.PMI®, PreProject Planning Guide of the U.S.CII, Engineering Promotion Association Project Management Branch Section Report – Research on Integration of PMS and CAE, 1993.

Case ◆ Systems Approach For Product Function

A product delivers some action and contributes to client function. First, "Input Elements That the Product Receives As Mission" need to be clarified. That is, objects and their conditions that the product works upon need to be clarified. If there are no objects to work upon, the significance of product's existence can be thought to be null. Important elements such as this must exist.

Next, as an object of action for the product, "Output Elements to be Output", must be clarified. That is, the output that needs to be generated as a result of the regular operation by the product and by describing the status change of higher phased input ,the product "actions" are defined.

Resources that the product needs for its action and side effects that the product generates also need to be described. It is suggested that these be represented in a diagram such as the "System Environment Diagram" or "Context Environment Diagram".



The internal structure and framework of the product can be looked at as a system. It is not adequate to look at the internal structure as paying attention to the "functional structure" only. With various view points mentioned in this column, the objectives should be built into the "model" and their characteristics unearthed up. "An Introduction to General System Thinking" by Weinberg would be a good reference for this.

Regarding the internal structure of the product, structural elements of parts and materials for the realization of functions have generally require a number of activities. These would have side effects that interfere with other functions in some instances, therefore, devices to avoid such would be necessary. Since the relationship between function and structural elements is complicated, it is often difficult to look at the internal structure as hierarchical structures like an organization chart.

● Whole and Parts, Objectives and Means

Taking the system as "Whole" and "Parts" is part of systems thinking. This method is familiar to many people, but one must pay attention to the fact that simply collecting parts would not make a whole and parts do not necessarily belong to one system. An example of the latter, is that an office worker is one member of an organization but at the same time he is one member of a family.

Objectives and means are the same way. Gathering means would not make an objective and in some cases means could be more important than objectives. For instance, an office worker works for the industry's objective but as a member of society, would purchase products supplied by industry.

● Soft Systems Approach

As mentioned above, the basics of a systems approach are, defining the system from the viewpoint of environmental diagram, whole and parts, and objective and means, to clarify the whole picture. This is sometimes called a hard systems approach. On the other hand, there are many problems having vague aspects undefinable with those approaches. For instance, due to the presence of numerous stakeholders in a project, their interests could be in conflict and arbitration may be difficult with the systems approach in some cases. Forming consensus among people concerned with different values and finding or creating relationships under the condition when the objective setup or relationship is not clear, the need for a lenient approach was proposed by Checkland and it is called a soft systems approach.

In a soft systems approach, stakeholders make freely, diagrams of the problem status according to each stand then put into words what they want – root definition of related system. Further, they compare

interests, think what really needs to be done, and repeat the process. Through these stages, they would have mutual understanding of the other side's situation and thought, and be able to reach a compromise.

Coming into the 1990's, this thought was accepted mainly in Europe and got attention. Japan, on the other hand, took notice early of the necessity for this sort of approach, brain storming, KJ method, and work design had been used earlier and they are familiar thoughts for them – refer to Concept and Problem Formulation Technique, P124.

● View Point of Modeling

When dealing with a problem which actually occurs such as analyzing objectives where many elements are inter-twined in complexity and predicting the status that changes with time is desired, representing the objective world as a "Model", examining from various angles is widely carried out. This is called modeling and is a technique that can pin point accurately the problem and cause. By representing as a model, the solution is examined as a concrete system and propriety or fault can be found. And, if modeling can be done, simulation by computer can be performed and clarification of phenomenon and assumptions with the case study can be carried out.

The real world which becomes objective for systemization seems that "Things" and "People" exist without any relevancy and in confusion, and incidents happen at random. In a condition like this, various modeling techniques are being suggested for capturing the structure as a system and finding out regularity and relativity. One modeling technique is not yet recognized as a world standard, but there are several candidates, for instance, UML – Unified Modeling Language, which Object Directed Technique Standardization Consortium is setting, or IDEF established by the U.S. Department of Defense. Depending on the technique, description methodsdiffers, but the common main view points of modeling are as follows.

■ Entity/Relationship

Multiple entities (things) that form the object world and the relationships (connection) among them shall be grasped. If it does not encompass the time changing process of elements, it is called a "static model".

In order to make an actual modeling of the phenomena of the object world using the available rules and principles, skills and insights are required. If the static model is correctly described, then it is easy to represent by words the constituent elements or workings of the system, or to rewrite it into a functional model.

■ Entity/Event and State Transition

In order to grasp the nature of an entity, a chain or rule of sequence of the events (occurrences) that cause a change in the state of the entity shall be described. Since one occurrence may cause a change in the state of multiple entities, it is an approach to grasp the "dynamic nature" of an entity. The model that describes the condition in which the phenomena of the object world undergo changes over time is called a "dynamic model". By describing the relation between an entity and an event, it can be seen that the ground on which people regard several "things" as "of the same kind" is the "analogy of the dynamic nature", and others. This approach seems to be of help to describing individually the elements that are related to the production activities and service activities.

Meanwhile, a method is employed to analyze the state transition by focusing on the relationship of sequence, and this is to abstract an occurrence to form a model only of the rules of the state change of an entity. Such a model is called a "state transition model".

■ Function and Conversion

As has been stated already, the technique of "function and conversion" is to use input, process, production, restriction and disturbance as a way to represent the working of the elements. Such a model is called an "input and output model" or "I-P-O model". In this method of representation, it can be represented how the state of multiple entities changes as a result of one activity or occurrence.

This method is of help to representing the working and operation of a system. The modeling by means of this method is convenient in many cases for representing the behavior of the entire system as mathematical expressions.

■ Interaction

When an entity has reached a certain state, or an occurrence has taken place, it is desired in some cases that other activities should be started. In such a case, there is a method to describe how the interactions among entities are. However, at present the method of describing the interactions is very poor, with few worthy to be recommended.

■ Procedure

It is to describe the sequence of a series of activities to be carried out to attain an objective, and the rules of the selection of activities depending on the condition or the sequence of activities. A workflow or business process is a kind of procedure. When there are a wide variety and a number of elements related to a system, the description of situations (cases) in which a procedure must partially be changed (selected) becomes extremely complex. More often than not, omission or logical mistakes are incorporated in the set procedure, to which attention should be paid. In an actual project, many problems are too complex to be described as a procedure.

In order to avoid and lessen these problems, by forming a subsystem out of the activities that are accompanied by several sequences, the formation of an entire system is represented as a combination of blocks. And it is recommended that a dynamic model should be described first for each subsystem and constituent element. By referring to this, it will be easy to judge which activity should be carried out depending on the situation. The "customer-oriented business process", as is so called in the methodology of BPR, can be realized on the basis of a dynamic model.

Not that every one of the above viewpoints must be used. It is desired that a modeling technique should be selected according to the nature of a problem. Also, attention should be paid to the fact that too much concentration on one method of notation may cause an oversight of the important nature of a problem.

● Concept and Problem Formulation Technique

As a precondition of the modeling, the analyzer must bear the "notion" in mind. When dealing with the problems of an organization or society, the concepts shared by the people who are involved in the system must be common to a certain extent; otherwise even communication is hard to be attained. Also, in a project that is accompanied by some reform or change, it is desired that the people concerned have consciousness that is uniform to a certain extent as regards its necessity (problem formulation). The soft systems approach as mentioned above is helpful to the concept formulation and problem formulation in the main.

There are a lot of techniques related to this field such as KJ method, etc., being utilized in various ways (see Table 4-3-5). Each method has its own features and suitability, and so it is desired that a method should be selected in an appropriate way according to the nature of a problem or the situation of an issue.

For instance, by using a technique called a divergence technique, ideas are extracted as much as possible, and by using a convergence technique, the collected facts or ideas are put together. And since an integration technique has the features both of the divergence technique and of the convergence technique, it would also be possible to implement the extraction of ideas all through to the putting them together.

● Chaos-Complex System and Project Management

In the world of computer simulations, in particular, it has been recognized that there is a problem that, even though the working of individual elements is definite and has regularity, unexpected results occur. For example, in a non-linear equation to forecast the weather, a minute change in the initial value gives an unexpected result. More amazingly, if all the results of a calculation are plotted on a screen, even the values are random, a form appears that has regularity as a whole. A problem having such a nature is called an issue of "chaos". The fluctuation in stock prices is also studied as one of the issues of chaos. It should be noted that in some issues of a project there exist elements that are similar to chaos, of which forecast or control is very hard to make.

In between this chaos and a system, there exists a problem. The state called an "edge of chaos" has a "self-organizing nature". For instance, in between the state of water and that of ice, a beautiful crystal is formed. Such an element or a collection of elements is called a "complex system". An organism is a complex system. For instance, the immune system of a human being consists of the working of various cells such as macrophages, and others, but it has no specific organ. Each element behaves on its own, and the overall working of it functions as immunity.

In a business or society, such a phenomenon can be observed as a very commonplace situation. A business or society is a collection of individuals that work in a self-sustaining way, and their cooperation has the business perfomed and social activities pursued. This led to the general recognition that an approach is required that has a viewpoint being different from the conventional one, for which some regard should also be shown. Of course, not much study has been done of the case in which the "complex system" is directly utilized for project management. But in such a case as handles social problems or business networks, it can be put to use for providing a clue when making an analysis.

Classification	Sub-classification	Technique
Diversion technique	Free association method	Brainstorming method
		Card BS method
		Brain-writing method
		Shortcomings enumeration method/wishes enumeration method
	Forced association method	Input output method
		Attribute listing method
		Check list method
		Matrix method
		Morphological analysis method
	Analogy method	Synectics
		Gordon method
		NM method
Convergence technique		Affinity graph method
		Cross method
		Characteristics factor diagram
		Storyboarding method
		Card part method
Integration technique		Work design
		High-bridge method

Table 4-3-5: Example of Problem Solving Technique

Outline

In projects, value creation activity is carried out with cooperative participation of multiple individuals, teams, departments, corporations, groups, etc., which have the same objective so that the projects result in a success. Project organizations are different from stationary organizations such as companies and public corporations in that the former is temporarily formed by members who directly participate in a project to achieve its goal. In addition, project and stationary organizations are also characterized by their activities in parallel with each other. Changes in the environment surrounding companies and projects are increasingly intensified, so project organization management that is flexible and prompt in coping with situational changes is required. Stationary organizations should make continuous endeavors to improve the level of the organization (degree of maturity) that performs project management for keeping competitiveness.

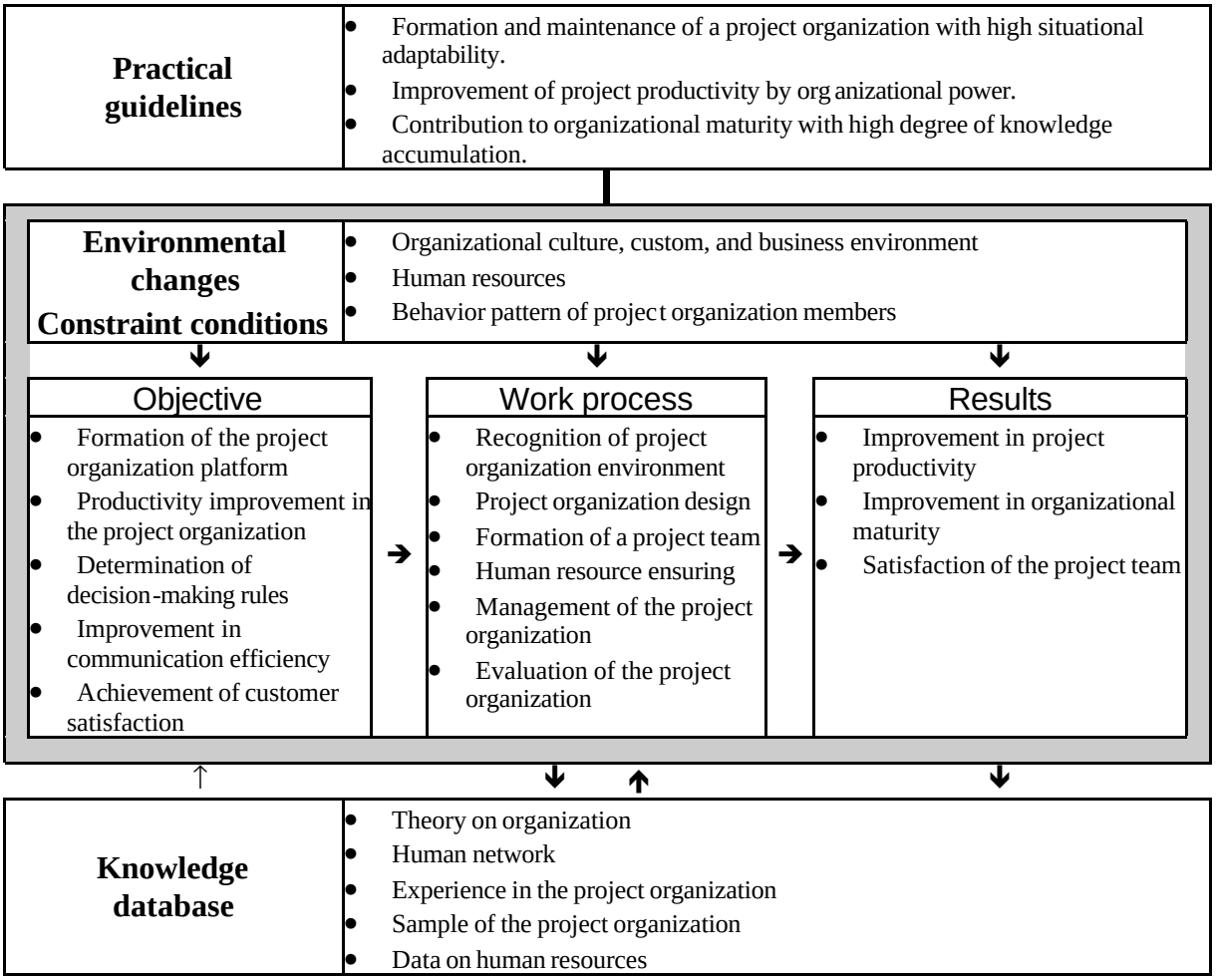


Figure 4-4-1: Overview of Project Organization Management

In projects, value creation is ultimately performed through accumulation of people's (individuals) contribution. Accordingly, senses of achievement, mission, and satisfaction of individuals who join the project organization greatly influence efficient management of the project and its success. Enhancement of purpose awareness and demonstration of leadership are significant factors to move people and are a core part in project organization management as well. This chapter also describes the role of the project manager, a core existence in a team, by considering that a project team is a group of individuals in the project organization who are directly involved with the performance of the project.

1. Project Organization

● Project Organization Environment

■ Environment Outside the Project Organization

In project organization management, advanced and complicated projects start with definitions of relationships between project achievement organizations based on its specific context. In other words, projects are implemented not in a manner as seen in conventional construction projects where project owners perform projects with clear objectives, but in a manner where multiple project organizations that have their own functions constitute a network for value creation activities for the whole project to achieve missions. It is important for the project organization to design and manage the organization in inter-relationships with other project organizations. As an example, there is formation of organizations in a project using project finance such as PFI. (Refer to Chapter 2. Project Finance Management, P.91)

■ Environment Inside the Project Organization

Since the project organization is formed temporarily, it has to select team members, establish methods for decision making, and form the basis for communications. Some of the members who participate in a project belong to an existing organization or some may be newly employed. Difference in cultures of the organizations to which team members belong or belonged often obstructs performance of the project in the project organization. (Refer to Chapter 11. Communication Management, P.273)

■ Stationary Organization and Project Organization

When a project is positioned in a stationary organization like companies, management of the project is sure to be bound by the rules and restrictions set forth by the stationary organization that is placed at the upper position, and formation of an adequate project organization is desired with the full understanding of the context of the stationary organization. Project organizations are designed to achieve business strategies of the upper organizations in consideration of achievement of both long-term and short-term goals of the upper organizations, as well as of the business environments thereof.

For example, corporate procedures and routes for approval of projects are important for smooth implementation of projects. In international enterprises, it should be fully examined how decisions are made from the global viewpoint and in local business units (e.g., Japan branch).

■ Characteristics of Project Organizations

Since projects are terminable, unlike stationary organizations, project organizations should be designed for each project, and a flexible scheme of organization management should be built to smoothly respond to organizational changes during a limited period of time. In addition, most members of project organizations belong to a stationary organization, and the scope of influence project organizations extend is different for each project and its phase.

Therefore, projects should have management organizations that maintain the period and cost set up under limited environments and conditions, and effectively promote achievement of goals by organically and comprehensively merging and combining limited resources (workforce, materials, technologies, tools and systems) in the constantly changing project cycle (planning, implementation, coordination, results, maintenance) and by aiming for optimization.

In particular, the following should be incorporated into management of organizations as key points and be implemented.

(1) Prompt and accurate conveyance of directions and orders to the practical level.
(2) Prompt decision making.
(3) A structure that facilitates communications with as few coordinators as possible.
(4) A structure that enables easy recognition of upstream and downstream situations to accomplish one's own duties.
(5) A structure that instructs team members to overcome their weak points and maintain and improve quality.
(6) A scheme for motivating team members to endeavor to accomplish the goal.
(7) A structure that enhances a sense of solidarity through delegation of authorities and responsibilities to the lower level.

In many cases, stationary organizations have their own codes of action in consideration of mature organizational culture, decision-making rules, communication methods, organizational practice, mutual recognition of the organization structure, political position of the organization structure, etc. However, in project organizations, all these are newly designed when starting a project, and should be specified in writing and be confirmed for each element. Therefore, whether to structure a clear organization plan will greatly affect future project management.

● Project Organization Design

■ Function Type Organization and Project Type Organization

Organizational approaches made by stationary organizations when implementing projects vary depending on how projects are positioned in the organizational system and practice. Stationary organizations typically consist of function type organizations and project type ones, and their mix, matrix type ones.

(1)FUNCTIONAL ORGANIZATION

The functional organization consists of sectors separated based on the functions that are needed by a stationary organization, and efficiency of each function is especially required. Each sector normally has a hierarchical rank and smooth communications, while projects are greatly affected by the culture of each sector and the boundary between sectors. In case a project manager is not assigned, the head of the sector takes charge of coordination of the project.

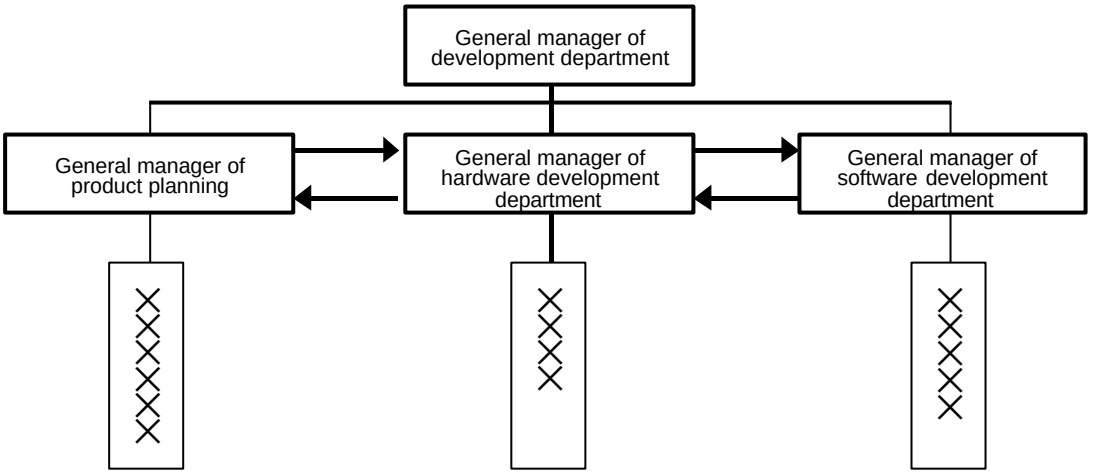


Figure 4-4-2: Functional Organization

(2)PROJECTIZED ORGANIZATION

Project managers have independence and strong authorities and the rights to choose, reject, and coordinate resources. In projectized organizations, motivation toward the project is enhanced. Indirect sectors provide support service to projects.

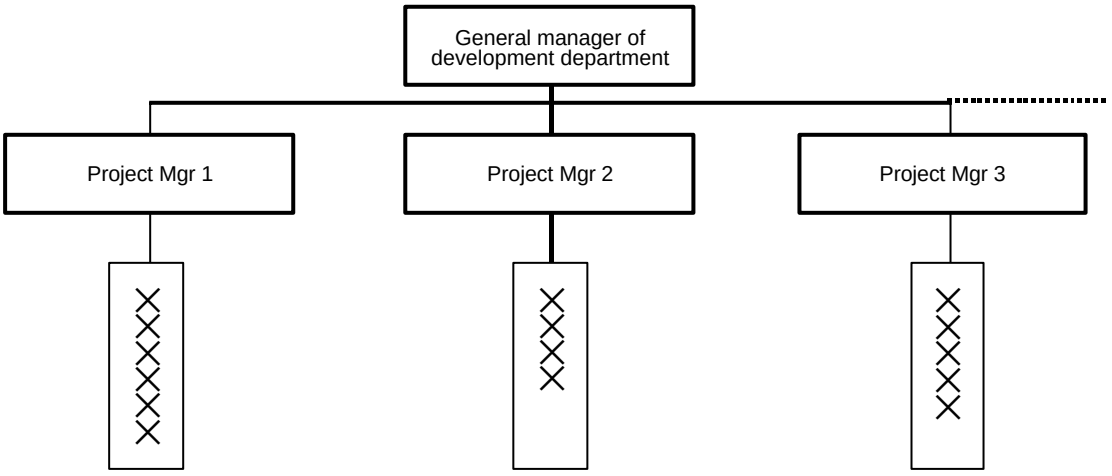


Figure 4-4-3: Projectized Organization

(3)MATRIX ORGANIZATION

The matrix organization has characteristics of aforementioned functional and projectized organizations, and consists of various types according to authorities of the project manager and head of functional sectors and methods for their adjustment, such as sector-coordination, work sharing, and resource pool types.

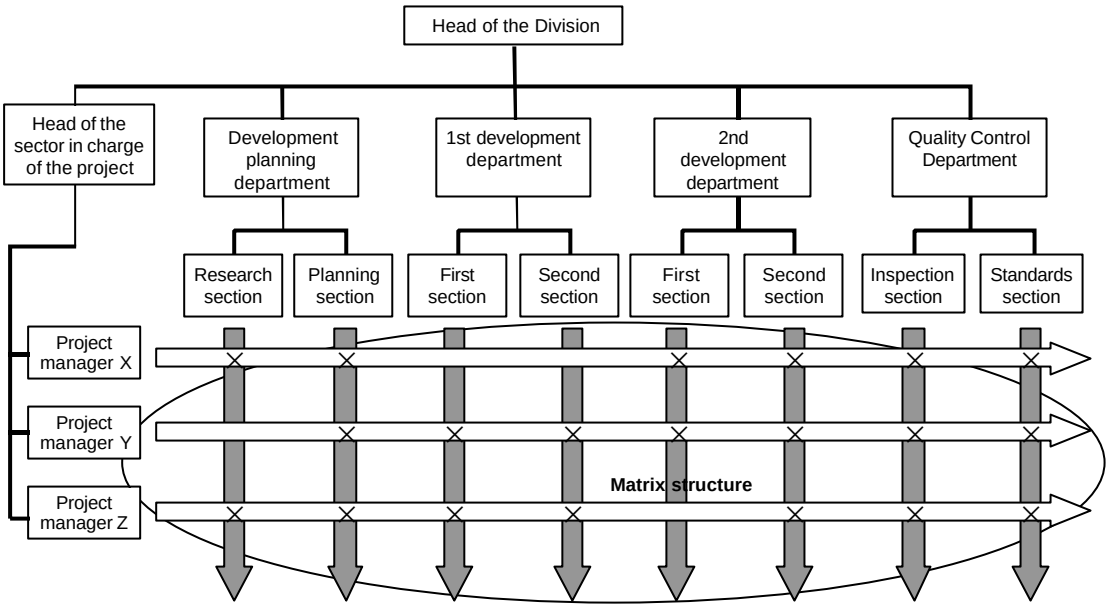


Figure 4-4-4: Matrix Organization

The above-mentioned three types of organizations have the following advantages and disadvantages: An optimum organization should be established in consideration of the project's features and nature.

- Advantages of the projectized organization (disadvantages of the matrix organization and functional organization)

(1) The chain of command is simple and clear.
(2) The flow of information is simple and clear.
(3) Prompt action and processing are possible for events.
(4) Priority of issues is easy to be decided in a single project.
(5) Confrontations between the project team and functional organizations are few as well as their adjustments.

- Advantage of the matrix organization (disadvantages of the projectized organization and functional organization)

(1) Necessary technologies and prompt action for supply of workforce in the process of accomplishing the project goal are more difficult than projectized organizations.
(2) Human resources can be effectively used.
(3) Information is likely to be used by other projects.
(4) Experts can be fostered and ensured effectively.
(5) When a project is finished, the return of project staff to the functional staff can be conducted efficiently.

■ Project Office

The project office* aims to realize optimization of the whole organization through efficient achievement of multiple, concurrent projects proceeding in an organization. When a matrix organization makes a decision on interests concerned with multiple projects such as priority of projects, the project office has a role and authority to coordinate interests of such multiple projects. This prevents a project from becoming dependant on personal decisions. Project offices have the following patterns:(**もともと削除箇所なし**)

(1)SUPPORT TYPE PROJECT OFFICE

The support type project office plays a role to support each organization of a project. Personnel who have once worked as a staff member are allocated to a project office and provide various types of advice for smooth management of a project to the project manager and line managers.

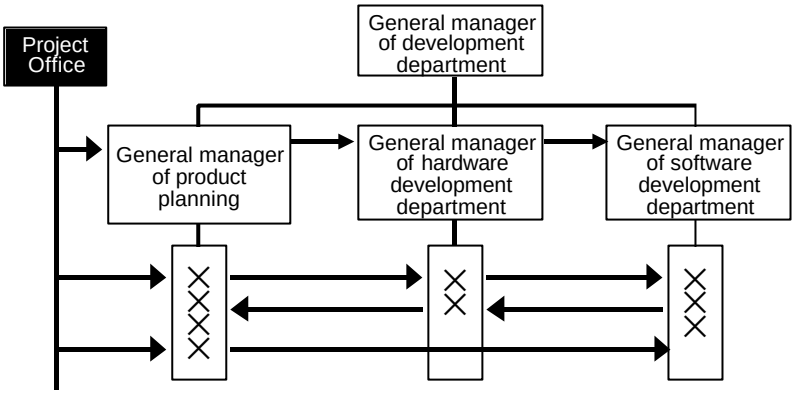


Figure 4-4-5: Support Type Project Office

(2)CONTROL TYPE PROJECT OFFICE

The control type project office has control functions and monitors all projects. The project office collects information on projects and analyzes the information based on objective data. If there is any problem in advancing a project, the project office gives warning and demands correction. In addition, visualization of projects becomes significant.

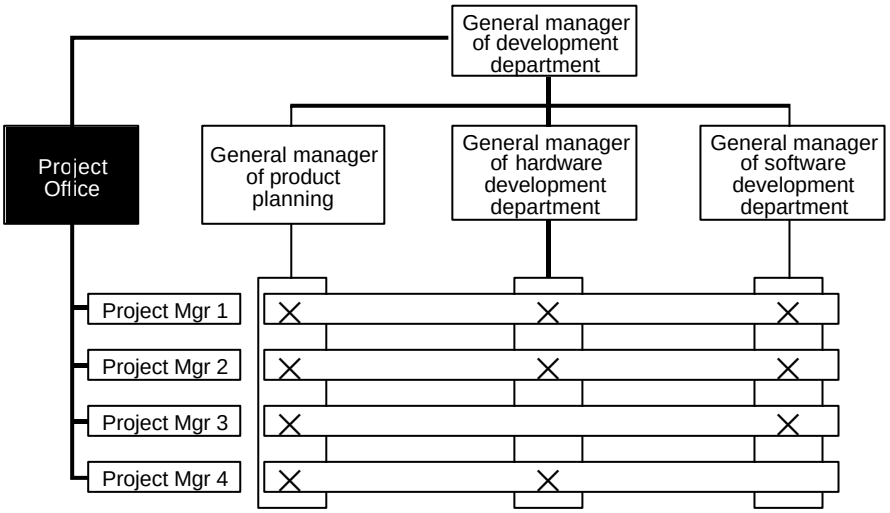


Figure 4-4-6: Control Type Project Office

(3)LINE TYPE PROJECT OFFICE

The line type project office has functions as an expert group of line manager and all projects are implemented by project managers who belong to the project office. Coordination among projects are committed to the project office manager.

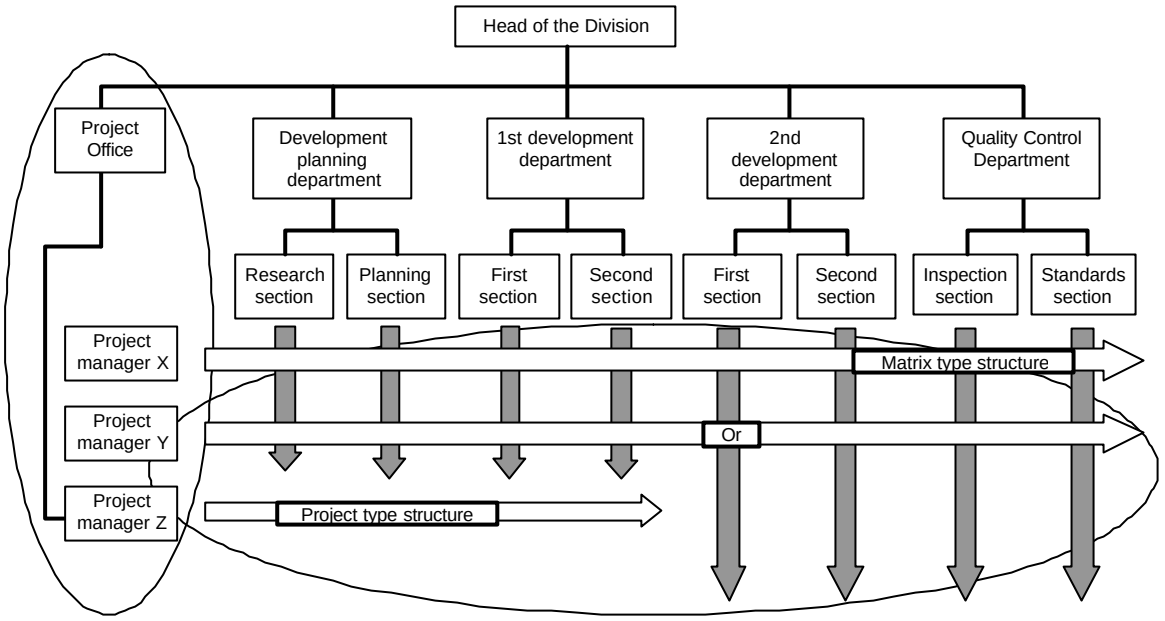


Figure 4-4-7: Line Type Project Office

When enterprises recognize the limitations of the functional organization in which they have so far implemented various projects, and aim to have autonomy and mobility in project management, these types of project offices also work effectively as a temporary organization unit on behalf of a project department.

■ General Theory Concerning Project Organization

In management of project organizations, general theories on organizations and Organizational theories concerning projects serve as effective basic information. Therefore, it is necessary to understand these organization theories and deal with various phases and issues that appear while advancing projects.

2. Project Team

Organized groups and teams play a core role in advancing a project. As mentioned in "Project Organization Design" (see page 128), a human project led by a project manager* is greatly affected by his experience, skills, attitude, and behavior, project organization structure, and culture of executive organization.

The key to success in a project in such circumstances is that the project manager effectively motivates project team members* who participate in project accomplishment and organizes them to have the members and group demonstrate their capability to the maximum extent. Then a cooperative system to achieve the project's goals and deliverables should be established. The concept of the typical project executive system is shown in Figure 4-4-8 below.

This section focuses on project teams as a project executive organization and the basis of the project implementation is common to any organization.

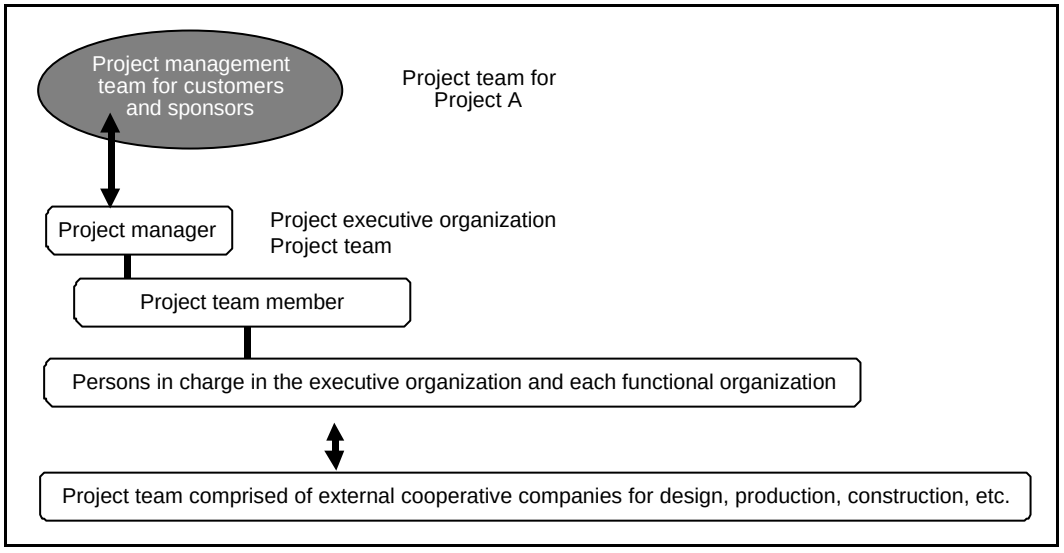


Figure 4-4-8: Typical Project Executive System

● Project Manager

In starting a project, a project manager is chosen before forming a project team. Criteria for choosing a project manager are different according to each executive organization, but in general, according to the types of management and contract for the overall project including clients, scale of the project, and cooperative companies, the head of the executive organization selects a project manager in consideration of management capabilities such as client relationship, effective communications skills, negotiation skills, solution competency, stress resistance, determination, and leadership, as well as his experience in project management. Some organizations select only project managers who have the qualification.

The project manager is given authorities and is responsible for the result of project. In this regard, it is important for him to control a project by keeping a balance among customer satisfaction, cost, time and quality. If a project manager also works as an engineer in the project or is not given sufficient budget and rights of command that are needed to manage the project, he is not appropriate as a project manager even if so appointed.

Case ◆ Roles of Project Manager

A system engineer with long experience was appointed as a project manager for a certain project. However, this engineer also had to take charge of design for a certain portion of the project. Then, he became tied up with the design work and neglig ent of performing his responsibility as project manager (control of the whole project), and then the project gradually collapsed.

In management of projects, it is vital to demonstrate and fulfill the function of project manager correctly.

● Project Team

The function of project organization is the maximum utilization of the capability of the executive organization to achieve the project goals and deliverables. The project organization is formulated separately from an enterprises' functional organization as a temporary organization with the aim to implement the corresponding project only. This concept is called "project team system" and a formed organization is called a "project team."

■ Project Team Formation

The project manager organizes a project based upon the right of command authorized by the head of the executive organization (higher-ranked officer). An organizational structure and team of a project should be determined according to its scope, time cost, level of technical difficulty and type of contract.

Project organizations are different depending on these conditions and the policy of the executive organization. What is important in the theory of project organization is the concentration or integration of responsibilities, authorities and information for implementing the project as a team. A project team should be changed according to time and place in pursuit of the optimum form, chain of command, management hierarchy, job type, and personnel arrangement. The advancement of IT technology has enabled a style of management as if time and place are not fixed, such as "multiple office organization" and "virtual office organization." (refer to Chapter 8, "Information Management" P.224).

■ Responsibility and Authority of Project Team Members

In implementation of a project, a structure of the aforementioned project formation is determined in response to the Work Breakdown Structure (WBS), and Responsibility Matrix (RM)* according to individual jobs needs to be prepared.

In addition, it is critical to appropriately allocate functions, i.e., who does what, and responsibilities, i.e., who determines what, to all team members concerned with the project. For this purpose, the responsibility matrix (RM), which illustrates relationship between responsibility and authority is generally used. Figure 4-4-9 shows an example for RM.

Case ◆ Significance of RM

RM should be specified in detail. In the event of procurement of parts, materials, services, etc. from outside the company, technical specifications are drafted by the engineer in charge and are determined by the head of technical department in charge of the project. The project manager approves technical specifications and the procurement department adds commercial matters such as purchase conditions. The conditions added by the procurement department are finally approved by the project manager. Such arrangements should be made for each operation at an initial stage.

Personnel / Work contents	A	B	C	D	E	F	• • •
Preparation of requirements and basic specifications	S	K	P	A		P	
Basic design	S	K	P	A	P	P	
Detailed design	S	K	A	I	P	P	
Production (Development)	S	P	P	I	P	K	A
Test and inspection	S				K		A

S: Approval K: Decision A: Executer (Drafter) P: Supporter I: Information Provider

Figure 4-4-9: Responsibility Matrix = (RM)

■ Personnel Allocation Plan

For formation of project team members, human resources fit for the project operations should be chosen. A Personnel Allocation Plan is drafted as the number of workforce sheets and the accumulation sheets, both monthly, which show with a bar chart when individual team members are allocated to the project and will finish their jobs and the cumulative number of the workforce. The management sheet illustrated with a bar chart is used as a basic material for adding up man-hours and is also effective for timely release individual project members. These sheets are also effective when planning or monitoring a large scale project that has sub-projects and when the executive organization plans the total workforce.

● Team Building

Team building* is an activity made for the effective advancement of project operations and the enhancement of executive capability. When a project is started, project members are selected from different sectors. So it becomes important for the selected project team members to have a common understanding of the project goals and other elements.

In Japan, unlike the office culture of Europe and America based on individualism, people work conventionally in an open space, which works as a strong point in job accomplishment by teams compared with other countries. A work environment where people can work together with face-to-face communication enables more effective communications. The basic concept of the terminology "team building" is traced back to the corporate culture of Japan but its methodology was re-imported from Europe and America. For example, in control of an overall project including a matrix project organization and clients, systematic team building methods of Europe and America should be understood.

■ Objective of Team Building

Team building is implemented to integrate common goals of a project. It is aimed at the enhancement of awareness, and enables effective project implementation. This also works effectively for solutions to problems that occur when implementing a project, management of changes, and decisions. Major objectives of team building are as follows:

(1) Decision of project implementation when a project is founded or sharing of decided items.
(2) Improvement of relationship with clients and cooperative companies
(3) Sharing of project management goals (scope, time, cost, risk, etc.)
(4) Recognition of technical problems and issues
(5) Human communications of project team members
(6) Recognition of the present status of the project and confirmation of future policy, etc.

■ How to Proceed on Team Building

There are many methods for team building, such as a method of common understanding of material items through intensive discussions by staying in a training center or other methods as shown in the following case. These can include project service, detailed technology, and restriction on time, a method of building amity among project team members, a method of using a kick-off meeting (KOM) at the start of a project, and a method of status checking meetings to be held every morning for five minutes or so.

Case ◆ How to Proceed on Team Building

Methods for proceeding on team building (confirmation of the project goal etc.) are as follows. This process is in some cases implemented by staying in a training center or other.

1. The project manager gives the objective and goal of the overall project to team members and they discuss and understand relevant material items (list items on a whiteboard and classify them).
2. Project team members itemize the goalsto the extent manageable (using WBS, KJ method, or other).
3. Record the results of the above processes on a document (to be signed by all participants for confirmation).
4. Promote amity among project team member through social gatherings etc.
5. Evaluate implementation of the results of team building with time and, in case of problem, draw out countermeasures.

   In some cases, the above process is repeated.

3. Quality and Development of Project Manager

A group of organized people play a core role in implementing a project, and quality and development of the project manager should be given a top priority. The key to success in a project is whether various types of project executive members can be assigned to a project team including the project manager.

● Project Leader

■ Requirements for the Project Leader

In program management or large-scale, complicated projects, multiple leaders such as a project manager and group manager become necessary. These leaders represented by a project manager are required to have the following capabilities in addition to various types of expert knowledge:

- Ability to integrate intentions of overall project members
- Ability to command (Leadership)
- Macro level judgment

When analyzed on characteristic features and basic skills of human resources, the following capabilities are required. As characteristic features, the following are required:

- Adaptability and novelty
- Desire to challenge and study
- Ability to solve issues without sticking to them

In general, these characteristic features are not all of the requirements for leaders. They are only materials for acquiring excellent deliverables. In addition to these, the basic level of skills for project management is required. The following are required of project leaders:

- Good communicator
- Encourage teams and take the initiative to lead them for development and growth
- Perform a wide range of jobs with broad knowledge

■ Leadership for Forming a Project Team

Leaders are required to lead team members in a project environment that is not fully organized. To be specific, they are required to be able to negotiate with managers and the personnel of the functional organizations that support the project without demonstrating their authorities. Leadership includes information process control skills that enhance the results of the overall project by selecting effective information for determining a policy in constantly changing circumstances of the project, and an ability to solve problems by integrating individual demands. Effective leadership styles are as follows:

- Clear leadership and orientation for the project
- Support for solution
- Supporter to have new members become familiar with the project team
- Ability to settle conflicts among project organizations
- Lead the group to a decision
- Ability to plan and draw out pledge
- Ability to clearly convey events
- Ability to present results of project teams to upper management
- Ability to lead technical matters to be determined in consideration for economic and personnel aspects.

Leadership skills can be improved with the desire to improve oneself and a strong intention to challenge competition. Improvement of leadership skills is like lifelong learning. When planning effective development of leaders in the organization, the head of the organization is responsible for the development of leaders.

Meanwhile, the key to leadership is "quality," not style. What matters is the essence of a leader's behavior that has timeless universality and applies to different cultures and industries. Superficial or trifling matters and shortsighted strategies have little meaning.

■ Various Theories on Leadership

There are many books from a long history or theory which describe leadership, e.g, by featuring a charismatic leader. A full-scale study of leadership started in the 1920's. As a result of such studies, the "characteristic theory" was generated which focuses on characteristics of personality and attitudes that are common to excellent leaders. In the 1940's, "style theory" became prevalent in the U.S., a familiar and democratic style of leadership was welcomed at an initial stage but popular styles had changed according to the change in circumstances of the times. In today's leadership theory, "contingency theory (theory on adaptation to circumstances)" is the main stream, and there are many studies on leadership as a major subject of group dynamics.

Case ◆ Leadership of a Project Manager

In a project, an engineering manager made cost claim negotiations arising from the change in specifications requested by a client, but they did not reach agreement. His boss, the project manager only said when consulted by him, as usual, "It cannot help because the client says No." The engineering manager sighed saying "He never says he will go to the project manager for negotiation on behalf of me." The project manager is hardly considered to have leadership. He is disqualified from the post.

● Quality and Capability of Project Personnel

Functions to be performed by project managers and management level personnel are organizing, planning, direction, coordination, motivation, decision making, negotiation, etc. Management personnel are generally required to have the following qualities and capabilities to perform management functions.

- Leadership, coordination, broad-mindedness, motivation
- Negotiation skills, bargaining ability, persuasiveness, self-expression
- Broad perspective, recognition, judgment, determination
- Flexibility, adaptation, cooperation, sociability
- Acting power, vitality, positive attitude, curiosity, sense of responsibility
- Logicality, planning quality, planning skill
- Technology and operation, broad knowledge on management
- International sensibility, understanding of and response to international issues
- Rich culture
- Mental and physical health, stress tolerance

● Development of Project Human Resources

Personnel who manage performance of projects such as project managers are not developed through acquisition of average learning or technologies but it needs all-round human development using all possible human resource development methods. This is the reason why human resource development is valued by project management.

Project management personnel are developed centering on OJT that aims at growing capabilities through practical operation with the aide of OFF-JT that provides group education using various human resource development methods. The most effective way to develop human resources is to practice OJT through determination of a necessary career path and accumulation of practical operation systematically under a set job rotation. This is called "career development."

● Code of Ethical Practice Required of Project Personnel

Various occupational groups, associations, academies, etc. provide for ethical regulations or codes of ethical practice respectively. Members are required to observe such ethical rules, and in the event of a breach, sanctions are imposed on them such as reprimand and expulsion. Academies and associations for engineers have ethical regulations or codes of ethical practice for members, but the views on compliance and violation acts vary considerably depending on the country Ethical regulations or codes of ethical practice in Europe and the U.S. are far from guidelines or goals for actions. They are close to a declaration. Members pledge to be loyal to their professions, endeavor for improvement of capability as professionals and their social positions, and to think and behave appropriately as professionals.

Thus, in international activities, it is quite significant for project managers, those who aim to be project manager, and those engaged in project management to deepen the understanding of codes of ethical practice.

4. Maturity of Organization

As a person's capability improves in accordance with his/her growth, it is possible to improve the capability of organizations. Organizational maturity represents the stages of improvement in the capability of an organization to perform a project from the viewpoint of process.

In organizations with low maturity, projects are likely to be processed in disorder: An urgent task is delayed and a task with a lower priority is advanced, or a necessary task is omitted and an unnecessary task is considered inevitable. In such circumstances, projects are likely to fail to a considerable extent. Meanwhile, in highly matured organizations, projects are performed in a smart manner. Only necessary tasks are performed and projects have a high probability of success.

There are various viewpoints for maturity models of project management. In this section, a maturity model focused on the link between corporate strategies and projects is described. In this model, the objective of an enterprise is broken down to some processes, such as a strategy to achieve the objective, a program as a practical activity to implement the strategy, a project incorporated into the program, and a task as a working level activity for the project and effectiveness in each process is evaluated. That is to say, as the following figure shows, this is a maturity model for organization level processes under the concept that corporate activities are organically performed by linking a strategy for an overall company with a program, project, and task as if they were toothed wheels.

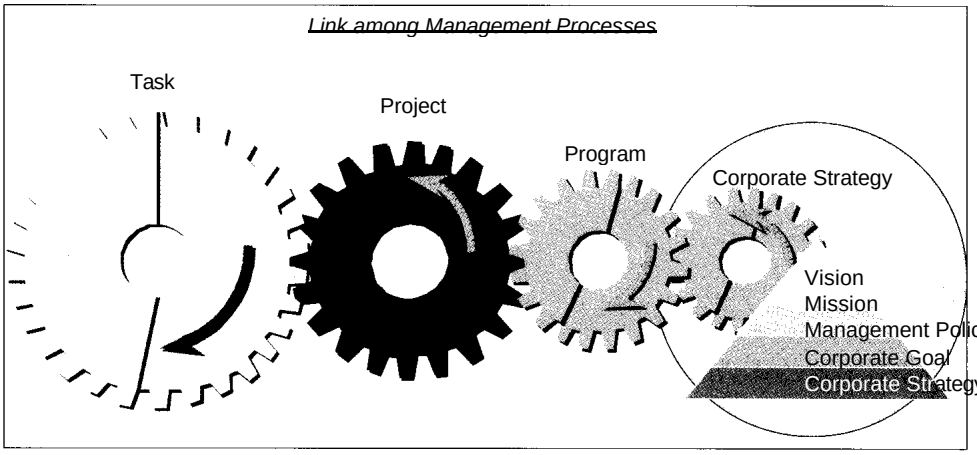


Figure 4-4-10: Link among Management Processes

In this process model, maturity is defined by classifying it into the following five levels:

Level 1 ◆ Haphazard

An organization has a low level of awareness of a project and performs haphazard project management. Enormous efforts are spent on the activity for solution (so to speak, fire fighting) and many projects result in failure. Whether a project ends in success or failure depends on personal capabilities.

Level 2 ◆ Systematic

An organization understands the significance of preventing the occurrence of problems and becomes more committed to planning. Whether a project results in success or failure depends on the team's capability rather than personal capabilities. An organization is able to manage similar projects sufficiently but becomes confused for new projects in which it has no experience.

Level 3 ◆ Scientific

Scientific management is performed and the project status is visualized through a system. Personnel concerned act based on visualized data.

Level 4 ◆ Integrated

Multiple projects are performed in an orderly fashion in an organization and no confusion occurs. A project is managed smoothly across the organizations in accordance with the corporate management process, and the project is harmonized within the organization.

Level 5 ◆ Optimization

Most projects result in success and the company has a top level competitiveness in the industry in all aspects including quality, cost and delivery. Corporate strategies are certainly linked with projects, and strategic projects are managed effectively. Sufficient authorities are delegated and project personnel work on project activities keeping a high motivation for a clear objective.

The status of the above types of organizations is shown for each process.

(1) Level 1 ◆ Haphazard

1) STRATEGY

An enterprise has no project culture and little awareness to link corporate strategies with projects. A great amount of funds and resources are spent on the operation to maintain the organization rather than strategic projects. Strategies are not linked with projects and recognition of programs is insufficient. Since a strategy posted by an organization is not shared among the organization, no specific actions are taken to put the strategy into practice.

2) PROGRAM

Little awareness of the concept of program and no system to assume responsibility for the implementation of projects. Screening and priorities of projects are decided subjectively, and no rules are established for the organization.

3) PROJECT

No activities are made as an organization to build and improve the process of project management, or to improve project management skills. Project management is performed in a haphazard manner, and success in a project greatly depends on personal capabilities.

4) TASK

Even identification of tasks using WBS etc. is not implemented, and tasks are not classified. Tasks are not controlled in terms of scale, and are unclear in responsibility. Checking the quality of tasks is left to persons in charge. No predetermined processes are prepared for the checking. This causes problems in quality and many rework cases.

(2) Level 2 Organization ◆ Systematic

1) STRATEGY

Strategies are planned in a top-down style, correctly conveyed among the organization, and understood by all members. Projects are recognized as a specific activity to achieve strategies, and discussions are made on whether strategic elements are necessary for screening of projects.

2) PROGRAM

The concept of program is recognized, and processes for screening program scopes and projects are prepared. A program manager responsible for the program is appointed and an environment where the program manager can participate in the project is prepared. A move to strengthen the "axis" of the project becomes active and an atmosphere comes up which pursues the result of the project rather than that of the organization. Rules for deciding priorities of projects are prepared in the organization but the order of priorities is not reviewed considering progress and coordination among projects with high priorities is not complete.

3) PROJECT

Whether a project results in success or failure depends on the team's capability rather than personal capabilities. An organization is able to manage similar projects sufficiently but becomes confused for new projects in which it has no experience. The management process for projects is prepared but is used for only a few projects or organizations. Visualization is started using project management tools but is centered on schedules or the like, not extended to resources or cost.

4) TASK

Tasks are screened and estimated based on experiences. The process to control tasks as an organization is prepared but is used for only a few projects. Troubles often occur to tasks in which no personnel have experience. Data on tasks are in some cases accumulated on a personal basis but the system for the organization to accumulate data is not prepared.

(3) Level 3 Organization ◆ Scientific

1) STRATEGY

Results of projects are reflected on the process to plan corporate strategies. A process is generated where feedback from new business produced by projects is periodically reflected on strategies and a cycle of "strategy - project - service - strategy" is established. Improvement of the corporate climate and culture necessary for successful achievement of projects is started, factors for success to achieve strategies are identified (Key Performance Indicator = KPI, Critical Success Factor = CSF), and specific actions to achieve success factors are broken down as programs and projects.

2) PROGRAM

Capacity planning is implemented on the program level or the overall organization level, and the long-term burden on projects within the organization is recognized at a rough level. Screening of projects, decision on the scale and contents, timing for injection and completion, etc. are checked with actual capability of organizational personnel. This enables a decrease in confusion resulting from the presence of multiple projects and long-term allocation of personnel for the organization. Further, criteria for success evaluation for projects are improved, and decision on objective success evaluation in accordance with the criteria becomes possible.

3) PROJECT

Systematic project management is performed and projects are visualized through periodical furnishment of project data from personnel concerned. Project management based on data analysis is practiced. A project office is founded as to prepare a system and environment that support multiple projects.

4) TASK

Past organizational data are accumulated and examined, and tasks are standardized. Standard WBS and standard operation manuals are prepared for all personnel. Progress, quality and productivity concerning tasks are visualized to be recognized by all personnel.

(4) Level 4 Organization ◆ Integrated

1) STRATEGY

Integrated management is possible including the strategy and project based on a common vision that has penetrated throughout the company. Further, the wall between corporate departments is cleared and the merger of different knowledge and technologies across departments is promoted. This enables creation of new business. Not only the feedback from downstream to strategies but also feedback to strategies through across-the-board merger of operation departments and sectors are generated.

2) PROGRAM

All data are integrated concerning profit and productivity of each project that are necessary for program management, and are ready for visualization. Information on the project portfolio is updated according to the results and the progress data on a project. Then decisions on the order of priority and direction of projects can be made based on highly reliable information. Balanced scorecards are introduced as a scheme to control realization of projects.

3) PROJECT

Projects are managed in an orderly fashion across the organizations in accordance with the company's project management process on a level to achieve multi-project management and integrated management. Harmonization between projects and the organizations are completed and overall optimization is accomplished. Complete education for project management is systematically performed and a project management skill map is prepared for use. Career path for the project manager is presented.

4) TASK

Data on tasks are periodically analyzed, and inefficiency and rationalization of tasks for the organization can be identified. Tasks to be improved are recognized quantitatively, and task rationalization and sharing are promoted on the organizational level. Task rationalization and sharing improve productivity and quality.

(5) Level 5 Organization ◆ Optimization

1) STRATEGY

Ideas and proposals of experienced individuals are actively incorporated into the strategy drafting process. Official strategy drafting processes prepared for the organization are extended to a personal level anyone can take the opportunity to participate in the strategy drafting process. Further, an open and free climate, which is inevitable for implementing project management, is created in the organization. The organization keeps on changing and a culture that accepts constantly improvement and actively promotes new trials is fostered.

2) PROGRAM

The degree of achievement of corporate strategies is visualized with various indicators. Indicator values with which the degree of actualization of strategies is measured are regularly collected as data and the degree of achievement is checked. Prediction of future achievement becomes possible depending on

the level of achievement for goal values and actions necessary for improvement can be implemented based on predicted values on data. Prediction of the future portfolio is possible based on predicted information of projects. Influence of new projects can be analyzed with portfolios in a time series. Program indicator values flexibly respond to strategic changes and data can be collected in accordance with indicators.

3) PROJECT

This is the level for optimization of the project management process.

The best project management process can be created at any time in accordance with corporate environment. Organizations are dynamic and provided with the option and flexibility that enables changes according to environments. Data on project management are collected, and analyzed regularly. Any problem in a process is corrected immediately.

4) TASK

Improvement of tasks are proposed and implemented not only on the organizational level but also on the personal level. Contents of proposals that are devised and improved for each employee are shared as an organization for all personnel to use. Further, proposed improvements, if necessary, are standardized as an organization according to needs.

Outline

The function of project objectives management can be likened, as it were, to a car navigator. A car navigator identifies a road map from several choices, which gives the cheapest charge and requiring the shortest time, to fit the purpose of the drive and destination. Also, it has a function to choose an optimum bypass and give notice if there is any traffic hindrance on the way.

The same applies to objectives management in project performance. It can be said that the function of objectives management lies in providing a route map for balanced accomplishment by assuming a process from each point in time leading up to the completion under the constraints of contractual conditions, resources and others.

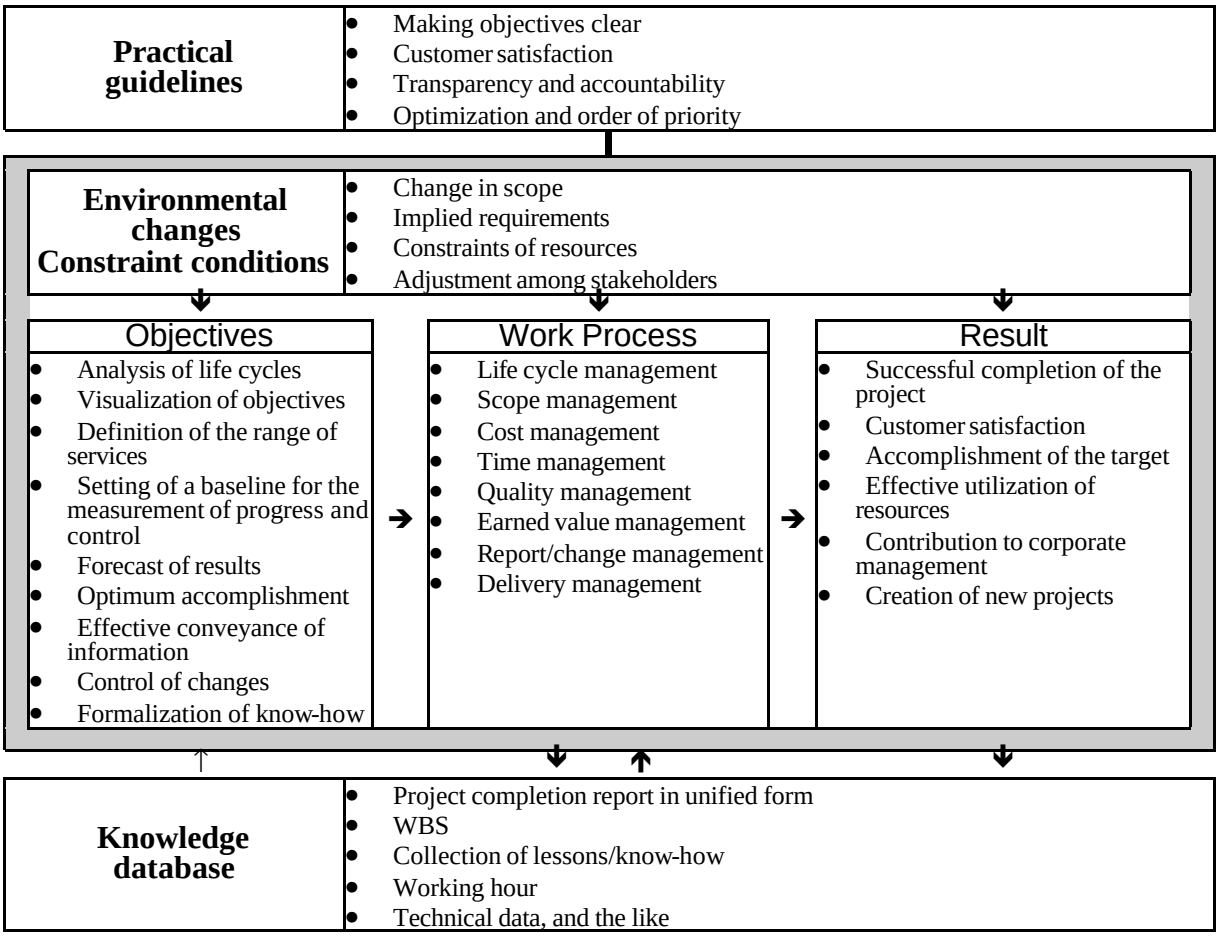


Table 4-5-1: Overview of project objectives management

Project objectives management is the work process that forms the core of project management, and as shown in the outline of project objectives managementconsists of life cycle management, scope management, cost management, time management, quality management, earned value management, report/change management and delivery management.

What is important in project performance is: (1) to unify the route and target of all the members of the project team by making the target definite and concrete, (2) to give assurance and reliability throughout the period of performance of the project for the customer, sponsor and project team members, by conveying a report on the present situation and the policy of solution about problems, (3) to maintain transparency and accountability (responsibility for giving fruit) of the operation of the project for the customer, sponsor and project team members, and (4) to seek optimization for achieving the target by determining order of priority. It is the aim of a successful project to devise a plan for performing the project by using these as a basic policy of performance.

The life cycle plan is to manage the conception of a project up to the realization of the target by dividing them into several phases, an example of which is to show the guideline of searching for an optimum life cycle cost on the balance of the acquiring cost and the operation/maintenance cost through analysis.

The main purpose of scope management is to make the target intended by the project concrete and to make the range of services definite. To attain this, it is also necessary to carry out initial design and make the specifications definite, which is called front-end planning.

Also, as shown in the interrelations among objectives management processes in Table 4-5-2, scope management plays the role of supplementing management by having an optimum balance in terms of integration, through dividing up the services into fragments of the level of work packages by means of the WBS (work breakdown structure), the relations of cooperation or tradeoff among the work processes such as cost management, time management, quality management, etc. by the work packages. Progress management is also carried out by making comparisons in time series among allocation plans of various resources, results and outputs, referring to the WBS as the standard.

The exchange of information and reporting(internal or external) the management of reporting changes occurring at all times, together with the management of the delivery of the fruit of the project, are also important functions as part of the project management work.

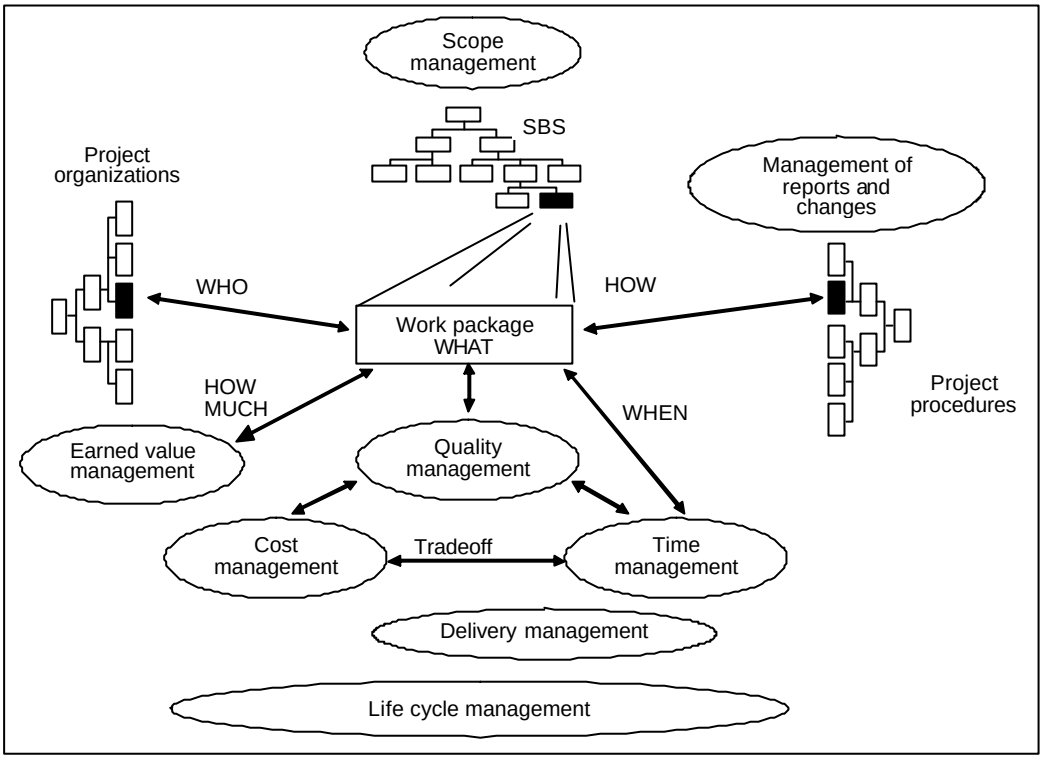


Table 4-5-2: Interrelations among objectives management processes

1. Life Cycle Management

● Life Cycle

■ Life Cycle of a Project

A project has its "start" and "end". During the period in which people participate in it and attain a certain specific target, much energy, namely labour forces, are input. They increase as the project goes on, while achieving results, and after reaching their peak, the amount of input of labour forces decreases toward the termination. This segment is defined as a "phase", and in many industrial projects, as shown in Table 4-5-4 (next page), the phases are named sequentially "Phase I Conception", "Phase II Planning", "Phase III Execution" and "Phase IV Termination" as seen in the table. There are many types of projects and the "phase" also has aliases like "stage", "step", etc., each of which is inherent in each industry.

Each phase has different human resources, quality and quantity of non-human resources, emphasis points of management, risk and other factors relevant to the project. To conduct optimization throughout the life cycle, by taking each of these as a subsystem as viewed from the entire system, and carrying out management to meet the features of each phase, is called life cycle management, or phased management, as outlined below.

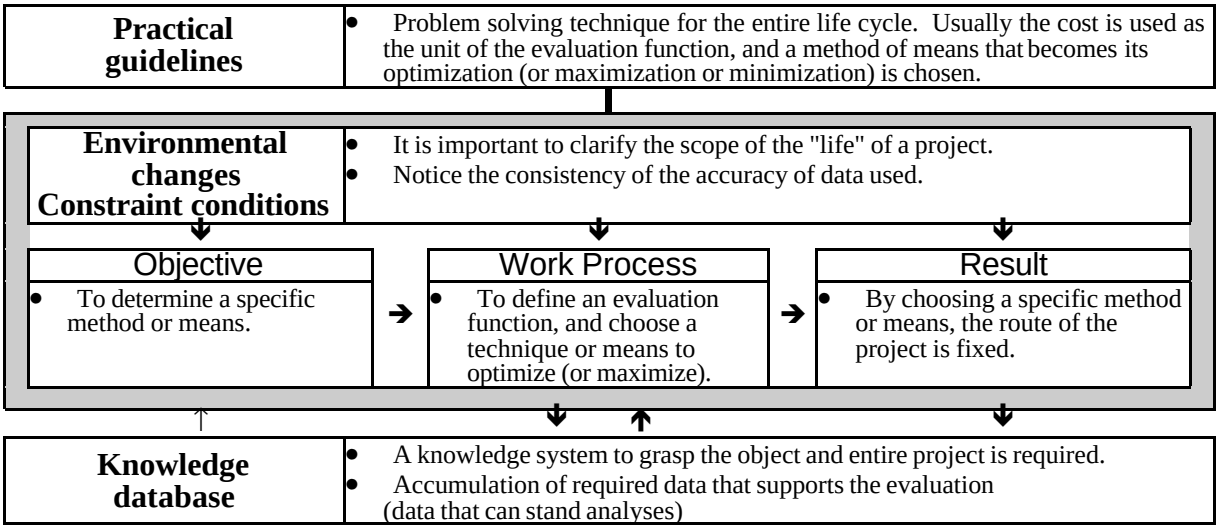


Table 4-5-3: Outline of life cycle management

Example ◆ Life cycle plan in a project of constructing a city-owned library

● We have considered an example of constructing a new library that fits the IT age.

[Mission**]**

To create ( ) City, with abright future, where the young keep on living, being able to coexist with aged people.

[Measures]

- To set up a "digital" library that matches the new life style, capable of being used at midnight and early in the morning as well.
- To utilize the land of a primary school that is scheduled to be abolished.
- To work out a zone where aged people and the young can coexist.

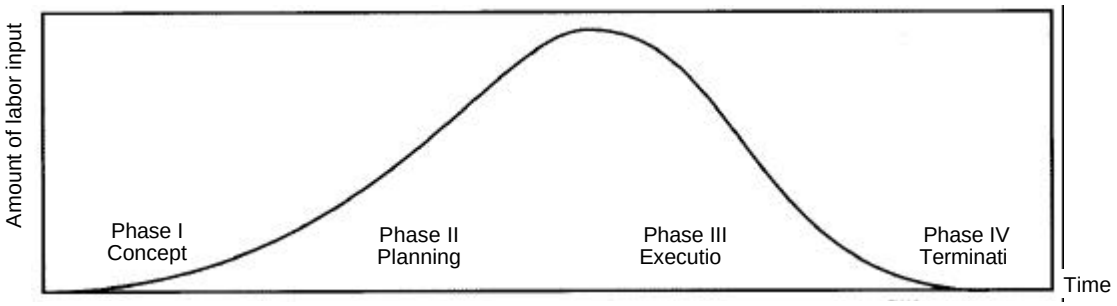
[Objectives**]** To maintain and improve the educational level and cultural level of citizens

[Policy]

- It will be a publicly built, privately operated PFI.
- It will be a building having good cost performance, by accepting the proposals of the contractors as much as possible.
- To create a concept, through participation of citizens.
- To refer to examples of Europe and America, in which citizens coexist.
- It will be kept in use with an assumed life cycle of 20 years.
- To minimize the life cycle cost by implementing life cycle assessment.

[Target**]** To complete it in 2 years, using a fund of 3 billion yen.

Usually 4 phases, as shown in Table 4-5-4, are employed, and the work to be completed within each phase should be as per the table below.[1] "To be completed" is mentioned based on the idea that in many government organizations or businesses, before advancing to the next phase, there are some checkpoints or gates, regarding which approval should be obtained. This idea is also incorporated in life cycle management. The terms used in many cases are: FS (Feasibility Study) for Conception, Definition/Design for Planning, Production/Procurement & Construction for Execution, and Turnover for Termination.



Phase I Concept	Phase II Planning	Phase III Executio	Phase IV Terminati
• Grasping needs • Establishing feasibility • Verifying alternative plans • Preparing proposals • Making basic budgets and schedules • Verifying project members	• Implementing schedules • Implementing investigations and analyses • Designing systems • Prototype construction/testing • Analyzing results • Approval of the start of production	• Manufacturing machines and materials • Constructing facilities/testing • Checking up on the supporting items • Producing systems • Verifying performance • Required modifications	• Training of personnel • Moving machines and materials • Transferring responsibilities • Releasing resources • Dismissing project members

Table 4-5-4: Work for each phase of the project and labour input to the work

■ Major Project Life Cycle

The feature of a project lies in its individuality and uniqueness, and there are no projects that are identical. But the types of projects have similar patterns, which can roughly be divided into the following three: (1) "New development projects" in pharmaceuticals, automobiles, household electric apparatus, etc. where new products are researched and developed with the aim of putting them into the market; (2) "Construction and engineering projects" such as building and plant construction; (3) "Software development projects" accompanied by system development aimed at business reform or the improvement of services.

In the example given in Table 4-5-5, terms that are frequently used in each industry have been used. These terms are different not only in each industry, but in each business as well, while level of use of human resources throughout the Project Life Cycle and identification of the primary purpose of each Phase are techniques that are generally used.

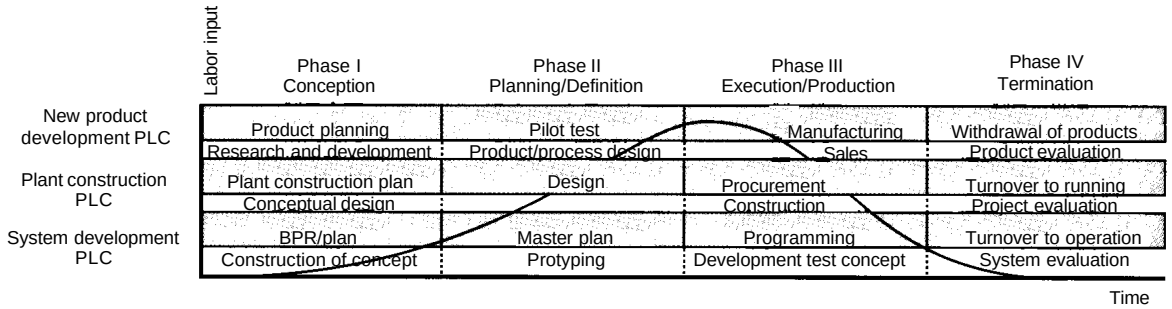


Table 4-5-5: Project Life Cycle (PLC) for different types of project

In the new product development projects of pharmaceuticals, automobiles and household electric apparatus, there is the life cycle of fundamental research, applied research, technical development, manufacturing/sales and withdrawal of products. Also, in the construction/engineering projects of plants and buildings, there is the life cycle of conceptual construction, design, procurement, construction, test run, and acceptance/turnover. And while there are various ways of notation in the life cycle of software development projects, by just focusing on the "development" phase out of the planning, development,

operation and maintenance and disposal, there is the life cycle of preparation for the start of development, analysis of system requirements, design of system methods, analysis of software requirements, detailed design of software, making of software codes and test, software combination, verification test of software suitability, system combination, verification test of system suitability, introduction of software to the actual machines, preparation for receiving software, and others. Table 4-5-6 shows an example of life cycle management of a typical software development project.

For each Phase it is important to identify which is the main person or organization responsible, the purpose to be achieved, the scope of the Phase and how the beginning and end of the Phase will be signified. The target and role of each phase; if defined accurately, the contents will be a bit different. For example, in a construction/engineering project, it is described from the standpoint of the contractor, and with the premise that the contractor undertakes the construction of the concept of the object up to the turnover of construction upon completion. However, when being seen from the standpoint of the proprietor, the description of the selection of contractors, placing orders and receiving the turnover and operation will be different from this example. Also, a phase itself can be deemed to be one project.

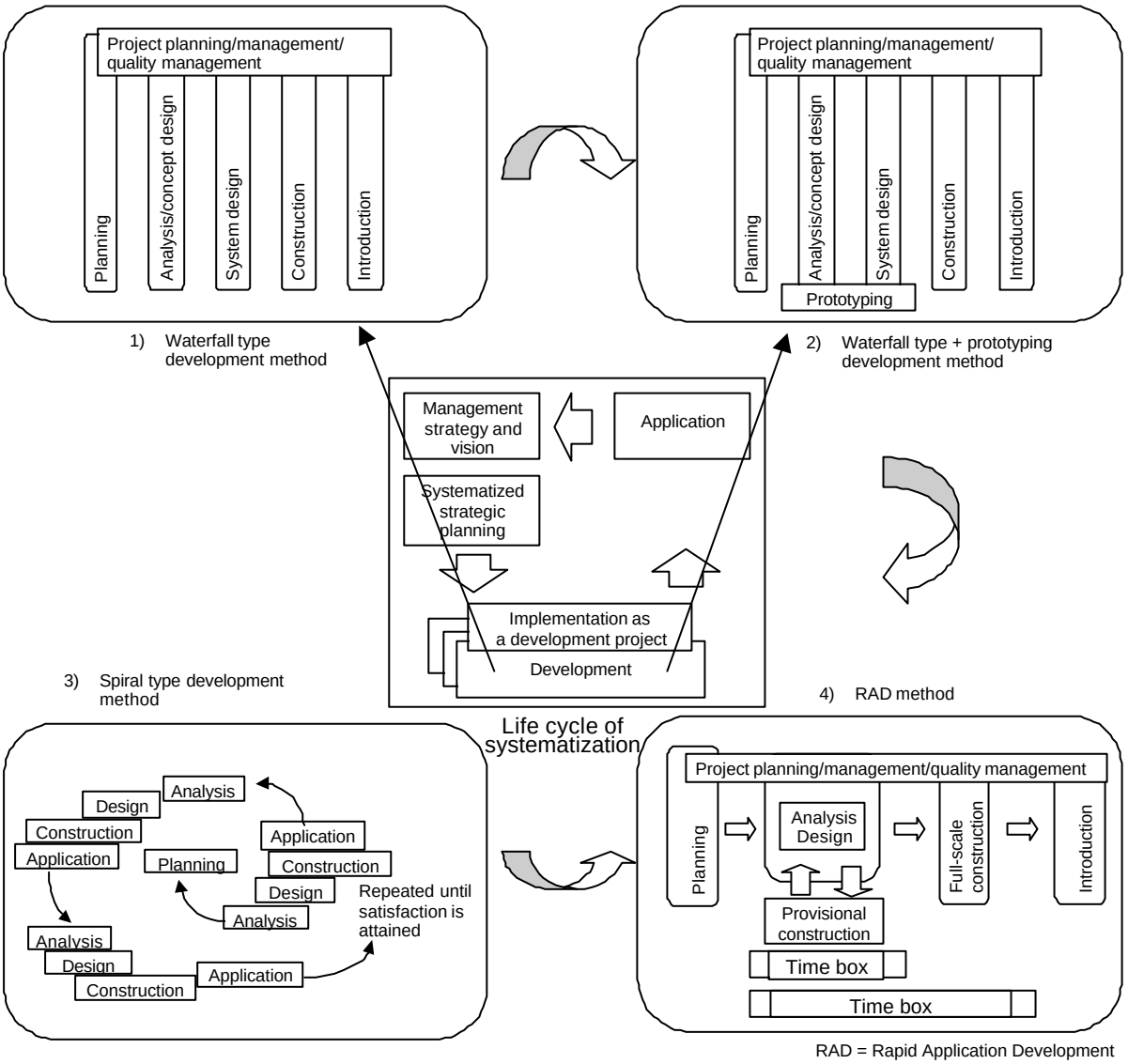


Table 4-5-6: Example of life cycle management of a typical software development project

In a research and development type project in which a totally new pharmaceutical is invented, or a non-existent technology is developed and put into practical use, there is a rough and conceptual target, but in some cases there is no conviction as to when and with how large a budget it can be accomplished. Even in a project in which the target itself is explored, it will not be carried out without any restriction on time and the budget. Efforts are made to make advances gradually by setting targets in stages. Although this kind of project operation belongs to a field of higher difficulty as project management, research in this area is being conducted. Even though many of these stages are the repetition of trial and error, they are implemented within a project life cycle (PLC) and are defined under certain rules.

■ Features as seen from the life cycle of a project

We can say that project management in some ways resembles a top-down management technique in which a rough concept is defined, and as time elapses, the contents are materialized with the input of resources, following the stages from the concept at the upper part toward the details at the lower part, while maintaining harmony throughout. Therefore, details are determined as time elapses, and the amount of information accumulated for attaining the target of the project increases like a geometric progression. It can be understood that if a change in contents occurs while having progressed to a certain point, its impact becomes greater as the time of the change is delayed.

Table 4-5-7 (next page) shows that as time elapses, namely as the phase progresses, uncertainties on various aspects such as the specifications, quality, cost, schedule, etc. of the project decrease, and conversely certainties increase, with the result that non-stationary and creative work decreases, and the proportion of stationary work, like piling up blocks, steadily increases.

In other words, in order to increase the investment efficiency, even if a large amount of resources is input at the initial stage of the project, by being able to determine project items, a greater reduction of cost can be expected, and changes also decrease, reducing the expenditure associated with the changes as well. To solidify the fundamentals of project items at the initial stage of the project is called pre-project planning (see the Prevention of changes, P.191) or front end planning.

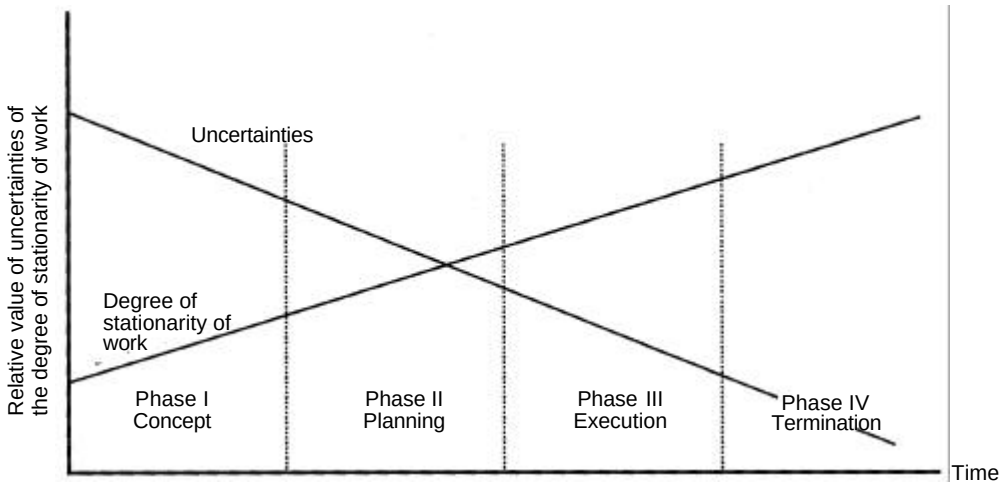


Table 4-5-7: Project life cycle

● Life cycle management

To seek the optimization of a project as a whole by dividing it up into phases having features, and carrying out management that meets those features, is called life cycle management. Usually, such rules are pre-determined and a target is set for each phase. The achievement of the target is verified and approved by a superior organization or an organization consisting of external stakeholders, after which the next phase can be started. If the target of a phase is not achieved, the said phase should be repeated until the accomplishment of the target, or the target is modified so that it can be challenged again. In a research and development project, such organizations are increasingly adopting the spiral management method in which the results of research and development are evaluated by repeating the said process.

The accomplishment of the target is visualized numerically to become the object of judgment. For this purpose, fruit (documents) is always required in a phase. In the U.S. DOD (Department of Defense) or NASA (National Aeronautics and Space Administration), be it an internal project or a project composed mainly of outsourcing, fruit for each phase is defined as regular requirements, and it is required to be submitted. It is then determined whether the next phase can be started by evaluating the result. In large corporations such as aircraft manufacturing, oil and chemical majors, etc., regulations of life cycle management are prepared to meet the internal situations, and are used in decision making or putting projects in practice. This is also to carry out at the examination of investment effects and risk management the same time. Also, some businesses make it an obligatory rule to let external experts participate in life cycle management.

● Life Cycle Costing (LCC)

Life Cycle Costing is an approach aiming to minimize the aggregate of costs that cover the entire life cycle of a project including products and others, and is also called life cycle cost analysis, however the abbreviation LCC relates to both. A typical example of LCC in an industry is given in Table 4-5-8.

According to the investigations conducted by the U.S. DOD (Department of Defense) and telecommunications industry, the details used to analyse accumulated costs throughout the life cycle are similar to each other, and some data shows that assuming that the cost of the entire life cycle is 100%, 10% is for research and development expenses, 30% for construction of facilities expenses and 60% for expenses for operations and maintenance. If the total of the research and development and the construction of facilities is assumed to be the facilities acquisition cost (40%), then the ratio of the facilities acquiring cost to the expenses for operation and maintenance becomes 40 to 60.[4] Some data shows that it is roughly 50 to 50.

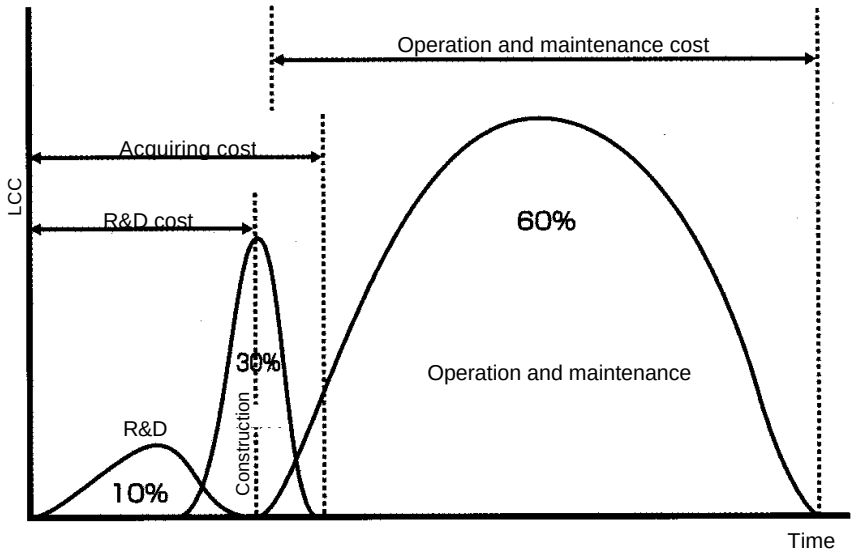


Table 4-5-8: Cost results for each phase of LCC

In the current trend to conserve energy and resources, this technique to evaluate LCC has become a focus of attention. But while it is splendid as a concept, its research has not matured so much as to be capable of being applied to all events and occurrences. Although it is used to evaluate alternative choices within the design/manufacturing method support system, etc., problems may occur in some cases. Although this technique can demonstrate its meaning when being carried out in the upstream stages, after entering into the stage of operation, the effects of use are fairly limited. However, in the upstream stages where it is expected that great results will be obtained, the details of the entire project may in many cases still be unclear.. Therefore, application of LLC across wide range is difficult in that there may be a shortage in data, lack of data, mistakes in the interpretation of data, use of an inappropriate technique, misuse of the data even when the right technique is used, incorrect recognition of factual relations and focusing on unimportant facts, and so on. Therefore, we can say that the technique of LCC is suitable for the use of devising strategies, etc., which have the value of use if the trend is grasped, rather than the accuracy. In a project of PFI, evaluation of the project itself cannot be made without the technique of LCC (see Chapter 2 Project Finance Management, P. 91).

Moreover, like project management, when LCC is started, the purpose of its use is verified first, and then the scope is fixed. Namely, it is very important in the life cycle to define "where to start, and where to terminate". If this point is ambiguous, the result of LCC also becomes ambiguous, and hence sufficient examination is required.

2. Scope Management

● Outline of scope management

In project management, the project planning during the initial stage is an important task to get the project to be done successfully. The first task in project planning is the preparation of a scope plan.

Scope management is a series of work process used to analyze all the tasks and resources required for the attainment of the final target of the project, and to ensure that they are implemented correctly and the required resources are secured. The important thing in scope management is to clarify the range of products or services included in the project, define and analyze the tasks required for it, and to determine the sharing of each task and put it into practice. Moreover, depending on the progress of the project, it is also important to manage the change of scope associated with the change in an environment and constraints.

Also, the work implemented by scope management becomes fundamental data not only of scope management, but of time management, cost management, etc. as well, and is therefore an important task of project management.

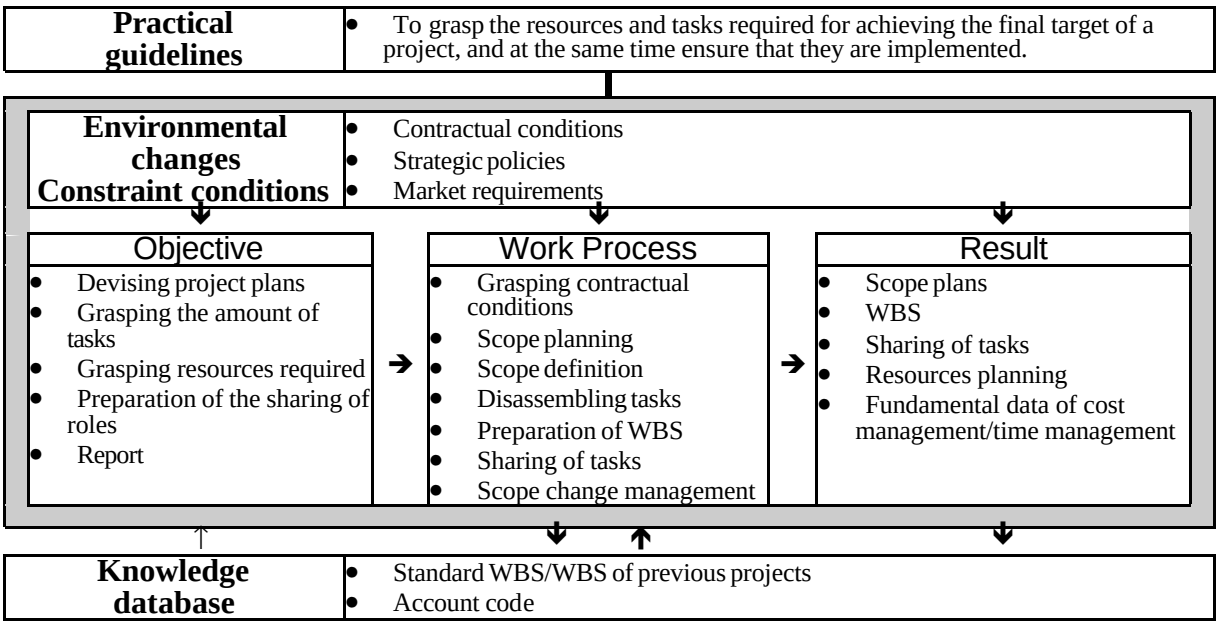


Table 4-5-9: Outline of scope management

● Scope plans

In order to achieve the target of a project, it is important that the work of the project manager in the initial stage of the project is to clarify the requirements of the customer and other stakeholders and identify the tasks that should be implemented. Prior to defining the project scope in detail, the conditions under which the project is placed are analyzed, such as the policy of the project and required technologies, etcneeded to prepare scope plans.

In the scope plans, documentation is made by focusing on the following items required to prepare for the plans.

(1) Outline of the results and characteristics of the project
(2) Tasks and processes required to achieve the target of the project
(3) Quantitative target of the project to be achieved

● Definition of scope

The definition of scope is the task that must be done first to make plans such as the budget, schedule, resources, etc. of the project, and the accurate definition of scope is the most important task for the success of the project. If the definition of scope is inadequate, it puts the project into confusion . Changes and tasks are unnecessarily generated, resulting in the overrun of the budget and schedule. The technique to define scope is the preparation of WBS. The definition of scope is implemented by focusing on the following items.

(1) Estimation of the cost, time required for tasks and required amount of resources can be made

accurately

(2) The baseline of cost control and schedule control can be defined.

(3) It can be made clear where the responsibilities and power of certain tasks lie.

Also, the scope in a project includes both scope of supply and scope of work.

- Scope of supply — Functions and elements included in the products or services supplied. Foundations, construction, equipment, plumbing, electricity, etc.
- Scope of work — Tasks carried out to supply products or services. Project management, basic design, detailed design, procurement, inspection, installation, test run, etc.

■ WBS (Work Breakdown Structure)

WBS is used to to represent all tasks to be carried out in order to attain the objectives of a project, systematically and in a hierarchical organization, based on the products of the project.

The 1st level of the hierarchy is usually the category of major "final products" of the project. Hierarchies of lower levels that follow it show the detailed definition of each task element required for the final products, and the lower the level is, the more detailed the contents are.

(1) Purpose of WBS

As projects increase in size, duration and complexity and become more globalized, the need to prepare WBS has increased. In large-scale projects, in particular, for the purpose of distributing the risk as well, projects are implemented in many cases by forming a combination of businesses as represented by a consortium, and in order to clarify the sharing of tasks among the constituent businesses and the range of responsibilities as well, it is effective to prepare WBS.

The following internal factor and external factor can be identified as the reasons for the WBS

- Necessity arising from the management of the project (internal factor)
- Requirements of the customer (external factor)
- Necessity arising from the performance of the project by a consortium or joint venture

1) UTILIZATION OF WBS DUE TO THE NECESSITY ARISING FROM THE MANAGEMENT OF THE PROJECT

The purpose of WBS and its effects in project management are as follows.

- Grasping and identifying all the tasks required for the project
- Clarifying the range of tasks, responsibilities and power corresponding to the organization. It is especially important when the project is carried out by a matrix organization.
- Setting of a framework for cost control and schedule control.
- Supplying a foundation for grasping the rate of progress and productivity of the project.
- Supplying calculation units for project resources.
- Quick response to specifications changes and additional orders.
- Flexible handling of requirements on various reporting.
- Supplying common communication tools for project members.
- Providing feedback of the results data of the project

2) PREPARATION OF WBS BASED ON THE CUSTOMER'S REQUIREMENTS

In some cases a customer may require a cost code system applied to the project and a system of work categories applied to the cost breakdown based on contracts, etc. In the case of a reimbursable (reimbursing actual cost) contract, in particular, it is required that the calculation of expenses and billing should be made according to this cost code system. Moreover, even in the case of a lump sum (collective contracting) contract, a common recognition base for the customer/contractor is required in order that the customer can monitor the progress of the project and also to mange the specifications changes and additional orders. For this purpose, WBS is prepared.

3) PREPARATION OF WBS BY A CONSORTIUM/JOINT VENTURE PROJECT

In a consortium or joint venture project, WBS is prepared for the purpose of clarifying the range of fulfilling mutual responsibilities, and verifying the progress of the project and report, as well as billing of expenses for specifications changes including additional construction work, and others.

Example ◆ Clarifying the scope of work

To clarify the scope of work is important for Japanese businesses among which lump sum contracts are prevalent, but there are few examples in which the basic conditions (requirements) of the project are set, or the range of services of each party is clarified by preparing WBS together with the customer at the time of the contract. In many businesses, the difference in interpretations that arises at the stage of implementation between the business and the customer becomes the cause of trouble. Likewise, in many cases problems occur regarding the definition of scope of work and the range of performance responsibilities among internal relevant sections, within the consortium, or with the cooperative company.

The clarification of the scope of work makes it clear where the performance responsibilities of the tasks lie, and at the same time it also forms the base of the management of additions and changes, and is particularly important for contractors in projects that are becoming of larger scale and more complex, from the viewpoint of avoiding risk as well.

(2) Construction of WBS

In general, when constructing WBS, it is said that there is no specific rule in the method of disassembling the constituent tasks of a project from the upper level toward the lower level systematically. Depending on the type of a project and the mode of organization that performs it, the composition of task division and the method of division vary. The task division is the process used to identify the tasks that are implemented in a project life cycle to a level capable of being managed, and to define them, in order to prepare WBS.

1) TASK DIVISION

Usually the products and tasks of a project become the constituent elements, and these elements must be determined in consideration of how the project is managed. For example, at level 1 of the process, division is made from the physical aspect such as the system configuration of products, areas, etc., and at level 2, division is made from the functional aspect such as the task category. Each constituent element needs to be divided so that the measurement of the rate of progress and the verification of results can be made.

Furthermore, in order to check whether the accuracy of the definition of each element is sufficient or not, the suitability of task division is verified. For each constituent element, it should be verified that an appropriate schedule target and a budget are granted, and that the person in charge of the implementation of a task can be identified. If inadequate, division or unification should be made until appropriate management can be made. Examples of WBS are given in Table 4-5-10 and Table 4-5-11 (next page).

2) WORK PACKAGE AND ACCOUNT CODE

The task element at the lowest level of WBS is called a work package. One work package is carried out under the responsibility of one person in one organization, consisting of research or technology, report, experiment, test, design, specifications, hardware elements, software elements, procurement, construction, services, etc. This work package can further be disassembled into "activities". The following should be noticed in preparing work packages.

- It should be the minimum unit of budget allocation.
- The range of activities and the responsible section or person performing activities should be defined clearly.
- There should be the starting point and ending point in activities.
- There should be definite inputs and outputs (fruit).
- The amount of work should be able to be forecasted.
- It should become the standard of measuring productivity.

Each task item of WBS is generally given a unique identification number called a WBS code (account code).

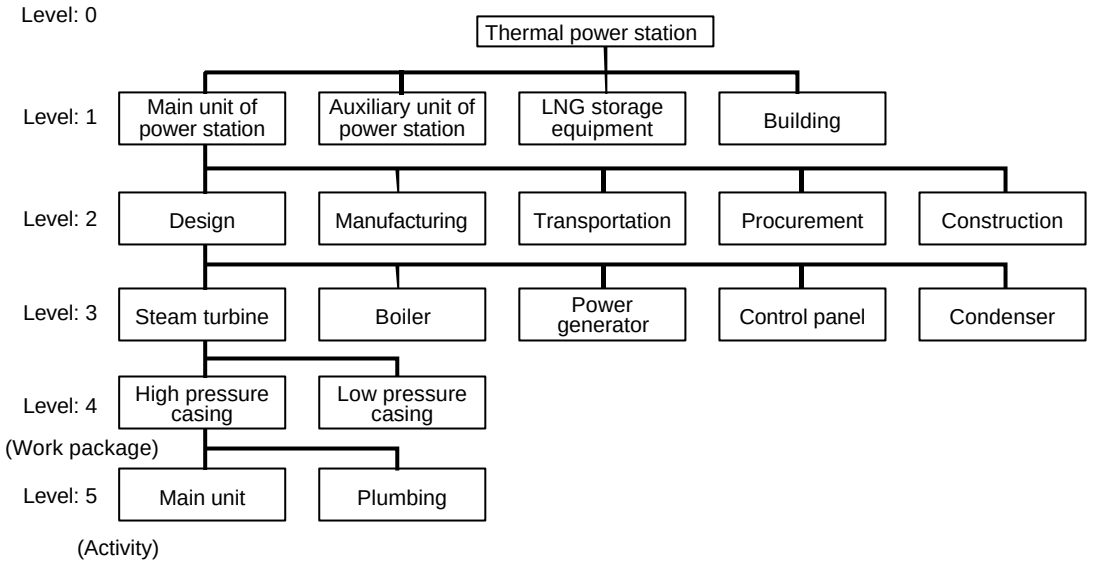


Table 4-5-10: WBS (example of a power station)

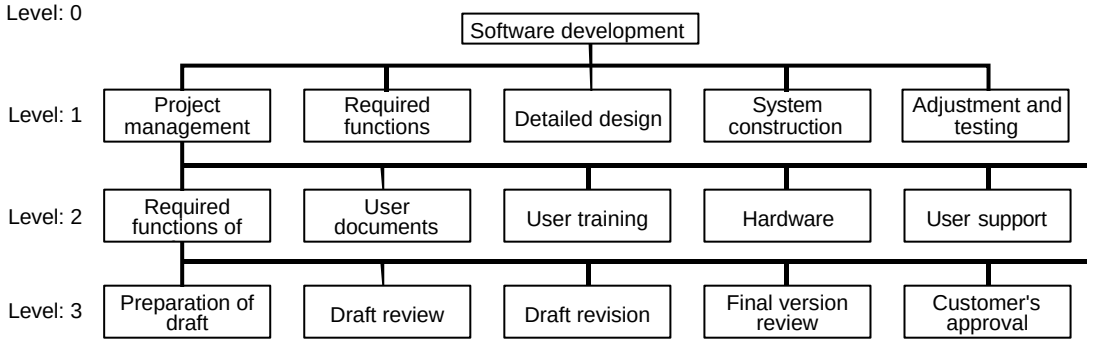


Table 4-5-11: WBS (example of software development)

3) STANDARD WBS

Basically WBS varies with each project, but most projects have similar task elements, and so the WBS prepared in previous projects can be used as the draft for a new project. It is the efficient way that in each business and field the standard WBS should be established for each of the equipment/machine types usually handled. Then the WBS can be adapted by deleting, adding, dividing and unifying each task element based on the uniqueness of each project.

Example ◆ WBS and budget compilation

WBS becomes the base of budget compilation and collection of cost information of a project. All the activities/resources of a project are allocated to WBS. By implementing budget compilation according to WBS, all the costs are calculated without any omission. Also where necessary, the budget of a project may be divided up into a lower level than the division level of WBS. For example, when the sections in which the cost incurred are different, or the expense elements are different. The relations between budget compilation and WBS are summarized as follows.

- The budget allocated to a certain WBS should equal the total of all the budgets of the WBS that is right below it and is connected to it.
- The budget that has been allocated to a certain WBS is not included in the other WBS on the same level.
- Each and every WBS has a budget that is allocated to it.

Thus the budget that has been compiled according to WBS becomes not only the basic data of cost management, but also the basic data of progress management, together with the schedule that has similarly been allocated according to WBS.

● Scope change management

■ Scope change system

The change of scope means the change from the range of services at the time of the contract. The scope change management system is placed as one element of the change management system of the entire project, and is the description of work procedures of scope change management. Its contents are composed of the clerical work processing procedures regarding changes, tracing management system of changed items, and the approval level of changed events, etc. The change of scope may arise from the following events.

- Oversight or lack of understanding at the time of defining the scope of products or services (change in the scope of supply)
- Oversight or lack of understanding at the time of defining the task to be implemented to provide products or services (change in the scope of work)
- External factor (changes in the relevant laws and regulations, etc.)
- Change to review the added value (VE after the contract, or a proposal of cost reduction by employing new technologies, etc.)
- Change in the customer's requirements, etc.

The change of scope is interrelated with other management items (risk management, time management, cost management, quality management, etc.), and mutual coordination with other management items is required to implement it .

■ Points of change management

For the points of change management, refer to "this chapter, 7. Report/Change Management" (P.116).

3. Time Management

● Outline of time management

Time management is a series of work processes used to optimize all the work/resources under the constraints of time in order to achieve the targets of the project such as the target delivery time, realization of the income and expenditure balance, etc.

What is important in time management is to devise an efficient plan of work procedures measuring time against the products or services included in the project, control of the progress according to the plan, and to foresee and mange the factors that bring about changes to the plan. By implementing time management, the time baseline, variations and actual progress are clearly shown.

The process of time management is maintained by enumerating the defined scope and keeping close relations with other management areas. It has a direct correlation, in particular, with cost management, and is an important task in project management.

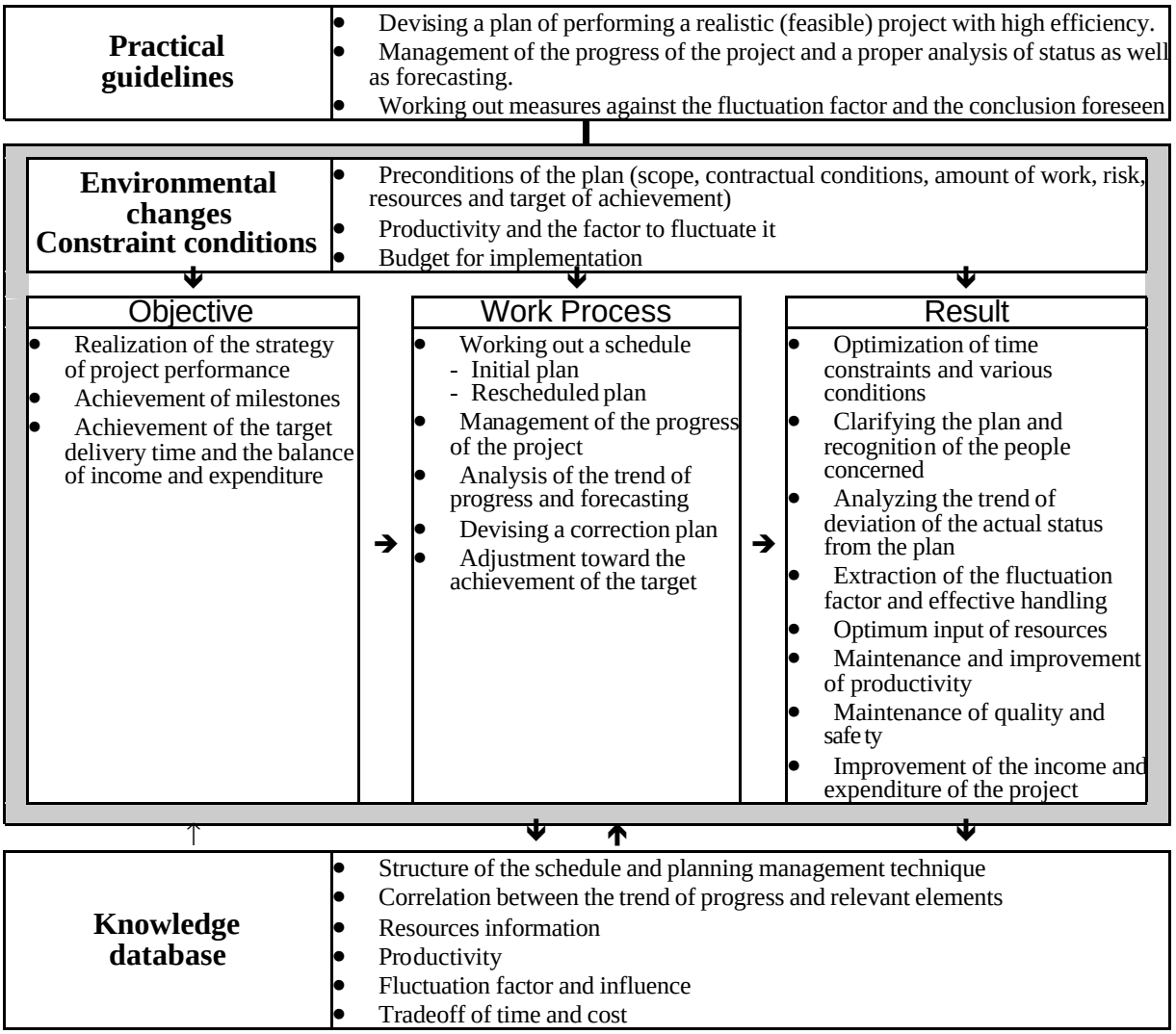


Table 4-5-12: Outline of time management

● Placing of time management in a project

■ Realistic plan and setting of the target

In order to complete a project successfully, it is necessary to devise a well integrated plan that takes into account budget, time and HSE (health, safety, environment) aspects. An important component in the initial stage of the project is to show how the management policy of the project will aid in the achievement of the target, and to assist in clarification of the implementation plan. When devising a plan, the following matters should be focused on.

1) Performance policy to lead the project to success and reasonable performance procedures and measures
2) Mechanism/method of tracing the progress of the project
3) Method to monitor the results (progress) against the plan and evaluate them
4) Forecast of the future and the study/devising/implementation procedures of corrective measures
5) Summary and analysis of the results and the procedure to devise plans of improvements for the future

■ Relations between the schedule and the cost

As shown in Table 4-5-13, while considering that the schedule and the cost related by tradeoff, realistic optimum values are pursued in relation to the characteristics of the project. It is required to understand that time and cost are closely connected with reference to the following:

- Optimum schedule to realize the minimum operation expenses
- Optimum schedule to achieve the maximum productivity
- Prevention of the deviation of the receipt of money from payment
- Securing the incentive (bonus) for achieving the target and the prevention of delay penalties

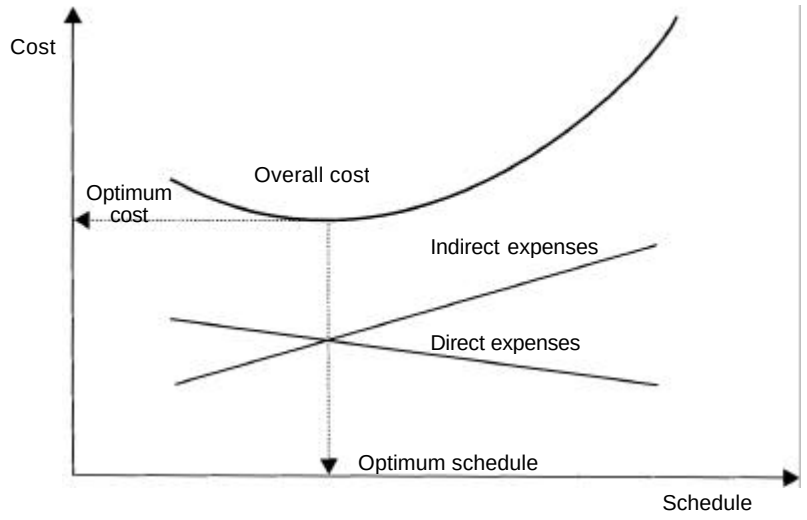


Table 4-5-13: Tradeoff relations between the cost and the schedule

Example ◆ Relationship between the cost and the schedule

When trying to shorten the schedule, we often experience the way of dealing with the issue of a schedule by means of cost (additional payment of expenses), as is typically seen in the examples of "increasing resources (personnel), stationing more competent resources (personnel), shortening the manufacturing time by placing an order for machines and materials at a higher price, and selecting a speedier transportation" means. In project management, it is required that without being confused by the direct expenses at hand, comprehensive judgment of the influence and conclusion of each expense should be made, thus making a decision that is deemed to be optimum.

● Required background knowledge

In implementing time management, while it is a basic requirement to have overall knowledge and experiences concerning the project performance, knowledge as shown below is also required background knowledge.

1) Overall knowledge concerning project management technologies such as Scope Management (see P.149), Time Management and others.
2) CPM (Critical Path Method) and the scheduling technique using a network (for their outline refer to the Scheduling by means of the CPM method, P.160).
3) Concept of outputs that are utilized in the analysis of the rate of progress, etc. (Earned Value Concept: see Earned Value Management, P.183)

● Preliminary tasks required for time management

The tasks represented on a schedule need to be properly recognized by all people concerned through the planning/performance of a project. It is an extremely important preliminary task to clarify the planning/management policies of the project, define the project scope and individual tasks, and systematize the definitions into the WBS system, and others.

(1) Summary of schedule policies by management

The project manager is required to devise the performance policy that will complete the project successfully. The schedule is the performance policy developed into a plan which shows the project as a concrete scenario.. The schedule plan policy and management policy are made clear at the initial stage of the project (inclusive of the estimation stage),

(2) Defining the object of control

This is an important task that directs the management units of each task. Studies of multiple aspects are required, such as the sequence and duration of tasks, interface with the performing organization, the range of responsibilities and supervision, sharing of work, optimum scale that can be managed, etc. The points of focus of these tasks are as follows.

1) Consistency of the planning/management levels of the project with the optimum management scale of the task scope
2) Recognition of the types of tasks and definitions that can be identified
3) Establishment of common definitions in planning/management that cover all the phases of the project
4) Setting of common codes for the purpose of the identification and processing of data (for documentation and data processing)
5) Common definitions for comparison with, and the analysis of, actual results
6) Consistency in supervising the tasks (work of the individual departments, work of suppliers, and management objectives specific to the project)

Example ◆ Points in devising project performance policies

In the case of the project to construct production equipment, the following items should be focused on when devising performance policies.

- Constraints (contract, location, resources, milestones , etc.)
- Composition/features of equipment (materials/products flow, and elements, arrangement, etc. of machinery and equipment)
- Factors that affect the cost greatly
- Factors of schedule risk
- Overall performance strategy of design, procurement and construction

● Plan

■ Initial plan

(1) Setting of procedures

In order to show how time management is operated in a project, the following procedures should be established.

- Schedule plan, including control procedures
- Progress measurement procedure
- Schedule and progress reporting procedure

(2) Schedule plan

The schedule plan is to establish a schedule that forms the base for the project execution. For this purpose, those who will be involved in project execution should participate in schedule development under the direction of the project manager. The framework of the schedule, should be verified in terms of its feasibility and efficiency, relative to budget estimates. Further, after the project has been started, the assumed plan at the stage of estimation in the light of constraints, shall be re-examined to establish the actual project schedule. The execution policy should be verified as soon as possible. Having completed the basic schedule, the project manager should hold a meeting of people concerned with the following intentions:

- To make the people concerned become familiar with the project performance policy and plan, constraints, etc.
- To verify the consistency of performance policies and plans of the relevant sections as well as the people concerned.
- To extract the problems in the critical path and plans, summarizing opinions on countermeasures.
- To check and seek an agreement on the project milestones.
- To confirm the intentions to observe the scheduled process of all the people concerned who participate in the project.
- To seek an agreement on the schedule level and purposes (an example is given below.)

Example ◆ Schedule of a large-scale project of the engineering industry

In a schedule, its level of detail is set in many cases according to the purpose of use (to deal with the level of users, in general). The framework that forms the base is unchanged, but to what extent it is represented in detail, and the matters to be emphasized vary depending on the level. The example given below is an example of a large-scale project of the engineering industry, but usually no such multi-layered management is required in many industries.

Level 1= Project master schedule
Level 2= Project control schedule
Level 3= Project task schedule (detailed development of Level 2)
Level 4= Detailed schedule for the management of important points

Included in the Level 4 - detailed schedule for the management of important points, are front end schedule (schedule for this purpose), critical schedule (important schedule), required delivery table for machines and materials, order of equipment operation, document list, arrangement status table for machines and materials, short-term management cycle schedule, etc.

(3)PROGRESS PLANNING

Progress planning is a method used to grasp the progress of a project at the performance stage, by distributing the weight of individual tasks onto the time axis, accumulating them, and preparing an "S curve" that represents the progress planning quantitatively, thus setting its measurement criteria. For this purpose, at the stage of planning, the setting of the criteria of measurement of the rate of progress corresponding to the phase of the project is required.

Example ◆ Progress planning of plant engineering

In the example of plant engineering, at the stage of planning, the criteria of measurement for the rate of progress is set for the design, procurement and construction components, as given below.

Design: Manhours (work hours) required for design is assumed to be the basis of measurement and:

- measurement is made by the design activity and event.
- measurement is made by the document that is the fruit of design.

Procurement: Budget for machines and materials is assumed to be the basis of measurement, and:

- measurement is made, with the order sheet as the unit of measurement, by orders and their intermediate accomplishment standard.

Construction: Estimated direct worker hour (= quantity x unit working hours) is assumed to be the basis of measurement, and:

- measurement is made by the actual amount of work and intermediate milestones.

(4)ESTIMATION OF RISK

In order to make the project perform smoothly, the risk in devising a schedule plan (uncertain factors) for the project needs to be identified, and the probability of occurrence and the degree of influence need to be estimated. If necessary, Monte Carlo simulations can also be carried out, to verify the degree of influence on the project schedule of various probabilities.

■ Rescheduled planning

As the project progresses, the details of the scope and the number of tasks become clearer. Various internal and external influencingf actors may cause the progress of the project to deviate from the initial plan. Although there is the danger of missing the target by frequently reviewing the plan, to continue project management with the plan based on the estimated information, or to perform the project with the deviation being kept intact, is likely to cause the development of the project to suffer thereafter.

The initial plan should be reviewed and reconfirmed (rescheduled planning) at predetermined intervals throughout the project. the scenario up to the completion of the project.

Example ◆ Judgment criteria of rescheduled planning

As given below, judgment criteria of rescheduled planning is estimated beforehand, and the project manager determines whether rescheduled planning is required or not. Criteria usually includes the following:

A change in schedule has occurred i.e. variance from the milestone plan such as the starting point/finishing point

- The variance between the rate of progress and the plan has exceeded certain criteria.
- The change of scope has started to influence the schedule plan.
- Information on uncertainties has been made clear and the review of subsequent tasks has become necessary.

● Progress monitoring and control

After the plan has been established and the project has started, it is essential to continuously review actual performance against schedule. In general, attention is focused on the following situations.

1) Variance of each task schedule on the time axis
2) Status of progress on an S curve
3) Task efficiency (productivity)
4) Status of the mobilization of resources
5) Status of risk factors

These require information on the latest results, and the procedure and report for collecting it need to be identified.

Example ◆ Information to monitor the progress of a project

An example of information required to capture the progress in ordinary construction/engineering projects is summarized below. Also, an example of a typical composition of information collection routes is given in Table 4-5-14.

(Design) = Status of preparing documents, status of consuming manhours

(Procurement) = Procurement status of equipment and materials, delivery status of equipment and materials, special delivery time requiring specific reporting and attention

(Construction) = Construction work progress report, workers mobilization table, machines and materials inventory table, special status report

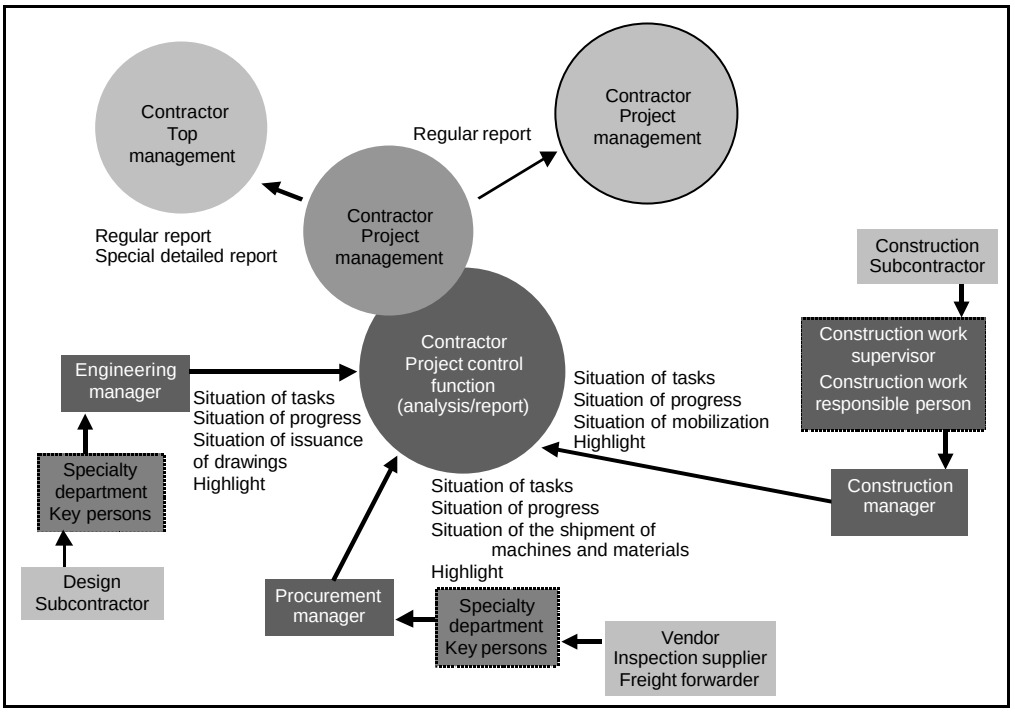


Table 4-5-14: Example of channels for gathering status information

● Analysis/forecast

A forecast is required to visualise the future of the project. This can be achieved by analyzing the trend based on the status analysis in the progress management/monitoring referred to in the foregoing paragraph. If the purpose of the forecast is to extract problems at early stages, materializing countermeasures, and excluding the factors that negatively influence the plan.

The following analysis, in particular, provides important information for the forecasting tasks.

■ Analysis of scope

It is required that a comparison of the status at the time of planning and the present status should be made, to understand the fluctuation of scope and to grasp the influence it has on the situation hereafter. The analysis of scope is a method used to capture the fluctuation of the planned amount of tasks together with their causes, and analyze the variance between them and the tasks completed (inclusive of the forecast hereafter).

■ Schedule analysis

Schedule analysis is to grasp the variance between the schedule planned initially and the actual status. Attention is focused on the following 2 points.

1) Verification of the changes in the critical path and of the float
2) Comparison between the planned date of each activity on the project schedule and the actual date (inclusive of the forecast date) on the time axis, and utilization of float

Analysis of the trends should hereafter be judged together with the analysis of scope, progress and productivity.

■ Progress analysis

In the progress analysis, the progress of the project is verified by means of comparison between actual degree of accomplishment at a point time with planned accomplishment at that point in the schedule and with planned accomplishment at completion, assumed to be 100%.
Basically, a comparison is made between the actual progress and planned progress. In addition, the trend of progress of actual work performed is analyzed to assist in forecasting.

■ Productivity analysis

Comparison is made between the expected efficiency of tasks at the time of planning and of the actual results. Ideally, the results are recorded, and analysis of trends is used as reference information for forecasting the schedule and progress thereafter.
comparison is made with reference to the following 3 items.

- Man hours required to achieve 1% of the progress
- Man hours required for performing 1 unit of the task
- BCWP (outputs as referred to in Earned Value Concept), ACWP (actual) and BCWS (amount planned at present) (see Earned Value Management)

If there is a significant variance among these, a detailed analysis should be undertaken by focusing on individual factors to study the measures which are required to be taken.

● Consciousness of attaining the schedule

Throughout the project, all the tasks are connected like a net. When the knot and the connecting rope are assumed to be each task and the period of task, respectively, if a certain task is prolonged more than the plan, its influence is relayed onto the next task, and in the end the entire net is changed into one having a long shape. Namely, the project becomes delayed. As a result, and as we have shown in the relations between the schedule and the cost (see P.155), the income and expenditure of the project will be most affected by the prolongment of tasks within the plan.

In order to achieve the set schedule plan, the people who are responsible for each task in the project must have consciousness of observing the schedule. Initial instruction and communication of the schedule is not enough. In addition, it is vital to ensure that the importance of meeting the schedule is continuously reinforced with all those contributing to its performance and that detailed task plans are regularly updated. Regarding this point, efforts on communication and the improvement in team building are required not only in time management but also in all aspects.

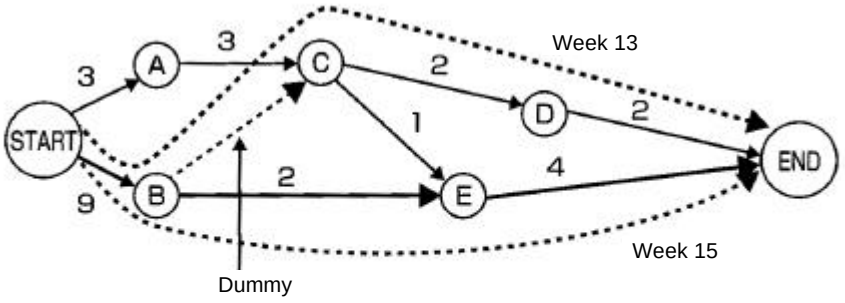
● Scheduling by the CPM method

As mentioned above, in order to achieve the target of the project successfully, proper planning/management of the project schedule (time) is an important element. In recent years, as projects increase in complexity, technologies become of high grade, and tasks become more complex at a rapid pace in order to realize more efficient project performance, more and more elaborate planning/management is required.

In such a context, the effectiveness of techniques that use networks such as CPM (Critical Path Method) and PERT (Program Evaluation and Review Technique) has come to be recognized. I the appearance of high performance computers resulting in the ability for data to be processed quickly has in turn lead to the, propagation, development and promotion of these techniques. However, PERT is not commonly used at present.

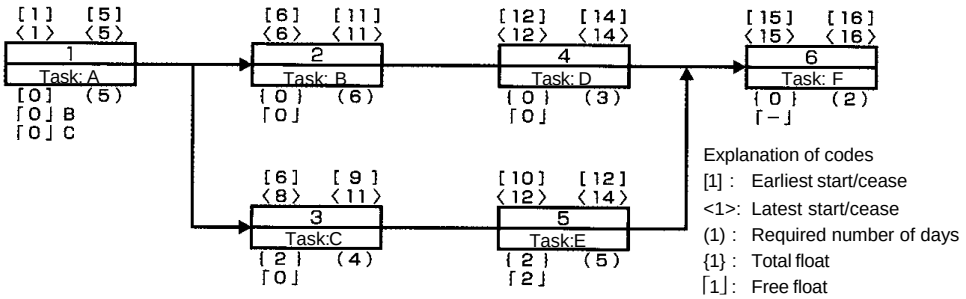
the Network Technique is used to show the logical interrelations among the tasks required for the completion of a project, each of which is clearly defined and classified, by connecting these with arrows and representing them in the form of a net.

As the method of representation of a network, there are 2 types, ADM (Arrow Diagram Method) and PDM (Precedence Diagram Method). The ADM was most widely used at first, (see Table 4-5-15), but the PDM has been used more widely in recent years (see Table 4-5-16), as it is considered easier to use than ADM. Another benefit is that most of the planning/scheduling software is prepared to fit the PDM.



Note) Dummy: When transferring from A-C to the subsequent task, if it is a prerequisite that Start-B has been completed, then a dummy arrow should be added.

Table 4-5-15: Example of an ADM network



Node No.	Activity Name	Start		Finish		Free Float	Total Float
		Early	Late	Early	Late		
1	A	1	1	5	5	0	0
2	B	6	6	11	11	0	0
3	C	6	8	9	11	0	2
4	D	12	12	14	14	0	0
5	E	10	12	12	14	2	2
6	F	15	15	16	16	−	0

1. Total float:: Difference between the latest start day and the earliest start day, or between the latest cease day and the earliest cease day. Maximum allowance days each activity can occupy.

2. Free float:: The days that will not affect the subsequent activity even if these allowance days (float) are used for an activity,

Table 4-5-16: Example of a PDM network

It is the intent of the network technique to simultaneously implement the time scheduling and the resource scheduling (having considered both time and resources) that seeks to optimize various types of required resources The basic procedure of planning tasks by means of the network technique is as follows.

1) To define all the tasks based on the WBS of the project, and to set the interrelations according to the task procedure.
2) To estimate the amount of resources/period required for each task.
3) To calculate the earliest start/finish time, the latest start/finish time, allowance time (float), etc.
4) To find the critical path on the schedule, and to make resultant adjustments to achieve a more manageable schedule.
5) To seek the adjustment of a task sequence and duration, with respect for constraints of the entire working period and entire resources.
6) To output the schedule and the result of the distribution of resources.

In addition, as a result of the downsizing and the lowering of prices of computers, project management techniques have also been developing rapidly, and the following multiphase functions are being added to the management support, with the schedule being its axis.

- WBS construction support
- Integrated management support for schedule and cost
- Risk management support

- Probability analysis of the degree of the realization of the plan

Thus, such software has developed and is often equipped with the ability to interface with other systems via the database, aiming at the integration of the whole system. It is expected that by utilising software such as this, the accuracy of the project plan, analysis of status and forecast for the future will be improved comprehensively, and the judgment support for the management will be strengthened.

4. Cost Management

● Outline of cost management

Cost management is a series of processes that starts with devising a budget for completing a project, and with the budget being set at the target, all the tasks and resources required for completing the project are converted to the index called "cost" and optimized.

To put it concretely, regarding the products or services contained in the project, the work is controlled by a single index called cost, following the procedure of estimation, study of income and expenditure, budget distribution, progress management, etc., and various problems in performing the project are solved, and at the same time factors that cause changes in the budget are foreseen and managed.

These work processes need to be developed by covering the defined scope and maintaining close relations with other management areas. In business, especially, there is the greatest likelihood of securing profit, and since the index called cost is directly connected to this profit, it is an important task that controls all the areas of project management.

In the former half of this section, , cost management concerning the creation, planning, implementation and operation of facilities, equipment, IT software development, etc. is explained, and in the latter half, the fundamental concept of cost concerning product development projects, etc. of manufacturing industries and its practical technique of management is explained.

The outline of cost management is given below.

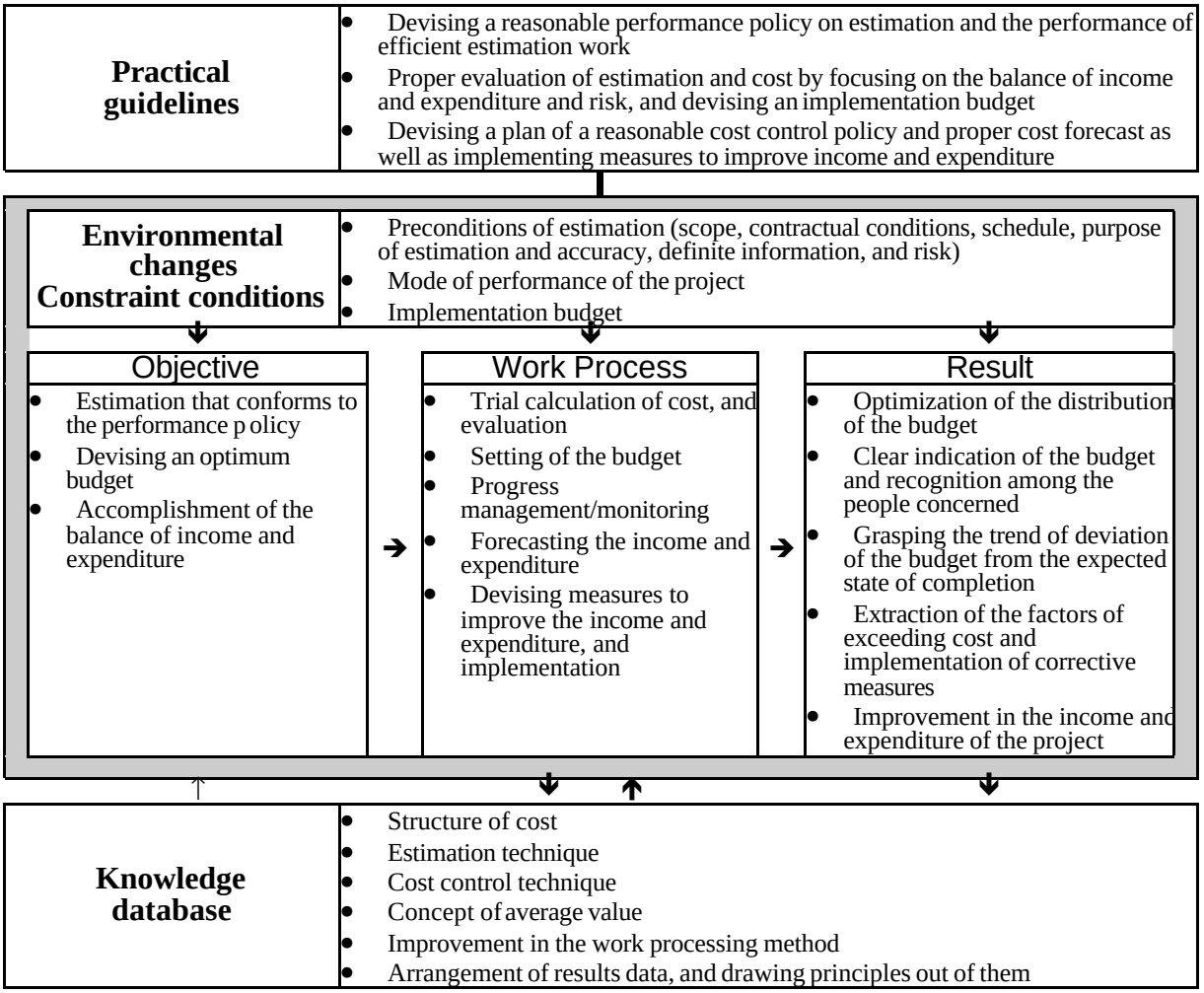


Table 4-5-17: Outline of cost management

● Cost management and cost engineering

■ Definition of cost engineering

Cost management is put into practice under the concept of cost engineering. The general definition of cost engineering is given as follows.

"Cost engineering is a field of practice in engineering technologies in which scientific principles and techniques are utilized in the issues of cost estimation, cost control, study of profitability, or business planning."

Meanwhile, to put the structure of cost in an equation, we get:

Cost = f (quantity, unit price, efficiency)

Namely, cost is deemed to be a function of 3 variables: quantity, unit price, and efficiency, and at the time of cost estimation and cost control, information on these 3 items is required. As examples of quantity, there are material quantity, and the number of tasks; and as examples of unit price, there are unit prices of materials, and the unit rate of workers; and as examples of efficiency, there are workers productivity, production efficiency of equipment, etc. Note that cost and price are different. Price is the value the product is sold at, namely, the result of general administrative expenses and profit having been added to the cost.

■ 3 variables comprising cost

To put cost management into practice, the fundamental concept of cost engineering related to the 3 variables of cost should be understood.

(1)QUANTITY (MATERIAL QUANTITY/AMOUNT OF WORK)

The historical data are collected/analyzed, correlations between the material quantity and the amount of work are found, the quantity is analysed, and verified. For example, there is a correlation between the production amount and the consumed driving power/personnel expenses in some production equipment, and a correlation between the volume of design documents and the design manhours,

(2)UNIT PRICE

Unit prices always exist , and the unit price is variable depending on the difference in quantity and productivity. This difference is analyzed in terms of engineering and statistics, to get an answer through logical estimation. Also, matters to be considered include cost index, scale factor, exchange rate, economic environment (for example, inflation rate), etc.

(3)EFFICIENCY

Work efficiency of each organization or business varies depending on time and productivity. Also, efficiency in the initial term of a project is different from that in the midterm. To study these differences is efficiency management. Included in the examples of efficiency management is the transition of productivity of manhours of design technical personnel, study of learning curves, etc.

■ Average concept

Average concept is a basic concept of cost engineering, which must always be kept in mind when implementing cost management.

Average concept involves finding out certain correlations or average values that are indicative in some way or other from the data of previous projects (e.g. amount of tasks, unit price, efficiency, etc.), making it possible to draw principles out of them, and then use these principles in future estimation. Three important aspects of average concept follow.

1) The greater the amount of historical data, the more reliable and useable the average becomes.
2) When estimation for each item is made, the principles of average concept do not apply.
3) Availability of statistical data makes estimation easier and more reliable.

Although the accuracy of average concept is lower than that of the aggregation method, by applying average concept to estimation, time for estimation and working force can be reduced. Average concept is an indispensable method in the Order of Magnitude Estimate (OME) and the Preliminary Cost Estimate (PCE) to be described later. It is also used as the comparison criteria when evaluating whether the result of estimation is proper or not.

■ Fluctuation factor and correction

When studying the cost, several fluctuation factors that affect the cost need to be considered, which will result in the need for corrections. For example, corrections are made to the differences coming from the productivity, unit prices of materials and personnel, etc. depending on the location (location factor). Corrections are also made in order to reflect the fluctuation of prices in relation to the transition of time. In this instance, time transition is continuously grasped as cost indexes, to make corrections. Market trends, competition between orders received in the project, and trends in the foreign exchange market also become the fluctuation factors, and need to be considered.

Example ◆ Cost estimation system for production equipment

In the cost estimation system for production equipment (sold on the market), a standard cost database based on average concept, or material quantity database (e.g.: volume of basic concrete per machine drive horsepower, or unit price per machine weight, etc.) is usually incorporated.

By utilizing this system, cost can be estimated by the use of data in the stage of basic design. Also, by collecting the cost of accessory parts in relation to the cost of a single machine, and the data of peripheral ancillary equipment, etc. that fit the environment of installation, and by drawing principles from them, estimation can be made without being intermediated by any third party. Moreover, these results can be used in the evaluation of the result of estimation as well. These examples are also relevant as examples of applying average concept.

● Mode of implementation of estimation techniques (cost estimation techniques) and items of quasi-cost

■ Implementation mode of estimation techniques (cost estimation techniques)

In estimation, different methodologies can be considered according to the purpose, required accuracy of estimation, available information, period of estimation work, etc. Typical concepts of cost estimation are given below, taking production equipment (plant) as an example.

Rough ——— Information ——— Detailed
Short ——— Required time ——— Long

Technique and type / Accuracy	Equipment capacity **slide** method	Factored & modular estimation	Aggregated estimation	Purpose of application of the technique
Order of Magnitude Estimate (OME) Accuracy 20 - 30%				FS (Feasibility Study)
Preliminary Cost Estimate (PCE) Accuracy 10-20%				Project budget, selection of equipment
Definitive Cost Estimate (DCE) Accuracy 5-10%				Project implementation budget
Basic material of estimation	Outline of project equipment	Basic design data	Detailed design data, design documents	Competitive estimation, fixed estimation

Table 4-5-18: Typical ideas of cost estimation (example of production equipment)

(1)ORDER OF MAGNITUDE ESTIMATE =OME

OME is estimation carried out at a stage where no detailed design data are available.

As a technique of estimation, a capacity slide method (also called the production equipment exponent method, or the 0.6 factor rule in plant engineering) is used in many cases. In this method the cost is estimated using a production ratio relevant to the nature of the product .

The purpose of estimation is the economic analysis of the project (feasibility study), study of alternative plans. The accuracy of estimation is about ±20-30%.

(2)PRELIMINARY COST ESTIMATE =PCE

PCE is estimation implemented at the stage where the concept design of the equipment has progressed, and basic specifications and outline of equipment have come to be verified.

The Ratio or Factored & Modular Method is generally used as a technique of estimation. This technique is based on the idea that a certain relation holds between the sum of construction expenses of production equipment and the equipment expenses that are the main cost item.

The main purpose of estimation is the approval of the budget of the orderer and the selection of equipment, for which accuracy of estimation is about ±10-20%.

(3)DEFINITIVE COST ESTIMATE =DCE

DCE is estimation implemented at the stage where detailed design of equipment has progressed, individual specifications of equipment has been fixed, and design documents that forms the base have been prepared.

It is general practice to estimate by aggregating quantity/efficiency/unit prices from the design information. In many cases inquiries are also made with construction contractors or equipment suppliers to increase the accuracy of estimation. It is put into practice mainly for competitive bidding, and forms a base for the implementation budget for the project. Hence an accuracy of estimation of ±5-10% is required.

Note that DCE is also applied to the check estimate that is performed during the performance of the project (for the details of check estimate, refer to P.182).

■ Quasi-cost items

When putting estimation into practice, the following quasi-cost items also need to be considered.

(1)CONTINGENCY

A contingency is the expenses for reserve against possible risks while implementing a project (probability of occurrence is unknown at that moment).

(2)ALLOWANCE

Allowance, an item of cost, refers to quantity or amount of money added to the Net Bill of Material and Net Cost that have been estimated, with a view to supplementing any imperfections in the estimation techniques that have been employed. For example, an allowance might be used to prepare for increases in the amount of tasks and materials, and losses of, or damage to, materials that may arise from the imperfection of estimation material, and others.

(3)ESCALATION

Escalation is used to adjust the fluctuations in unit prices of equipment and materials or labor expenses after cost estimation of the project. and is covered as reserves that are included in the initial estimate based on a forecast of expected unit price fluctuations.

(4) GENERAL OVERHEAD

General overhead is not a cost item of each project, but is the cost required for the operation of a business, including the rent of headquarters offices, charges for water, electricity and heating, publicity and advertising expenses, personnel expenses of management sections, research sections, etc., and the like, which are the expenses borne by all projects.

Example ◆ Implementation of the Order of Magnitude Estimate (OME) at the initial stage

Implementation of the Order of Magnitude Estimate (OME) at the initial stage is to assess which cost items represent a large ratio, and how much will be the sum of estimated project costs. By means of this, the user/owner can determine whether or not to make investment in plant or equipment and others, while the contractor can focus on or pick up items for cost reduction.

● Cost control

Cost control involves managing cost quantitatively by means of the control elements of quantity, efficiency and unit prices. Cost control is an indispensable task in managing the balance of income and expenditure of the project, and is also directly connected to the management of a business.

■ Mode of implementation of cost control

Cost control is implemented in the following mode and procedure.

(1)ESTABLISHMENT OF A SYSTEM TO BE EMPLOYED

Before starting the budgeting, the control mode of the project is established by following the procedures.

1) Establish the policy and idea of control.
2) Establish the minimum control unit based on the FWBS (Functional Work Breakdown Structure) and PCWBS (Project Control Work Breakdown Structure).
3) Establish the control level for each cost category according to the scale, **the type of** contract and features of the project.
4) Establish interfac**es** with the schedule controller and the financing section.

(2)BUDGETING

In performing a project, a budget is required. After the implementation of a project is fixed, a budget is made **with** following the procedure.

1) Check whether there were any omissions or excessive estimations.. If detailed estimation was impossible and there are some costs that have been collectively included in an account item, such costs are assigned to the applicable WBS.
2) In the case of using currencies other than the Japanese yen in overseas projects, exchange rates are set while performing the project.
3) Reflecting the result of the above tasks, DCE is converted to the control budget (implementation budget).
4) The budget (cost, quantity and efficiency) is distributed to the control package.

(3)FORECAST OF THE CASH FLOW OF A PROJECT

The forecast of the cash flow of a project is an estimate of the time and amount of income and expenditure during the process of performing a project, , and is made by combining the schedule and the budget. Its purpose is to manage so as not to cause any shortages in the funding required for the operation of the project. The balance is typically checked by continually plotting each of the accumulations of income and expenditure during the performance of the project in a graph so that they can be seen in contrast.

(4)CONTROL CYCLE

The control cycle is generally implemented according to the cycle given below. A matter that attracts the attention of the people concerned most in the control cycle, is forecasting the numerical values at the time of completion. The numerical values at the time of completion are forecast first by analyzing the present status and then forecasting what this will mean in terms of status at completion. In case of budget overrun, causes should be analyzed The amount in excess of the budget should be kept at a minimum, and a plan of corrective (preventive) measures to produce a surplus of the budget (underrun) is proposed. The effects of the measures that have been taken are monitored. The foregoing tasks are the most important work of the person in charge of cost management.

The cycle of the tasks of cost control (cost control cycle) is given in Table 4-5-19.

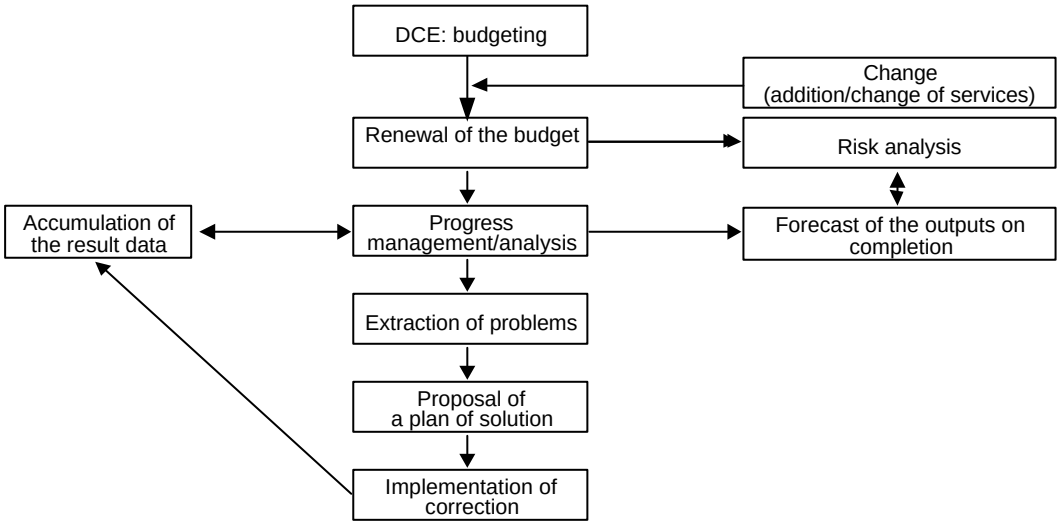


Table 4-5-19: Cost control cycle

Miura Comments : All progress management should be change to " Progress Control" .above.
Forecast of the outputs on completion above right side should be " Forecast of the estimate at completion"

● Cost control techniques and cost fluctuation elements

■ Typical techniques employed in cost control

1) EARNED VALUE

It is a method of forecasting the cost and schedule at the time of completion by indicating both of the rates of progress of cost and schedule on the same chart and comparing them with the target values (planned budget and delivery time). It is also called the "outputs method".

2) PROGRESS MEASUREMENT

In order to measure and analyze the rate of progress of the project logically and quantitatively, a Progress Measurement Baseline is provided for each task item. In general, by taking the quantity with which the progress of tasks can be verified, a planned output (amount of money) is calculated. The progress measurement is also used as the meaning of the "method of measuring the rate of progress of a project".

3) SAMPLING

After the project has been started, estimate of tasks can be reviewed and compared with the quantity in the budget. By making a sampling such as this, misunderstandings / mistakes of the designer can be discovered, allowing confirmation of the provisional conditions of design, and an early forecast of the trend of bulk quantity.

4) TREND ANALYSIS

By displaying the results of the progress of previous projects (monthly accumulations) on a graph (curve), and contrasting them with the result values under performance on the same table, their differences can be grasped quantitatively. Moreover, supposing that the present differences and trend will persist in the future as well, the planned completion is forecasted. This technique of analyzing the trend is, for example, used in the forecasting of the following items.

- Trend of the purchasing cost of machines and materials of the same types that are purchased in large quantity.
- Forecast of the direct expenses for the project home office, and manhours.
- Forecast of the number of workers
- Forecast of various types of productivity

5) CHECK ESTIMATE

Based on the information of the latest project, all the constituent elements (quantity, in particular) of the remaining cost are renewed at the same time, whereby the output on completion is forecasted by means of the aggregation method. Table 4-5-20 is an example of having been applied to a construction project of production equipment.

	Planning Check Estimate	Production Check Estimate	Final Check Estimate
Rate of progress of design services	30%	70%	95%
Rate of progress of construction services	0%	5%	25%
Overall rate of progress	20%-30%	40%-50%	60%-65%
Objectives	To update DCE based on the result of the basic design.	To forecast the planned amount of completion by reflecting all the result of detailed design.	To fix the quantity by incorporating the information on the drawing for construction work as well. The final output of completion is forecasted as the control base.

Table 4-5-20: Example of Check Estimate

■ Cost fluctuation elements

Typical fluctuation elements in cost control are changes in the scope, amount of work, responsibilities, schedule, etc. Explanations of general control of changes are given hereunder in the type of work of an owner, a contractor and a subcontractor.*

1) CHANGE HANDLING

Additions and changes in services that were not initially planned (not stipulated in contracts) are processed by means of change handling. It is clarified whether the changes were required by the owner, or they are the items required by the contractor or supplier, and then they are transformed into cost to be processed for calculation. It is important that individual items are clearly recorded and managed continually.

2) CHANGE HANDLING WITH THE SUBCONTRACTOR

The relation between the orderer and the contractor regarding changes as described in 1) also occurs between the contractor and the subcontractor. In this case as well, as in 1), individual items are clarified and processed. If the work is distributed to multiple subcontractors, since the conditions and environment of placing orders of each of them are different, such tasks have important meanings as the investigation of

causes, influence, the relation of cause and effect as well as their record and examination of cost, especially for individual items.

Example ◆ Overrun of the budget and implementation of a check estimate

Potential problems of a project that lead to the exceeding of the budget (cost overrun), caused by changes in the scope of services or in design, fluctuations in the schedule or productivity, can not be grasped in some cases by a comparison of the daily budget and results only, and so a check estimate is implemented in a suitable time to extract problems, and to calculate a planned amount of completion having higher accuracy.

Also, measures to be taken toward the performance of the project thereafter are studied, and an action plan to decrease the cost overrun is also prepared. Usually, in a check estimate, the cost that has occurred or that has been committed is handled as having been fixed, and the remaining services are estimated by means of the aggregation method.

● Basic system of a cost concept

Hereafter, cost management is explained by concentrating on the concept of "cost" **referring the system product development and production program of manufacturing industries.** This management technique has sufficient suitability in contracting industries such as construction/engineering project as well, where the strengthening of market competitiveness is an absolute requirement.

The management system concentrating on the cost concept in cost management can be divided into the following : 1) cost planning, 2) cost maintenance, and 3) cost improvement. These three collectively motivate cost decreasing activities, and promote the achievement of the profit target of the entire company.

1) COST PLANNING

Cost planning is the **strategic** cost management in the development/design stages of products/services (including the project). It is a technique to reduce the cost under the sales prices that have been set by considering the competition. The target cost is obtained from the viewpoint of securing the target profit of a business, and achieving the target in the stage prior to manufacturing by means of the techniques such as VE (Value Engineering) and others.

In this sense, cost planning is different in nature from the cost maintenance and cost improvement that are the cost management techniques in the stage of manufacturing. It has been recognized that cost management in the upstream or planning stages where the cost structures and commitments are set is extremely effective in decreasing cost, while the room for improvement of cost in the manufacturing stage has become more and more diminished as a result of the shortening of the product life cycle. Hence, cost planning has been increasingly applied.

2) COST MAINTENANCE

Cost maintenance is the cost management that is implemented in the stage of project implementation and in the stage of manufacturing, to achieve the target cost that has been obtained by the cost planning as in 1) above.

Namely, in cost maintenance, the target cost that has been obtained by cost planning for each project is set again, through considering the actual production conditions in the implementation stage (production equipment and production methods, etc.), as a standard cost for each manufacturing process (or a manufacturing process standard cost). And the variance between this standard cost and the actual cost is recognized as a gap in the implementation process stage, its cause is made clear, and measures to exclude the cause are taken at the work level.

3) COST IMPROVEMENT

Cost improvement is the cost management process used to achieve a level that is lower than the standard cost in the implementation stage of the project. As has been already described, while the cost maintenance in 2) is the management technique to make the actual cost match the standard cost on the premise of the existing production conditions, the purpose of cost improvement is to modify the existing production conditions by fully making use of the production management/cost calculation techniques such as VE, JIT, TQC, TPM and ABC which will be described later, and to make the actual cost become lower than the standard cost in the end.

	Implementation phase of cost management	Objectives of cost management and contents of activities	Role of administrative accounting
Cost planning	Stage of the development and design of products	• Accomplishment of the "target cost" that realizes the midterm and long-term profit of a business (a large-scale revision of the standard cost of old products) • Change in production conditions and activities of the incorporation of cost mainly by means of VE	• Management of the rate of progress of the target cost by means of the estimation cost calculation for each product (for each component) • Economic calculation of equipment and plant investment • Setting of the standard cost for each product
Cost maintenance	Stage of the manufacturing of products	• Control to make the "actual cost" match the "standard cost" • To be centered on minor improvement aiming at the "maintenance" without changing production conditions	• Analysis of the variance with the actual cost by means of the standard cost calculation system for each section
Cost improvement	Stage of the manufacturing of products	• Achievement of the "cost reduction target" to realize the profit budget of a business (continuous reduction of the existing standard cost) • Persistent changes in the existing production conditions mainly by means of VE, TQC and JIT	• Assignment of the target reduction amount to sections through the budgetary system

Table 4-5-21: Comparison among cost planning, cost maintenance and cost improvement

● Cost planning

As stated in the previous paragraph, in order to maintain competition, it is important that while undertaking cost management all three aspects of cost planning, maintenance and improvement are carried out. Above all, in project management, it is also said that the upstream activities specify 70% of the cost incurred, and hence it is a very important management activity.

The cost planning activity is the cost tool related to the planning/development of products. It is not just aiming at the cost calculation in the planning stage of products/services prior to the manufacturing, but is an activity to set a cost target based on the market-oriented attitude considering market type and market prices relative to product strategy

Since cost planning is a mechanism of cost setting based on the product strategy of a business, it varies between business, and herein a generic example is given in the figure below (Table 4-5-22).

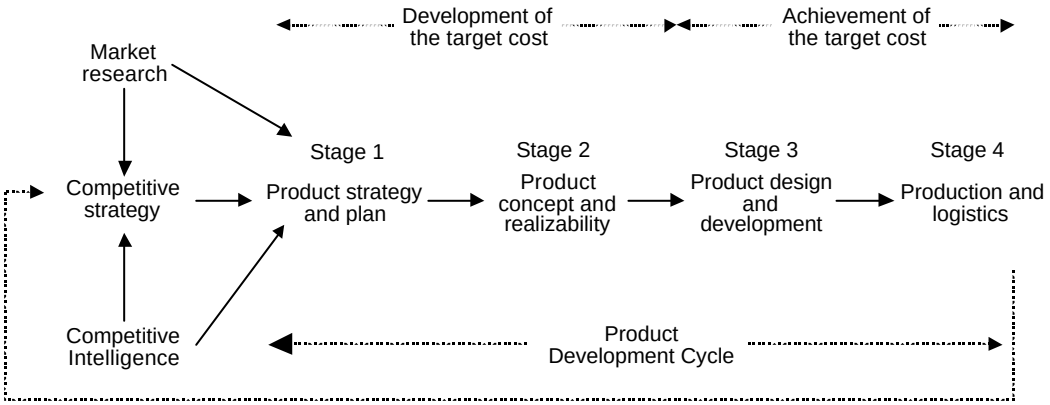


Table 4-5-22: Cost planning process model

■ Elements of cost planning

Explanations are given below of the concepts required for the successful cost planning and the techniques used.

(1)LINK WITH THE PROFIT PLANNING

The starting point of cost planning is derived from the midterm profit plan or long-term profit plan that show the mid- to long-term profit target of a business. Based on these profit plans, the amount of profit (target profit) to be obtained in each fiscal year is determined, and based on the aggregate amount of these target profits, the setting of an individual target profit for each product is made.

In setting the target profit, the development plan of the new product and the investigation of the market trend are also considered as reference. The target profit is not assigned to each product from the beginning, but in many cases is assigned to each product group or series.

(2)SETTING OF A TARGET COST

After the target profit has been set, the target cost is set. There are several examples to set the target cost, and the setting method of the target cost that is characteristic of cost planning is the so-called "deduction method". The setting of the target cost by means of the deduction method is given in the equation below.

Target cost = Desired selling price-Target profit

If the target cost is set by means of this "deduction method", there is a tendency that the level of the target cost becomes tight (a severe level). And therefore, in the practical work, there is the "aggregation method" in which a cost increase by adding functions on the basis of the cost of the existing product, and a cost reduction by means of the elaboration of design, etc. have been considered, and the "combination method" that has combined the deduction method and the aggregation method, etc.

(3)DISASSEMBLING OF THE TARGET COST FOR EACH FUNCTION (ASSIGNMENT)

After the target cost for 1 unit of product has been set, now the target cost for each function is assigned. For example, in the case of an automobile, the target cost is disassembled into each of the roughly classified functions of upholstery, chassis, body, engine, and transmission. The reason for assigning the target cost not for each component but for each of the roughly classified functions is that the assignment of the target cost itself is assumed to be made to the existing components, and if the assignment is made directly to each component, there will be restrictions on the idea or measures of a new cost reduction.

(4)ASSIGNMENT OF THE TARGET COST TO EACH COMPONENT/PERSON IN CHARGE OF DESIGN

The target cost is then assigned to each component. In addition, the target cost for each component may also assigned to each person in charge of design. This corresponds to a level being further one step lower than the assignment to each function as mentioned above. In parallel with these assignments to each component and to each person in charge of design, the decision is made as to whether the components are manufactured internally or externally . With regards to the components for which orders are placed with suppliers, proposals of the target cost will be made to the suppliers.

(5)MEANS OF ACHIEVING THE TARGET COST

By which means the target cost that has been assigned as above can be achieved? The means of achieving the target cost is studied below.

The target cost is set under the situations as mentioned above, and so in many cases it is set at a level fairly lower than that of the present product cost. Hence, there are several types of means for achieving the target cost, and of these, typical ones are explained herein.

[1]STAGE OF APPLYING THE VALUE ENGINEERING

VE can be classified into the following depending on its stage of application (see Chapter 10 "2. Value Source", P.262)

1) ZERO-LOOK VE (MARKETING VE)

This is VE applied to the product planning stage. ". This stage is said to be the stage of "concept design", in which VE activities against the product concept are developed.

2) FIRST-LOOK VE

The first-look VE is a VE activity in the product development stage, and it is centered on the VE in the design stage. Here the person in charge of design takes the initiative in studying the method of cost

reduction, by cooperating with the development section, experimental manufacturing section and further with the production section. This also has the meaning of preventing cost increases discovered by the participation of the production section after the manufacturing of products has commenced.

3) SECOND-LOOK VE

The second-look VE is a VE activity that is carried out after the start of mass production. Herein, the review of the shape and materials of products as well as the cost reduction activities by means of the improvement in the work procedure and the method of work at the time of manufacturing are mainly pursued.

The difference in the levels of VE as described above, can be summarized in Table 4-5-23.

	Zero-look VE (Marketing VE)	First-look VE (Development VE)	Second-look VE (Product VE)
Stage of VE implementation	Commodity planning	Preparation of production, detailed design, basic design, concept design	After the start of mass production
Object of VE	Commodity concept	Product/group of products	Component
Viewpoint of VE	Function	Function	Function

Table 4-5-23: Level of Value Engineering

[2] MILESTONE MANAGEMENT

In the cost planning activities, while centering on the above-mentioned VE activities, various activities are carried out for the purpose of attaining the target costs that have been assigned to the details. These activities are divided into several steps, and the degree of achievement of the target cost is verified for each of the steps. This is called milestone management.

[3] TOOLS OF COST ESTIMATION: COST TABLE

The cost table has the function of a manual and database to make a cost estimate in order to check the degree of achievement of the target cost of products and components, and to judge the suitability of the prices of components purchased from outside sources. To put it concretely, it enables the cost estimation of materials and fabrication expenses to be made for each quality of material, shape and fabrication method.

● Cost maintenance

The tool for cost maintenance is the Standard Costing system.

The purpose of standard cost management is, in the manufacturing industries, the improvement in the task efficiency in each individual place of production, and the measurement of the level of efficiency to achieve it.

In project management, the standard cost is often utilized as a cost control means in the stage of task implementation and in the stages of planning/development (planning, concept design, and detailed design).

In order to carry out the standard cost calculation, it is a precondition that the estimation of total work hours required for the final project completion and the standard rate (unit price) for each job have been calculated, and that the total standard cost is calculated for each task stage by multiplying the standard work hours by the standard rate. By calculating the variance between this standard cost and the actual cost, the cost data required for the management of the project milestones is supplied to the task supervisors together with the quality information and information on the rate of progress.

The process of cost control (cost management) starts at the setting of the cost standard, which consists of the procedures of the conveyance of the cost standard to the person in charge of the cost management, measurement of actual costs, measurement of the variance between the standard cost and the actual cost, cost variance analysis and report, and improvements for the purpose of increasing the cost efficiency.

Of these, the setting of the cost standard is made on the basis of the target cost. However, the target cost is not used as it is. As the standard cost, the following 3 standards can be set in general, according to the difference in its degree of attainability.

1) Basic Standard Cost
2) Theoretical Standard Cost
3) Current Attainable Standard Cost

The Basic Standard Cost is a long-term invariable standard, and it becomes a baseline to clarify the trend in relation to the standard cost which is set for realistic management.

The Theoretical Standard Cost means the minimum attainable cost level on the basis of the maximum efficiency that is attained by engineers with the present equipment and specifications as well as

under the best operating conditions.

The current Attainable Standard Cost is the standard cost that is attainable with a good efficiency level while forecasting the actual operating rate in the future, and the level includes the normal loss from spoilage and loss from decrease as well as idle time that are usually expected.

In view of the above, if, by the judgment of the management, the Theoretical Standard Cost or current Attainable Standard Cost is adopted as the target cost, then the target is not necessarily fixed. Rather, it is to be set according to the environmental and technical situations of an individual project (program). However, the cycle of cost management is planning/maintenance/improvement, and so it should be considered that the tightness of the standard cost is changed by the improvement of activities.

Note that the standard cost as mentioned herein handles the direct costs. Regarding the indirect costs, they are spent for the period and for each department, and therefore do not correspond strictly to individual products/programs as direct cost. It is required that by estimating the entire production activities in each section at the time of the budge compilation, and by means of the level operating rate (with the assumption that it is less than the theoretical operating rate) obtained as its result, the setting of the standard ratio of allocation should be made.

● Cost improvement

For example, if the other company has utilized new technologies and put products of low prices into the market, even if the production is made under the production conditions with the standard cost being as a premise, we are put into a disadvantageous state in terms of competition. Therefore, in order to lessen such risk, it is indispensable to engage in activities to lower the cost (cost improvement activities) even after the production has started.

The techniques such as TQC, TPM, JIT, VE and IE have been supporting continuous cost improvement activities in the daily production process. And it can be said that administrative accounting also plays an important role for cost improvement activities. In this paragraph, two approaching methods of cost improvement activities will be described.

■ Approach of cost improvement

The cost improvement can roughly be classified into 1) Cost improvement for each product, and 2) Cost improvement for each cost element.

Cost improvement for each product is implemented as a following up of cost planning activities when there is a big gap between the actual cost and the target cost during a certain period after the manufacturing (mass production) of new products and services has been started. It may also be implemented with a view to recovery of profitability in future product manufacturing.

Meanwhile, the cost improvement for each cost element is promoted by developing the cost reduction target required for the attainment of the profit plan into each hierarchy of the organization during the course of the budget compilation.

■ Cost improvement for each product

In the cost improvement for each product, VE should be implemented, led by the purchasing/manufacturing department, and the improvement of the quality of materials of new products, change in the shape of components, improvement in the fabrication method, and review of work procedures, etc. are carried out. Also, in the cost improvement for unprofitable products, usually a project team is organized, and the cost reduction measures are taken on the basis of the cost analysis for unprofitable products,.

■ Approach of cost improvement for each cost element

In the cost improvement for each element, by means of the administrative accounting system, the target of cost reduction is set according to the procedure as shown in Table 4-5-24, and its progress is managed. What kind of role the administrative accounting system plays in the approach of cost improvement for each element, is reviewed hereunder by focusing on the manufacturing sections.

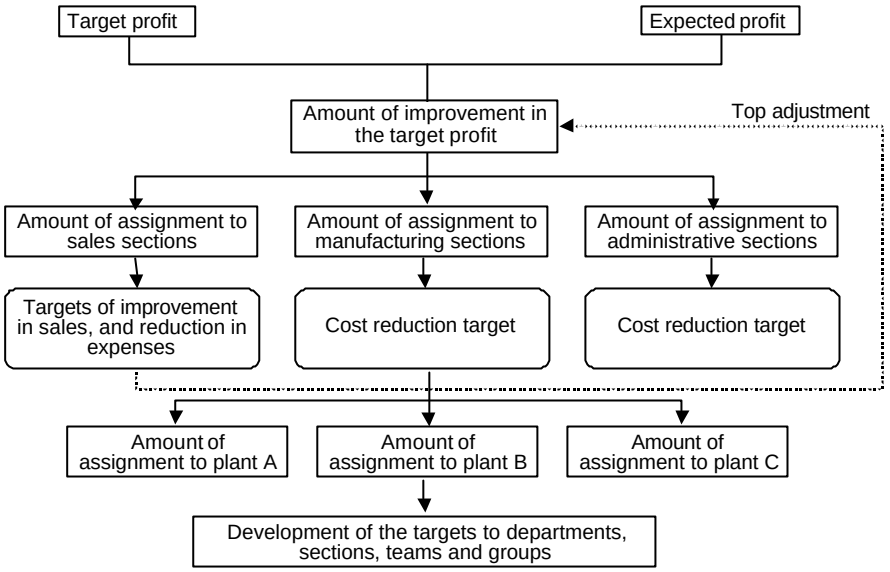


Table 4-5-24: Setting flow of cost reduction target

Miura : section ? department ??

(1)CALCULATION OF THE AMOUNT OF IMPROVEMENT IN THE TARGET PROFIT OF THE ENTIRE COMPANY AND ITS ASSIGNMENTS TO SECTIONS

First, the amount of improvement in the target profit of the entire company is calculated as given in the equation below.

Amount of improvement in the target profit = Target profit-Expected profit

= Target profit- (Target sales-Cost in progress)

The target profit mentioned herein is the profit derived from the mid- and long-term profit plans. , The cost in progress is the aggregate cost in the case of the planned quantity of sale in this period having been produced with the cost structure being the same as that of the last period, which is the cost excluding the efforts of improvement in this period

(2)DECISION ON THE COST REDUCTION TARGET IN MANUFACTURING SECTIONS

Each section sets the target value that is realizable on the basis of the amount assigned. In manufacturing sections, the amount of cost reduction is assigned, and the cost reduction target is set based on the modifications of various production conditions, etc.

(3)ADJUSTMENT WITH TOP MANAGEMENT

The manufacturing sections, sales sections and administrative sections propose realistic targets to top management. and if top management is satisfied with the amount of improvement in the target profit, actual achievement of these targets is examined. However, if top management is not satisfied with the proposed targets, then they will be re-examined and the targets for each section will be adjusted accordingly.

(4)ASSIGNMENT OF THE COST REDUCTION TARGET IN MANUFACTURING SECTIONS TO PLANTS

The target of each section that has been fixed after the adjustment by top management is then broken down again in each section. In manufacturing sections, the cost reduction target of the entire manufacturing sections is assigned to each plant by considering the ratio of manageable expenses to the total cost of each plant, the amount of occurrence of the actual cost in the preceding period, and the results of cost reduction among others. And in the plant, this amount of assignment is developed from the departments-->sections-->teams-->groups, and the amount of cost reduction target is set at each level.

(5)MANAGEMENT OF PROGRESS OF COST IMPROVEMENT ACTIVITIES

After going through the above processes, the amount of improvement in the target profit of the entire

company is set to the bottom of the organization, and the cost improvement activities such as TQC, etc. are carried out for achieving the target, with its progress being measured and managed.

● Activity Based Costing (ABC) and Activity Based Management (ABM)

■ Activity Based Costing (ABC)

The Activity Based Costing (ABC) is a cost calculation technique that has been worked out to solve the problem of how the indirect expenses contained in the traditional cost calculation should be allocated.

The cost can calculated by dividing it into direct cost and indirect cost. Direct costs refer to how much was spent for manufacturing the product, i.e. raw materials and materials cost, and indirect costs are the selling and administrative costs, physical distribution costs, research and development costs, etc. or those **costs** that cannot be directly measured. Depending on the nature of the business and products, the indirect costs incurred due to this allocation can exceed 50% of the total cost.

In order to strictly analyse the profit of each business or for each product/ customer, these indirect costs must be added to each business or product in a way that is as close to the actual costs as possible. Otherwise, large costs cannot be identified or the manner in which the profit has been obtained, which may lead to a problem that an erroneous decision is made by using figures that differ greatly from the actual costs incurred. By understanding how the resources have been used against the cost object such as the business, products or customers, in the course of work, in accordance with the actual activities, the result is reflected on the cost of products, which is called ABC.

Through Activity Based Costing, major work processes and activities that comprise the work are extracted, and the Cost Driver (activity action factor) that reflects each activity best is selected, by means of which the cost is grasped (Table 4-5-25).

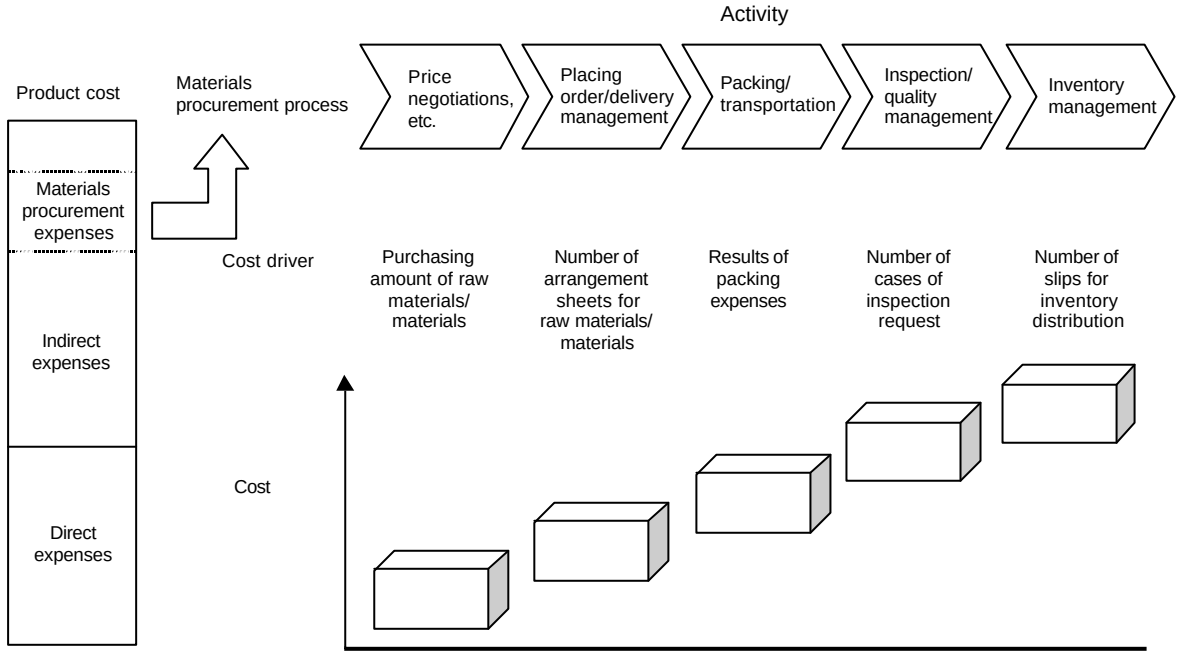


Table 4-5-25: Activity and allocation by means of activity indexes (example)

As a result of this, the difference in cost for each of the products can now be captured more accurately. For example,

1) When comparing new products with the conventional main line of commodities, a fairly long time is spent in researching the selling and administration of new products, but the cost has been allocated according to the ratio of sales, therefore more cost is allocated to the main line of commodities.
2) When small volume products are being compared with products of a to be produced in large volume, the small volume products require more time and labour for manufacturing them. However, the cost will have been allocated according to the ratio of sales, which means more cost is allocated to the large volume products.
3) In research and development costs, during which a specific product development project occupies the research equipment and may take longer than others, the equipment depreciation costs and its personnel costs are allocated according to the overall research and development ratio, and so they are

much different from the expenses incurred by the actual time of occupation.

By applying the Activity Based Costing, the costs incurred by these activities can be grasped as those being closer to the actual ones, thus enabling us to grasp the profitability of the business and products more accurately.

However, while in the Activity Based Costing, activities are defined in detail, and by selecting the Cost Driver of each activity, the cost can be reflected more accurately, while the time and labor for capturing it increase. Therefore, it is important to clarify why the cost should be understood, and to grasp it by defining activities at a level that is suited to the purpose.

■ Activity Based Management (ABM)

Activity Based Costing analyses the cost by focusing on the work process and activities. By merging Activity Based Costing with BPR (Business Process Reengineering), considering the work regarded as indirect costs as value added ,and engaging in management to ensure that the work can be carried out efficiently at all times; this is called the Activity Based Management.

In the Activity Based Management, by analyzing the added value of the work process based on the cost information obtained by the Activity Based Costing, wasteful and redundant processes and activities are reduced and made more efficient, thus improving work performance. Moreover, it is set as a target that by incorporating within an organization a mechanism that can measure the indexes and results of such an increase in efficiency, the promotion of an increase in efficiency is made at all times. (Table 4-5-26)

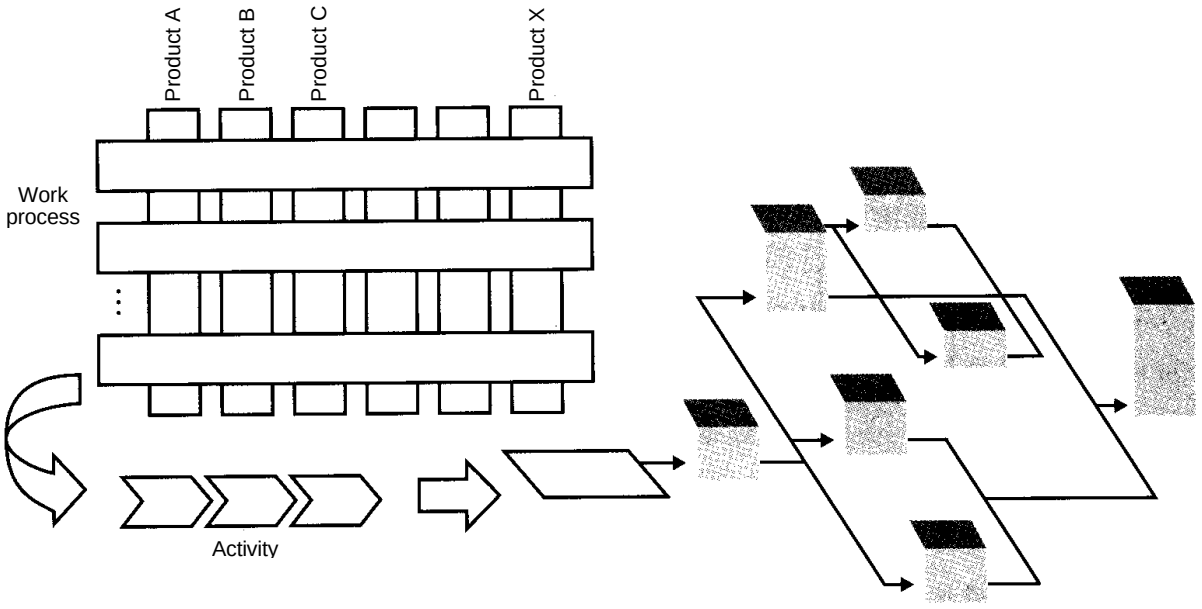


Table 4-5-26: Work process and ABM

5. Quality Management

● Outline of quality management

Quality management is a series of process designed to economically create the products and services of the quality that meets customer requirements. It is important that the products and services are investigated, designed, produced to the quality required by the customer and are sold economically and efficiently, enabling the customer to use them assuredly and with satisfaction. Also, by implementing quality management, defects can be found out at early stages, more choices of countermeasures can be obtained, and the adverse effects to the cost and schedule can be kept to a minimum.

Quality management is the management function of provide products and services of planned quality through quality planning, quality assurance, quality audit, quality improvement, etc. under the predetermined quality system, based on the management policy and the policy (plan/contract) of the project.

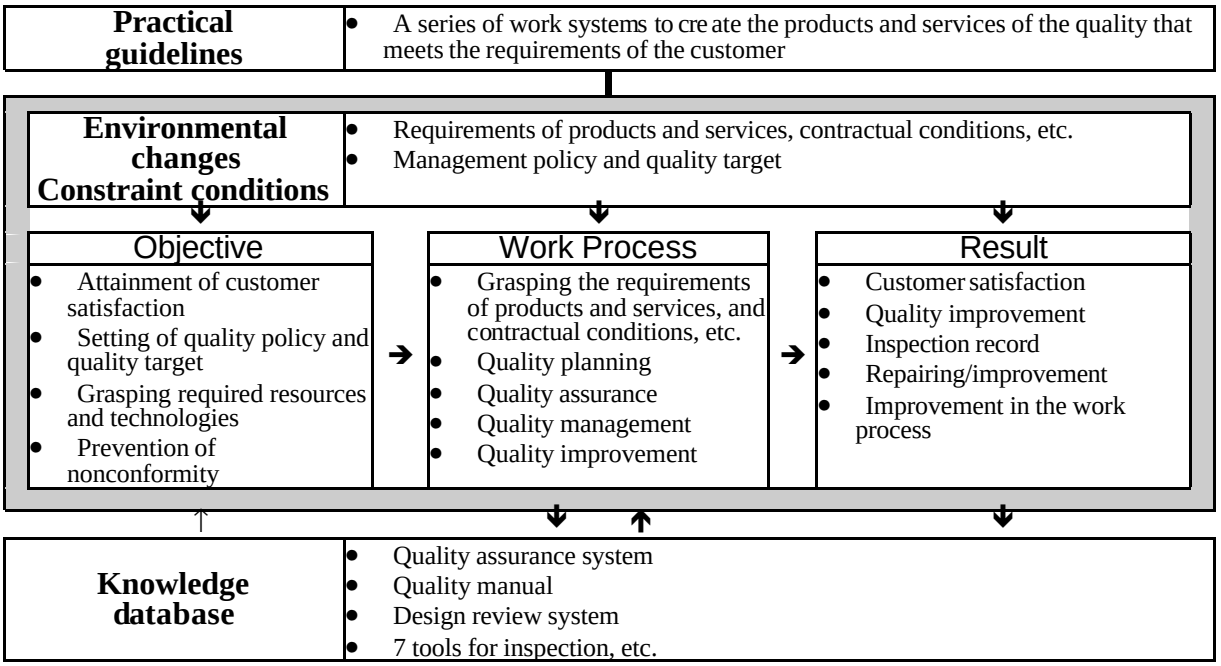


Table 4-5-27: Outline of quality management

In the 1970's in many countries in Europe and America, standards concerning quality assurance were established. The international competitiveness of Japanese-made industrial products of high quality, contributed greatly to Japan's thriving economy. By contrast, the economic development in Europe and America was not good enough, initiating the trend of increased importance of quality in Europe and America. These standards concerning quality assurance were established independently without uniformity, showing a danger that international trading activities might be obstructed by it. Therefore, there was a movement of making international standards on quality assurance by unifying these standards. As a result, in 1987 the ISO 9000 family standards were established. After that, in 2000, revision of the standards was made. The following standards have been translated and adopted as the Japanese Industrial Standards.

- ISO 9000 (Quality management system - Basics and terms)
- ISO 9001 (Quality management system - Requirements)
- ISO 9004 (Quality management system - Guidance on performance improvement)

(Note) ISO is said to be applicable to many fields, but in fact may not be as applicable to software development. For this reason, application of the standards to software development should be done with care. The following literature can serve as reference. "Opinions on the Application of ISO 9001;2000 to the Field of Software" Union of Japanese Scientists and Engineers/SPC Research Committee, edited by Software ISO 9000 Research Group, May, 2001.

Meanwhile, TQC (total quality control) which has been introduced from Japan, has developed into TQM in the U.S. Improvement in the quality of process by means of quality improvement is an absolute condition in creating good products economically, forming the basis of the idea of TQM, that the "quality is incorporated in the process". (For the details of TQC, TQM, see Chapter 10 "TQM Activities", P.266.)

In organizations where software of a high quality is developed, the development process is clearly defined, implemented securely, management is practiced based on quantitative data, and the required improvements are carried out promptly. In the early 1990s the Capability Maturity Model of software development was developed with the initiative taken by the U.S. Department of Defense. This model is based on TQM, which was thought to be hard to apply to software development projects. It is said to have enabled staged evaluation of capability to deliver and it has become one of the criteria used to certify the development capacity of a business, mainly in the U.S. and countries where the IT industry is growing. In 1998, as part of a movement international standards for evaluating the software development process, ISO/IEC TR 15504 "Information Technology - Software Process Assessment", usually called SPICE, was established, and is under standardization.

● Quality and definition

Quality means the degree to which the requirements of the collection of equipped characteristics are met. The equipped characteristics include materialistic (mechanical strength, chemical substance, electrical conductivity, etc.), sensual (color, odor, sound, etc.), active (sincerity, honesty, etc.), timelike (punctuality, reliability, etc.), human engineering-like (safety, etc.), and functional (automobile speed, etc.) characteristics. Requirements may be explicit as in contracts, etc., or may be implicit. The needs or expectations that are demanded as obligation are also requirements.

Meanwhile, the grade is a distinction or rank that is given to different requirements on quality, regarding the products and services having the same use. Therefore, having good quality and having high grade are different events. Often given as examples of this distinction are the first class and economy class in airplanes, and the difference in class of the same type of automobiles. To determine the level of quality and grade required is extremely important in clarifying the customer's requirements.

● Quality management in a project

■ Quality of project management

Quality of management is important in not only the securing of quality of the final products of the project (hardware, software, services or a combination of these). The way of doing the project and management procedures should also be indicated clearly and assured. The common items of project management to all of the "IV. Individual Management" in this book are organization, life cycle, scope, time, resources, risk, information, value engineering and communication. Project management is applying the continuous procedures of design, planning, implementation, coordination and results for these items in order to attaint the target of the project.

■ Policy of management

The important thing in starting a project is that the management sets the policy for achieving the quality of the project (program). In devising the policy of management, the following items should be considered by management.

- Understand the needs of the customer clearly.
- Set the quality target for final products and the quality of project management procedures.
- Arrange an environment for attaining the quality of set products and quality of procedures.
- Implement continuous improvements throughout the life cycle of the project and in each project.

Policy of management refers to the level set by the management as a policy of the entire company and as a policy on program management. The project manager of each individual project needs to set the same policy in light of the policy of the organization.

● Quality planning

Quality planning is to set the most appropriate quality level concerning the quality characteristics of products or services of a project, based on its contract basic requirements, and to determine the way to satisfy it. Quality planning is not to be implemented by itself alone, but is carried out in parallel and coordination with plans for the other processes such as schedule and cost, etc.. The important point of quality management is that quality is not attained by inspection, but is attained by proper quality planning. The quality system of a project involves description of organization, responsibility, performance procedure, work process and the required resources to implement quality management, and is included in quality planning.

● Quality assurance

Quality assurance is a series of systems of implementation to ensure that the quality required by the customer is sufficiently satisfied.

Recently, not only the customer's requirements but the quality required by society and the environment is come to be regarded as an important result of quality management . By not only considering the aspects of use of products and services, but also considering the "low pollution", "Product liability", "environmental destructibility" etc., it can be ensured that the use of project products and services will not give trouble to the surroundings and society.

The basics of quality assurance are to give reliability and satisfaction to customers (inclusive of stakeholders) by checking and agreeing on these requirements at the initial stage of the project, and then clarifying how the project is performed. Results are obtained as part of a quality management system, in order to make the requirements meet the applicable standards/specifications, laws and regulations, etc. The project manager and project team members are subject to accountability against predetermined quality requirements.. The details of these are as follows.

■ Principles of quality management

In ISO, it is held important that top management participates in quality management, and that supervision and management need to be done in a systematic and transparent way for the efficient management of organizations. The 8 principles of quality management follow.

1) Regarding the customer as important
2) Leadership
3) Participation of people of all the hierarchies
4) Process approach: When activities and related resources are operated and managed as one process, the desired result is attained more efficiently.
5) System approach to management: To clarify, understand and operate/manage the interrelated processes as one system, contributes to the effective and efficient attainment of the target of an organization.
6) Continuous improvements.
7) Approach to decision making based on facts: Effective decision making is based on the analysis of data and information.
8) Mutually advantageous relations with the supplier: The organization and the supplier are independent from each other, and the advantageous relationship between the two increase the value creation power of both.

■ Basics of a quality management system

The customer requires products and services having the characteristics that meet the needs and expectations. Needs and expectations are expressed in products specifications, which are called the customer's requirements. The customer's requirements may be specified by the contract with the customer, or may be determined by the organization itself. In any case, the customer finally determines whether the products and services are acceptable or not. The needs and expectations of the customer change, and as competition and progress are also influences, the organization is required to continually improve products and processes.

An approach of quality management requires that the organization should analyze the customer's requirements, and continue to manage the processes that greatly affect the making of products and services that are accepted by the customer. The quality management system can provide a framework of continuous improvement in order to increase the possibilities of improving the satisfaction of the customer and other interests.

■ Approach of a quality management system

The approach to construct and implement a quality management system consists of several steps including the following matters.

- Clarify the needs and expectations of the customer and other interests.
- Set the policy and quality target of the organization.
- Clarify the processes and responsibilities required for the attainment of the quality target.
- Clarify the resources required for the attainment of the quality target, and supply them.
- Set a method to measure the effectiveness and efficiency of each process.
- Set indexes to judge the effectiveness and efficiency of each process.
- Determine the means to prevent nonconformity and remove its causes.
- Establish the process of continually improving the quality management system, and apply it.

Example ◆ Characteristics of software development

The characteristics of software development make it difficult to fulfill the requirements of quality assurance. This is caused by the following.

- Unlike industrial products, it depends greatly on human resources. (The weight of manpower is big in making software.) Therefore, there are many parts that are not standard products.
- Software is hard to see. Hence, its quality level is difficult to evaluate.
- Only few appropriate evaluation indexes are available.
- The quality of software products used, packages and the like, is not necessarily good.
  The guarantee on the combination with the operating platform and with other products, packages, etc. is not sufficient. Depending on the amount of data, amount of transactions, etc., its functions and performance may not properly be demonstrated. This is partly because competition is hard in the field of IT, the speed of changes in technologies/products, etc. is extremely high, and the vendors of these cannot use sufficient cost, and others.

The understanding of the above characteristic problems is required, and in employing new technologies/new products, verification to be made in advance is indispensable.

Also, the characteristics of software development as mentioned above, form the background of the movement to attach importance to process management (maturity model and software process assessment) as has been described in the "Outline of Quality Management" (P.177) rather than to product management.

■ Quality audit

Quality audit is involves systematically examining and evaluating whether the examination and quality management activities of the quality system of a business are implemented according to the quality system. Included in the criteria of audit are:

1) those set forth in laws
2) those set forth in contracts
3) those set forth as criteria to give qualifications, etc.

In addition, a quality audit can be divided into the ones carried out regularly and the ones carried out irregularly, or can be divided into the ones implemented by the internal auditing personnel that received proper training and the ones implemented by a third party, such as accreditation organizations of quality system, etc.

● Quality management

Quality management involves inspecting whether products and services are in compliance with the predetermined quality criteria, and in case of unsatisfactory results having been obtained, investigatin the causes and taking measures to resolve them.

Included in the inspection are measurement, verification, and tests, carried out to verify whether products and services meet the requirements or not. Inspection is carried out not only on final products and services, but on each task to produce products and services as well.

In the quality management of software development, a review of the fruit of each phase or task is important. It is important, in particular, in producing products of high quality and low cost, to carefully implement reviews in initial stages. The cost of discovery and correcting the errors at the stage of requirements definition can be relatively small, but as the project proceeds to the stage of system design, and to the stage of coding, the cost to discover and correct errors goes up exponentially. This is similar to the importance of design review in construction/engineering projects. The cost to correct errors in the stages of procurement and making is much greater than the cost to correct errors that have been found in the stage of design. This is not only true of the influence on the cost but also the influence on the schedule as well.

The basics of quality management are as follows.

1) Select the management elements and clarify them.
2) Clarify by means of what kinds of criteria and points the project should be performed in relation to products and services.
3) Determine the measuring method of whether the criteria and points are going on according to plans.
4) Evaluate them in light of the results and determine the countermeasures or measures of avoidance.
5) Determine the corrective measures of fundamental problems with reference to nonconformity, and provide feedback.

The process of TQM, the basis of quality management and quality improvement, includes Deming's management cycle. It is given in Table 4-5-28.

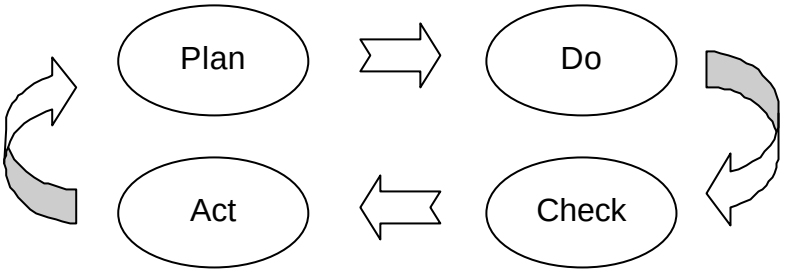


Table 4-5-28: Deming PDCA cycle

■ Quality management technique

The following can be given as typical quality management techniques.

(1)BENCHMARKING

It is a technique to find out items to be improved by comparing the superiority of the results, capabilities, technologies and products of one's own company with those of other companys. Also, it is a technique for comparing the technique that has been practiced in other projects and can serve as a model for the implementation and planning technique of the project, in order to create an idea of quality improvement and to set the standard measure for evaluation of results.

(2)CHARACTERISTICS FACTOR DIAGRAM

The characteristics factor diagram is a diagram to show the relationship between the cause and the effect of a matter at a glance, and is also called a "fish-bone diagram". The feature of this diagram is that a major cause is assumed to be a branch, and each of minor causes, as assumed to be twigs, is attached to it.

(3)PARETO'S DIAGRAM

The Pareto's diagram is a diagram in which the number of cases of occurrence of defects, failures, breakdowns, etc. and the amount of lost money are classified into causes and events. These are represented in a column graph in the order of amount, and their accumulated ratios of occupation are indicated above in a line graph. By making a Pareto's diagram, it can be judged at a glance which item should be handled first in taking measures to get effective results, and which item can be disregarded. Also, by checking the transition (timelike change) of characteristics values and ratios of defects and others, the changes and trends can be judged.

(4)MANAGEMENT DIAGRAM

The management diagram is a diagram on which a line has been added that serves as a criterion of making judgment. This is called the Upper or Lower Control Limit, and if the inspected value exceeds this limit, then it is deemed to be abnormal, serving as an index for taking actions of clarifying causes and implementing countermeasures.

(5)CHECK SHEET

THE CHECK SHEET IS A TABLE TO PRESENT CLEARLY WHERE THE DATA WHICH ARE COUNTABLE, SUCH AS THE NUMBER OF DEFECTS OR DEFICIENCIES, ARE CONCENTRATED IN THE GROUPED ITEMS.

6) STATISTICAL DESIGN METHOD

When assembling several components, factors such as the unevenness of the dimensions of assembled parts, and the relation between the overall characteristic values of the entire assembly consisting of various components and errors in constituent components, may become problems. To design by introducing probability distribution in evaluating the unevenness in each constituent element and the unevenness of the whole such as described above, is called the statistical design method. It can be divided into the moment method and the Monte Carlo method.

(7)IMPROVEMENT PROPOSAL ACTIVITIES

In order to maximize the results of a company, the ideas and practices of all employees are utilized. This is an activity to improve the results greatly by finding out with the eyes of all employees and improving the problems and matters that need to be handled, but are hard to find by the improvements that

should be originally made in the daily work in a corporate organization only.

(8)OTHERS (SEE "EXPLANATION OF TERMS" AT THE END)

Scatter Diagram, Stratification, Histogram, Average Value and Erratic Pattern, Correlation and Regression, Pilot Program Method, Taguchi Method, Multivariate Analysis, FMEA, FTA, Just In Time, Six Sigma, Design Review, Phased Termination Review, Task Termination Review, Structured Walk-through, Product Liability Law (PL Law)

6. Earned Value Management

In management of project performance, as in driving a car using a navigation system, status analysis and forecast should be made quantitatively, by real events such as whether or we have left the planned route, whether we are passing through planned points on the journey, when reaching the destination, etc.

In project implementation, it is often seen that a delay in schedule, blow out of budget, or the like occurs, resulting in the project not proceeding as, but by using the Earned Value (outputs) to grasp the situation quantitatively, the progress of scope, cost and schedule can be seen with the same measurement criteria in an integrated way, thus the state of progress and effect of the project can be evaluated.

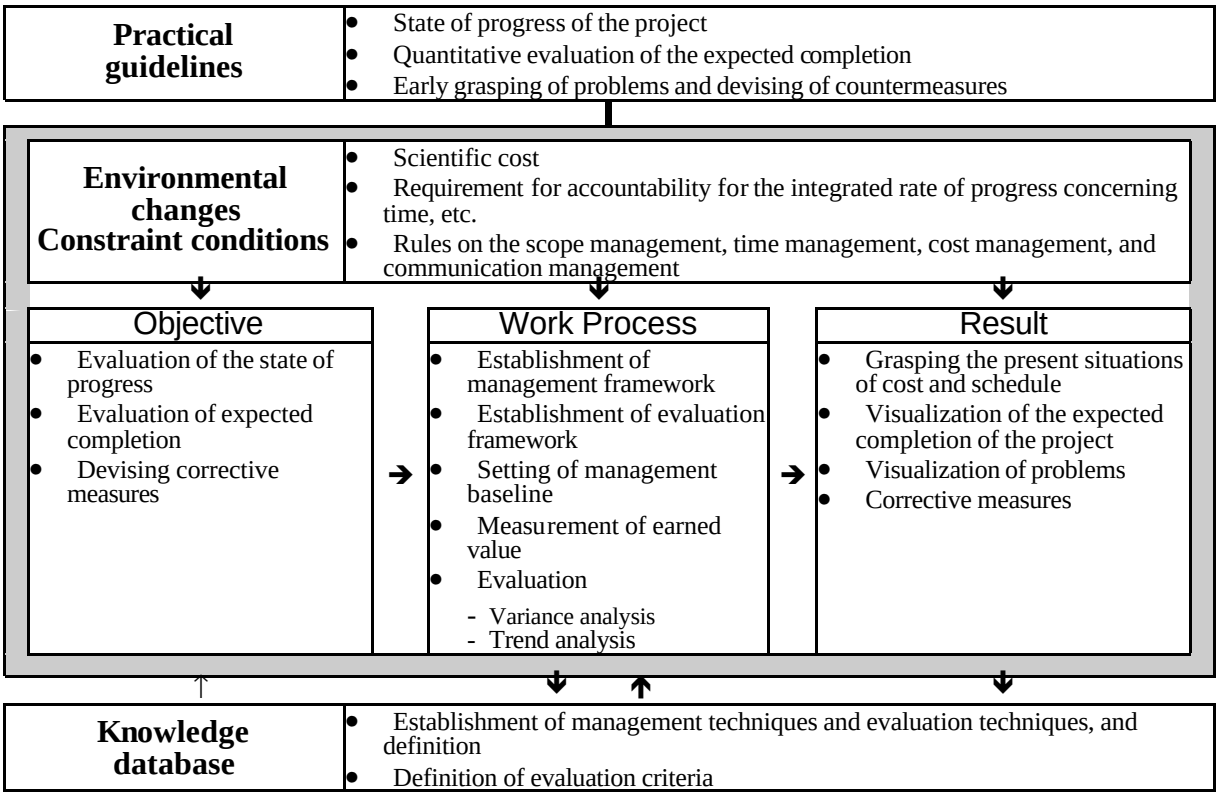


Table 4-5-29: Outline of progress control

● Planning

The project implementer carries out the establishment of the framework of collecting and integrating the project information, and of the framework of evaluating the project, in order to grasp the progress of scope, cost and schedule in an integrated way with the same measurement criteria. In addition, the criteria to evaluate the project is set up.

Example ◆ "Framework to manage" and "framework to evaluate"

If the purchasing of a house and starting to live there is assumed to be a project, then the setting of a budget for items such as the house, furniture, move, etc., and the setting of the date of starting to live there are made. The divided items are the "framework to manage" whereby information is collected and integrated, and the "framework to evaluate" the comparison between the budget and the results as well as the state of progress.

When building a new house, a framework to manage is formed by assuming the design documents/application for construction, foundation work, structural work, exterior structure work, etc. to be the unit of management, and the evaluation of construction work is made by making comparisons between the planning of cost, schedule, etc. and the results, and summarizing them (evaluation framework). The Cost Account Plan at the time is given in Table 4-5-30.

CAP name: Building

Work package	Method of measurement		January	February	March	April	May	June	July	August	Total
1. Design documents/ application for construction	Milestone method	Plan	500	1,000	3,500						5,000
		Outputs									
		Results									
2. Foundation work	Percentage method	Plan			4,000	4,000					8,000
		Outputs									
		Results									
3. Skeleton work	Diagram method	Plan				4,000	7,000	4,000	7,000		22,000
		Outputs									
		Results									
4. Exterior structure work	Milestone method	Plan						1,000	2,000	1,000	4,000
		Outputs									
		Results									
5. Total	---	Plan	500	1,000	7,500	8,000	7,000	5,000	9,000	1,000	39,000
		Outputs									
		Results									

Table 4-5-30: Example of Cost Account Plan (CAP)

■ Framework to manage

A framework, at the lowest level, designed to collect and combine the project information as required for integrating the schedule and the cost for the **project**, is called Work Package or Cost Account, which is managed by an appointed organization and a person in charge that is responsible for the performance. This framework contains the following 4 elements.

1) Description of task items
2) Description of the task period of carrying out the task
3) Approved resources required for carrying out the task
4) Organization and person in charge of the management of the task

■ Framework to evaluate

Usually, a project is divided into numerous Work Packages and Cost Accounts, and the optimum level and framework for evaluation are required. For this purpose, an evaluation unit that has summarized the Work Package and Cost Account at the lowest level is provided. This evaluation unit is called Cost Account Plan, and contains the following elements.

1) Description of activity contents
2) Starting date and ending date of each activity
3) Budget (amount of money, required time, etc.)
4) Person in charge
5) Section in charge
6) Work Package
7) Evaluation method of the earned value

■ Performance Measurement Baseline

In order to carry out the project evaluation, the Performance Measurement Baseline (PMB) that forms the planning base for earned value, is prepared for each Cost Account Plan. An example of Performance Measurement Baseline (PMB) is given in Table 4-5-31 "Integration sample of CAPs."

Note that since the Performance Measurement Baseline is a concept related to time it is handled in time management. It is a general practice where the task is carried out following the fastest task procedure (early base) or where it is carried out following the slowest task procedure that does not affect the completion of the project (late base) are also prepared.

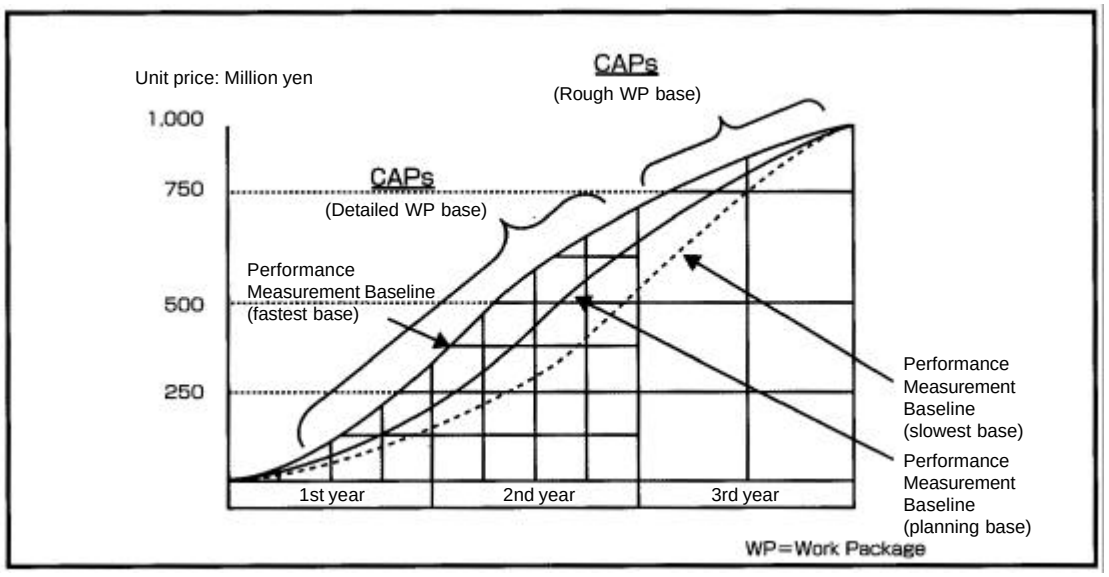


Table 4-5-31: Integration sample of CAPs

■ Measurement criteria for earned value

There are several earned value measurement methods, and four typical methods are shown below. Earned value analysis is conducted by adopting the measurement method corresponding to the task.

1) WEIGHTED MILESTONE

A method to carry out weighting by setting up a progress rate for each milestone.

2) FIXED FORMULA

A method to set up a progress rate at "commencement" and "completion" of task (eg. 50% at commencement and 50% at completion). This method is suitable to short-term tasks.

3) PERCENT COMPLETE ESTIMATIONS

A method to input the actual progress of a task in percentages based on the judgment of the person in charge **as 100% at completion.**

4) COMBINATION OF PERCENT COMPLETE ESTIMATIONS WITH MILESTONE GATES

A method to calculate earned value by using Percent Complete Estimates at the Milestone Gates. In addition, there are also ancillary tasks individual results of which are difficult to measure. In this case, a way to set up earned value at a fixed rate throughout the period is prevalent.

5) Equivalent Completed Units

A method to calculate earned value by the number divided after the measurable objectives are decomposed into small groups which are countable.

6) Earned Standards

A method to drive the optimum measurement way of earned value for the task from the historical data.

7) Apportioned Relationship to discrete Work Package

A method to apply appropriate method from 1) to 6) explained above for each discrete work package.

8) Level of Effort = LOE

A method to drive the earned value from the same for the task which has close relationship or the ratio of actual work periods and total work periods.

● Control

The evaluation of a project is done by focusing on the deviation between the Performance Measurement Baseline and the results, evaluating by means of the Earned Value, and estimating the cost and period upon completion of the project at regular intervals. The evaluation is made based on the following 3 elements, in combination with one or more of the following: variance analysis, performance

and trend analysis.

- Budgeted Cost of Work Scheduled (BCWS): Period budget (BCWS)
- Budgeted Cost of Work Performed (BCWP): Earned value (BCWP)
- Actual Cost of Work Performed (ACWP): Result spent cost (ACWP)

In order to evaluate the situation appropriately, it is required that the monitoring of the project should be made by changing the level of evaluation at regular intervals and in stages. With regard to accounting, while the project information is collected, the levels for the purpose of management, such as "each CAP level", "summary level", "project total", etc. are set for each month, to monitor the project.

■ Variance analysis

The differences of the costs, and of the schedules are put into numerical values by means of the earned value (BCWP), to represent them as "Cost Variance (CV)" and "Schedule Variance (SV)*"

■ Performance

The performance of the cost and the schedule is put into numerical values by means of the earned value (BCWP or EV), to represent them as SPI (Schedule Performance Index) and CPI (Cost Performance Index).

When evaluating performance, the improvement of SPI and the improvement of CPI do not have the same meaning, and it often can be seen that the improvement measures of SPI brings about cost impact, affecting CPI greatly. In devising the improvement measures, the judgment of management is requested.

■ Trend analysis

By representing whether the progress and efficiency of the project is improving or deteriorating on the time axes, trends can be indicated.

- Example of display

In order to grasp the status of the project easily, a combined presentation of the curve of accumulated rate of attainment and the graph of accumulated difference is effective. Table 4-5-32 shows the "Performance Curve & CV/SV Trend Report", and Table 4-5-33 shows the "Performance Curve & CPI/SPI Trend Report".

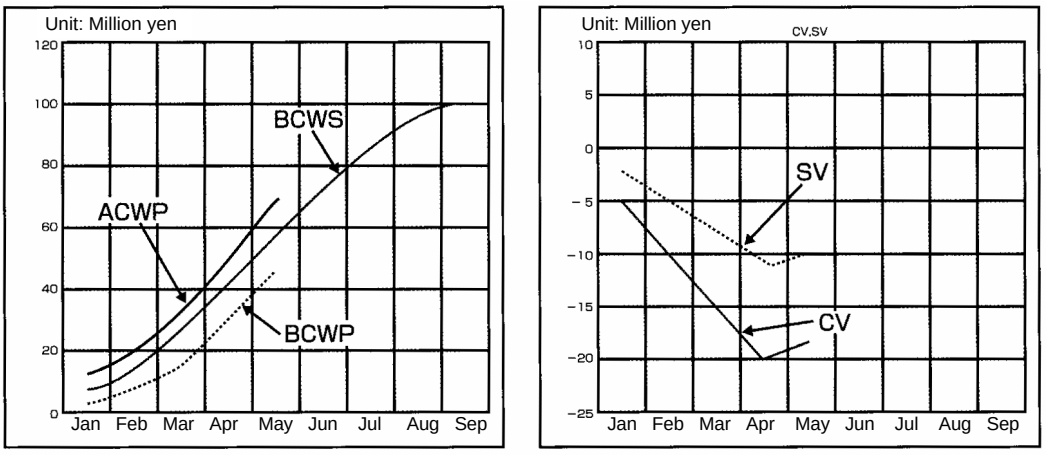


Table 4-5-32: Performance Curve & CV/SV Trend Report

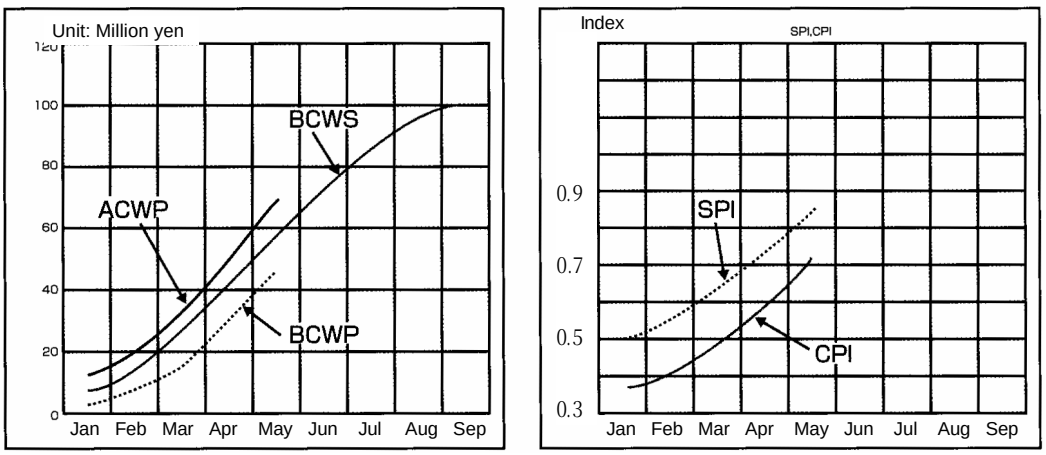


Table 4-5-33: shows the "Performance Curve & CPI/SPI Trend Report

■ Forecast completion

By means of the cost schedule performance, the estimated cost and estimated period at completion of the project can be obtained.

- Forecast of the final cost

The final estimated cost (EAC: Estimation at Completion) of the project can be obtained from CPI by means of the following equation.

$$EAC = \frac{\text{Estimate to Complete (ETC)}^*}{CPI} + \text{Cost incurred already}$$

$$= \frac{BAC - BCWP}{CPI} + ACWP$$

$$= \frac{\text{Budget at Completion (BAC)}}{CPI}$$

(Note) Budget at Completion: The amount of budget at the time of completion
Estimate to Complete: The amount of estimation hereafter up to the completion

• FORECAST OF THE SCHEDULE RESULT

The final estimated period of the project can be obtained from SPI by means of the following equation.

a) $\frac{\text{Project period}}{SPI}$

b) $\frac{\text{Remaining period}}{SPI}$ + Period of consumption

As a technique to calculate the project completion date, there is the critical path method (CPM) based on the network schedule, which is an effective tool for estimating the project completion date.

• AFFECTING FACTORS FOR THE RESULT OF THE PROJECT

When forecasting the final cost and schedule result of the project, the following 3 elements affect on them greatly.

1) Quality of the project base plan
2) Actual performance against the base plan
3) Determination of the manager to control (change) the final result

● Change in the Performance Measurement Baseline

The Performance Measurement Baseline of the project is changed when scope change occurs. In general, it is desirable that the conditions of changing the Performance Measurement Baseline should be set at the stage of planning, for example, in the case where the scope change exceeds 10%. Also, if it is judged that the Performance Measurement Baseline is not suitable due to a great delay in schedule, it may be changed after negotiations have been made.

7. Report/Change Management

● Project performance and communication

■ Transmission of information within the project

During the time from the start of the project to the end, numerous pieces of information are exchanged. The more the participants in the project there are, the more the number of those with whom information is to be exchanged increases at an accelerated rate. It is important in performing a project, how the creation, collection, transmission (distribution), accumulation (storage) and final processing of information is made in an organized way, without waste or omission, and managed.

■ Significance of reporting

The "reporting" that forms one mode of standard communications in performing a project, is to provide a specific recipient with useful information on the operation of the project at the right time. There are the one made at regular intervals, and the one made irregularly, and various means of reporting are available. We can say that the significance of reporting lies in clarifying "where at present" the project is, and "how will it be hereafter (what should be done)", and in promoting common understandings among the people concerned.

The reporting at the stage of planning aims to make the people concerned become fully familiar with the policy of project operation, and the reporting in the stage of execution is for sharing among stakeholders the state of progress of the project and where excellent actions or problems/issues are. And the reporting at the stage of completion is made, aiming to officially record the final specifications of deliverables, and the official acceptance of deliverables, and also to utilize in the project in the future useful results data, Lessons Learned, etc. that have been obtained through the operation of the project.

■ Project communications plan

At the start of the project, a project communications plan needs to be devised. This plan determines, of various types of information on the project, "who, what, when, to whom, how" should be created, collected, transmitted and accumulated.

■ Reporting plan

The plan of reporting, which is one of the means of transmission of required information, includes the type of reporting, reporting means for each type, Distribution Matrix, frequency, contents, level of the grade of detail, base of the calculation of the rate of progress and the method of calculation, plan to collect result values for performance analysis and cost reporting, fixing of the baseline (planned values such as scope, budget, schedule, resource, etc. and it is desired that these should be developed in time series.)

■ Coordination procedure

In the case of a project performed under a contract, it is practiced often that a coordination procedure that has specified the way of communications is agreed upon between the orderer and the contractor, in accordance with which exchange of information is carried out.

■ Document management and document in electronic form

In the accumulation (storage) of documents, planned and organized document management (filing system) is required. Depending on the type and amount of information to be exchanged, the storage may be collectively managed in a single place, or it may be managed by distributing in multiple places according to the predetermined classifications. In any of these cases, it is essential that a document (data) management system should be constructed at the initial stages of the project, specifying the method of classification, place of management, management code, manger, procedure of replacement with the latest version/criteria of discarding the old version and others, with which all the people concerned should be fully familiar.

In recent years, the development of electronic technologies/IT develop has enabled us to store a much larger volume of various data in electronic form (such as Electronic Document Management System = EDMS, etc.), and in this case also, a definite work instructions/management system is required.

■ Progress report

While there are various forms in the progress report to be made during the performance of a project, such as to provide comprehensive coverage of the whole project, or to cover only the exceptional matters, etc., it is a basic practice to make a comprehensive one regularly (monthly, in general). The report must be concise and definite, being able to transmit necessary and sufficient information to the receiver.

In recent years, it is a trend to disclose the project information widely, with a project home page that has used Web technologies, etc. having been employed.

■ Close-out report

At the stage of completion of the project, it is generally practiced that documents, drawings, data and the like concerning the final deliverables stipulated in the contract are prepared and delivered to the orderer. In the case of construction/engineering projects, in addition to the major design drawings that are also called mechanical catalogue, fabrication drawings of fabricated products and parts list, the operation manual, maintenance manual, inspection record and others are included. In the case of a software project, likewise the final design specifications, system manual, instruction/operation manual, inspection record, etc. are included.

In general, a technological record of such final fruit, contracts and documents of correspondence exchanged with stakeholders, etc. are also stored internally, in preparation for an occurrence of any irregularities in the future. In addition, in order to record useful result data that have been obtained during the performance of the project, a report called the Project Record or Close-out Report is prepared and stored.

Also, in recent years, as a result of the start of propagation of knowledge management, such an attempt has been made, in addition to above raw records, to prepare summary information by means of a specific format, or to enable the key word search of the project information to be carried out, so that referencing and reuse in the future may be made with ease.

● Change Management

■ Change

As a project progresses, parts that were indefinite or unreasonable at the beginning may be clarified, or changes (addition, deletion or change) in the plan at the beginning may have to be made often due to the changes in the situation surrounding the project, we can even say that there is no project that has not undergone any change from the plan at the beginning. Therefore, it is one of the key points in getting the project to be done successfully how securely and smoothly changes can be handled.

Requirements on changes are made in various forms such as verbal or in writing by stakeholders inside or outside of the project. These changes may possibly give influence to the project itself or all the areas of the project performance plan to **fulfil** the completion of **deliverable**s. Therefore, a handling procedure of changes that is systematic and documented is required, with which all the people concerned need to be fully familiar.

■ Change and contract

In the case of a project that is performed through a contract by the **owner** and the contractor, the contract (or its attached documents) must bear a detailed definition of the contracted contents. While it may depend on the mode of the contract, the definition of the contracted contents is specified in detail, including not only the object of contract, scope of services, specifications, design criteria, performance specifications and basic conditions, but also the range of responsibilities of the **owner** and the contractor, delivery time, constraints on the performance of the project, and others. However, even the contracted contents are specified in detail, in the course of the actual performance of the project, the performance in accordance with the contract may be made impossible. Hence, based on the recognition that changes in the contracted contents are inevitable, it is a general practice as standard clauses that provisions on the handling procedure of changes are specified as one item of the contract. In the case of a project where the contracted object/services are not to be visualized, or unable to be specified quantitatively by numerical values, like a software development project, in particular, the description of the specifications of the object is represented in an ambiguous way in many cases, and there is a possibility that the interpretations of the orderer and the contractor may differ from each other, and therefore, sufficient attention needs to be paid to the description of the contracted object.

■ Influence of changes

Changes of the plan at the beginning have influence on all the areas of the project plan (scope, cost, schedule, resource, risk, quality, technologies, etc.) As direct influence associated with changes, there occur an increase in cost due to redesign, remaking, etc., a delay in schedule, and an increase in the number of people mobilized, and others, but the influence is not limited to these. There will occur unstationary work such as a decrease in the morale and "willingness" of team members, designers and workers, remaking of the project performance plan and the advising of the changed parts, and others, as well as the relocation of personnel, overtime work and congested tasks due to the pressing demand, leading to a decrease in productivity.

While changes may occur at all the stages of the project performance, it will greatly affect the target to be attained in the project if what has been decided in the upstream stage is changed in the downstream stage. Therefore, it is essential that the management of design changes in the upstream design stage

should be emphasized.

■ Change management system

In the case of an in-house project that does not use a contract, or, even if a contract is used, in the case of changes in the plan or design changes for the parts that belong to the range of responsibilities of the contractor itself, it is a must in securing the quality of **deliverables** and smooth performance of the project to establish a change management system and conduct the management in accordance with it. This change management system is composed of the work process including the following items.

- Setting of a project baseline
- Monitoring and registration of changed items
- Evaluation and influence analysis of changed items
- Approval or rejection of changes based on appropriate power
- Renewal of project plans
- Change Tracking System

Also, the processing procedure sheet, Change Tracking System, approval criteria, change implementation report that are required for these steps may collectively be called the change management system. The important points throughout these steps are thorough documentation and appropriate document management, and it is desired that they are managed in a unified way.

Example ◆ Importance of the change management system

In a software development project, there often is a trend that its scale expands without limit. "As development goes on, things that were ambiguous at first are made clear gradually. What could not be seen can now be seen. Accompanying this, things that are desirable also increase. Due to these reasons, the customer's requirements increase." Such causes give rise to changes in the plan.

Meanwhile, software has flexibility, and is adjustable, and hence it is likely to be handled between persons in charge of practical work only, i.e. between an SE on the vendor side and the person in charge on the customer side. The countermeasures need to be linked to the procedure of confirmation of contractual changes. Namely, it is essential that a change management system is constructed, in which it should be set forth that if there occurs any variance between the baseline determined and agreed upon by both parties through a contract and the contractual contents due to the changes/additions of a large scale, then changes in the contract need to be made.

■ Prevention of changes

Frequent occurrence of changes give negative effects such as an increase in the project cost and a delay in the schedule, and one of the proposals being made in CII (Construction Industry Institute, USA) with a view to preventing them, is the Pre-Project Planning (=P^3). This is intended for projects including design through to construction, and is to decrease the degree of changes by designing and defining the contents of the project as much in detail as possible prior to the contract of the project (or in the initial stage of it). Another proposal is for the development of the Project Definition Rating Index (=PDRI), which is intended for process plant design/construction projects and building projects, to measure the grade of detail of a project **definition.**

● Problem management

In a project such as an R&D project or software development project, etc., in which there are many development elements and many indefinite elements exist in the project itself, there occur technical problems and matters that need to be studied on a daily basis. Such an event that needs some action is called an issue, which is described in an issue list and information is shared among project members. There are a wide variety of issues, including the one that can be settled by a simple handling and the one that needs sufficient studies. In general, as for an important issue that has a large range of influence, disassembling of the issue is carried out, and after the constituent factors are clarified and the cause is identified, effective countermeasures are studied. It is then included in the action list, to be put into action.

It is desired that these issues are grasped at the time of occurrence and handled promptly. A delay in handling may give great impact on the performance of the project. Also, many of the contents of these issues are qualitative information, which requires a different viewpoint from that for the quantitative management information such as time, cost, resource, etc. In addition, in a corporate environment in which similar projects are implemented, it is also highly probable that an issue that has occurred in a project will lead to the solution of a problem in other project, and the sharing of information on issues across projects may also lead to a great improvement in efficient solution of problems in a business.

8. Delivery Management

● Process of project turnover

The completion and method of turnover of a project are not always fixed, but are determined for each project **by contract**. The turnover of plant in construction/engineering projects is carried out in the way that the completion of the responsible **scope** of the contractor as specified in the contract is confirmed by both the contractor and the customer. By transferring the management responsibility of plant to the customer, it is called turnover by the side that delivers, and takeover by the side that receives the delivery. Usually, excepting the case of a full turnkey contract, it is carried out some time after the mechanical completion of the plant up to the **completion** of the **commissioning.**

Meanwhile, when being seen from the customer's standpoint, if the customer concludes a **financing agreement** with a financial institution based on a project finance, even when the physical turnover with the contractor has been realized, the completion of the plant may be deemed to have not been made in terms of the **financing agreement.** This is likely to occur when the financial institution requires, based on the pledging clause of the **financing agreement**, that the customer should satisfy the preconditions that the project should produce cash flow securely and steadily, in parallel with the physical completion of plant.

Such a way of thinking is called financial completion, in contrast with the physical completion. When being seen from the customer's viewpoint, unless the pledging clause of the financial institution has been met and the completion of the plant has been verified with it, the **fulfilment** of obligations to the financial institution concerning the completion of plant will not be released. The turnover of the project for a software development project varies depending on the type of project, scope of work, sharing of roles, etc. with the customer, and is determined for each project based on the contents of the confirmation sheet as agreed upon between the two parties: the customer side and the supplier side.

The turnover in software development is made after the completion of the responsible scope as agreed upon by the confirmation sheet has been confirmed by both of the customer side and the supplier side. The important point in the responsible scope in the stage of **establishment** in software development is that, the transfer of the system **built** in software development to the operational test phase using an actual operational environment and real data becomes the point of turnover, and the management responsibilities and the main body of work thereafter are transferred to the customer side. The procedure from the **built up** stage of software development up to the completion of the project can be seen as follows.

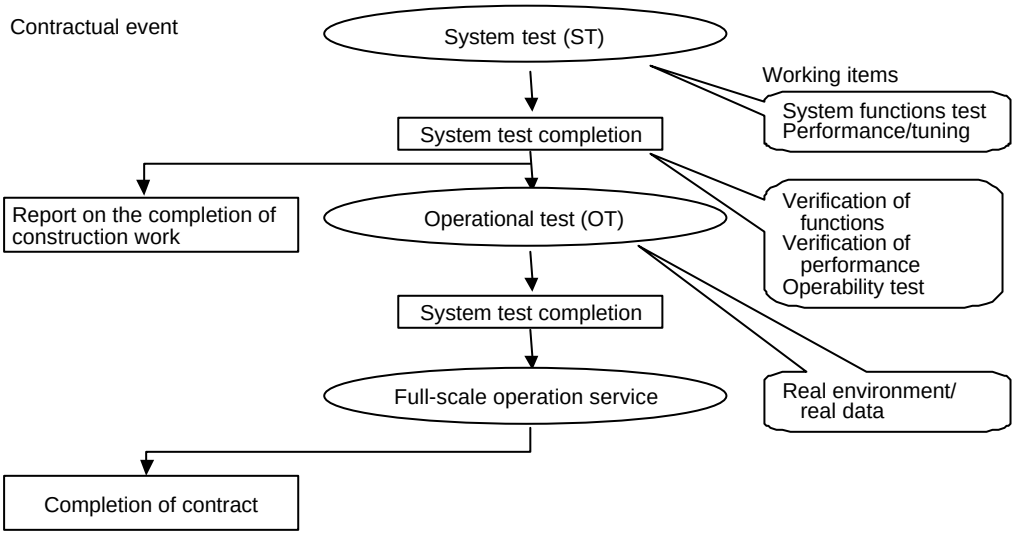


Table 4-5-34: Flow up to the project turnover in software development

The contract of software development is carried out in 3 stages basically. Those 3 stages are, requirement definition design stage, **built up** stage and operational preparation transfer stage. While the turnover as the delivery of products is carried out in each stage, the **deliverables** of the project, namely the turnover of the whole system is usually carried out upon completion of the **built up** stage (system test completion). The completion as a project is made upon full-scale operation (service-in) after the operational test phase has been finished. A contract is often concluded by combining the 3 stages into one, or by combining more than one of them.

● Test run and guarantee of performance

In any project, verification is required as to whether the target set at the beginning has been attained. For example, the verification of the guarantee of performance in construction/engineering projects is one of the most important items, and its details are specified in detail at the time of concluding a contract. It is required to verify whether the plant of which construction has been completed is, including the quality and production amount, etc. of its products and byproducts, in compliance with the contractual specifications in terms of the process performance during the production process and the utility consumption performance required for the production. Namely, as items to certify the performance of plant, there are mechanical performance, process performance, utility consumption performance, and others.

In the meantime, while a contract may not necessarily include physical elements, as in a loan **agreement**, this means conceptually that the verification of the attainment of a target becomes the verifying action as to whether the contractual obligations have been fulfilled or not.

The guarantee of performance in software development is one of the important items, as are the system function and quality. The details of the guarantee is specified at the time of concluding a contract, or by means of a confirmation sheet as agreed upon by the supplier side and the customer side, or others. The integrated performance, which is a combination of the mechanical performance and the soft processing performance, is inspected by the system test work under the virtual environment of full-scale operation, and at the time of the operational test, the work cycle is put into trial operation under an environment of full-scale operation, the final performance is verified, thereby verifying whether it is in accordance with the contractual specifications, etc.

● Turnover and acceptance of a project

The turnover and acceptance of a project may vary in their contents and mode, depending on the objectives and contents determined by the contract. Their essence becomes the release of contractual obligations. For example, in construction/engineering projects, usually they are often carried out when the performance that was the objective at the beginning has been verified. However, if the customer's contractual requirements are not limited to the demonstration of performance, the turnover is carried out accompanying the fulfilment of contractual obligations.

Meanwhile, the turnover of a software development project is usually carried out upon completion of the system test after the **built up** stage has been finished and the system performance and guarantee of performance have been obtained under the virtual environment of full-scale operation. As a result of this turnover, the main body of work is transferred to the customer side, but in many cases, even in the operational test stage, the supplier side continues relations, by keeping an eye on the full-scale operation, out of the necessity of handling initial irregularities in the operational test and others, in accordance with the stipulations of the contract or confirmation sheet. After the operational test is over, the transfer to the service-in is also finished, and the service-in (full-scale operation) has been started, the project is then completed.

Outline

As shown in "II. Project Management," project resources consist of six types: material, platform, human, intellectual, information, finance.

Assuming that the various processes and techniques that constitute project management correspond to the software in a computer system, resources can be compared to the hardware that supports the system. Needless to say, a project will not function if either is omitted. A project can only be completed when adequate resources are secured at an appropriate time under management of the overall project. Project resource management refers to the management function that clarifies and adequately secures resources necessary for the project.

That part of resource management relating to "human resources," management and concerning human development is described in detail in Chapter 4, "Project Organization Management," while "financial resources" is described in detail in Chapter 2, "Project Finance Management."

The process of resource management has four objectives as shown in Fig. 4-6-1: work process, results, and knowledge database.

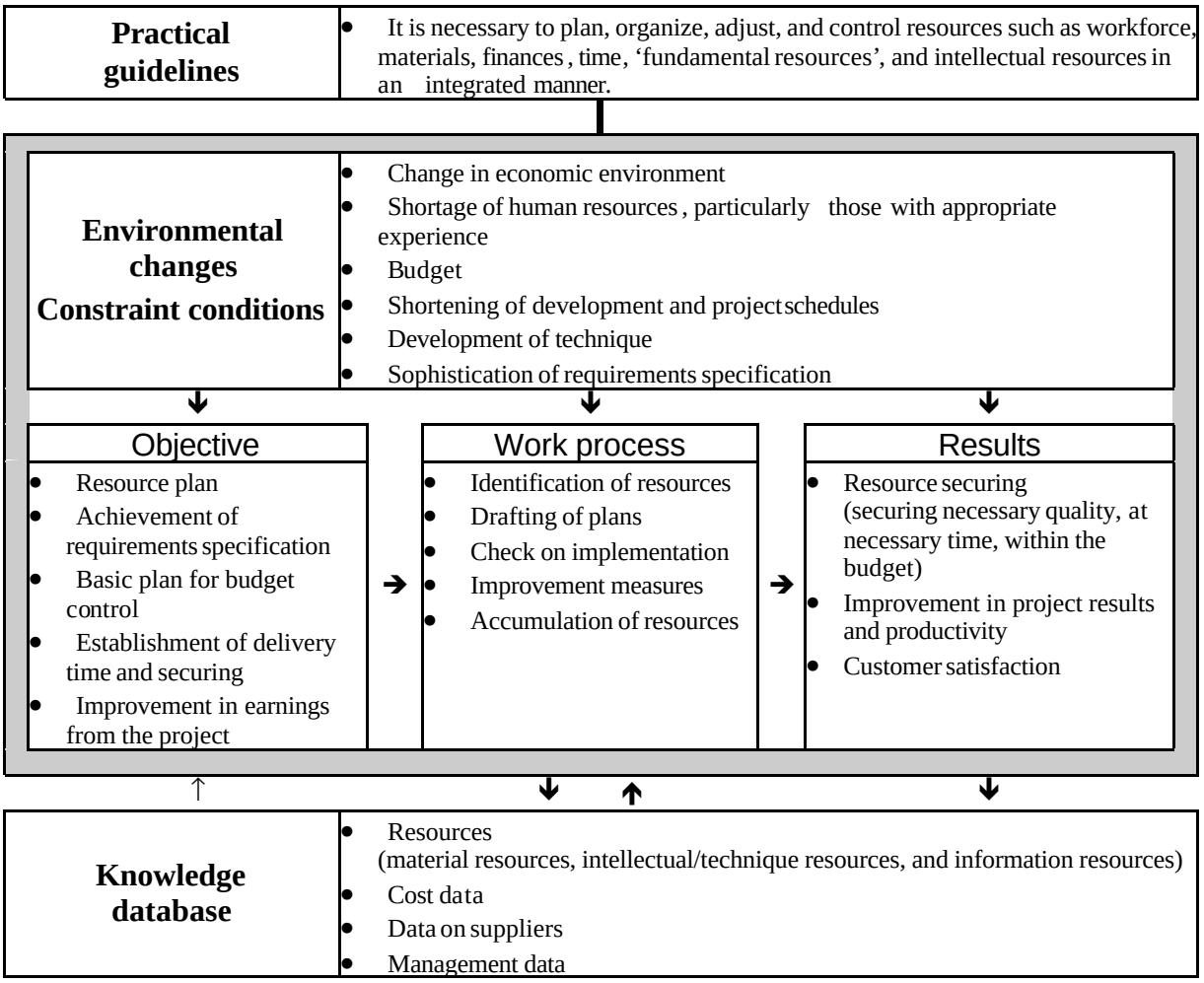


Figure 4-6-1: Overview of Project Resources Management

1. Resource Management Process Cycle

● Process Cycle

Plan describing resources necessary for the project, resource procurement / provisioning and resource recovery, is a cycle of processes as is the case for other types of management. A resource plan is drafted as part of a whole project and its processes form a cycle.

Specifically, the cycle consist of identification of resources for a project, drafting a plan to secure them, securing and checking them under the plan, and taking measures when improvement is necessary. This is repeated as a cycle for each project. In addition, if resources that generate new value are obtained in the course of implementing a project, these are included and accumulated as internal resources that can be available to other projects in the organization. This cycle serves as a cycle for the overall organization across the scope of specific projects[1].

Figure 4-6-2 illustrates the above mentioned process cycle.

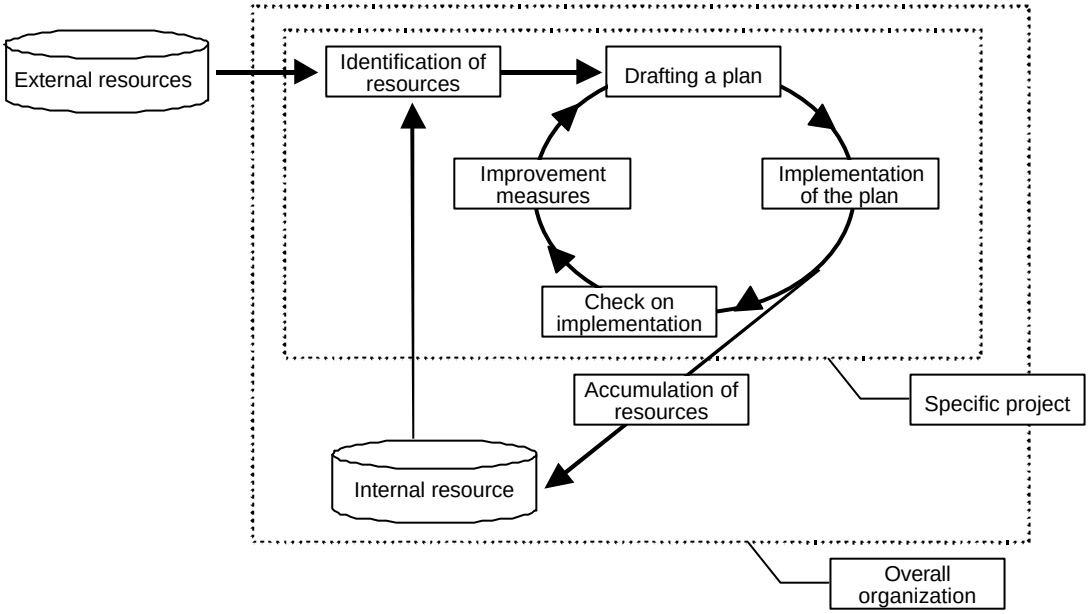


Figure 4-6-2: Resource Management Process Cycle

● Information Sharing and the Use of IT

Resource management is a project activity not only addressing the procurement of project resources and re-use of organizational resources but also requiring standardization of approach that recognises the needs of the overall organization.[2]. Advancement of information technology to assist in resource management is outstanding.

In re-deployment of resources, information sharing is essential for reuse of resources including material ones, and for this purpose, the management of resource data, the creation of information and its management using IT/IS capabilities is inevitable. The value of intellectual and information resources are optimised through sharing and can also be managed through IT / Information Systems

Current Information technology (distributed systems including the Intra Internet and databases) provide practical methods for realizing the integrated management of information, and providing free access to people concerned. Such management of information / knowledge sharing is recognized in the discipline of knowledge management (refer to "Knowledge Management," P.262).

In resource procurement, electronic exchange of transaction data such as order reception / placement through networks, (EDI - Electronic Data Interchange), has become popular in 1990's. EDI was developed mainly for support of high volume transactions between enterprises. In recent times, business-to-business (B to B) electronic commerce through the Internet including new vendors and suppliers is becoming increasingly important.

Use of information systems such as the Internet ensures efficiency in information exchange.

Enterprises therefore should examine fully how to use and incorporate such systems into the work flow. Further, there are considerable risks involved in adopting the latest information technology as it is still subject to significant change and development, and these risks should be taken into account.

Fundamental resources (also called shared services, core services, corporate infrastructure) serve as a the base for sharing resources. The basic elements of such fundamental resources for information sharing are computer networks and database management systems, and should be examined from a managerial viewpoint when preparing system architecture; their functions and performance, and what types of systems and networks should be implemented.. Thus, resources that are available to the overall organization belong to fundamental resources.

2. Specification of Resources

● The Basics of Specifying Resources

Basic information to be referenced when specifying resources is as follows:

(1)WBS

The WBS helps systematic identifications of project elements that require resources, and is the most significant reference information for identifying and selecting resources.

(2)RESULTS INFORMATION

The results from other projects, what resources were required and to what extent in similar tasks in the past projects are examined to assist in preparing the specification of resources.

Figure 4-6-3 shows examples of resources.

Category	Examples
Material resources	(1) Materials (2) Location (3) Equipment (construction equipment, computer hardware, etc.) (4) Software (5) Engineering environment
Platform resources	(1) Network (2) In-house systems such as accounting systems (3) Engineering tools (4) Project management information system (PMIS)
Human resources	(1) Project personnel (in-house, transfer) (2) Service contracting (consultants)
Intellectual resources	[Intellectual Property Rights] (1) Patent (2) Utility model (3) Trademark (4) Copyright (5) Know-how / knowledge (6) Brand
	[In-house technology] (1) Advanced technology, core technology (2) Specification of human resources
Information resources	(1) Management related data (a) Standards / guidelines (b) Templates (c) Past performance (d) Data on individual projects (2) Common data for the organization Intranet information (3) General information (a) Industry information (b) Sales information (c) Technology, business or industry specific information (d) Other necessary information
Financial resources	(1) Equity and debt (2) Stocks and shares

Figure 4-6-3: Examples of Resources.

● Essentials of Resource Specification

(1)IDEAL RESOURCES

The process of resource specification starts with examination of the ideal or optimum resources for implementing the project, and avoids focusing on restrictive conditions such as whether such resources can be obtained or whether the budget is adequate..

Essential resources required will become clear in the course of setting up the scope of the project. When the function of scope setting is conducted separate from the function of resource procurement, information should be exchanged frequently between the two functions.

At this stage, labor resources need not be examined because they are inevitable for projects. This is done at a later stage when resource plans are drafted, examination is started on the size of necessary

workforce and means of procurement.to acquire it.

(2)IMPORTANCE OF RESOURCES

The importance (essential nature of) of each resource for implementing a project should be clarified. For example, the following classification can be used:

1) Indispensable (The project cannot be accomplished without it)
2) Necessary (The project can be efficiently implemented with it)
3) Not essential (The A project can be efficiently implemented with it but no problem occurs without it)

The above classification can be also used as guidelines when examining overall resource acquisition strategy, and when considering priorities and restrictive conditions at the stage of "Resource Plan Drafting." The importance of those resources classified as item 2) or 3) above is examined again at the stage of plan drafting from a the viewpoint of cost performance.

(3)AVAILABILITY OF RESOURCES

Possibility to secure each resource should be examined. How and from where to secure resources should be also examined. Specifically, it is critical to make it as clear as possible according to features of resources whether to obtain them from outside the company or use the resources reserved in the company, or from where resources should be obtained.

(4)MEASUREMENT OF RESOURCES

Concerning progress management (progress in securing resources etc.), it is required to set up quantitative metrics (standard for measurement) according to types of resources for checking the progress to the plan. For that purpose, units of resources and others should be clarified when specifying resources.

● Deliverables in Specifying Resources

A deliverable in the process of "resource specification" is a resource list.

■ Resource List

A resource list refers to a list of resources necessary for a project including desirable resources. Essentiality of each resource is indicated in the list.

3. Formulation of Resource Plan

- Basic Information in Formulating a Resource Plan

(1)WORK BREAKDOWN STRUCTURE (WBS)

WBS serves as basic information for formulating a resource plan as is the same with the process of "resource specification."

(2)WORK PLAN SHEET

The work plan sheet serves as basic information for formulating a plan particularly concerning a period when resources have to be secured.

(3)RESOURCE LIST

The resource list is formulated in the process of "resource specification."

(4)PERSONNEL PLAN

A plan concerning the workforce needed for a project.

(5)INFORMATION ON THE LOCATION OF RESOURCES

Resources are comprised of internal and external procured resources. Each type of resource is itemized as follows: Intellectual and technical resources, where resources and human resources are considered closely related, is in close connection with management of "human resources." Information resources are closely concerned with knowledge management.

- INTERNAL RESOURCES

1) Resources held (including resources reused)
2) Development of in-house engineers
3) In-house personnel
4) Available capability

- Available amount
- Available period

- EXTERNAL RESOURCES

1) Vendor
2) License
3) Engineer dispatch, technology introduction
4) Personnel dispatch, service contracting
5) Industry information / sales information
6) Available capability

- Available amount
- Available period

(6)POLICY OF THE ORGANIZATION

In many cases, organizations have their own policy as to whether to purchase or rent equipment used for projects. Including such methods for resource procurement, policies and attitude toward resource planning should be fully recognized.

(7)RESULTS INFORMATION

What resources were required to what extent for similar tasks in past projects, in which phase they were needed, from where they were obtained, etc. are examined to use the results for formulation of a resource plan.

- Formulation of Resource Plans

(1)EXAMINATION OF PRACTICAL PLANS FOR EACH RESOURCE

Examination should be made on the procurement of each resource. It should be also clarified by when each resource needs to be prepared.

These examinations should be made based on WBS and Work Plan Sheets. What are needed as resources is screened out from the work package of WBS, for instance, concerning material resources, examination should be made on what needs to be prepared by when, what is the technology needed to

perform the work, whether the know-how on the technology is procured internally or externally. In this case, information on the past performance can be referred in a quantitative aspect, and can be used for checking omissions.

A vendor list for external procurement is one of the items to be prepared across the board and shared as knowledge.

(2)EXAMINATION OF PERSONNEL PLAN

The size of workforce needed for a project repeatedly fluctuates in accordance with the progress of the project. With determination of a peak period of workforce, full examination should be made on the possibility of securing workforce for each phase of a project as well as on whether workforce can be secured. Principally, workforce should be estimated in a time series and the trend in the life cycle of a project should be taken into consideration.

In this case, concerning the transfer of in-house personnel from the relevant project to another project, adjustment needs to be made with the organization of personnel from the company-wide viewpoint. Further, this view might be a little too managerial, but for individual members, an ongoing project is only one of the projects from a long-term viewpoint. Therefore, unless a clear picture of job assignment on a long term basis is presented to individual members and to some extent includes other projects, morals and morale among them may decline. Thus, management of job assignment for individual members and adjustment within their organizations is a critical factor that affects the achievement of individual projects.

Estimation of the workforce necessary for the initial stage should be fully examined so as not to cause additional mobilization of workforce at an actual operation stage. this can result in an increase in cost and delay in the schedule.

In addition, since there is generally a great difference in the capability of individual work members, examination on workforce procurement should be made based on the past performance or introduction. Software development in particular is greatly dependent on personal skills, so skill evaluation becomes a matter of great concern.

(3)DETERMINATION OF THE OPTIMUM PLAN

In drafting a resource plan, multiple alternative plans should be prepared in consideration of various cases such as difficulty in procurement, and comparison and examination should be made for them. Formulation of alternative plans requires different approach to acquisition of resources necessary for a project. For instance, if a necessary resource cannot be obtained, examination will be made on measures for searching for alternatives. This also leads to review of necessary resources.

In examination of alternative plans, by using information of the past performance and various solutions, a draft plan that is considered as the most appropriate is determined as a final plan among alternatives in light of the objective of a project and restrictive conditions of the project,

In addition, as a risk hedge, a number of available vendors should be secured for overall resources.

(4)EXTERNAL PROCUREMENT PLAN

The following matters should be examined in particular when procuring resources from external sources.

A) CONTRACT TYPE

Since contract types may differ according to individual equipment and services, an optimum contract type should be adopted in consideration of their respective advantages and disadvantages. As examples for this, there are lump sum contracts, cost reimbursement contracts, and unit price contracts (refer to "Contract" P.249).

B) ORIGINAL ESTIMATE BY THE PROJECT EXECUTIVE ORGANIZATION

Original estimates are used as a base for evaluating estimates.

C) NECESSITY FOR STANDARDIZED DOCUMENTS ON PROCUREMENT

Standardized documents are required for procurement work. Use of standardized documents could enhance the quality of regulations for materials and services.

D) EXECUTIVE BUDGET

When a procurement budget accounts for greater part of the total project budget, results of procurement inevitably affects achievement of the project. Therefore, an executive budget should be drafted for the management of this expenditure.

E) PROCUREMENT ORGANIZATION

In light of project management, a procurement function should be provided with a project or an executive organization to clarify responsibility. Efficiency of procurement tasks are in many cases improved through common or integrated management, such as market research continuously conducted on a company-wide basis, examination of vendors and outsourcing companies, compilation of cost data, adjustment of delivery periods among projects, and cost reduction through lump sum purchase for multiple projects. For these reasons, many companies have their own in-house procurement function within the organization. Meanwhile, when vendors need to be selected in full consideration of individual project requirements such as demand for special technologies, attention should be paid so that items provided with the necessary functions, performance and quality are procured as planned through close communications between the executive organization and procurement organization of the project. Similarly, when a trade-off occurs between a delivery period and cost, it should be clarified which has priority.

In addition, acquisition of intellectual resources from outside the company using license etc. for intellectual assets should be consulted with expert sectors, such as legal affairs, concerning the contents of contract including conditions for license use.

F) PROCUREMENT USING THE INTERNET

Procurement using the Internet is possible for the purpose of reduction in communication cost, procurement time, etc. In this case, it should be confirmed if the project executive organization and vendors have sufficient information infrastructure.

- Deliverables in Resource Plan Drafting

(1)RESOURCE LIST

A resource list created by excluding unnecessary items from the resource list formulated when specifying resources.

(2)RESOURCE PLANNING SHEET

A planning sheet to procure resources and others.

4. Implementation of Resource Plan

This is a process to acquire the necessary amount of relevant resources at an appropriate time and at an adequate cost based on a plan drafted in the process of "Formulation of Resource Plan."

Procurement management is critical for procuring external resources.

● Basic Information in Implementing Resource Plan

■ Resource Planning Sheet

A planning sheet drafted in the process of "Formulation of Resource Plan."

● Implementation of Resource Plan

(1)PROCUREMENT

Based on the resource plan, procurement is made for each resource. In the case of external procurement, collaboration, e.g., with the material department, is important. Details for implementation of procurement are described in the following section .

In the case of internal resources (including personnel), coordination with sectors that hold relevant resources is critical.

(2)INSPECTION

This is for checking whether the necessary amount of resources is acquired at an appropriate time and with adequate quality.

● Implementation of Procurement

(1)PROCUREMENT MANAGEMENT

Resource procurement management in projects is classified into the following three categories. The operation processes for equipment and service procurement is shown in Figure 4-6-4. The use of external resources is called “outsourcing” in comparison with the use of internal resources.

A) PROCUREMENT OF EQUIPMENT AND MATERIALS

Based on the specifications determined at the design stage, equipment / materials (including software) necessary for implementing a project are procured. Procurement operation refers to a series of operations starting with purchase operation and ending with delivery of successfully inspected delivery items.

B) PROCUREMENT OF SERVICE

Procurement of services necessary for project implementation from outside the company may occur at every stage of a project. Service procurement refers to operations starting with consignment of operations and ending with completion of services under the contract,

C) LICENSE

Acquisition of license for technologies necessary for project implementation by paying values to the right holder.

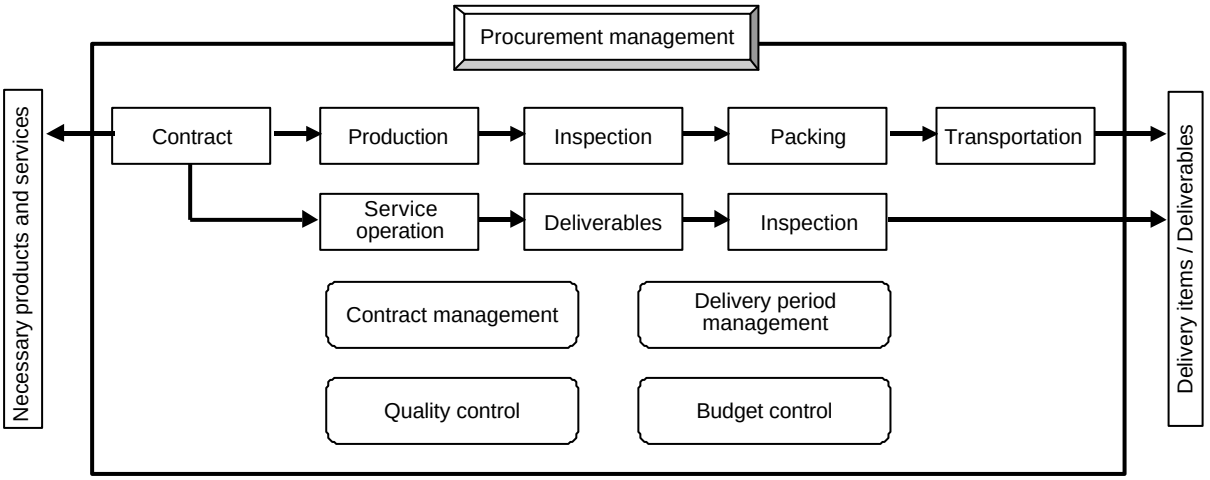


Figure 4-6-4: Process of Procurement Management

(2)MANAGEMENT CONCERNING PROCUREMENT OPERATION

Management concerning procurement operation has the same process structure as management of the whole project.

A) CONTRACT MANAGEMENT

Contract management in procurement includes monitoring of operation performance by contractors under the contract, management of deliverables to meet requirements under the contract, and payment of proper value for deliverables to contractors under the contract.

Since contract management includes legal and accounting factors, cooperation of legal affairs and accounting departments as functional organizations is inevitable according to need. Contract management starts with a pre-contract process, i.e., preparation of documents for bidding, and continues until expiration of the guarantee period even after deliverables are delivered. The copyright of software is determined on the relationship of rights under the contract.

It should be managed constantly what influence the change after execution of the contract concerning contract conditions, specification of equipment / materials, and service contents will have on the project schedule, contract amount and quality. In a broad sense, as shown below, contract management includes quality control, delivery period management, and budget control.

B) QUALITY CONTROL

Quality control refers to confirmation of whether ordered equipment / materials and deliverables of services meet requirements of the contract. It also includes management by the orderer to avoid occurrence of quality problems and monitoring of the status of quality control by the contractor.

C) MANAGEMENT OF DELIVERY PERIODS

Schedules for individual procurement operations are monitored based on the overall schedule including the phase of purchase operation and delivery of deliverables such as equipment / materials and services. Further, collection of information that affects delivery periods, coordination with contractors and clients concerning the factors of delay in the delivery period, etc. are also included. Since a delay in the delivery by one contractor could seriously affect the overall schedule or cost, management should be made not to cause late delivery, and deliverables that seriously affect the schedule should be taken into full consideration. Late delivery could occur due to an event attributable to either the orderer or the contractor. In management of delivery periods, both parties should be treated equally and full attention should be paid.

D) BUDGET CONTROL

Fluctuation of costs due to change in economic environment, scope, specification, and quantity are managed during the project. Values to be paid to contractors are also managed.

- Deliverables in Implementation of Resource Plan

(1)RESOURCES

Resources are obtained based on the resource plan.

(2)RESOURCE DATA

Records concerning the resources obtained during the project are used for checking implementation or recycling of resources.

5. Resource Check and Control

● Monitoring

Resource plans mentioned in the preceding section should be constantly monitored to ensure they are carried out as designed. Pursuit or follow-up is necessary to see if various resources are procured as planned. For this purpose, an adequate method for collecting data needs to be established. In formulating a plan, attention should be paid so as to collect such data easily. In the case of many resource items, utilization of information systems is inevitable. If such systems are not prepared, establishment of such systems should be examined not only for a sole project but also for the whole company as part of establishment and improvement of fundamental resources.

Case ◆ Metrics in Software Development

In software development, it is considered difficult to determine standards for measuring development of software as it has no appearance. However, since management is impossible without measurement data, various indicators to show progress in development have been prepared. For example, as an indicator that shows the scale of software, there is a method called "function point method." In this method, the indicator of scale is calculated by focusing on functions to be achieved. As program languages have become diversified these days, the lines of code (LOC) for source codes are inconsistent with estimates. Therefore, this function point method is becoming prevalent.

As mentioned, it is critical to clarify in advance standards for measurement in monitoring and makes consistent evaluation.

● Analysis, Evaluation and Prediction

In projects, a practical implementation policy and standards for measuring progress are established as a project implementation plan during the initial planning stage. Based on such standards for progress measurement, plans and their results are compared, the difference is analyzed to pursue causes, and the overall project is evaluated. Further, prediction is made on resource supply until the time of completion.

For example, in procurement of equipment / materials in a project for plant construction etc., it is critical to review the procurement plan regularly, e.g., adjustment of quantity of equipment / materials, in accordance with the progress in design. Additional mobilization of construction machines or personnel requires lead time and often results in delay in the schedule, so timely evaluation and analysis of progress and status are required, and if any signs of risk appears, countermeasures should be taken at an earlier stage.

As countermeasures, it is necessary to have sufficient time to manage the project without additional mobilization, e.g., by re-arranging the order of priority for each activity in the improvement / correction plan.

6. Improvement / Correction Plan

As a result of analysis, evaluation and prediction in the preceding section, if any problem is found that affects the process of a project (change in the quantity of supply, timing, vendor, etc.) re-formulation of the resource supply plan and review of the prediction are required.

Re-prediction of resources refers to re-arrangement of the resource schedule drafted on the time management in consideration of restriction of time and resources.

Initial resource schedule in schedule plans are often based on the assumption that resources are fully secured. However, since resources usually have limits and a number of individual operations often require the same limited resources at the same time, a situation often occurs where resources have to be re-distributed without delaying the delivery period of the whole project. In such cases, operations need to be re-arranged by delaying an individual operation in light of the standard for decision making. If the problem is not solved with such rearrangement, another decision, e.g., additional mobilization of resources, needs to be made.

Mobilization of human resources requires special attention. This issue will be easily understood by taking an example from software development which is carried out by personnel. . Delay in work at any field is likely to be solved through additional mobilization of workforce, and this is more common in software development, which has less computerized aspects. This is likely to occur even if people concerned know that they should not.

However, it has been pointed out since the 1970's that additional mobilization of human resources in software development could lead to further delay rather than a correction of the delay. In particular, if additional workforce is mobilized at the end of the process, the project can be more seriously affected by delay etc it could be more seriously affected. This is because software is developed by the staff who exchange communications with each other and the frequency of communications will be increased due to addition of human resources. Furthermore, new personnel need to be introduced to the context of the project as they have no prior knowledge. This introduction can take time and is also a reason for further delay.

It is significant to perceive a sign of delay at an earlier stage, and if it has become clear that mobilization of human resources is inevitable, additional mobilization should be determined in consideration of whether this addition may or may not cause any problems including the character of personnel to be added. If it is difficult to work for a project without full understanding of the contents of the project or if future schedule is expected to be seriously affected, a team can be formed consisting of some current project members to intensively work on recovery of the delay and new members injected into sectors that are short in workforce and are less affected due to their entrance. In either case, additional mobilization entails high risk, so attention should be paid to accurate estimation at a planning stage.

The flow of the above process is shown in Figure 4-6-5.

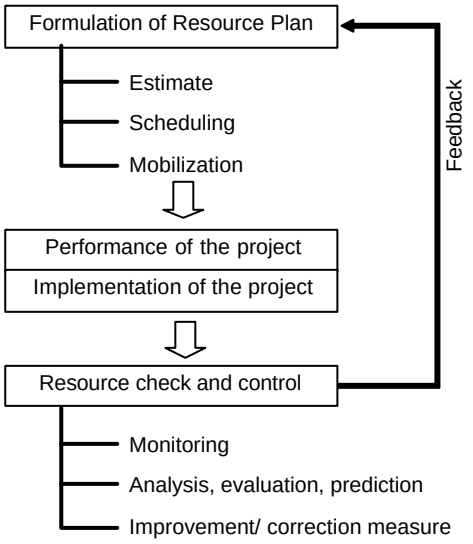


Figure 4-6-5: Flow of Improvement / Correction Plan

7. Accumulation of Resources

● Significance of Resource Accumulation

Projects aim at achievement of intended objectives by accomplishing the project. within a set period and budget. To achieve such objectives, material, platform, human, information, intellectual, and financial resources are used, and as a result, plants, buildings, software, research and development, etc. are generated.

Material resources are either consumed and disappear or are used for another purpose. Meanwhile, resources such as information, knowledge and technology are broadened, deepened, and increased in value. Completion of the intended object is a deliverable of projects, while quality improvement in resources other than material ones is also a great deliverable of projects.

Often new technologies are developed from challenges encountered with existing technologies and can lead to the discovery of a new fact. It is said that there is no creation without accumulation.

Even if the scope of resources is broadened or quality of resources is enhanced through the use for a project, it is insignificant if such resources are used only for the project. Deliverables generated from the project should be transferred to the next projects.

Project organizations tend to have a strong tendency to value the success in only relevant projects and have less intention to pass deliverables to the future or next projects. However, in order to enhance quality as well as productivity and increase competitive power as an organization, it is critical to understand features of these resources, accumulate resources as an organization that have been improved through the use in implementing a project, enhance motivation to use them for future projects, and put it into practice the deliverables derived from past projects.

● Recycling of Intellectual, Technical, and Information Resources

(1)STOCKING AND STANDARDIZATION OF RESOURCES

Of various resources, data, information (flow information), intellectual assets and technology information, in particular, which have been obtained through projects, contain many items that can be re-used in other projects. Enterprises should accumulate such information and create knowledge systems and databases in order to utilize them for future projects. This is referred to as information stocking. However, disordered information needs a greater effort when searching and may result in little or no use. In addition, handling information without intention may cause omission of critical information and lessen the effect of compiling the information in the first instance.

For accumulation of information and its effective recycling, the information should be arranged and accumulated in good order. A systematic framework to stock information is significant, and organizations should build a resource accumulation system, examine re-use of information and handle information with the intention to re-use.

To that end, accumulation and standardization of information for use is effective. Knowledge used for past projects can be used as a common base through standardization and can be utilized effectively .

There are many items to be standardized such as processes, documents, tools, available technologies, and quality standards. Development of a calculation routine and computation with simulators with software are examples of standardization, and with these, anyone can obtain the same answer and efficiency can be improved.

Since the method of standardization itself is an information resource, it should be established based on sufficient experience to make standardization appropriate. In addition, constant review is necessary from the viewpoint of users. This is a difficult task that goes against the idea that standardization should be stable however attention should be paid to this matter when considering the method of standardization.

(2)SIGNIFICANCE OF SYSTEMATIZATION

Many intellectual, technical and information resources are buried in the brain. Enhancement of these resources to an organizational level requires their accumulation using tools such as documentation, but in consideration of actual utilization, further accumulation such as an information system becomes significant in relative to the increase in the quantity of information.

In recent years particularly, most technical information is electronized and technical simulation is made with applications such as CAD (Computer Aided Design), CAE (Computer Aided Engineering) and PDM (Product Data Management) etc. In addition, information concerning management of projects is

accumulated using the PMIS (Project Management Information System).

Systematization of information is simply the accumulation of assets that have been buried in human resources as assets of the organization in a visualized manner. This systemized environment plays a role in changing most of the tacit knowledge that has been explicitlly buried in an organization. Also in providing or organizing information, it is possible to reduce the burden necessary for making the information explicit (organization, compliance with standards, entry, etc.) by devising systems, which promotes the renewal of information.

For example, a system that allows prior simulation of events based on accumulated technical information enables not only effective use of technical resources but also saves many material resources (workforce, materials, equipment, etc.) and drastically improves the speed and productivity of projects. This is the same with management related information.

Meanwhile, systematization also puts technologies into a "black box." It should be noted that this causes a problem in development of project managers and engineers, and is an issue which should be discussed in the future.

- Practical Measures for Resource Accumulation

(1)MATERIAL RESOURCES

Material resources are characteristic of processing rather than accumulation.

A) ESTIMATE FOR RESOURCES REMAINING AFTER PROJECTS

Ideally speaking, in implementing a project, only the necessary quantity of materials and equipment should be purchased systematically under the schedule and they should be used up at the end of the project, but the reality is that something is sure to remain after completion of projects. Therefore, it is important to identify remaining amounts and where the use of materials, equipment, construction machinery, can be stopped and examined for re-use.

B) ACQUISITION OF INFORMATION CONCERNING UTILIZATION OF REMAINING RESOURCES

In some cases, the use of reminder materials, equipment, construction machinery, etc can greatly affect the profitability of a project. Therefore, it is a critical issue when terminating a project how such resources can be used.

(2)INTELLECTUAL AND TECHNICAL RESOURCES

A) ORGANIZATION OF PROJECT DOCUMENTS

Organize project documents so that others can read and understand them, such as contracts, specifications, drawings, cost data, material quantity data (BM / BQ), driving data, progress record, minutes, and issues incurred and solutions. Follow guidelines for organization, if any.

B) ORGANIZATION OF INTELLECTUAL AND TECHNICAL RESOURCES THAT ARE GENERATED WHILE IMPLEMENTING THE PROJECT

It is critical to organize information in order to re-use intellectual and technical resources that are generated while implementing the project such as technologies, how to advance projects and methods of construction, and to generalize them as much as possible so that they can be transferred for use in other projects. As mentioned in the preceding section, standards play a great role in any organization.

Unlike material resources, software is easily subject to recycling because it is never consumed or used up, while it is considered difficult to re-use software for other projects because it is dependant on the contents of design for individual projects. However, re-use of software (segmentization, standardization) is critical in light of productivity or quality improvement. Therefore, at a stage before design and production, measures for recycling of resources should be planned and practiced. Object-oriented design methods and programming are considered fit for re-use.

C) ACQUISITION OF RIGHTS TO INTELLECTUAL AND TECHNICAL RESOURCES

If another entity acquires the right to intellectual / technical resources originally developed for a project, license fee has to be paid for using . In the case of software development for example, when contracting, attention should be paid to ownership of the rights such as copyright, patent and license, and

the scope of their application. If necessary, contracts should be signed taking into consideration recycling of resources.

D) INFORMATIZATION OF INTELLECTUAL AND TECHNICAL RESOURCES

This is as described in "Stocking and Standardization of Resources."

(3)INFORMATION RESOURCES

Information resources of projects that are considered to be accumulated for future are as follows:

A) PROJECT INFORMATION

Documents concerning project information should not be simply filed but should be organized so that they can be read by other managers etc. and are re-used and referred to with ease.

B) PERSONAL RELATIONSHIPS BUILT WHILE IMPLEMENTING A PROJECT

While implementing a project, it is a fundamental requirement to contact and cooperate with many people such as clients, vendors, makers and contractors to advance operation. It can be beneficial to maintain relationships with capable people concerned not only for the current project but also other future projects.

C) UNIQUENESS OF REGION (COMPANY)

Information concerning the client with whom a project was implemented is a common asset not only for the project but also for enterprises that joined the project.

Efforts is required to convey the way of thinking, how to proceed with work, customs etc. concerning the client to those engaging with the client in the next project.

In projects implemented overseas (or locally with overseas clients), cultures, historical backgrounds, way of thinking are often quite different. Therefore, these must be clearly conveyed to achieve successful projects.

D) LIST OF PEOPLE CONCERNED WITH THE PROJECT

Informatization is a matter of course critical for projects, and information that has difficulty in expressing its explicit knowledge, needs a system where such information is accumulated in a form similar to a project database and people can ask those who have experience. This relates to human resource database.

E) UTILIZATION AS IT INFORMATION

As mentioned in "Recycling of Intellectual, Technical, and Information Resources," for intellectual, technical and information resources, it is necessary to prepare a system that enables easy search and access using information technology. It is desirable to build a system that allows access to and use of a resource database through internal intranet, which is a fundamental resource.

- Examples of Resource Accumulation

(1)LESSONS LEARNED (MATTERS AND LESSONS LEARNED THROUGH EXPERIENCES)

Many precious experiences obtained through accomplishment of a project should be handed on to similar future projects and be used for improvement of performance for implementing a project, e.g., by holding a review meeting when the project is finished. Items for examination should include matters that resulted in success or failure of the overall project and should be documented accordingly,. Concerning matters that resulted in failure, the examination should not aim to pursue responsibility but to clarify their causes.

Results of such examination should be compiled, e.g., in the case of plant construction type projects, by management, engineering, procurement, work, control, trial operation, and delivery, or by sector, to make them as common resources for the company.

This aims to use various experiences and understanding obtained through project accomplishment for improvement of organizational capability to implement projects without limiting them only to the project or individuals engaged therein.

(2)ACCUMULATION OF PROJECT DOCUMENTS

In some cases, enterprises build up great assets by storing documents on all the projects they have so far carried out. They used to keep such documents in paper, but they now store them in electronic media

using information technology so that they can be readily accessible. Such systems are effectively used to utilize past experiences when implementing similar projects.

Case ◆ Summary of Project Know-how

An engineering company compiles project know-how as a database titled as "What to Do in Such Cases" in order to hand over experiences obtained through implementation of projects to project managers and key staff.

This company, in the project performance manual, decided to hold a meeting for lessons learned whenever each project is terminated to accumulate experiences learned through projects as know-how. This summary of project know-how is itemized by pre-contrast, execution, turnover, etc. for both domestic and overseas project in consideration of being easy-to-use.

● Intangible Assets

Among the accumulated resources, the intellectual resources and information resources are significantly valuable as intangible assets. This use of them has recently been positively promoted. Intangible assets are generally defined as those calculated by deducting the amount of tangible assets reported on the balance sheet from the aggregate market value of stocks of the company. For example, Kunio Ito made a trial calculation [(2)] of the change in ratio of intangible assets to firm's value as shown in the table below.

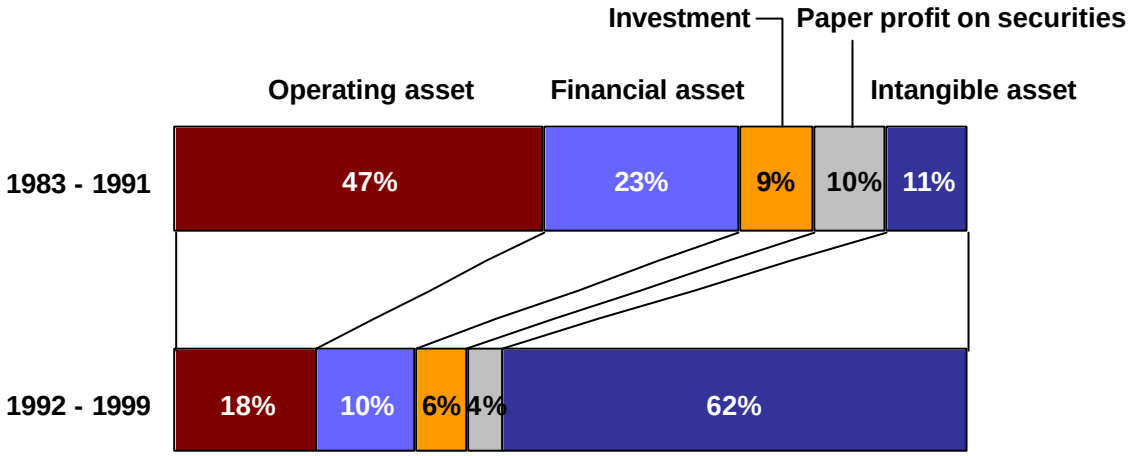


Figure 4-6-6: Change of Asset Composition of Value Creating Company

The figure indicates that the intangible assets have produced most of the recent company value. Project productivity can be improved and company value can be created in terms of intangible asset by resource management of projects, especially by accumulating and recycling intellectual and information resources. In general, intangible assets comprise various elements. The typical elements are as follows.

- Intellectual asset: human asset, research and development capability, and license (patent, trademark, etc.)
- Customer asset: customer database, trusting relationship with customers
- Brand asset: product brand and corporate brand

All such elements are included in the general examples of resources shown in Figure 4-6-3, which indicates that resource management and intangible assets are inseparable.

As shown above, intangible assets are becoming a principal factor that determines the company value. On the other hand, management of intangible assets has been considered to be very difficult because of lack of methodologies to manage intangible assets and quantitative evaluation values to sustain the methodologies although intangible assets are recognized as resources. It seems that management of intangible assets will become possible by calculating evaluation values based on the information base shown by the information management by using the concept of resource management shown in this chapter as a basic methodology.

Case ◆ Brand Economics

For brand assets that have been considered to be most difficult to be evaluated quantitatively among intangible assets, a model that enables quantitative management has been proposed recently. "Brand economics" is a model to devise brand strategies by combining brand information with EVA. (It is a method evolved by Stern Stewart, a U.S. consulting company.) Many such models seem to be proposed from which the most useful one can be chosen in the future..

Outline

Projects are accompanied by uncertainty as their basic attribute which always contains risk, and, if no measures are taken for dealing with risk, successful results cannot be obtained from projects. In this regard, it should be understood that risk can be managed to some extent. Compared with Europe and the the U.S., due to its historical and cultural backgrounds, Japan is said to be behind in risk prediction, risk control and countermeasures, and risk management as an important aspect of project management.

This is attributable to the fact that large-scale state projects are based on the national budget for each single fiscal year, so risk management over the project life cycle has not been required. Further, accountability to stakeholders was not so seriously required in Japan because projects under fixed-amount contract type agreement (lump-sum contract type agreement) have been the norm, rather than actual-cost-amortization type agreement and unit-price agreement type projects, which are popular in the U.S. and Europe.

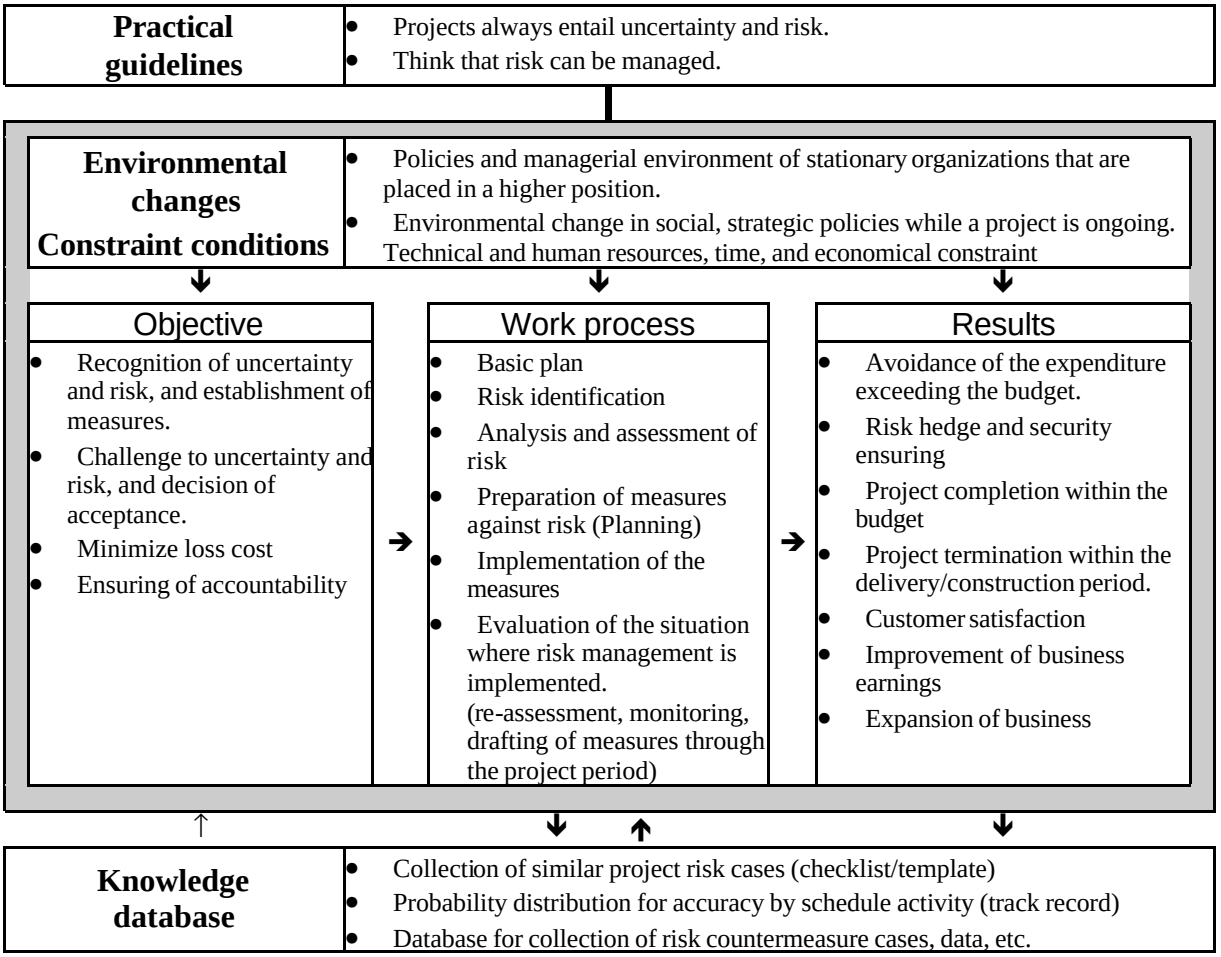


Figure 4-7-1: Overview of Risk Management

In such circumstances, measures to deal with risk has not been valued in enterprises and as a result, great risks have been tolerated. However, in the modern age, characterized by fast technical innovation; increasing demand for financial reform in state and private-sector projects; reduced project timescales and budgets; and intensified competition, the demand for accountability is expected to become increasingly strong. In this sense, more extensive use of risk management is considered inevitable.

Chapter 2, "Project Finance Management" also describes arrangement of the scheme for reasonable risk sharing and reduction among project stakeholders. This Chapter (7), explains practical basic knowledge and methods for managing risk in any project situation. In projects, implementation of risk management leads to control of many risk events and may lead to realization of an opportunity that enables better results and development.

Risk management starts with drafting a risk management policy for the relevant project based on the environment where the project is placed, such as project policy (plan, contract). Then, risk events are

identified by analyzing the constraint conditions and uncertainty that are included in the overall project policy, agreement documents, etc. Through quantitative analysis and assessment, countermeasures are prepared, they are implemented and the status of implementation is assessed and monitored throughout the project lifecycle.

These are principally performed repeatedly, not only once at the initial stage of the plan. In the same way as seen in other practical areas of project management, the lessons on risk learned in this process have to be arranged and utilized by creating a database. The knowledge on risk management thus learned should be used through integration as practical skills in the phases of project planning and implementation.

1. Basics of Risk Management

● Essence of Risk

Risk refers to an uncertain event that affects the objective of a project that is about to start and includes results and extent of influence it may cause. Such results and influence do not necessarily mean unfavorable ones but risk may bring favorable results. Uncertainty surrounding a project is classified as shown in Figure 4-7-2.

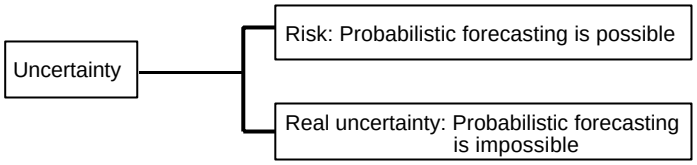


Figure 4-7-2: Uncertainty

As shown in Figure 4-7-3, risk is also classified into various types from diversified viewpoints such as internal risk, external risk, dynamic risk, static risk, pure risk, and speculative risk.

Internal risk:	Risk within the scope where a project team can extend control and influence. (risk on personnel securing, cost estimate, etc.)
External risk:	Risk out of the scope where a project team can exercise control and exert influence. (risk on market trends, government policy, etc.)
Static risk:	Risk related to acts of God, or damage caused by human error and crime.
Dynamic risk:	Risk related to changes, particularly changes in human desires and development of machinery and organizations.
Pure risk:	Risk in a case that has no interest but damage only.
Speculative risk:	Risk in a case that has both interest and damage.

Figure 4-7-3: Examples of Risk Definitions

In addition to the above risk definition, it should be understood that a risk chain between direct risk (peril) and environmental factor that incurs risk (hazard) could cause a serious problem in project management.

Case ◆ Risk Chain

To take an example from a traffic accident, a combination of "overspeeding (peril)" and "frozen road (hazard)" constitutes a risk chain and could cause a serious accident.

In implementing projects, risk classification from the standpoint of what risk has occurred for what reason and what measures should be taken is useful for risk management as a tool for specifying risks that are classified based on experiences by business type.

As examples for the above, risks surrounding projects are classified into 9 categories as shown in Figure 4-7-12 (P.151). However, in the process of actual implementation of projects, there are risks due to uncertain factors such as drastic changes in political situations, economic environment, or technical innovation, or risks attributable to corporate capabilities such as personnel, technical and procurement aspects, and a risk chain as mentioned in the preceding case may occur at each stage of project implementation.

Meanwhile, risk management focuses on how, in uncertain conditions, to maximize controllable regions, to minimize uncontrollable regions where relationship between causes and results is unseen, and how to make decisions that bring favorable results. Thus, this is different from finding solutions for problems incurred or issues in achievement of goals.

● Basic Concept of Risk

■ Optimization of Basic Elements of Risk

Risk consists of a result expected to obstruct achievement of the final objective of a project (a qualitative / quantitative event or situation such as loss, accident, and disadvantage, which has a possibility to work as a change) and probability of the occurrence of such results. Risk also refers to issues that arise in a project, such as "Is this project completed by contractual delivery or construction period?", "Is the project achieved within the budget?", "Is security for project team members ensured?" and "Will deliverables of the project assure predetermined functions and quality?"

There are three basic elements for risk.

1) Risk event
2) Risk event uncertainty and probability
3) Impact of risk event (Amount at Stake)

Therefore, the risk can be shown conceptually with the following function:

Risk = f (risk event, uncertainty <probability>, impact).

■ Nature of Risk in the Project Life Cycle

Nature and contents of risk vary depending on how to recognize project life cycles (see P.145) and greatly differ according to contents of projects.

The risk in the life cycle of a project for ordering construction of facilities has natures as shown in Figure 4-7-4. Risk events and opportunity-bringing events at the beginning of a project will decrease as the project proceeds, but impact of risk events (damages caused by the occurrence of risk) will increase as the project comes near termination (completion, delivery). In other words, a planning stage is a "period with many risk events" and a stage of completion or delivery is a "period with great impact."

If countermeasures against immature portions in planning a project or setting up its requirements are found insufficient as a result of evaluation that is made at an initial stage of a project based on risk management including risk specification and quantification, it will be easily understood that the impact from the occurrence of a problem will become greater as the project proceeds. In the case of ordered projects, it is characteristic that total risk amount (theoretically, total direct and indirect expenses that will be needed when a project is interrupted or is not delivered as scheduled) and a possibility to bring opportunity (bonus, incentive, increase of added values through ingenuity and device) are defined through contracts or other, and relevant risks are examined at an initial stage.

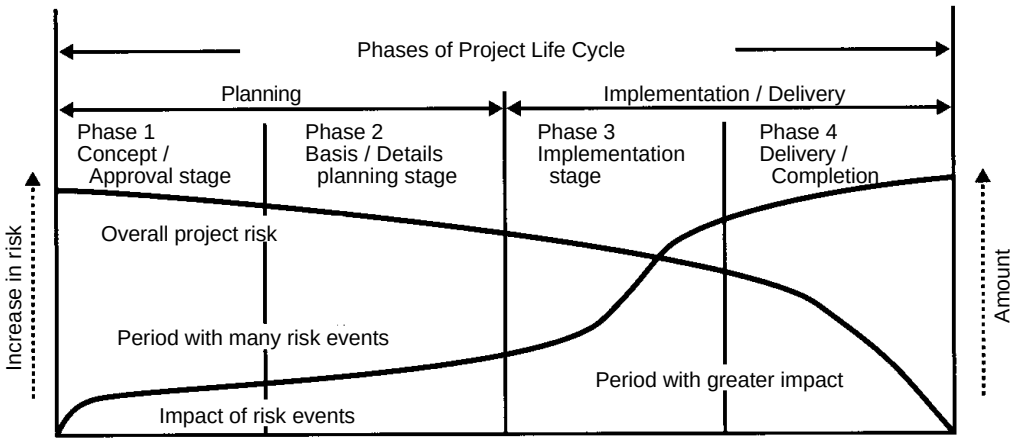


Figure 4-7-4: Nature of Risk in the Project Life Cycle

Note: The above figure shows a project life cycle consisting of several phases and the status of risks during a period from the start of the project with RFP (Request for Proposal) as development of them, until its termination with delivery.

When a development project to develop, produce, and sell products is considered as one project, natures and contents of risks are different in each phase of the project's life cycle consisting of product development, production and selling. In the development phase, risks have a great theoretical value but the majority of actual risks is comprised of resources mobilized (such as human resource and funds) and this increases step by step with the lapse of time.

On the other hand, technical development and facility construction to manufacture products being developed are started in consideration of the level of product development, and become considerably

different from components and contents of risk events. The stage to sell produced products has also a different phase, so new risk elements will appear such as market risk and interruption of supply of raw materials. In projects to develop and manufacture products, total risk is the sum of absolute quantity of mobilized resources (human resources and funds) and direct / indirect expenses in the case of accumulation or interruption. This constitutes the impact of risk events but is premised on the acquisition of an opportunity that exceeds such impact as expected profit from product sales.

Meanwhile, when construction projects are seen from the standpoint of clients, projects are considered to have a longer life cycle and a series of activities such as development, construction, operation and management is recognized as a project (e.g., in the case of business right contract such as PFI and BOT, the whole contract period including an operation period is included in the project). In this case, natures and contents of risks and their impact changes in each phase of the project life cycle.

Figure 4-7-5 shows the nature of risk when a project life cycle is comprised of multiple and different phases. For clients, risk is comprised of a phase where loan or construction agreement is concluded at a development stage and a framework to realize the case is formulated.

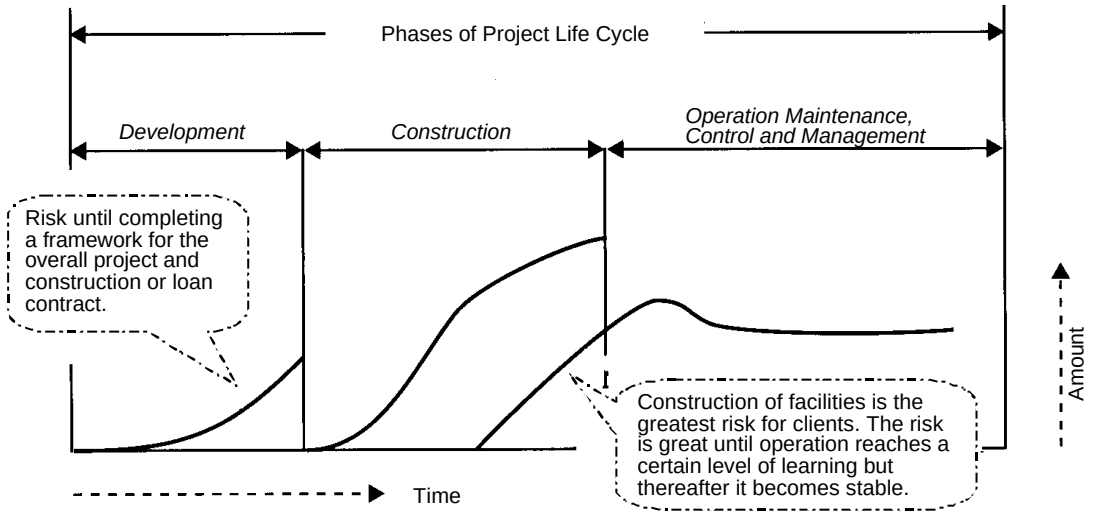


Figure 4-7-5: Nature of Risk from the Client's Viewpoint with a Longer Project Life Cycle

Note: The phase in Figure 4-7-4 is based on the development of the same risk events (homogeneity of risk events). The above figure 4-7-5 is comprised of risks different by phase (heterogeneity of risk events). In this case, total risk shows the integration value of the whole and each phase could overlap in part as layer during a certain period. Since the size of risk events is different depending on projects, the above figure 4-7-5 only shows a conceptualized image.

The impact of risk events increases through the construction phase, then decreased and becomes stable in the operation phase. (Similarly, for clients, the greatest risk element lies until their assets are surely built and the framework of the project is realized.) On the contrary, opportunity for clients means increase in profit in the operation phase, which depends on the quantity of funds needed for development or construction and the quality of operation and management. It is characteristic of a broader scope and width for determining opportunity.

Generally, in the case of development projects (development-type products to develop new products, or build a framework of the whole project such as project finance), uncertainty is high and theoretical value of risk is great at an initial stage. However, development is actually, advanced by managing resources (human resources, funds) mobilized for development, making phased mobilization into projects, and monitoring the extent of project actualization. Specification and analysis/evaluation of risks and countermeasures against risks should be examined step by step on trial and error basis. This is because actualization is planned in the process of development. However, considering a prolonged project life cycle, there is no change in the basic concept that countermeasures against risks are prepared at an initial stage of projects.

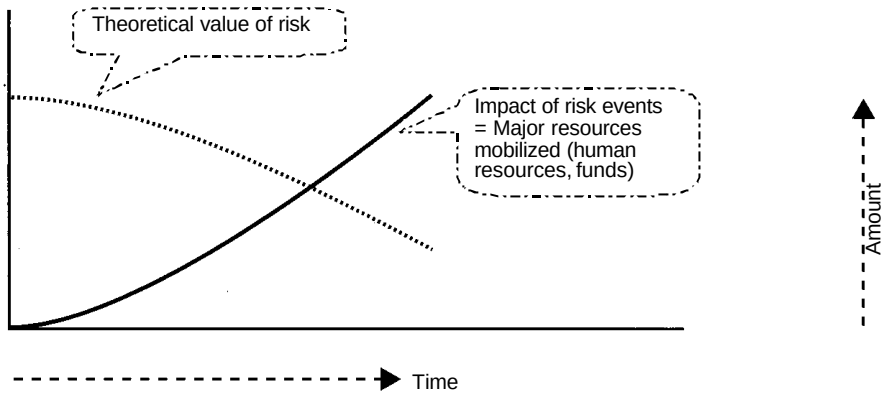


Figure 4-7-6: Development Risk Management in Development Projects

Case ◆ Risk in Power Plant

In the case of power plants, construction risk as a contracting constructor is as shown in Figure 4-7-4. Meanwhile, risk on projects from the standpoint of clients is as shown in Figure 4-7-5. The risk until completion of a contract framework or loan agreement is in proportion to the absolute quantity of resources mobilized. However, if a framework is fixed, a maximum logical risk value in future development is obtained at that point and detailed countermeasures against risks can be set up.

As far as construction is concerned, risks are principally as shown in Figure 4-7-4. However, in the middle of a construction period appears a risk concerning establishment of a system for operation (build up a supply system for power generation fuels, education for personnel, preparation for an operation system, etc.) Further, risk increases until completion, and continues to exist after completion until plant operation reaches a certain level, and in a stable operation period, risk is reduced to a certain level.

Risk events during an operation period consist of various elements. All interruption factors that cause trouble to stable operation constitute risk such as market risk, risk on interruption of supply of power generation fuels, accidents and force majeure events. However, contents of risk and status of impact are largely different those in the construction phase.

When the client considers the whole process including operation during a certain period as a project, it is appropriate to recognize risk events and evaluated their development for each phase. In this case, the greatest risk for the client in the life cycle lies in achievement of physical completion during a set period. Because once the facility starts operation, income-earning activity will be started and investment can be collected, but unless the facility is not completed, no income will be earned. It is also possible to consider that phased proceeding in investment collection will reduce the risk on the overall project. For the client, the greatest risk caused by physical damage at an operation stage is an accident that causes damage to the rotor shaft of the turbine. Because, this case contains a risk that if there is no preliminary machine, the project business itself may collapse since exchange of the damaged part will take a long period.

Case ◆ Risk in the Software Industry

It is no exaggeration to say that software is now related to development of every new product such as electric appliance. The average development period in high-tech industries is about six months. Although delivery periods are short but, in order to respond to the recent fast move in the world, the latest software must be used. As a result, development has to be made on the assumption of using the latest OS or chips that will be released later. Since built-in software is combined with hardware, in such environments for development, development is first made with hardware.

When development is started, the portion of software that depends on hardware is developed using software simulation, but when software is completed and the latest OS and chips are installed, the expected performance is often not demonstrated. In such cases, since hardware cannot be changed for solution, a direction to solve the issue by changing software will be suddenly issued, and as a result, the volume of software development becomes several times compared with the original plan. Since such phenomena will occur always in the latter part of projects, the will entail cost increase due to sudden personnel reinforcement or conspicuous influence on efficiency or quality, so that in some cases, products are recalled after released to the market.

Few companies draw up such scenarios or countermeasures from the beginning but most companies plan a project imaging an optimistic scenario, so that in most cases, a problem occurs "suddenly" and a project falls into an extreme confusion. Further, such experiences have not been accumulated and used as knowledge in the company, not a few companies repeat confusion on each occasion.

● Risk Management Core Process and Effectual Knowledge and Methods

The core process of risk management starts with drafting a risk management basic plan for the project and is as shown in Figure 4-7-7 below.

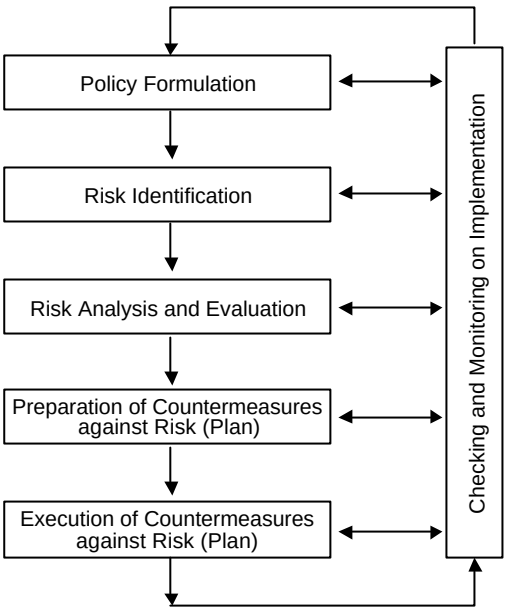


Figure 4-7-7: Risk Management Core Process

■ Policy Formulation

A process to set forth basic policies on methods and strategies for risk management in project implementation.

■ Risk Identification

A process to examine what risk sources or events exert influence on operation for project implementation and describe characteristics of risks in documents through brain storming and reviewing contracts and specifications.

■ Risk Analysis and Evaluation

A process to evaluate and quantify the probability and influence of events considered to cause risk and interaction between risks.

■ Preparation of Countermeasures against Risk (Plan)

A process to draft countermeasures including risk aversion, mitigation, distribution and transfer as means to maximize opportunity and minimize threat.

■ Execution of Countermeasures

A process to execute planned countermeasures. In risk management, checking and monitoring on implementation from risk identification to countermeasures execution should be made repeatedly.

● Basic Recognition of Risk Management Practice

Basic recognition of the following items is important at the start of risk management.

- Assumes that there is risk.
- Take countermeasures by reasonably identifying (predicting), analyzing and evaluating risks to the extent possible.
- Risk has a possibility of turning into an opportunity.

It is wrong to think, that risk aversion is inefficient because risk is uncertain and its identification is difficult. Those concerned should think that project implementation is always accompanied by uncertainty and risk management is inevitable.

2. Formulation of Risk Management Policy

● Clarified Policy for Enterprises / Executive Organizations

Top management of enterprises and executing units within enterprises should clarify basic policies and management systems for risk management. Then, they should determine who is responsible for management and maintenance of risk management systems in the enterprise or executive organization. For example, in a project including planning and execution / management, a meeting of "Risk Countermeasure Committee" consisting of those concerned with the project and experts, or "Risk Examination Meeting" is held. Then, standards and structure for management, e.g., verification of total risk amount and countermeasures periodically in a set method, should be determined.

● Formulation of Policy for Individual Projects

In individual projects, in accordance with the risk management policy provided for in formulating policies for the enterprise or executive organization, the project strategy and policy fit for risk management are formulated and clarified as a management brief. The project manager makes this policy and brief well known to those concerned with the project to make them effective, and implements the core process of risk management in the next phase.

3. Risk Identification

This process identifies as many risk events as possible that should be managed in a project. Risk identification is to analyze "What will occur" and "How and why it will occur."

● Basic Information for Risk Identification

In risk identification, with understanding of the concept and basic knowledge of risk, the following requirements, which are included in the policy, plan, contract of a project, are examined as basic information or sources of risk. Descriptions in the parenthesis show examples.

1) Strategic policy (What is determined as a strategy when a project is started? etc.)
2) Restriction on country and culture (Problems arising from difference in the county / culture of clients and other stakeholders, etc.)
3) Customer satisfaction (What is the project objective? What is an interruption factor? etc.)
4) Contractual restriction (What is an issue on contractual items that has difficulty in implementation? etc.)
5) Policy of the organization (What is the problem arising from the project organization or corporate organization? etc.)
6) Restrictions on requirements (Items with possibility of becoming a problem on requirements such as basic design conditions)
7) Technical restriction (Is new technical element included?, Issues on specifications required from customers and quality, etc.)
8) Restriction on time (Where is difficulty concerning the schedule? etc.)
9) Procurement policy and plan (Selection of vendors and external designers and determination of their performance, etc.)
10) Economic restriction (Issues on cost totalizing when receiving orders, restrictive conditions, etc.)

Sources identified above, complemented by experiences from similar projects (human knowledge) and past information from feedback data (DB), are used as a basis for risk identification

● Methods for Risk Identification

Any sign appears before various risk events occur concerning a project. Therefore, it is critical to perceive such signs at an early stage and take measures. The following are major tools and techniques for analyzing such signs. For details of the following, refer to the glossary attached at the end of this book.

1) Check list Method
2) 6W1H Method
3) Brain Storming method
4) Tree Analysis
5) Interview with Intellectuals
6) Review
7) Delphi method

4. Risk Analysis and Evaluation

● Basis for Risk Analysis and Evaluation

The intention of risk analysis and evaluation is that decision makers in program management use them as means for selecting appropriate policies by predicting and deciding uncertain issues through quantification of positive and negative events for projects, which are expected to occur in future, by mainly using basic methods of probability and statistics.

Many risk events in projects subsist in various fields such as advanced (novel) technical field, technical development, engineering, marketing, finance, and project organization. Experts engaged in these fields with high ability in many cases have no basic knowledge of project management and occasionally make wrong selections due to a poor decision-making process resulting from the organizational influence. Many enterprises and organizations stick to precedents in decision making itself, and cannot respond to the trend of the time, relying on unscientific systems. Results of such risk analysis and evaluation extend great influence particularly on cost, schedule, and quality.

Risk analysis is to make decisions on risk and uncertainty by a method based on mathematical, logical thinking. The greater uncertainty is included in a project, the more reliable risk evaluation is required.

● Risk Quantification Method

Risks should be quantified and evaluated. This section describes typical methods of quantification. Calculation for risk quantification serves as a guideline for evaluation of impact of risk events.

■ Simple Quantification

This is a method for recognizing risk events using indicators as seen in a matrix based on the possibility of occurrence and the size of impact. However, in this method, the quantity of project risk is not calculated as monetary value, or neither comparison between risk events nor the total risk quantity can be recognized. Indication by point is useful for recognizing overall project risks, e.g., which risk event should be paid attention, and examination of risk countermeasures.

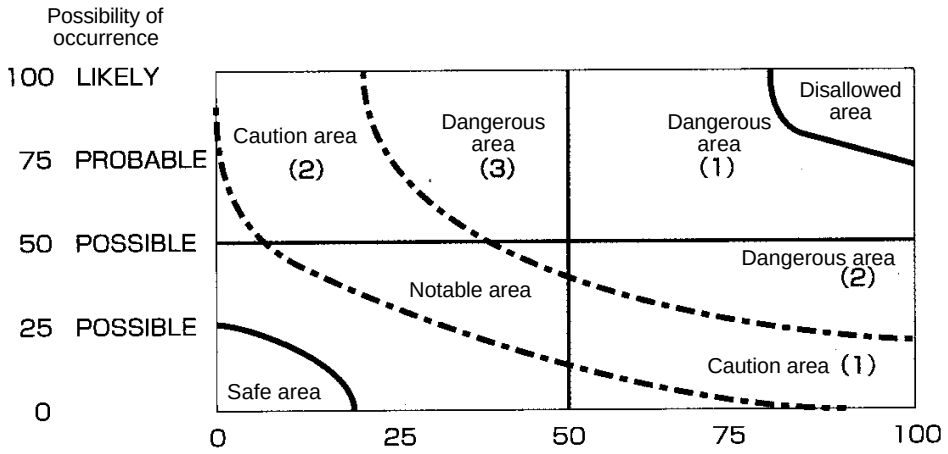


Figure 4-7-8: General Evaluation of Risk Events

There are also various methods similar to the one in the preceding paragraph, which include indication of points with a matrix table consisting of possibility of occurrence (probability), comparison of risks by project, and evaluation of project risks.

Note: Standards for deciding impact should be set forth by integrating standards for each business unit.

■ Evaluation of Monetary Value of Risk

Evaluation of the monetary value of risk is obtained from the following formula:

Total risk amount = Σ individual risk amount = Σ [Uncertainty (probability) × impact (monetary value)

- Uncertainty: Estimate for probability of occurrence of each risk event
- Impact: Amount of influence when each risk event occurs (profit or loss)

Further, evolution of the monetary value of risk is useful as a means of decision making under uncertainty. When there are some options for the same event, the sum of probabilities for the occurrence of each event amounts to 1.0 on the theory of probability. Using this basic principle, scientific decision making becomes possible based on the logic tree of options (decision tree). The product of probability (possibility) and monetary value (amount of result) is called "expected monetary value (EMV)."

Case ◆ Logic Tree Leading to Decision Making

The logic tree (decision tree) depicted in Figure 4-7-9 shows a case where Company A has options for producing a system -- whether to produce the system in the company by purchasing relevant software or outsourcing the production to a contractor. In this case, decision is made by predicting probabilities of favorable and unfavorable future scenarios of the market, amounts of results (profit) for each scenario excluding software purchase and outsourcing costs, and calculating EMV.

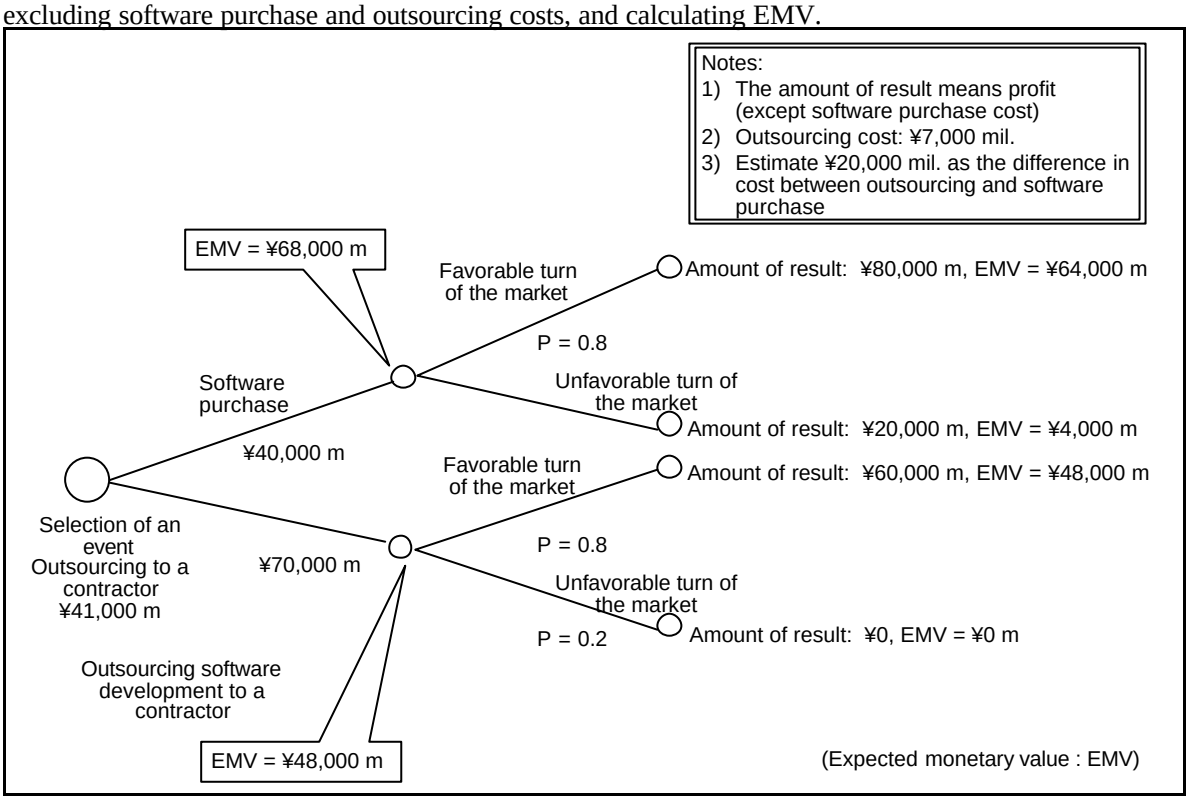


Figure 4-7-9: Logic Tree (Decision Tree)

■ Method with Statistics and Simulation

For estimating the total cost of a project, the range of prediction for the total project cost can be obtained based on the cost predicted through individual item estimates using a method of calculation used in statistics. In this case, the method of calculation for probability distribution is used.

In analysis using simulation, modeling is made by selecting risk events and estimating the probability of occurrence for each event. In modeling, trial run is conducted with PC software etc. that is based on the Monte Carlo method by utilizing past performance data and probability distribution by the nature of risk events (Uniform distribution: when no information can be obtained concerning events, Normal distribution: natural phenomenon, product errors, etc., Triangular distribution: when the probability of the occurrence of a certain value is high between the maximum and minimum values) and by estimating the impact (monetary value, schedule, etc.) when a risk has occurred using parameters as well such as maximum and minimum values in accordance with the distribution type. Decision is made by analyzing the result of this.

5. Preparation of Countermeasures against Risk

Risk prevention is to take necessary countermeasures in accordance with the order priority to reduce or eliminate risks analyzed and evaluated in a project. Risk prevention is classified into the risk control plan for risk aversion, mitigation, distribution and transfer, and risk finance for financial approach to risks that have difficulty in complete elimination even with above means.

● Composition of Risk Countermeasures

As shown in Figure 4-7-10, risk countermeasures are roughly classified into risk control plan (risk aversion, mitigation, distribution and transfer), and risk finance (risk transfer, risk holding).

Risks that are not subjected to aversion, mitigation, distribution or transfer by the risk control plan or cannot be dealt with by the risk finance are held in the project as risk. If a troublesome risk event occurs when implementing a project and any appropriate countermeasure is not found, workarounds are required.

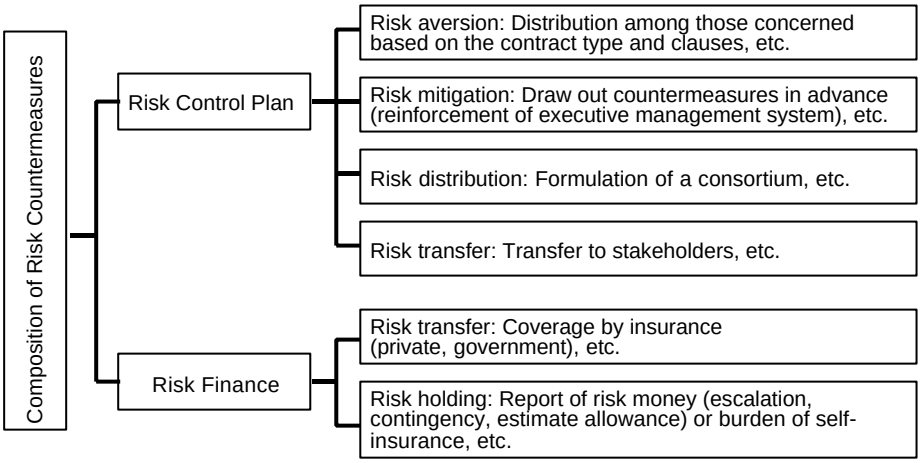


Figure 4-7-10: Composition of Risk Countermeasures

Risk coverage expense that is accounted for in the estimate for a project to take measures against this risk holding is risk money, which is, as shown in Figure 4-7-11, classified into three categories: escalation, contingency, and estimate allowance.

< Escalation >

Preliminary expense to be included in the estimate in advance for adjustment to prepare for a case where cost to implement a project changes after the initial estimate due to an uncontrollable market factor, and a difference is expected to occur between the initial cost and the final cost when the project is completed.

< Contingency >

Risk preliminary expense to be included in the project budget to prepare for a potential cost that generally has possibility of occurrence but has difficulty in quantification at that point due to its uncertainty.

< Estimation Allowance >

Preliminary expense or preliminary quantity which clear recognition is difficult in specification or quantity when estimating the project cost, but it is included in the estimate by multiplying each item such as design, production and construction by a certain factor because it is surely expected to generate as cost.

Figure 4-7-11: Definition of Risk Money

● General Process for Devising Risk Countermeasures

Concerning general solution processes in projects for risk analysis evaluation and countermeasure determination, to take an example from project bidding, they are classified into the following three categories:

(1) Selection from alternatives

- Purchase from outside the company, in-house production, or leasing.
- Size and the number of facilities and equipment to be purchased.
- Best methods for using and disposing assets

(2) Value selection

- Value and elements of projects or new business
- Contract risk or estimate for project income

(3) Optimum value for variables

- Possibility of order reception and bidding amount for the maximum value arising from the reception
- Optimum composition and function of equipment and devices

6. Compilation of Lessons on Risk

Since projects have both temporariness and originality, risk management is diversified and difficult, and for that reason, such diversity and difficulty become inevitable management factors. Therefore, for effective advancement of program management, it is critical to utilize past performance data and make the best use of knowledge of experts and experienced personnel. To this end, a series of processes and results concerning risk management of individual projects should be organized and retained as lessons, case collection, and database. As preconditions for this, a system of knowledge database should be established in enterprises.

● Collection of Similar Project Risk Cases

When a project is terminated, results of risk management should be checked using the latest version of project check list (identified risk events) that is frequently revised and should be retained in an easy-to-use manner for subsequent projects.

● Probability Distribution Data on Accuracy for Each Schedule Activity

To raise the accuracy in schedule risk analysis, differences and fluctuations between the planning schedule and performance schedule should be statistically arranged and data on probability distribution should be retained. Similarly, it is critical to have basic data for proceeding with simulation analysis such as statistic analysis on project cost, without limiting to schedules.

● Collection of Risk Countermeasure Cases

As well as the collection of project risk cases, it is critical to prepare a case collection that has arranged countermeasures and lessons concerning their results and deliverables.

No.	Risk Category	Outline
1	Political and economic risk	Influence on the profitability of projects such as "Sharp fluctuation in foreign exchange" and "Development of inflation" due to drastic change in political situation or economic environment.
2	Social risk	Risk attributable to laws, license and permit, safety, infrastructure, labor conditions, etc. when implementing a project in a foreign country. This risk such as environmental assessment and citizens' movement also affects the schedule of projects in Japan.
3	Contract risk	Risk attributable to "guarantee against late delivery, guarantee for performance of a plant or system, payment conditions, insurance conditions, etc." out of the type and clauses of a contract exchanged with the client, vendors, and contractors.
4	Client risk	Risk such as friction with the client that occurs when implementing a project due to the difference in recognition which arises from little recognition of the client's idea, work system, project implementation method, technical level, etc.
5	Technical risk	Risk attributable to "insufficient capability" or "optimistic perspective" concerning the technology necessary for the project.
6	Procurement risk	Risk such as bankruptcy of vendors and contractors as suppliers, and defective function or late delivery of products (including systems) attributable to insufficient capability.
7	Management risk	Risk attributable to business management, operation, business policy, etc. of an enterprise.
8	Financial risk	Risk concerning debt collection, finance, and investment
9	Personnel risk	Risk concerning personnel securing and quality appropriate for the project.

Figure 4-7-12: Classification of Risk

Outline

In this chapter, we explain how information and information technology (IT) should be utilized in the work of project implementation.

In recent years many projects have become more creative and of a more complex system than before requiring the consideration of global environmental issues and the creation of business under an environment of global competition, etc. as well as the demonstration of results in a short period of time. Therefore, while it is a matter of course that a project should be put into practice efficiently, it is a must that not only the technology, knowledge and know-how of the organization of one's own, but those existing in the world at large should also be put to use as much as possible, thereby enabling prompt and appropriate decision making to be reached. What will exert great power in creating an environment to meet these requirements is the information technology (IT), which is also the objective of this chapter.

In this chapter, we explain the concept of information systems in relation to the project work, the function of information systems to be applied to the project work and the construction of project information systems.

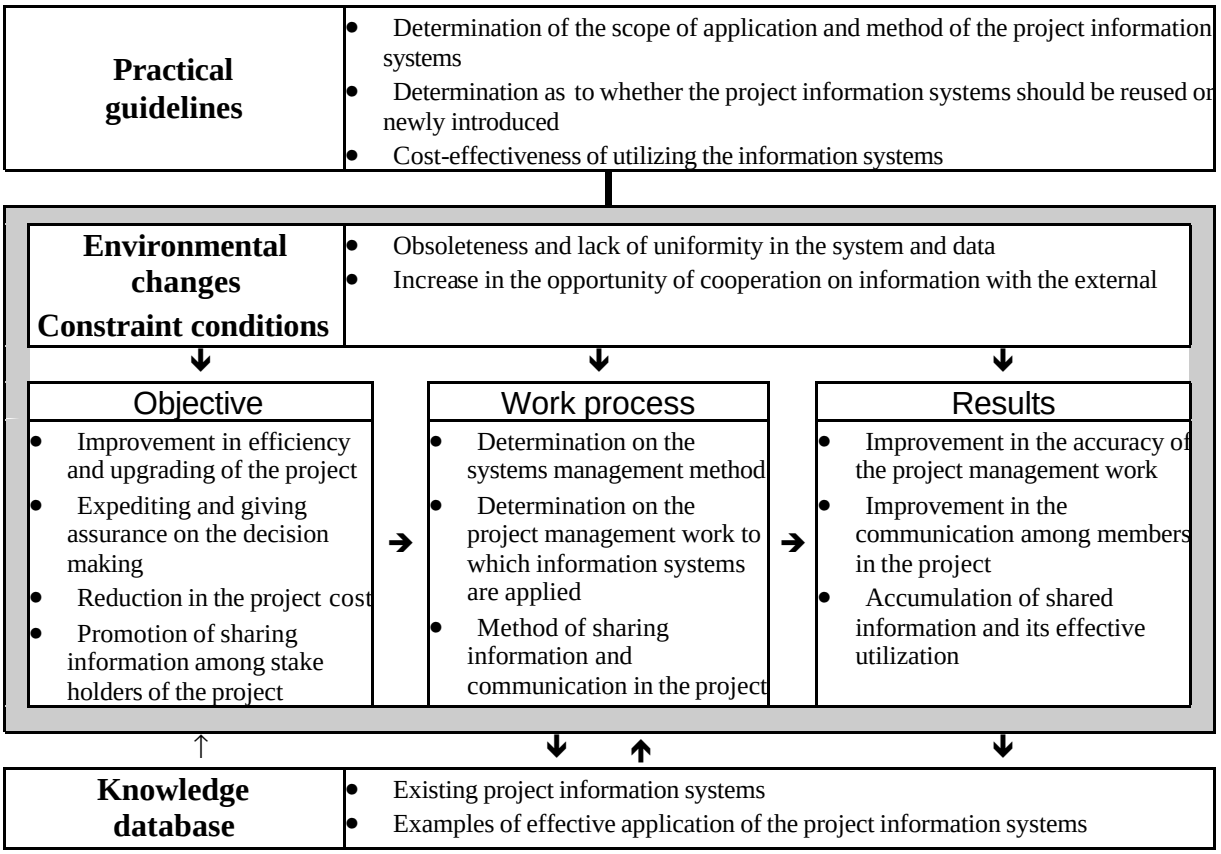


Table 4-8-1: Overview of Project Information Management

1. Information Resources and Project Management

● Information Resources and Intellectual Resources

For companies corporations, and business entities, information and use of it are, like bloodstream for the human body, important activities that decide their fate. It can be said that information management is an indispensable resource for facilitating visibility, sharing knowledge, promoting information flow, and quickly and effectively creating value and solving complex problems.

Information can be converted to intellectual asset through collection, processing, distribution, sharing, establishment of databases through accumulation of information and conversion of information to knowledge. Information technology serves as an important factor for the conversion.

● Information Management

Information requires freshness, quality, and sharing, and the cycle to maintain, evaluate, and improve this process is one of the important elements of the information management.

It can be said that intensive use of information and use of information technology for the purpose of solving problems are the most important aspects of information management.

● Project Management and Information Management

■ Project Implementation information and Management Information

Information about project implementation and management is indispensable for promoting projects as planned and achieving goals. It is no exaggeration to say that design of mechanisms to do so, which needs to be carried out simultaneously upon commencement of projects, determines the feasibility of the projects. Project management does not display its great force unless information management functions as expected.

■ Electronic Field that Connects Human System with Cultural System

Project commencement has another important aspect – creation of a personnel base that consists of human resources and teamwork as well as a cultural base that triggers creative ingenuity. It is information base and electronic field that heighten the synergy effect of personnel base and cultural base. In this context, electronic field means a global and open field that enhances communication and collaboration and creates knowledge.

2. System of Information and Structure of Project

● System of Information

The most important mission of information systems is to grasp the facts in every aspect of a project and support the communication among the people involved. Hence, the information systems have a mechanism to support communication.

For this purpose, it is important to design the system of information (see the Concept Schema on P. 158) so that the facts of a project can be grasped properly. Generally speaking, it is dangerous to accept the data specifications that are handled in the present organization or industry as they are. These data are designed for use for individual business purposes in many cases, and there often exist discrepancies, duplication or contradictions between the business tasks within the same organization. If the data on the same event are prepared and stored in duplicate or triplicate for different purposes, discrepancies will occur in contents depending on the different timing of preparation or different recognition of the people who collect the data, resulting in confusion in the people's recognition and decisions. It is desired that the data on the same event should be controlled collectively.

However, the organizational units have different roles, and they may collect and store different data based on different interests in the same event. In such a case, having grasped the relations between these data and having clarified the extent to which discrepancies may occur, it should be disclosed to the people concerned in controlling these data.

When designing the system of information, the distinction of primary data from secondary data is essential. Primary data are the data that represent the facts that occurred in the real world. When a fact occurred, observation is made, and the recording of primary data is made promptly, to store it in the database. Secondary data are the data that are extracted and processed from the primary data, and are prepared for specific purposes (introduced data).

It is particularly important to define the specifications of primary data. Primary data are the data concerning the "things" to be handled in a project and the "people", "organizations" etc. that are involved therein (called "entities"), and the data that represent "activities" or "occurrences", or the like (called "events") that cause a change in the state of entities.

● Structure of Project

The structure of a project is composed of the following cycles and processes, as defined in "Chapter 1 Project Strategic Management". The project is not performed independently in each cycle and process, but is performed while maintaining cooperation between them as well as with the management and with other sections, and also with other businesses (Table 4-8-2).

● Management cycle

- Program Management Cycle
- Project Management Cycle

● Project work process

The primary data specifications are defined in conformity with the work of each of these cycles and processes, and the information systems are constructed.

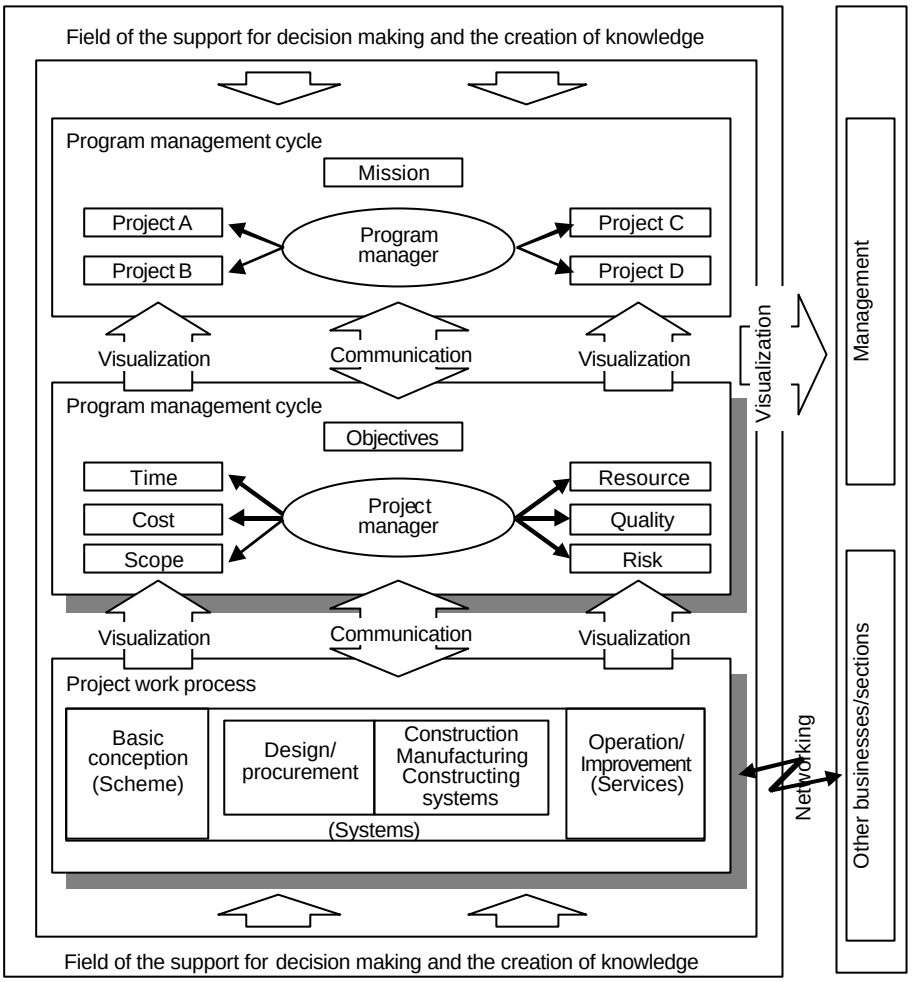


Table 4-8-2: Structure of Project Work

3. Types of Information Processing Functions and Relations (Conceptual Structure of Information Systems)

As described above, by classifying data in stages, the types of information processing functions and interconnection between them can be obtained. The conceptual structure of the information systems is as given in Table 4-8-3.

● Primary Database

The database for "entities", "events", etc. described in the "System of Information" above is the primary database.

As the primary data corresponding to "entities", there are "things", "people" and "organizations", and as the data items that give them the meanings, "specifications", "quality", "cost", etc. are incorporated. Also, as for "activities", which are the primary data corresponding to "events", data items of "plan" and "results" (time, etc.) are provided. Herein, it is not appropriate to handle "planned data" and "results data" as being of separate types. These should be controlled collectively in a group of data items for showing a specific "activity" (for example "placing an order"), so that the plan and the results can be compared.

When project activities are performed, the state of entities undergoes changes at all times. The mission critical application or logistics application reflects the change in the state to renew the contents of the database. Hence, by referring to the contents of the database, the up-to-date state of the real world of a project can be obtained. The database is used in common by the people concerned, including the project manager, as a means to grasp the real world properly.

In the "entities", there also are some abstract ones such as technical standards. Such technical criteria data are collected and accumulated based on the business know-how or technical knowledge that was acquired previously. If the project management is to be carried out smoothly, it is also important to accumulate the criteria data abundantly, enabling them to be referred to whenever there arises necessity.

● Mission Critical Application (Application Related to Fundamental Work)

A mission critical application means the application related to fundamental work such as sales the management system or accounting system, or the like, of which error in software or interruption in operation may have the danger not only of the stop of work but also of a huge amount of loss or a collapse of credibility, and for which extremely high reliability is demanded.

When it is used for the activities of a project, and at first if the objective fruits of activities are designed, or material or human resources to be procured are planned, then the "activities" plan is registered in the database. Next, "transaction data" are obtained to grasp the fact of "activities". Then, there must be a change in the state of "entities" in some way or other, as a result of "activities". And then, by means of the transaction processing function, the transaction data should be disassembled into the data that represent the change in the state of "entities" (normalization of the transaction data), and the data in the database representing the state of "entities" are renewed.

Since this part is closely connected to the practical work of the project, and is directly related to the control of all the activities, it belongs to the mission critical application, and generally is in the mode of on-line transaction processing (real-time processing). If the project activities are diversified and carried out in different areas under cooperation, it will become in the mode of diversified on-line transaction processing.

● Logistics Application (Application Related to Support for Work)

A logistics application means the application related to the support for work such as data analysis and task scheduling, which is not directly involved in the work processing and of which mission is "logistics (supply of provisions for military units)".

When designing the objective fruits (products) or services of a project, the activities for realizing them need to be planned. Also, equipment, machinery and materials required for the activities need to be supplied at the right time. If completely new products or services that have not been used before, these activities, machinery and materials must also be designed anew. But in many cases, project activities and procurement of machinery and materials are planned by referring to the technical data (technical standards and others) and cost data of the products and services experienced previously.

Therefore, elaboration is needed to devise these plans. A mere listing of activities to be carried out will not satisfy the required delivery date. There is a danger that implementation would be made impossible as a result of many pieces of work converging in a certain period. In order to meet the delivery time or milestone date, elaborate work need to be done concerning the synchronization, performing in parallel, surpassing, etc. between the items of tasks in the project activities. Also, the range of

fluctuations should be suppressed as much as possible, in order that the high-priced machinery and equipment as well as workers can fully be utilized. It is essential to adjust the schedules so that there may be no idle time of workers or machines.

Such a processing belongs to the "logistics application". Many software packages that are sold on the market regarding project management, and on the scheduling, in particular, are used for this part. The purpose of making plans using these packages is to provide necessary labor forces, machinery, materials and others at the right time, thereby ensuring the intended project activities to be carried out at the right time.

● Data Extraction, Distribution and End User Computing

The mission critical application and logistics application correspond to the fundamental part of the project management. The data concerning the "entities" and "events" that have been accumulated in this fundamental part are collected based on the roles and interests of the user, forming the user's database (information services). The user extracts and processes these data by him/herself, taking out the desired data and using them. This is called the end user computing.

Those incorporated as the end user computing are the applications for grasping and evaluating the results of project activities and the appropriateness of the processes, which are exemplified by the cost management, quality management, and others. Therefore, common know-how on the management needs to be incorporated in the part for collecting as the user database the data that are suitable for these objectives.

By means of the end user computing, the data become the "information" that fit the objectives of use by the user. However, misunderstanding may occur if the meaning of the original data is not understood. It is essential to check the meaning of the data by referring to the specifications of primary data.

In Japanese businesses, it is a general practice that information service and end user computing are collectively called the "system of information". In order to ensure that end user computing is successfully implemented it is preferable to use off the shelf packages rather than investing in the development of specific applications for this purpose.

The requirements on information of the user change rapidly. The project manager also requires information of a high grade as his/her techniques and skills are improved. Therefore, if such programs for providing information are developed, there will occur changes and expansions frequently. Even the user makes a request for immediate supply of information, it will not be available until the information systems personnel make a change, with the result that there will be frequent cases of being unable to keep up with the solving of problems. For this reason, the development of programs should be spared by means of the end user computing that employs the existing package software for data extraction and distribution.

Also, the way of contact between the user and the computer heretofore was made by the method of fetching information by the user (Pull type). With this method, there arises the problem that important information of a project may not be conveyed promptly, being affected in many cases by the IT literacy of the individual user. To prevent this, it is desired to change it to the method of delivering information by the computer's side (Push type). By using the agent technology which is one of the latest information technologies, this can be realized, and a system that can be put into practical use has also appeared.

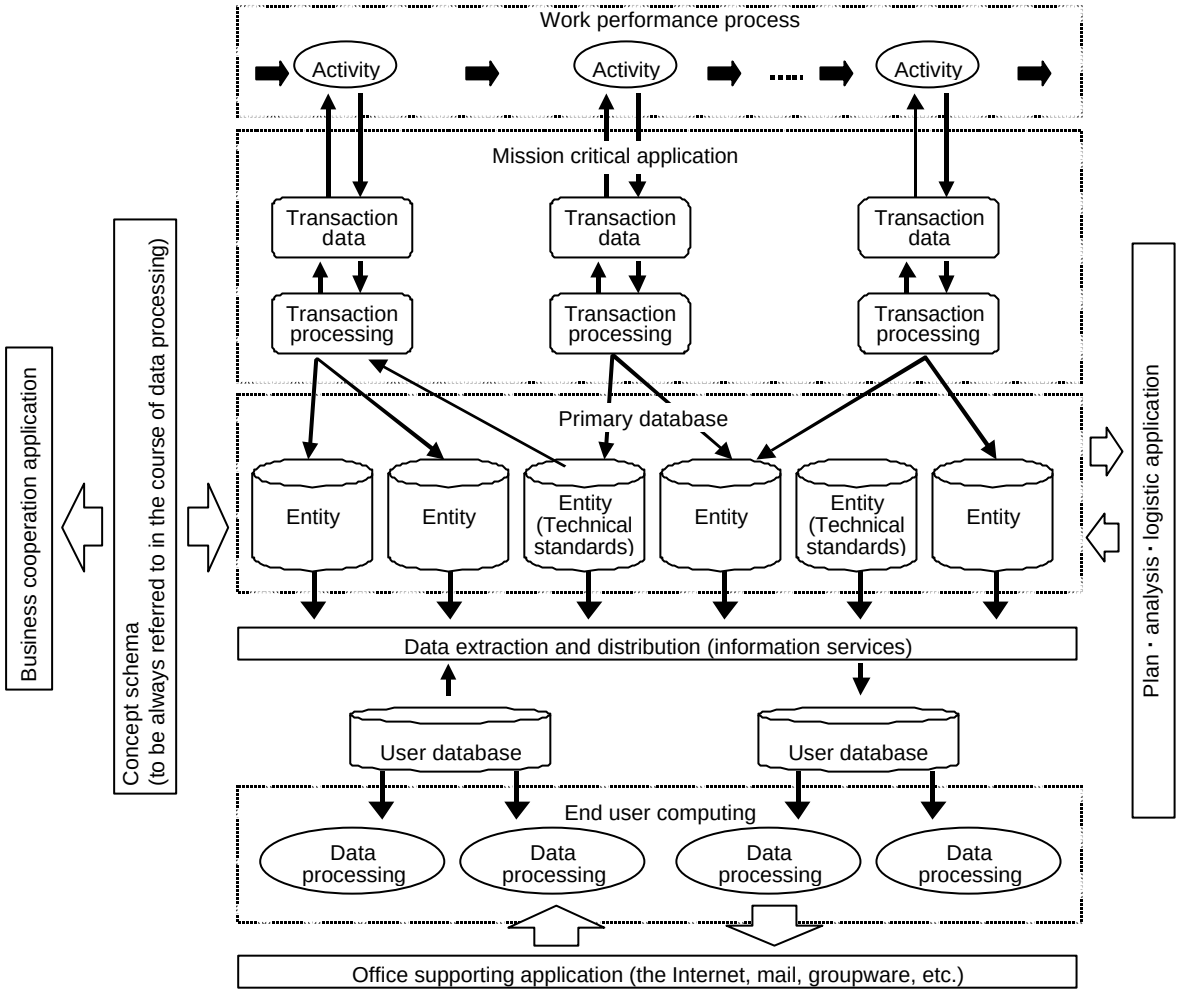


Table 4-8-3: Concept of Information Systems

● Concept schema

When developing information systems, it is a general practice that the real world as its object is described as the structure of data. Such a way of thinking and structure are called the "concept schema" in the field of software engineering. As shown in Table 4-8-3 on the preceding page, this concept schema is repeatedly referred to in the course of information processing in order to interpret the meaning of data.

What is defined and registered as the concept schema, is the type of that which exists in the real world (entity) or what will appear in the future, the type of activities performed or occurrences, and the relations between them. The concept schema becomes the business model of the project activities. Of course, the contents of concept schema may vary substantially depending on the business mode. Shipbuilding and bridges are different, and the development of pharmaceuticals and the software development are different in nature. But when being seen as projects, there also exist common parts to a considerable extent.

Meanwhile, computer programs are the methods of calculations of data processing (algorithms) described in computer languages. The program structure is backed by software engineering, and is designed based on the data structure. Therefore, if the data is designed and accumulated according to the concept schema, then the structure of information systems must reflect the structure of the real world, with its complexity being kept to a minimum.

But the data specifications of the package software and the like being sold on the market do not necessarily match the concept schema of a project. In order to adjust the discrepancies of the data specifications, data processing modules or others need to be incorporated for each project or business, which makes the structure of information systems a bit more complex.

● Office Support Application

In project activities, information such as writings or drawings of indefinite format, or the like are handled frequently. In order to exchange such information, software such as electronic mail, groupware, the Internet, intranet, etc. is utilized. Accordingly, it is desired that office information processing systems should be put in order as the Infrastructure to support project activities.

The construction of office support applications is not accompanied by any specific "software development" in many cases. By introducing and installing software tools that are sold on the market, they can be put to use at once.

However, there is a trend that after a while, some kind of software is likely to be incorporated anew. For example, some software executes the circulation of documents for approval or the making of a report on the work results, or the like by the use of work flow software. Besides, it has also become the general practice to execute the application related to fundamental work or the application related to information by calling it from the office support application. An example of this is the ebusiness by means of the Internet.

However, the tools of office information processing has been developed by aiming at free exchange of information, there is a danger that some malicious act or accident may cause an invasion into the office support application from the outside, or a destruction or capturing of data. A mechanism to cope with such a threat needs to be incorporated not only in the office-related application, but in the fundamental work-related application as well.

● Business Cooperation Application

As a result of the progress in information technology, it has been generalized to construct applications to support business cooperation among businesses, and they are used in common by multiple businesses. It started long ago as VAN (Value Added Network), followed by the appearance of EDI (Electronic Data Interchange) and externally connected systems of financial institutions, and now portal sites that aim at the creation of various markets have emerged.

These business cooperation applications seem to be convenient, capable of being easily utilized in project activities, at a first glance. But it is only an appearance, and unexpected damage or losses may occur unless an internal checking system or fundamental work-related systems are firmly established.

In the process of project activities, there are so many highly uncertain elements, such as an occurrence of unpredictable circumstances or issues that are undeterminable until the distant future, or the like. To prevent these from leading to the business trouble in the future, mechanisms and rules of business cooperation need to be incorporated in the information systems.

4. Project Information System

Based on the aforesaid conceptual structure of information systems, explanations of the overall Project Management Information System (PMIS) are given below. Table 4-8-4 shows the composition of the project information system.

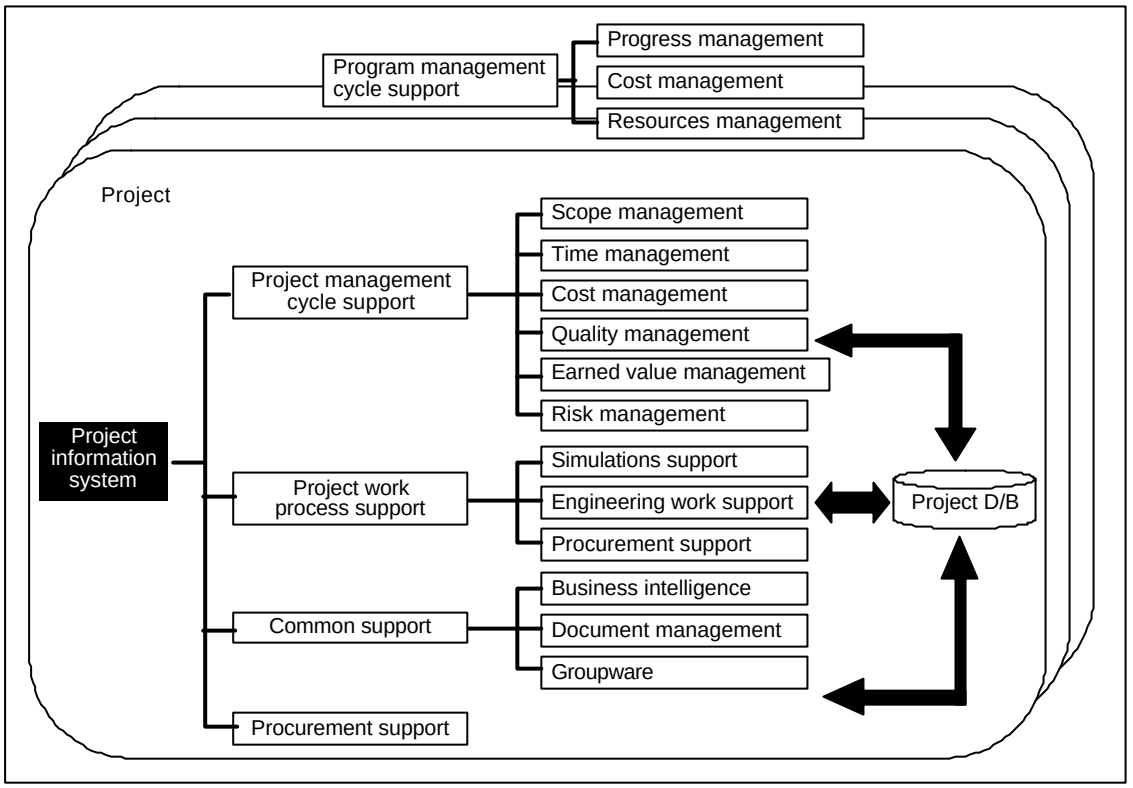


Table 4-8-4: Project Information System Functions

● Program Management Cycle Support Function

The program management cycle support function is the function to support the management to maximize the results of multiple projects. To put it concretely, supporting information and analysis tools are provided for the decision making such as determining the priority of projects, interrupting a project and concentrating resources on a specific project where necessary, and initiating a new project.

This function is composed of the following 3 main functions.

(1)PROGRESS MANAGEMENT

It provides the function of monitoring the state of progress, risk, important problems, and the status of action, as well as the function of managing the state of progress of multiple projects as the comparison of forecasts and results. By means of this function, the manager can grasp and evaluate the state of progress, problems, etc. of each individual project or multiple projects, in the form of unified information and reports.

(2)COST MANAGEMENT

It provides the function of monitoring and analyzing the cost planning, results and forecast of each individual project, as well as the function of summarizing the cost information of multiple projects according to the management purpose.

(3)RESOURCES MANAGEMENT

It provides the information for performing resources management for each program management section, by grasping the management information of material and human resources for each project unit or for multiple projects.

Example ◆ Setting up a specialty section for project management

An information-related corporation set up a specialty section for project management, which summarizes the state of progress of each project, and indicates the state on a large screen display unit, thereby allowing all the people concerned in the section to grasp and share the state in carrying out the management work

● Project Management Cycle Support Function

The role of information systems in project management is to support the processing of each management work, and to enable the objective of each management work to be attained efficiently and effectively, and also to provide an environment that allows the results of each management to be accumulated and reused as knowledge resources so that they can be shared and utilized.

The project management cycle support function is prepared for each management work, consisting of the following 6 functions.

(1)SCOPE MANAGEMENT

1) WBS (See Chapter 5, P.149)

(2)TIME MANAGEMENT

1) Schedule plan 2) Progress plan 3) Progress management
4) Analysis and evaluation (See Chapter 5, P.154)

(3)COST MANAGEMENT

1) Cost estimation 2) Cost control 3) Evaluation of economy (See Chapter 5, P.163)

(4)QUALITY MANAGEMENT

1) Inspection tool 2) Statistical processing (See Chapter 5, P.177)

(5)EARNED VALUE MANAGEMENT

1) EVMS (See Chapter 5, P.183)

(6)RISK MANAGEMENT

1) Risk analysis and evaluation (See Chapter 7, P.209)

● Project Work Process Support Function

The project work process support function is to support the execution of various types of project work that realize the required fruits and services, consisting of simulations support, engineering work support, procurement support, etc.

(1)SIMULATIONS SUPPORT

It provides a group of tools that support business strategy, business model, project planning and making programs, etc. in the upstream phase of a project. It consists of tools that carry out information searching and the construction, analysis and evaluation of a model in terms of its functions.

(2)ENGINEERING WORK SUPPORT

1) COMPUTER AIDED DESIGN=CAD

It is a function to support technical calculations and the processing of drawings at each stage of the design process, providing also the support for exchanging information with other CAD that is used for document management concerning design.

2) COMPUTER AIDED ENGINEERING=CAE

In a narrow sense, it is a supporting function to optimize the engineering of development and design. In a broad sense, it is a supporting function to seek the overall optimization of a series of engineering work such as development, design and manufacturing. It pursues the integration of structural models, etc. and the design materials, etc., carrying out the support for each engineering work and the transmission of information among such work.

3) COMPUTER AIDED MANUFACTURING=CAM

It manages the processing procedure and technical information in manufacturing, and provides support for manufacturing. The information it handles includes the working design information (tools, machines, processes, etc.), production management information (equipment, maintenance information, etc.) and production information (product evaluation data, etc.)

4) COMPUTER AIDED TESTING=CAT

It is a function to provide support for the reviewing in the design stage, and support for the actual inspection process.

Note that in the information industry, the same work support function is called CASE (Computer Aided Software Engineering). The support function in the analysis and design phases in the upstream of a project is provided for each design technique, as in the structured design technique, or object-oriented design method. The support function in the programming test phase in the downstream of a project is called IDE (Integrated Development Environment).

(3)PROCUREMENT SUPPORT

The procurement support function is to aim at making more efficient and the accumulation and sharing of information concerning a series of work such as the preparation of procurement specifications, selection of suppliers, evaluation of estimates and inquiries, management of placing orders and of the process at those who have received the orders, management of transportation, management of local warehousing.

This procurement support function has been put to use in cooperation with Electronic Commerce (EC) via the Internet in recent years. The material management, which handles how a component has been used after it was purchased and delivered to a plant or construction site, can be traced more accurately by improving this procurement support function.

- Common Support Function

The common support function of each cycle and process includes the following three.

(1)BUSINESS INTELLIGENCE

The business intelligence provides a group of tools for searching and analyzing the data and information of the project information system and utilizing them as information of a higher grade in the program and project management cycles. It has information searching (data mining), analysis/monitoring and reporting functions as its tools. Also, it has a function to provide the management cycle with the result of analysis/monitoring on a real-time basis, being linked with the work flow.

(2)DOCUMENT MANAGEMENT FUNCTION

The document management function, in a narrow sense, is a function to manage the huge volume of drawings and documents that are generated in the project life cycle electronically and in an unified way (Electronic Document Management System=EDMS), but in a broad sense, it means the Product Data Management System (=PDM) in which the information on the fruits and services that a project has as its objectives is managed in a unified manner throughout the life cycle, thereby seeking improvements in QCD (quality, cost and delivery). The product data management consists of the following functions.

1) DOCUMENT MANAGEMENT

Various documents such as CAD drawings, word processor documents, handwritten documents and photos are stored without respect to differences in making documents, utilizing them by searching by means of the difference of hierarchies or of attributes, or the like. Also, history management of documents is carried out, providing a search for the latest document as well as a search for the history.

2) PARTS MANAGEMENT

It supports the classification of parts comprising a product, addition of attribute information (characteristics, unit price and degree of recommendation), searching function, and the searching of documents by using the parts as a key for the search, and others.

3) PRODUCT COMPOSITION MANAGEMENT

It performs the management of constituent relations between the parts, history management, and the management of the delivery of data with the production side.

4) PROCESS MANAGEMENT

It manages the process of check, approval, release and disposal, and carries out the status management and searching of drawings, documents and parts. Also, it enables documents to be exchanged between related sections inside and outside the company in cooperation with the work flow.

5) OUTPUT DRAWING MANAGEMENT

It carries out the management of the number of output drawings, of whom the drawing has been sent to, and of the history of output drawings, in relation to the documents.

6) DESIGN CHANGE MANAGEMENT

It manages the design change information, documents and parts by specifying the relations among these, managing at the same time the status of documents and parts in the design change process. Also, it conveys the design change information to related sections inside and outside the company.

7) DESIGN PROGRESS REPORTING FUNCTION

It is a function to manage the document management information in a unified manner, and to grasp and search the progress information for each purpose of management.

(3)GROUPWARE

The groupware is a tool to seek the conveyance of information and the sharing of information among the members, and to seek the improvement in efficiency of the group work by putting the work process in electronic form and systematizing it, and it belongs to the office support application.

In general, the transmission and sharing of information have been restricted in its quantity, quality and conveying speed, as being separated from the transmitting source in terms of the organizational and geographical distance. However, these restrictions can be removed by the mail function and functions such as electronic bulletin board, electronic meeting, scheduler, etc. provided by the groupware. Also, the project work is mainly the adjustment with multiple related sections inside and outside the company, with a lot of work of indefinite format, making it fairly hard to fulfill the improvement in efficiency of the work process and the expediting of decision making. The introduction of groupware will change these types of work of indefinite format into the ones having definite format (in electronic and systematized form), enabling the project work to be made more efficient, and the decision making to be expedited.

- Cooperation Support Function

(1)NECESSITY OF COOPERATION BETWEEN PMIS AND THE CORPORATE INFORMATION SYSTEM

The corporate information system can roughly be divided in the following 3 systems.

1) FUNDAMENTAL WORK-RELATED SYSTEM

A system that supports the work forming the core of a business.

2) WORK SUPPORT-RELATED SYSTEM

A system constructed for such a purpose as rationalizing the processing of clerical work, collecting information, thereby helping in decision making, etc. (for example, technical support system, customer information system and management support system)

3) DAILY ROUTINE-RELATED SYSTEM

A system that supports the composition of terminals corresponding to the interface with people, etc. as well as the input and output.

The following can be named as the main functions of the fundamental work-related system that forms the root of corporate management.

- Financial and accounting system
- Sales management system
- Purchasing management system
- Production management system
- Inventory management system
- Physical distribution management system
- Human resources management system

These systems carry out the processing of daily work regarding the sales and purchasing, production and accounting, etc. that become the basis of corporate management. The daily work processing of a business that provides a project as its services, is also performed by these fundamental work-related systems, as is the case of a business that provides other commodities and services. For example, the management work of the sales, payment, etc. of a project is processed through the sales management system and the accounting management system (see Table 4-8-5.)

The upper limit of the pooling of personnel, state of deployment, and state of operation are managed by a fundamental work-related system called the human resources management system (which is placed as forming a part of PMIS in some businesses), and in cooperation with this system, the data are fed to the time management system, cost estimation system and cost management system, or are returned for feedback as result values. Moreover, the ordering information concerning purchasing is also delivered to

the person in charge of a project, purchasing section, accounting section, etc. simultaneously. In the project, the purchasing information is used for budget control or schedule management, whereas it is managed in the accounting system as the accounts receivable information, and after the receipt of delivered goods and acceptance have been made, the processing of payment is carried out. Also, the design information of PMIS is used for preparing Bill of Material (=BOM) through MRP (Material Requirements Planning).

Like this, PMIS and the fundamental work-related system are operated under close cooperation. It is important in terms of corporate management as well as project management, that these pieces of information should be capable of being used on a real-time basis as much as possible.

Included in the work support-related system are the customer information management system, technical support information system, purchasing support information system, and others. Information on customers, technologies and vendors is accumulated in these as a knowledge base. For example, in the engineering or design work of a project, information accumulated in the technical support information system is used for the selection of materials and fixing the specifications. Also, in selecting the vendors of products to be purchased, information accumulated in the purchasing support information system is used. These pieces of information are accumulated as a common database for the entire company, capable of being referred to by the authorized person in charge of a project.

The daily routine-based system is a system to support man-machine interface, carrying out the support for making it easier to see the screen, and enabling the input and output operation to be made more easily and smoothly.

Thus, in the running of a project, not only PMIS but also various corporate information systems carry out the support. By means of the cooperation of PMIS with other systems, the project information has come to be put under unified management as part of the fundamental work information, as is the case of other work systems.

(2)PMIS AND ERP

With the appearance of work integration (Enterprise Resource Planning =ERP) packages, cases of introducing a system that utilizes the ERP package as the fundamental work-related system are increasing. The major reason for the spreading of ERP packages includes the following.

- The fundamental work does not become competitiveness inherent in the company (core competence).
- It can be introduced at a cheaper price and in a shorter period of time as compared with the development within the company.
- As the spreading of networks goes on, the use of versatile systems rather than the systems of the company on its own has made it easier to connect to the networks. The progress of networking technologies is quick, making it impossible to catch up with new technologies with the own development. Under the circumstances, advantages of obtaining and maintaining the latest technologies by securing system development personnel have become so slim. Rather than that, by relying upon the technical development of ERP vendors, the timely introduction of the latest technologies with competitiveness can be secured.

As a result of the development of the Internet, numerous net ventures have appeared and started to threaten the existing businesses, which has made the development of own systems become the burden contrarily in keeping up with the latest technologies. The management itself has become aware of this point, and started to promote the introduction of package software instead of the own development, which has been a great trigger of the propagation of ERP packages.

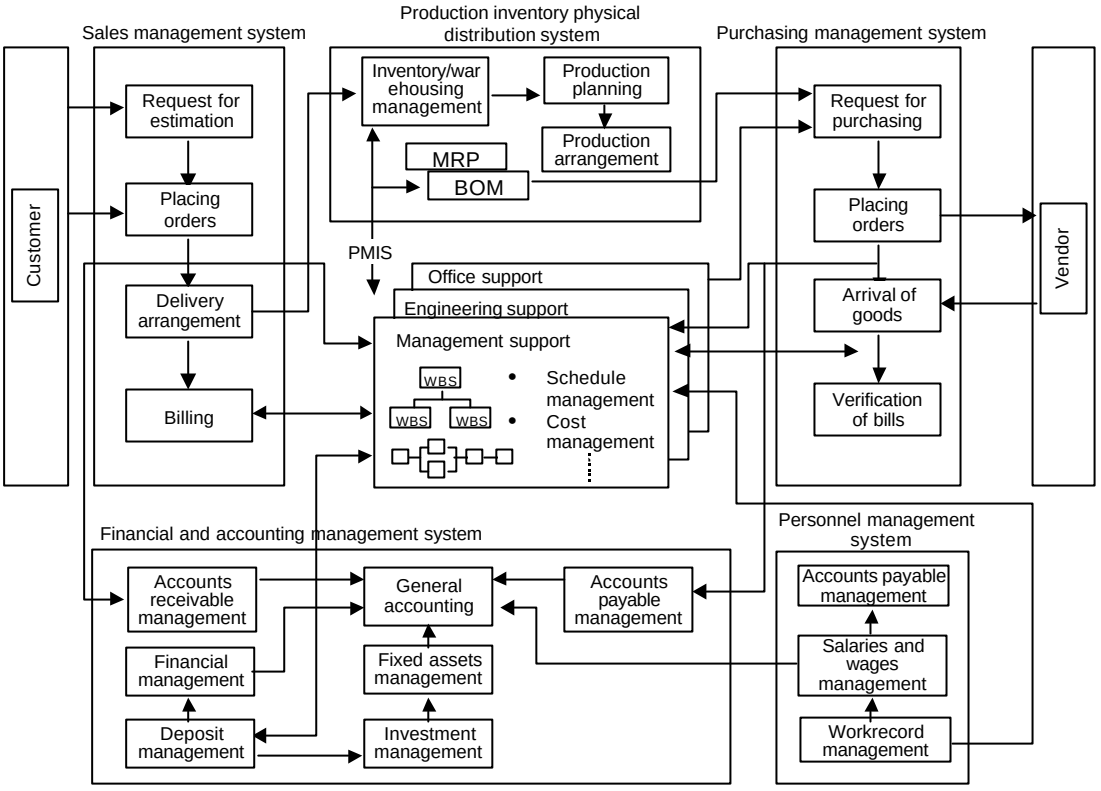


Table 4-8-5: Cooperation of PMIS with the Fundamental Work-related System

As for the function of project management provided by this package, it is equipped with the schedule management of a project, progress management based on WBS, etc., and it is connected with the fundamental work-related system on a real-time basis.

Recently software specializing in project management has also become available, which has more enhanced functions of schedule management and budget result management than other ERP packages. The project management has become important not only in conventional projects represented by plant construction, etc., but also in the field of system development, and hence examples are increasing in which an optimum package is introduced that fits the use and scale of the company that introduces it.

(3)PMIS AND EC

In B2B (Business to Business) that is an electronic commerce mode among businesses, direct sales on the Internet, opening of a market place by cyber trading firms, and direct connection between the product supplier and the purchaser, have emerged as new modes of EC. As for the use of EC by a project, the most feasible ways are the procurement through the market place and the method to engage in transactions by directly gaining access to the sales site of the person with whom transactions are to be made.

In a project, it is not a rare case that procurement from external sources may amount to 50 - 75% or more of the total amount of the project, and hence the result of procurement affects the profit of a project greatly. Since many products purchased in a project are of special specifications based on the design peculiar to each project, they are not fit for purchasing in EC where transactions of versatile products are prevalent.

However, since the procurement work starting from an inquiry for estimation, negotiations on selecting suppliers, contract, urging, inspection, delivery instruction, receipt of delivered goods, through to inspection and payment, has a great share of the project work, the use of EC results enables the work related to procurement in a project to be reduced, leading to the reduction of a great deal of cost.

Furthermore, the use of EC also leads to the reduction of procurement cost itself. For example, in a market of versatile products focusing on material such as steel, plastics, etc., various market places of B2B have been started, with sellers and buyers all over the world meeting one another there. Consequently the price difference and dfference in quality according to areas have been made clear, which has enabled sellers that were not known to people before to participate in this market. As a result of this, the product prices have been made open, providing conditions more favorable to buyers. Some have reported that the

procurement cost using these can be made about 10 - 20% lower than the procurement cost of conventional methods, and it is expected that they will expand further hereafter.

Direct transactions with vendors on the Internet are also expanding. Large-scale international tender projects stir up great interest in vendors all over the world. As a result of making open the information on products to be procured on the Internet by the businesses performing projects, vendors worldwide have come to be capable of responding to Request for Proposal (=RFP). This has increased the opportunities of transactions that could not be thought of before for both vendors and businesses performing projects, enabling the purchasing of products of high quality and low price to be attained.

Reflecting such situations, the fundamental work-related purchasing management system has been made to be able to handle the Internet so that B2B purchasing can be promoted, which will make the purchasing request through EC and purchasing information combined with PMIS information.

Example ◆ Integrated Project Information System

An engineering company runs a system that supports in an integrated way the project management process and the execution process. Its objectives are as follows.

1) To realize engineering of high quality in a short delivery time.
2) To contribute to the plant total life cycle of the customer by utilizing the design data in electronic form as they are in the plant operation management, maintenance and security management of the customer.
3) To realize a concurrent engineering environment by means of the unified management of design information by putting it in electronic form, thereby coping with global operation.
4) By exploiting design tools at the time of the initial design, a study of feasibility and economy can be conducted in a short period of time with high accuracy, thereby expediting the customer's decision making on plant construction.

The integrated project information system to realize these is composed of the functions as given in Table 4-8-6. Namely, various type of design support, three-dimensional CAD integrated design, engineering database, material management, site management, document management (Electronic Document Management System = EDMS) and the project management are integrated, and engineering, procurement, construction and the project management work is jointly operated, thus demonstrating effects. As an office support function, groupware is employed.

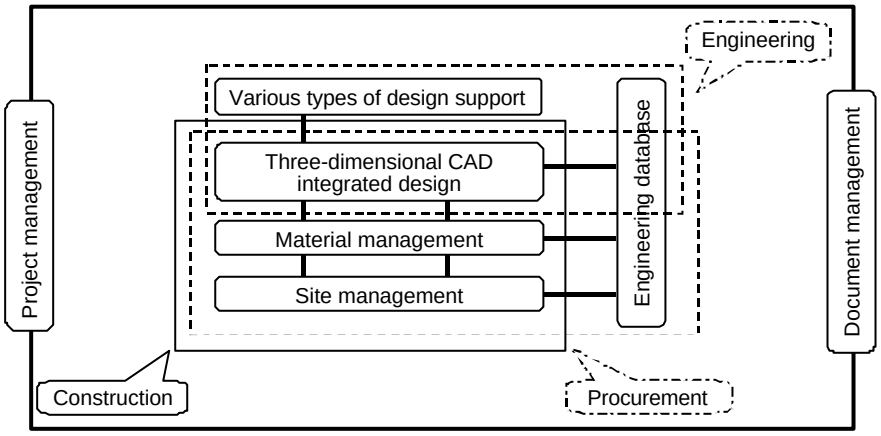


Table 4-8-6: Example of Integrated Project Information System

5. Construction of Project Information System

● Viewpoint of the Construction of Information Systems

Each project is different in character and mechanism from others. Hence, the construction of information systems that support project activities is also included in the project activities. But if information systems are constructed from scratch for each project, it will not be possible to keep up in many cases. It will shorten the period of putting into practical use and also reduce the cost in many cases, if the existing information systems or packages and others sold on the market are used as much as possible.

It will be one of the core competencies for an organization performing a project to have reusable project information systems. Several matters should be noticed in the reuse of packages sold on the market and the existing systems.

Firstly, the data structure should be noted. First, it is essential that data specifications are so designed that the project activities will be grasped as they are. If most of the data specifications are consistent with, or in correspondence with the existing information systems or packages sold on the market, there is a great possibility that they will be capable of being reused.

Secondly, the reuse of data should be studied. In project management, cases frequently occur where no judgment can be made due to lack of data, or unnecessary purchasing is made. It is extremely desirable that similar projects experienced before and data of similar products should be contained in the information system, and will be reused.

Thirdly, the state of progress of project activities should be grasped according to a change in the state of "entities", as quickly as possible (on a real-time basis if possible). If the rate of progress is judged by an ambiguous criterion like the rate of progress being n%, then it often will result in great regret when there arises the need for making corrections. The rate of progress should be judged by determining milestone deliverables and monitoring the achievement of real progress. For this purpose, it is essential to construct a simple system to manage the rate of progress.

Fourthly, a mechanism for managing real things (real articles) should be constructed. Even if material and machinery required for project activities have been procured, such situations many occur that their whereabouts are unknown, or they are kept in the depths and cannot easily be taken out, etc. In a site where supervision is not fully exercised, there also is the danger of being lost or stolen. It is desired that a mechanism should promptly be constructed such as putting real article labels on real things, registering the real article management data in the information system, thus tracing the place of storage or moved place, etc.

Fifthly, construction should be done in stages. It is essential that confusion in a project should be avoided by constructing the information system elements that satisfy the aforesaid fundamental matters on project management one by one, starting from the most needed area. In the case of shipbuilding where products are manufactured repeatedly in the same place, a refined project management system may possibly be constructed, but in a construction project overseas, such a case as does not allow the construction of a complete information system occurs frequently. It is important to construct a system in stages, making adjustment to the circumstances.

Note also that if the management work such as cost management, quality management, etc. is constructed at the back-office together with the experts in the field, this can be done in parallel with the development of fundamental work-related information systems, which will be welcomed by the people working at the site.

● New Business Operation Methods Accompanying Information Technology Development

In addition to the viewpoint of constructing information systems, it is worth considering whether a new business operation method accompanying the development of information technology should be employed. Now, it is indispensable for a business to construct new mechanisms that correspond to the trend of digitalizing and networking within the company, thereby maintaining competitiveness. Various types of package software are now available to take advantage of these new technologies, making it possible to realize advantages in a much shorter time and at a much lower price than before. Further, new technologies have encouraged emergence of new business operation methods as outlined below.

(1)SHARED SERVICE

Shared service is, literally, the sharing of service.

As a result of a series of changes in accounting systems, now a business has to undertake the management that will increase profit not only of the parent company itself, but also of the entire group covered by the range of consolidation. In such a context, the one attracting people's attention as a means to reduce the cost of the entire group is the promotion of shared service in the entire corporate group.

When seen as one corporate group, various similar types of work are performed there. Be it the parent company, a subsidiary, or an overseas affiliated company, a business having a certain scale absolutely needs financial accounting and purchasing procurement work, orders processing work and system operation and others, as the work for supporting production and sales activities. And such supporting work is counted as indirect expenses, which is to be added to the cost of the business.

Such work can be done more efficiently with a fewer number of personnel by concentrating functions if they are within the same corporate group. As information technology develops, such work has come to be capable of being done anywhere physically. By installing terminals at the site of each company of the group, making inputs and outputs of business data there, and concentrating actual processing work at one place, work efficiency can be improved and the maintenance operation of systems can be unified.

By sharing these expenses for concentrated processing and expenses for the maintenance operation of systems among the affiliated companies, the overall cost can be reduced. This is the way of thinking of the shared service. The indirect expenses that can thus be reduced amount to as much as 20 - 40% of the total indirect expenses, which is a great reduction as a business.

Businesses having global business operation or businesses with a lot of subsidiaries have unified the sections that carry out such work as a corporate center. In the corporate center, a strategy center that aims at improving corporate values and a support center that aims at cost reduction by shared service are set up, thereby seeking to strengthen overall competitiveness (see Table 4-8-7).

Table 4-8-7 shows an example of seeking the strengthening of an organization by setting up a corporate center. Within the support center (see Table 4-8-9) are common sections such as accounting, personnel, systems, call center, etc., thus making it possible to carry out unified management. Moreover, by constructing systems networks all over the world, the work is integrated globally (see Table 4-8-10). Some global businesses have also appeared, within which, by implementing such shared service, the function of the support center is transferred to an area with lower personnel expenses, thus realizing the overall cost reduction.

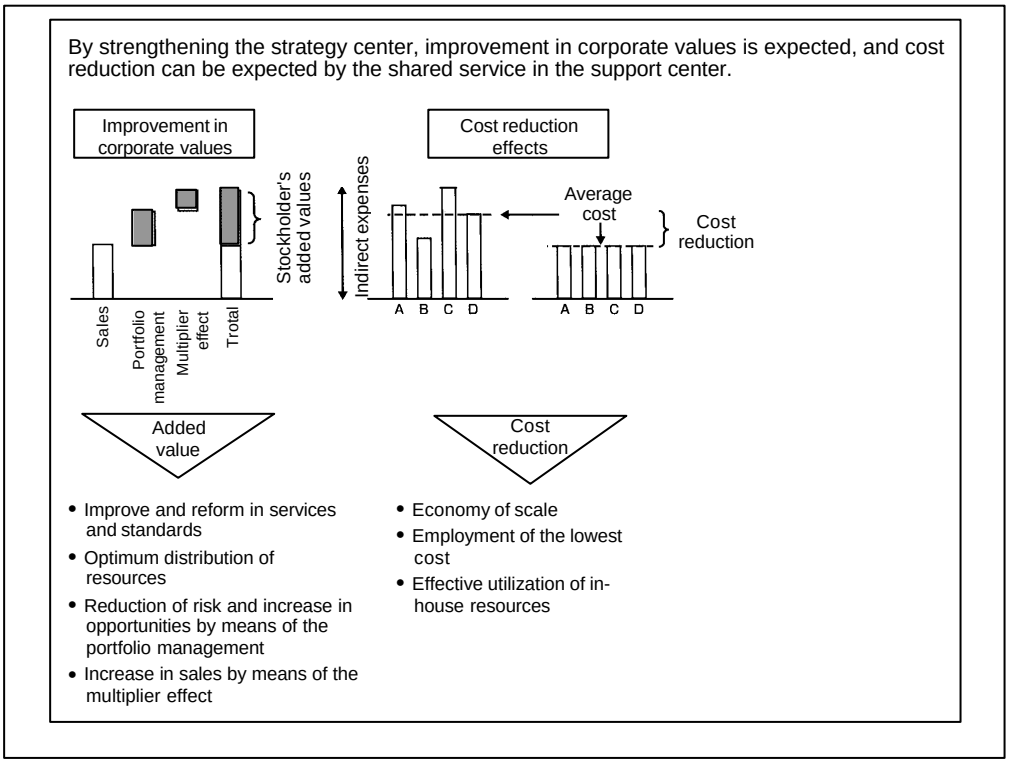


Table 4-8-7: Effects that can be expected from the corporate center

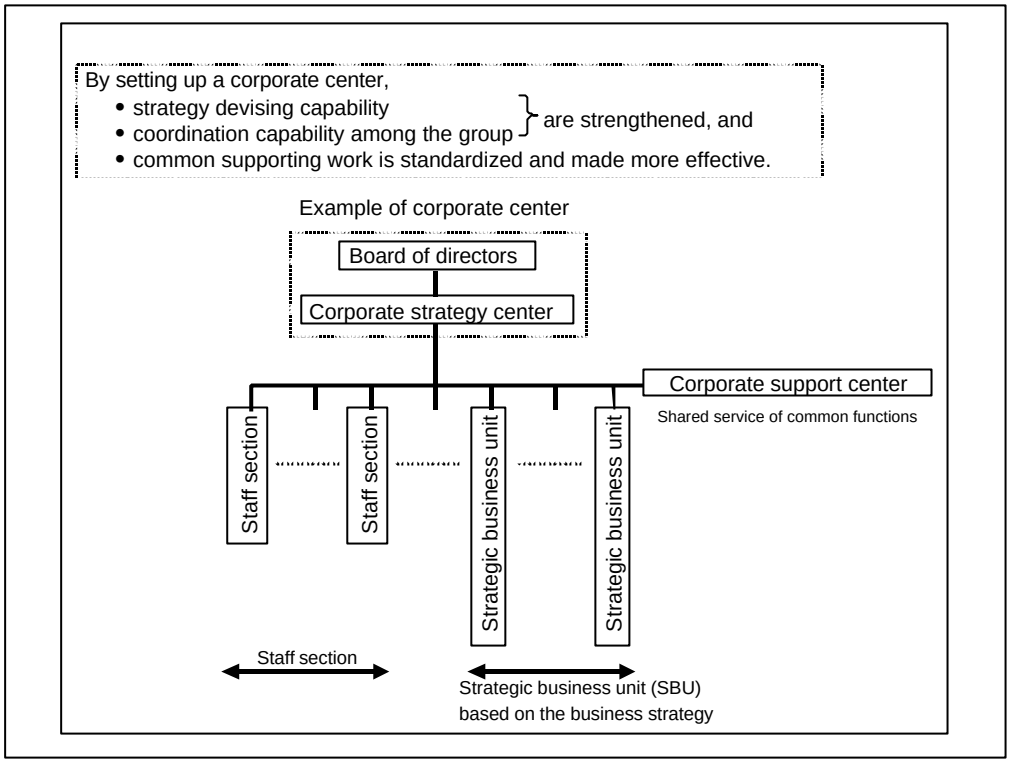


Table 4-8-8: Strengthening of an organization by means of the corporate center

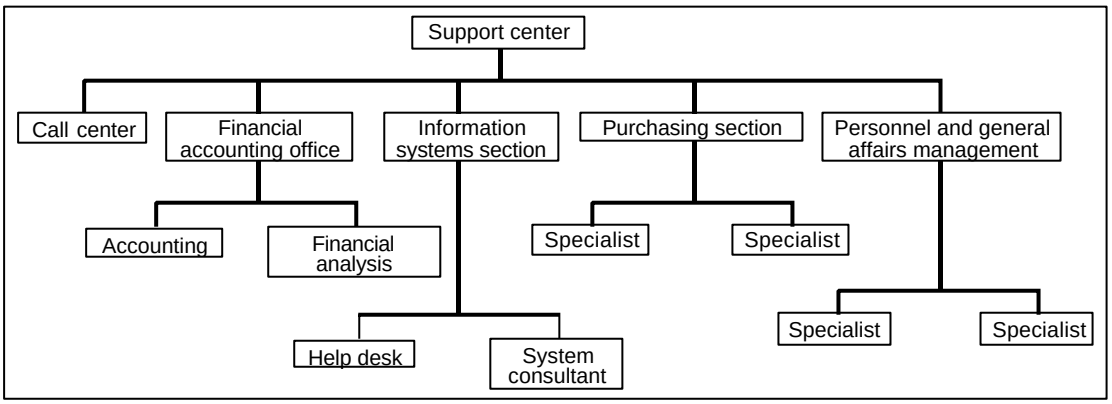


Table 4-8-9: Composition of a support center

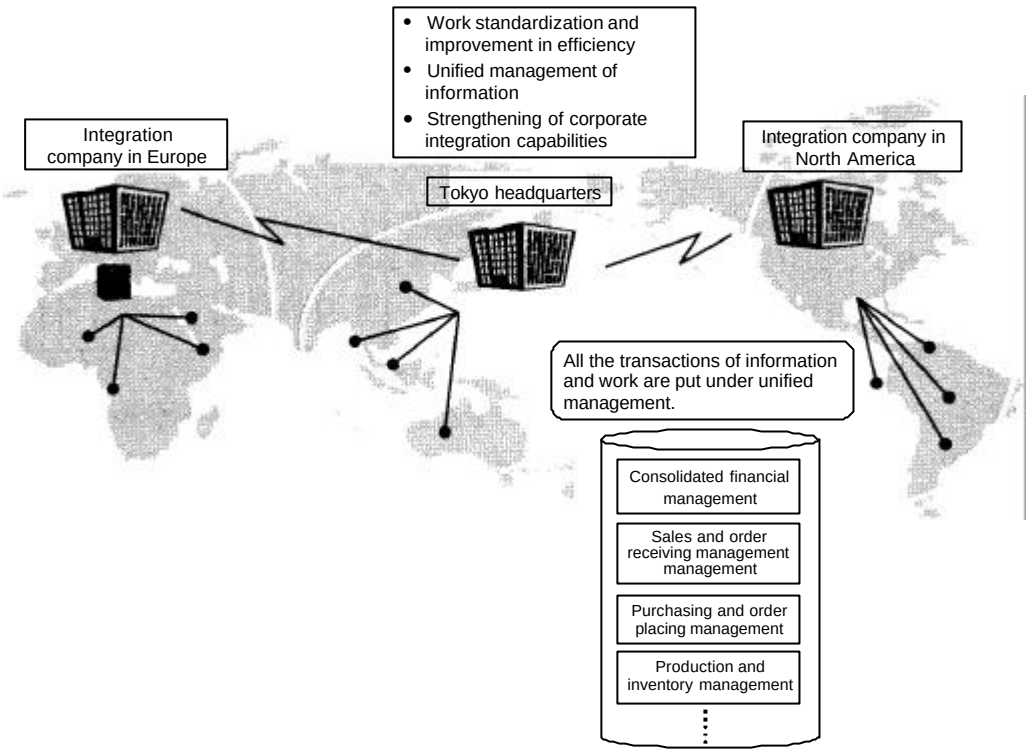


Table 4-8-10: Image of global business integration

(2)OUTSOURCING AND APPLICATION SERVICE PROVIDER (ASP)

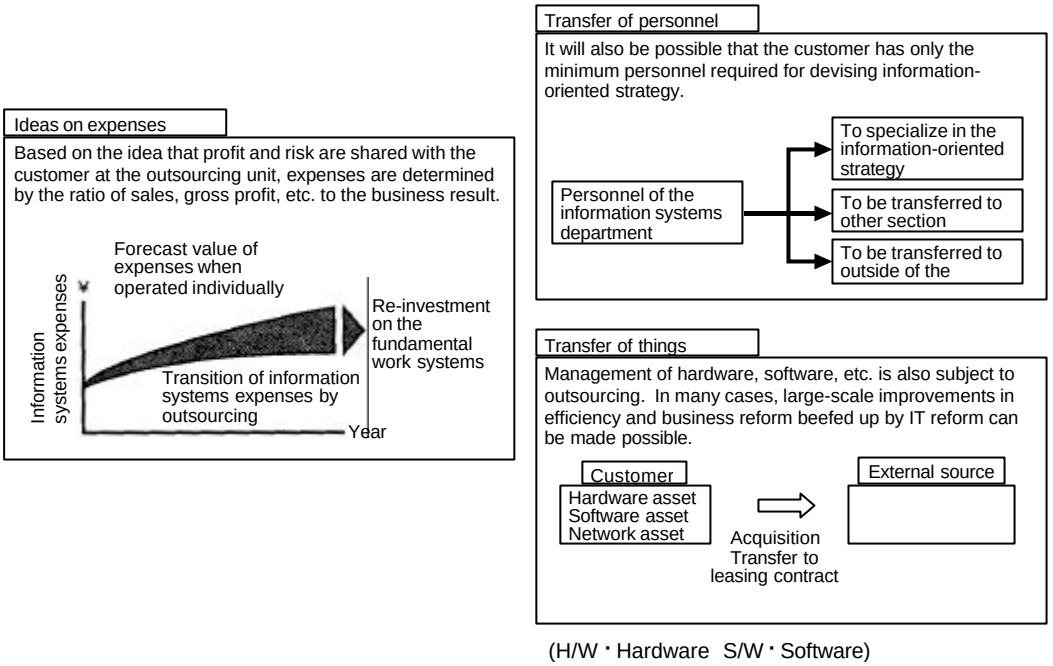
In an environment of global competition becoming even harsher, businesses are directed not only toward concentrating their own resources on such business that forms the core of the company, but also toward concentrating their functions on the function that forms the core, with the other functions being entrusted to external experts. By doing this, the fixed expenses are transformed into variable expenses, thereby reducing financial risk and maintaining competitiveness.

The functions, skills and know-how to form this core are called core competence, and the aim is to convert non-core competence activities to variable expense items through outsourcing (placing an order with an external source). Although the work of the corporate center is indispensable for a business, it does not form the core of corporate competitiveness. In this sense, there are many examples in Europe and the U.S. in which businesses have put the function of this corporate center to outsourcing.

Outsourcing does not mean mere placing orders with an external source for some work or entrusting it to temporary workers. For example, in some cases a business has required employees in the support center it owned to retire from the company, and be transferred to an outsourcing company, with which it has concluded an outsourcing contract, thus continuing the work as ever (See Table 4-8-11). There also are some examples of selling equipment such as computer systems, etc. to an outsourcing company, to reduce the fixed expenses by means of the lease-back, etc. An idea would also holds that functions and information other than the core competence are not to be retained internally, but to be put to outsourcing entirely.

A business that has sprung from such an idea is the Application Service Provider (ASP) business, and suppliers providing such services by means of the Internet are called ASP. By using ASP, initial investment can be kept at not more than one tenth of the amount required conventionally, with almost no plant and equipment investment being required except the terminals of the system. Ordinary system maintenance expenses are also inexpensive as seen from the overall cost, and can also be transformed into variable expenses.

By entrusting an external source with the support center, a change of fixed expenses and assets into variable expenses is pursued.



(H/W・Hardware S/W・Software)

Table 4-8-11: Outsourcing of the support center

Outline

Relationship management refers to a series of operational processes that define the type of relationship between stakeholders who are involved with a project, and maintains good conditions to guide the project successfully. Its objective is to achieve the project to the satisfaction of customers/stakeholders and to further aim for the maintenance and development of the project in a continuous and sound relationship with stakeholders.

In the operational processes of relationship management, three steps are considered: "planning", "maintenance", and "restructuring" of relationship. When it comes to relationships in a project, the first thing to do is to define what stakeholders become involved with the project in what positions. For instance, in a project of constructing a building, a property owner, a builder, tenants, local residents, architect's office, contractors, and banks will be involved. They are stakeholders and the process of defining their lineup and a manner to associate with them is called the "design of relationship."

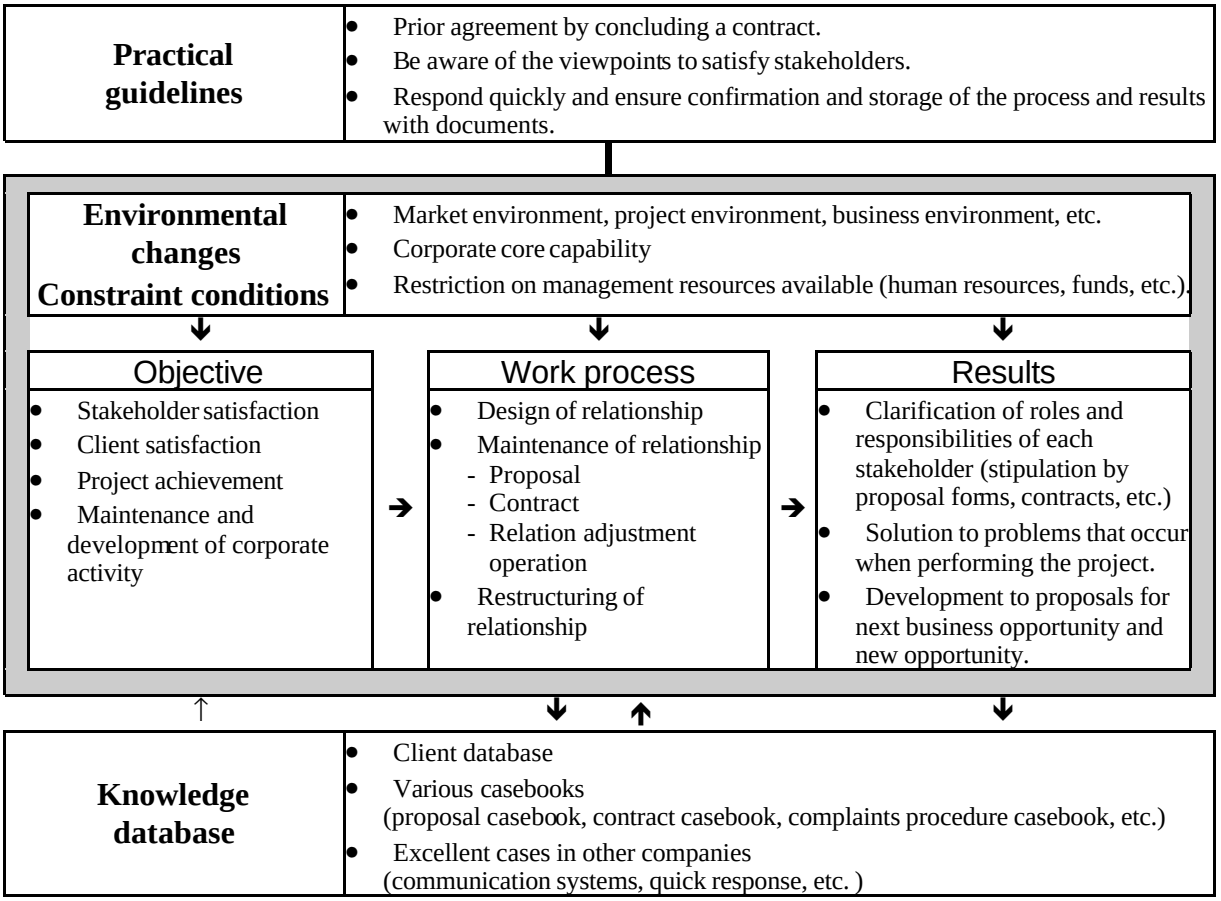


Figure 4-9-1: Overview of Project Relationships Management

With a defined relationship, the project manager facilitates the daily performance of the project to the satisfaction of stakeholders, and, if conflict occurs, they try to settle it based on the contract and pursuit of the objectives for sharing, etc. This process is called "maintenance of relationship."

Although a design of relationship formed in a project is temporary, the activity of each stakeholder as an enterprise is continuous. In the previous example of building construction, the contractor will try to maintain the relationship with the builder to acquire next business opportunities or maintenance service for the building. Accordingly, in actual business, the relationship designed for a project is applied to similar projects repeatedly, or continues through changes and reconstruction according to business environments. This process is called "restructuring of relationship."

Deliverables obtained from these operational processes include the agreement on roles and responsibilities by stakeholders which are stipulated as a "contract", solution to the problems caused by conflicts among stakeholders in performing the project, and development of business that leads to future opportunities.

The individual that first designs relationship and maintains it is, in many cases, a "client" who needs

the project, or a "project executer" who plays a major role in performing the project. Therefore, the type of relationship is greatly affected by the business environment, core competencies, managerial resources available, etc. of the client or project executer, in addition to the terms particular to the project (overall market environment the relevant project is related to or environment unique to the project).

Client database should be the knowledge database that is obtained or to be used in the process of each step of relationship management. In company-to-company relations, there are various relationships other than that for the relevant project, so the project manager cannot be indifferent to such information. In recent years, some companies have worked on forming a system that allows for integrated management of various relations and consistent response to clients as enterprise. Moreover, it is also effective to arrange or use various casebooks and refer to other companies' excellent cases as required.

In conclusion, three practical guidelines are mentioned. First, "prior agreement with a contract." This is the most significant and effective operation in relationship management to obtain as precise contract as possible in advance concerning the events that could cause a conflict later among stakeholders. Second, "be constantly aware of the viewpoints of stakeholders such as clients." What matters most is to notice a sign of conflict and resolve it beforehand. Third, if a trouble occurs in spite of the endeavors mentioned above, a response should be made quickly and the confirmation and storage of the process and results should be included with the documents." Quick response and confirmation/storage of the process and results are the most important actions in preventing enlargement or rehash of the problem and minimize its influence.

Hereafter are described the three operational procedures in relationship management: "Design of relationship" "Maintenance of relationship", and "Restructuring of relationship"

1. Design of Relationship

Whatever relationship is being built, the list of stakeholders should be first prepared. The lineup of stakeholders likely to be involved is dependant on the market environment of a project (e.g., lineup of competitors), project environment (e.g., stakeholders at a specific area), and business environment of companies that participate in the project (e.g., shareholders, industry), etc. The sections that follow describe stakeholders, as elements that constitute the relationship, and then client relationship, as the client is key to relationship design.

● Stakeholder

As explained in the common view of "II. Project Management" (refer to P.17), when an enterprise performs project activities, various stakeholders become involved centering on the client with whom the closest relationship is being built. Since enterprises have both an economic aspect to pursue profits and a social aspect to exist in a society that accepts them, project activities share these responsibilities.

In corporate management, the attention focused on stakeholders is required, but stakeholders involved in individual projects do not necessarily require the same attention as those at corporate management level. Furthermore, stakeholders vary depending on the type and size of the project.

Concerning the implementation of a project, conflicts of interest often occur among stakeholders who are required to cooperate with each other. In the case of stakeholders related to each other through economic contract, a relationship based on business is likely to be built as partners who pursue corporate profits, while a relationship based on social responsibility of enterprises should be established with stakeholders who have non-economic concerns.

Environmental problems such as pollutionrepresent non-fulfillment of social responsibility by enterprises. There are many cases where an enterprise was forced to leave its local community due to accidents, , which resulted from the focus on profits and neglect of the local community by the enterprise. In projects, management which fulfills social responsibility is important. In addition, there is a possibility of illegal acts such as bribery and corruption or coercion as well as unfair demands on small and medium suppliers.

The corporate behaviors mentioned above may cause direct friction or result in confrontation with shareholders or local residents. Therefore, in project management, as is the same with corporate management, management in consideration of stakeholders and in compliance with corporate ethics is required.

● Client Relationship

The core component of relationship management is client relationship. Even in a product development project in an enterprise, where the contractual relationship between the client and project executor is not obvious, it is critical to understand that good products are developed by constantly considering the client and recognizing their needs. In any case, there is always a client that needs the project and acknowledges the value of its deliverables. Meanwhile, the individual that promotes the project and has it produce deliverables is the project executor. A project is based on the relationship between these two individuals as a core relationship.

The design of a relationship is based on identification of those who are involved in achievement of a project and their roles, so the recognition of core competency of each stakeholder , i.e., "What they can do for the project?", serves as a basis for design. To be specific, in light of the process where the client relationship is designed, the individual that first plans a project usually draws up a rough design of the relationship. This entity is in many cases a client that needs the project or a major project executer who receives direct profit from implementation of the project.

■ Design of Relationship Focused on Client

When a client plans a project, the client has a goal to be achieved and projectizes it. To take an example from construction of a power plant, the electric power company as the client clarifies the necessary capacity for additional facilities according to estimated demand, and specifies requirements for the project such as an appropriate period and location. In this process, matters that affect relationships, i.e., which individuals or groups are in charge of which part of the project, are examined at the same time.

In the above example of a power plant, a part designed in the initial plan of the plant may be ordered separately at an earlier stage, or may be implemented by the company itself if its has sufficient resources. In addition, relevant companies such as equipment makers, building contractors, and civil engineering contractors will vary according to the scope of construction, and the structure among stakeholders changes depending on whether they contract separately with such companies or they assign a company as a main entity to conclude contracts. Furthermore, the relationship also changes depending on whether these tasks

are assigned to old vendors or vendors are chosen through bidding.

Thus, when designing relationships focused on the client, in the process of determining an outline of a project, roles and positions in the project are first determined, then the scope and structure of stakeholders and method of determination are decided including who arranges other necessary portions in what manner, and how to decide them.

■ Design of Relationship Focused on Project Executer

Design of relationship focused on the project executer is roughly classified into two types.

As previously mentioned, when the framework of relationship is designed chiefly by the client, at the next stage, there is a call for participation to major project executers (candidates) and, in response to this, they propose an execution plan. In this process, project executers (candidates) redefine their (expected) scope of participation for the project and design more detailed relationships. For example, to start a project like plant construction, an organization assumes the following functions should be established:

1) Project management organization (contact with the client, overall coordination)
2) Local management organization (management of the worksite where facilities or various buildings are constructed)
3) Design / engineering organization (system design, procurement design)
4) Procurement organization (purchase of supplies and services, management of order contracts)
5) Administrative organization (human affairs, accounting, general administration, public relations, etc.)

Relationships will greatly change depending on whether these organizations are managed by the company's own resources or shared with other companies. Principally, the overall project should be designed by defining the scope or performance of the company and incorporating other mutually-beneficial companies into the relationship of cooperation based on the company's core competency and management resources available at that point.

Meanwhile, a project executor can play a main part in deciding the outline of the design of relationship. In the above example of a power plant, a project to "establish a common spare parts supply center for multiple power companies" would be such a case. Such projects are often planned from the viewpoint of suppliers that provide spare parts and services, not from the viewpoint of the power company as the client. To be specific, an enterprise whose core business is maintenance of a major part of the power plant and supply of spare parts integrates needs of multiple clients and plans business in consideration of clients with which the enterprise has no relationships. In some cases, the enterprise aims at a more integrated system involving other parts suppliers or distribution companies.

The flow of basic design in this case is integrated into a process of establishing a structure for the client from the perspective of what value should be created for the client as a project focusing on the company's core competency, and, at the same time, of designing the relationship with other project executors that supplement the company's functions.

2. Maintenance of Relationship

When relationships surrounding a project are designed and functions of each stakeholder are identified, it is critical to keep them in good condition. The key stakeholders are usually the client and the order contractor, i.e., project executor. The relationship between these two entities is generally started with presentation of a "proposal" and is fixed with an agreement described in a contract. In relationships between the client and other major stakeholders such as cooperative companies and relevant government offices, any arrangement is in many cases made based on agreement specified in a contract.

In the course of implementation of a project, various frictions or conflicts are expected to occur among stakeholders whose interests are different from each other. Therefore, a major task given to project managers is the prevention of such troubles and, in the cases where this occurs, coordination of relationships aiming for solution based on contractual arrangement etc. Hereafter is described "proposal" and "contract," which are related to maintenance of relationship and "relationship coordination" while a project is proceeding.

● Proposal

Proposal consists of two types: One made when designing relationship (project planning by the client or the project executor. Refer to aforementioned "Client Relationship") and the other made by the project executor (candidate) in response to call for participation from the client when an outline of the project is fixed. The former is a proposal for value and the latter for implementation of the project.

■ Project Execution Proposal

Call for participation from the client to the project executor (candidate) is generally made in a form of a request for proposal (RFP) from the client. Since projects are usually processed through competitive bidding, a proposal from the project executor (candidate) is sometimes called "bidding document" and project executors are called "bidders." In the case of large-scale projects, it sometimes takes several months to draft a proposal beforehand with scores of full-time staff members working under a proposal manager. A field survey is also carried out in some cases. For clients, it needs great efforts to evaluate all proposals from every bidder and select an optimum bidder out of them, so in some cases they screen bidders through pre-qualification.

In the case of large-scale projects, a proposal by a single company sometimes has too great risk or has to cover a scope with which the company is unfamiliar, so a consortium is in some cases formed with other companies to make a proposal. Project Execution Proposal generally includes the following items:

- Quotation
  Proposal for estimated amount or payment conditions.
- Technical Proposal
  Proposals for the scope of provision for services and equipment and their specifications, etc.
- Project Execution Procedure
  Proposal for project execution systems, processes, history of responsible members, how to proceed with the project, etc.

Alternative proposal is made when the original proposal cannot satisfy RFP. An example is seen in a proposal for the use of Japanese products in compliance with the JIS when American or European standards are designated as requirement specifications of materials. Alternative proposals are made not only when a bidder cannot make a proposal that meets RFP, but also when actively proposing a better plan than RFP as an adverse proposal. In some cases, differentiation is intended by proposing an alternative plan that is cheaper and faster than those of competitors.

In software development, specifications required by a client are likely to be unclear at the stage of RFP. Combined with many options for achievement and fast technical changes, proposal drafting has a difficulty unique to software. A popular method is to estimate the complexity in the software to be developed (Types and the number of components, and types and the number of relationships between elements) and then estimate man-hours based on this.

When proposals are submitted to a client, the client starts evaluation and screening. During this process, inquiries about the contents or request for alternative plans are often made with bidders. If necessary, interviews are conducted with key people expected to be in charge of project execution. After such evaluation and screening are finished, negotiation on contract including monetary value will start as a final stage. When both parties reach agreement, a contract is signed and the proposition is terminated and followed by the project,

■ Project Value Proposition

Project life cycles and phases will be defined differently by different stakeholders. For instance , the client or orderer of a project may conceive the full life cycle of a project as encompassing concept

through delivery of final benefit or operation of a facility, while a contractor may see their project as only that part of the client's project that is encompassed by their contract. For the party that contracts a project, a project execution proposition is a foregoing part of commencement of a project and the project ends when the project is completed after receiving the order. However, for the sponser of a project, completion of the project is start of its business, and true results are seen for the first time when the plant or system created by the project demonstrates performance as scheduled, operates smoothly, and generates expected earnings.

In this sense, for the sponser of a project, the project starts with planning. For clients and sponsers, a project is a means for achieving their business. A project starts with being drafted as a business plan, and whether a project can be started depends on whether the plan has business value or brings profit to the company.

For planning a project, a value proposition that brings profits to the enterprise is critical. This value proposition is not necessarily made from inside the enterprise but in some cases, is made by a third party and accepted for projectization. This value proposition is sometimes brought to bidding and the bidder who made the best proposal is selected as a contractor. In recent years, the number of clients and projects that require such value proposition is increasing. Further, since price often determines the results of bidding, profits are in many cases reduced. It is also significant for enterprises to create projects by actively presenting value proposition to clients in order to ensure business with high profitability or expand business opportunities. It is essential to know clients and their needs and business to make an accurate value proposition, and for this purpose, enterprises are required to conduct business positioning more strategically and concentration of resources on specific business.

Value proposition refers to the proposal for value creation and addition for enterprises and includes creation of new business and expansion / reform of present business. Generally, the decision on starting value proposition is made after the possibility of projectization and investment profitability are evaluated through a feasibility study.

● Contract

Contract is an act to finally agree on the relationship of rights and obligations that are presented through proposition among the client, the project executor, and major stakeholders surrounding them. Contract is a critical concept on which questions and problems which may arise while executing a project concerning interests among stakeholders are solved. It is not an exaggeration to say that the success or failure of a project can depend on the contract. There are many cases where enterprises suffered an enormous losses due to an inappropriate contract.

Cases where knowledge of international contracts is required are also increasing in the business environment of Japan due to an expansion of overseas procurement and increase in the number of overseas enterprises entering into the Japanese market, as well as the entry of Japanese enterprises into overseas projects. Specialized lawyers are generally involved in contracting in Europe and the U.S. but such cases are few in Japanese enterprises. They should understand that involvement of lawyers is essential depending on the environments of project.

, However, despite what specialists are involved in a project, the project manager should demonstrate leadership in contracting because he knows what conditions should be included in the contract, taking into consideration risks that are unique to the project. Hereafter, the general knowledge requiredon contracts as well as their types and examples of clause structures are described.

■ Types of Contracts

There are various types of contract depending on the objectives of the project. The following are some typical types of contracts:

1) CLASSIFICATION BY METHOD OF PRICE ESTABLISHMENT

- Lump-sum Contract

A method where the contract price for a project is fixed upon contracting. There are some variations such as fixing a price regardless of fluctuation of economic indexes (Firm Fixed Price) as well as adding price adjustment conditions through escalation. If the specification of projects is identified upon contracting, clients usually prefer this lump-sum contract because the risk on the project budget can be minimised. Meanwhile, the risk of cost fluctuation is principally assumed by the order contractor. The contractor should pay careful attention that the contract includes contingency cost or specifies exceptional matters (exemption from specific fluctuation events).

- Cost Reimbursement Contract, Cost-plus Fee Contract

A method where project cost is reimbursed on an actual cost basis and fees are paid in a predetermined method. There are some variations on this according to the methods usedfor determining

fees or setting ceilings on cost. This method enables a project to be started even if its specification is not fixed. However, since final cost may deviate from the estimate, the client should estimate a contingency cost for the budget.

- Unit Price Contract

A method where project cost is determined by multiplying the contractual unit price by the actual quantity of materials used for completion. In this method, risk on unit price change is assumed by the order contractor and risk on quantity change is assumed by the client. This method is appropriate for projects such as civil engineering work, which have fixed work contents but unclear quantity of materials.

- Other Methods

Concerning methods for setting up prices in contract, variations are possible by combining the above methods for one project in accordance with cost fluctuation risks. (e.g., actual cost reimbursement for the expense to dispatch instructors based on the lump-sum contract method.) It is also possible to set up bonuses (incentives for success) according to results of a project (delivery period or performance), or further to share proceeds from management of deliverables (such as plant). There are various opportunities to collect project cost, so it is critical to have a new concept on price setting methods in the contract without sticking to existing patterns.

2) CLASSIFICATION BY THE SCOPE OF CONTRACTUAL RESPONSIBILITY

In large-scale projects such as plant construction, there is a concept in which a project is separated into phases such as engineering, production / procurement of equipment, and installation work. The contract is classified on the scopes where such phases are contracted. The main categories are as follows:

- Engineering contract
- Engineering + Equipment / material supply (There are types according to periods when risk responsibility is transferred such as Free on Board [FOB] and Cost Insurance and Freight [CIF])
- Same as above + Installation guidance
- Engineering + Equipment / material supply + Installation work (Engineering, Procurement & Construction = EPC contract, turn-key contract, etc.)

From a broader perspective, variations of the contract scope are possible such as Build, Own, Operate (BOO) contracts which includes services such as feasibility studies for planning a project, various surveys and consulting, and monitoring and controlling after operation is started, as well as "concession agreement." Since the scope of contract responsibility is strategically selected from the viewpoint of how to share risk between the orderer and order contractor, as is the same with the aforementioned price setting methods, there could be various other techniques that differ from existing patterns according to diversified business types.

To take an example from development of information systems, the scope of responsibility can be separated as follows:

- Planning support work
- Basic design work
- Software creation work
- Work for supporting preparation for system migration and operation

These are based on a strategy where contract method is separated from risk management, rather than simple separation of phases in accordance with progress in work. In other words, in software development, the specifications required by the client are often unclear, so it is desirable to separate the work to determine the requirements of the system development work based on requirements. Since the former work is chiefly done by the client, the order contractor can do supporting work only in the cost reimbursement method, while the later work may take the form of a lump-sum contract based on contracting. Similarly, since operation-related requests from the client are expected to considerably increase after this stage of preparation and, as a result, relevant risk becomes greater. It is desirable to separate a contract to have supporting work of the cost reimbursement type.

3) CLASSIFICATION BY CONTRACT PARTY

The above 1) and 2) are both based on so-called "main contract" between the orderer of a project and the order contractor (main contractor). In executing a project, there are various contractual relationships among stakeholders as follows:

- Secondary contract (between the main contractor and its cooperative companies)
- Tertiary contract (between cooperative companies and secondary cooperative companies), etc.
- Technical alliance contract, business collaboration contract, consortium, joint venture agreement, etc. (between the main contractor and its partners)
- Loan contract (between the client and loan institutions, between the main contractor and loan

institutions)

■ Composition of contract

There are various types of contract clauses according to objectives. The following outlines some general contract clauses and their contents.

1) WHEREAS CLAUSE / CONTENTS OF AGREEMENT

Explanation of the background of agreement and specification of the objective of contract concerning what is agreed on.

2) DEFINITION OF TERMS

Definition of significant terms used in the contract.

3) SCOPE OF CONTRACT, SPECIFICATIONS, AND PERFORMANCE

Principal text of the contract. The more specified and detailed this is, the less uncertainty and risk has a project.

4) PRICE AND PAYMENT CONDITIONS

Description of prices, their pre-conditions (such as currency, exchange risk, and shipping conditions), payment conditions, etc.

5) DELIVERY CONDITIONS

Identification of the date and place of delivery and specification of risk bearing and period of ownership transfer.

6) CHANGE AND APPROVAL

Procedures for a change that occurs to the scope of contract and specifications, and approval of the client for specification, etc.

7) GUARANTEE CONDITIONS

Description of guarantee contents, requirements for exemption from the coverage of guarantee, guarantee period, etc. There are generally performance guarantees (guarantee for agreement of the performance of project deliverables with the contract), guarantee for latent defect (guarantee for soundness in delivered equipment for a certain period after delivery, i.e., guarantee period), etc.

8) EFFECTIVE PERIOD OF CONTRACT / TERMINATION CLAUSE

Description of requirements for validation of contract, or arrangement for pre-mature termination

9) FORCE MAJEURE

List of force majeure events that allow contract parties exemptions (acts of God, war, revolution, etc.)

10) INFORMATION / INDUSTRIAL PROPERTY RIGHT, ETC.

Description of how to handle information exchanged between contract parties for performing the contract (obligation of confidentiality etc.). and protection of intellectual property rights to contract articles, and obligation of solving issues on claim filed by a third party against violation.

11) LIMITATION OF LIABILITY

Clause on limitation of damage compensation (ceiling) or limitation on details of damage (indirect damage is not included, etc.), arrangement for contractual damage compensation for delayed delivery, incomplete performance, etc.

12) ARBITRATION

Description of a method of coordination when an issue is not solved between both parties.

13) GOVERNING LAW

Arrangement for a country under whose law the contract is concluded.

● Relationship coordination

Relationship coordination is to execute a project smoothly by resolving conflicts among stakeholders concerned with the project. Generally, parties to a contract refer to the client and the project executor (main contractor), or main contractors and subcontractors (cooperative companies or partners who receives

a common order), or subcontractors and their subordinate equipment or service suppliers (vendors). In project execution, conflicts can occur among these parties.

In the above cases, when there are three or more parties, their interests are complicatedly concerned with each other. It is a key function of project management to coordinate and control such conflicts concerning interests of parties and direct them to proceed with the project in the same direction. Hereafter, the coordination of relationships between contract parties and other stakeholders, and as related key words, "negotiation," "claim handling" and "quick response" is described.

■ Coordination of Relationships between Contract Parties

The following are the factors that aid coordination among parties involved in a contract.

1) SCOPE OF ARTICLES OR SERVICES TO BE PROVIDED

Issues attributable to an increase in production costs resulting from a discrepancy in conditions or specifications for service or data exchange in the boundary of the scope of provision or service (called "battery limit [BL]" in plant construction, or "interface" in systems) concerning items whose necessity was unknown or which were not specified when purchased such as special tools, parts, and preliminary items attached to products, manipulation manuals, and support service.

2) LEVEL OF QUALITY IN DEMAND

Issues attributable to difference in recognition of quality standards, e.g., difference in recognition of demand for quality depending on preference of wall or floor materials of a building, etc., difference in recognition of size or details of the scope of provision in design specifications or requirement specifications, or increase in service cost arising from demand for user's preference or convenience of use.

3) TECHNICAL ISSUES

Issues attributable to claims against technical workmanship that have no problem in light of specifications, e.g., too noisy, dissatisfaction with performance, slow response to manipulation, etc.

4) DELIVERY PERIOD

Issues attributable to claims from a party when late delivery impacts on other processes and the resultant losses exceed the limit of liability for the party concerned.

5) PRICE, BUDGET, PAYMENT, ETC.

Issues attributable to discrepancy in estimated price or budget that occur in cases of addition or change or in payment conditions.

Concerning items on which occurrence of a problem can be foreseen as mentioned above, arrangement on details should be made through contract between parties concerned. In the case of international parties, the details mentioned above are described in a contract.

Most Japanese companies have tended to start projects based on past business practices or mutual relationships of trust without deciding on detailed matters. Particularly when the schedule of a project is tight, contracts are often hastily signed without confirmation of details and projects are started with inherent risk. If all parties concerned have a tacit understanding and no difference in recognition, there will be no problem but in the case of large-scale projects, discrepancy in details will often occur. If the contracted amount of budget is sufficient, excessive demand on other parties or omitted matters can be absorbed, but if there is no reserve funds due to competitive bidding, parties concerned will become protective of their interests and conflicts are likely to occur.

In project management, it is critical to avert troubles without disadvantaging a project by anticipating discrepancies and dealing with them so that they may not come up as conflicts. In case another party recognizes a discrepancy, coordination should be made through discussions with each other. Since an experienced project manager is familiar with adverse effects arising from conflicts, he tries to eliminate their causes as early as possible, and to take evasive measures through negotiation with other parties. Further, he endeavors to stop occurrence of problems by building relationships of trust with other parties through management of the overall project.

In international projects, since parties have different cultures, conflicts are likely to occur when one party cannot understand the other or does not know the process for agreement. Therefore, it is important to understand the culture of the other party.

If workarounds as mentioned above do not function effectively and a conflict has occurred, negotiations should be made with other party based on the contract. Contracts specify clauses on penalty, cancellation, waiver, force majeure, and, in the case of international projects, regulations for applicable laws and place for arbitration. Project managers should be familiar with these aspects of the contract. If necessary, the lawyer in charge of the project should attend negotiation meetings or all negotiations should be entrusted the lawyer.

■ Coordination of Relationships with Other Stakeholders

Conflicts can possibly occur with individuals other than aforementioned parties in contracts. They can occur triggered by issues concerning the social responsibility of enterprises as mentioned in "Stakeholder" in this chapter (P.246). For example, conflict with local residents concerning the environment, and coordination with administrative or government agencies correspond to such issues. A project whose existence itself cannot be accepted by local residents, or a project that affects daily life of local residents like pollution due to noise, vibration, and contamination caused during or after the project execution -- such projects are causes of conflicts. Once a conflict occurs, it often becomes a serious social problem, and is likely to take a long time for resolution. Therefore, careful responses are required. If the existence of a project itself cannot be accepted by local residents, a prior survey should be conducted on the project's influence on surrounding area using a method such as environmental assessment, or a survey on local residents or briefing sessions should be held for residents to understand the project and confirm that it is reasonably implemented. Furthermore, concerning licenses and permits of local administrative bodies and the government-affiliated institutions, it is necessary to devise measuresto minimize conflicts such as through prior survey of actual conditions.

■ Negotiation

As mentioned above, averting conflict or resolving an issue that has already occurred is always accompanied by negotiation. The essence of negotiation lies in asserting one's interests, bargaining with the other party, and persuading the other into accepting one's position. However, being too aggressive can trigger resentment, and even if agreement is made, may leave friction. Therefore, perfect negotiation is where both parties have a common goal and reach agreement, and end negotiations favourably.

Proficient project managers have learned the aforementioned negotiation skills through experiences and use them effectively in relationship management. Negotiation skills form part of general management skills and are not unique to project management. The following are general points for negotiation described from the viewpoint of project management.

1) DETERMINE A PERIOD

Critical issues for proceeding with a project are in many cases required for solution at an early stage, so negotiation should be started immediately after relevant events are confirmed.

2) SELECTION OF PARTICIPANTS IN NEGOTIATION

A project manager should select participants in negotiation by fully understanding the parties concerned, their relationships, their interests, etc.

3) INFORMATION COLLECTION

It is critical that the project manager has the correct information concerning the issues at hand and understands the position of each party.

4) DOCUMENTATION OF PROCESS

Details of problems, and the process of resolution and its results should be recorded in documents and be retained through confirmation of each of the parties concerned. Immediate written notice when an issue has occurred is particularly critical. A delay or ambiguity in this process could make the issue unnecessarily complicated.

5) USE OF INFORMATION TECHNOLOGY (IT) ENVIRONMENT

Communications should be regulated in IT environments. Since most documentation is stored electronically owing to proliferation of IT, guidelines for information exchange, negotiation means, confirmation of results, and storage of information should be prepared.

6) INFORMAL NEGOTIATION

Not all negotiations are necessarily made at the table. Telephone conversations, fax communications, e-mailsand casual conversationscan be considered as negotiations, and the time spent on these is generally more than the time spent on formal negotiations. Daily communications with stakeholders are the most important for the project manager. Such communications often eliminate problems in advance and enable smooth negotiation under a relationship of trust.

■ Claim Handling

Claims are made when the behaviour of an individual or oranisation does not agree with the ethics, expectations, and goals of other parties. Claims made by stakeholder in various phases while executing a project are recognized individually as a conflict and efforts are made for solution, but attention should be paid to claims because they are more significant than such conflicts. Of various conflicts that come up

during execution of a project, issues that are unique to the project, e.g., the boundary of the scope of supply or difference in interpretation of requirement specifications, may be solved on the spot. Meanwhile, claims are expressions of dissatisfaction from the client that include emotional elements to some extent. The root of such claims is often concerned with products common to the overall company beyond the scope of a specific project or service quality. For example, even when a conflict itself is settled, if too much time was spent on the settlement, or similar problems occur repeatedly, it will incur a claim.

Such claims are in some cases are not completely solved even if the project manager tries to settle cases only within their authority. If they continues to settle cases incompletely without recognizing the meaning of what they are doing, it has a risk that a case will become serious on the company-wide level. In handling claims, the project manager should grasp the essence of claims and have an insight into the claim concerned with the overall company, and a managerial system to deal with such claims as company-wide issues is required.

Industries of mass production goods and services for many unspecified customers generally have "customer service centers" or "call centers" to actively receive various complaints on product and service qualities for quick solution and feedback systems to utilize details of complaints for improvement in products and services.

This also applies to project type products and services. All entities represented by the project manager that have contact with the client have a role to actively listen to the client's claims as a "customer service center," and a system to quickly deal with claims, record them, convey the data to competent organizations, and plan improvement is required as a corporate organization.

■ Quick Response

Quick response to customers works effectively in averting issues or settling them after the occurrence. The reason for taking up quick response separately here is that this is a critical indicator for customer satisfaction and that a system to ensure quick response is a key to service business.

Approach to quick response as a management skill began in late 1980's in the textile and apparel industry of the United States, which had been in trouble due to a severe competition with cheap import goods suppliers, and then the concept of quick response has spread among general consumer goods makers. Establishment of an information network using e-transactions has enabled remarkable improvement in the response to consumer needs with resultant substantial reduction of average delivery terms; production adjustment due to a shift from market production to production by order; stock reduction; conversion to production of value-added products addressing fashion trends; and maintenance of sufficient competitive power against cost-competitive overseas products.

The same types of challenges as mentioned above are effective in project-type products and services. As described above, in relationship coordination while executing a project, attention should be paid to how to handle claims, and the major cause of claims lies in delay or inefficiency in response. When a client points out some issue, if the response to it is quick, it will not cause a claim. Even when a claim occurs, a quick response enables a change to client satisfaction. A system for such quick response should not be positioned at the level where the project manager simply endeavors to be quick in response but response as a corporate organization, preparation of a work procedure using the IT environment, etc. are required. Project management systems with advanced IT environments enable constant monitoring of the progress in projects, recognition of delay risk and its cause at an initial stage, and preparation of countermeasures. Such information sharing with the client eliminates time difference in recognizing issues between the client and project executor and excludes the possibility of occurrence of claims due to time difference.

There is also the concept of prior incorporation of a structure into a system which enables quick response concerning system maintenance after the operation is started. For example, a service that immediately starts preparation for response when any problem is recognized is possible through prior-installation of various sensors into a plant and remote monitoring of the status of sensors after the start of operation. This case shows that the viewpoint of project life cycle including not only response during the project execution but also operation of the system and its abolishment is effective for ensuring the client's satisfaction through quick response. This is because an enterprise that provides such a structure by incorporating it into a system can take an advantageous position not only in project execution but also in maintenance and management business.

3. Restructuring of Relationship

● Restructuring and Maintenance of Multiphase Client Relationships

Project work is done over a limited period and the relationship with the client often terminates when the contract expires. However, for enterprises, it is critical not only to terminate the project successfully and within budget but also to ensure the client continues to select its products or services. Even when a project ends, related maintenance services or new projects are often started. Often a new service scheme that is different from existing ones may be launched as a project and the client may accept a proposition for such new schemes.

Continuous provision of good products and services in inter-company transactions, including projects, results in maintenance of the quality of the products or services and long-term maintenance of good transaction relationships with the client. It is critical to maintain a good relationship with the client so that their enterprise selects the company's products or services.

For this reason, it is critical to build relationships with clients on various levels. Building multilevel relationships with the client facilitates smooth transactions and business expansion. . For example, it is important to build relationships with upper level personnel such as presidents and directors, with manager and contact-person level personnel, and to build relationships between personnel such as purchase and sales sections and engineers. The more diversified the relationships that are built, the closer inter-company transactions become.

The project manager should lead the company to actively build relationships with the client, aiming for continuous relationships when the project is ongoing. Meanwhile, as the relationship with the client becomes more diversified, it will become difficult to keep a consistent relationship as a company. For example, the organizations contact person may have a good relationship with the client company's contact person and they might be about to reach agreement, but this may be interrupted due to a meeting between a competitors president and the client company's president. Such cases are common. Another possible case is that a client may become displeased because a new salesperson promises different things from the previous salesperson, or an engineer provides a quite different service from the one outlined by the salesperson .

It is obvious that consistent responses to the same client based on common information will increase business opportunities and efficiency. Further, in multiphase response, it is clear that strategically response is more efficient. In recent years, some companies begun utilizing a system called Customer Relationship Management (CRM) with the aim of company-wide consistency in their responses to the same client by establishing a structure for integrating the management of information using advanced information technology. Furthermore, such companies aim for quick responses to clients by achieving CRM on the in-house network. CRM has the following major aspects:

- Work efficiency improvement by systematization and use of the Internet.
- Maintenance and reinforcement of relationships with clients and accumulation and analysis of information to be used for marketing.

● Strategic Alliance

To keep good relationships with clients, there are methods other than reinforcement of sales activities through the establishment of multiphase client relationships and utilization of IT as mentioned above. It is also useful to establish of stronger long-term relationships through the strategic formulation of inter-company relationships of alliance or partnership. In this regard, the most typical alliance is the one between manufacturers and raw material suppliers or parts makers. In chemical plants for example, since pipelines are connected inside the industrial complex, management of the complex should be made in conformity with the client. Therefore, long-term relationships are likely to be built between the client and suppliers. In addition, some companies have a long consignment contract with an engineering company for plant maintenance.

In recent years, some companies have adopted a system called Supply Chain Management (SCM) with the aim of stock reduction or efficient physical distribution by directly connecting the production plan of clients with that of parts or raw material suppliers through a system, or by directly connecting the sales plan of retailers, such as super markets, and the production plan of manufacturer's factories through a system.

Japanese companies in the past used license agreements to build alliance relationships aimed at technology introduction. However, as global competition has become intensified, fewer companies are selling the technologies they have developed. This is because companies granted license have often matured into powerful competition when the license has expired. Instead, companies tend to focus their resources on core competence and make alliances with partners to provide ancillary services. Alliance

relationships between strong companies are also increasing. This has been seen in recent industrial restructuring of financial institutions and the process industry. In this age when the complete corporate self-sufficiency involves too great a risk, these alliances are significant not only in building a superior, competitive relationship by supplementing each party's weak points but also in maintaining and expanding the relationship with clients.

Outline

As defined in "II. Project Management," projects are a value creation undertaking with a specific mission. The specific missions of projects can be defined as provision of specific values to specific stakeholders. Successful termination of a project means that a value the project aimed at has been achieved.

For an enterprise that aims to create something through a project and maintain and develop business, it must recognize what stakeholders, in particular the client, intend to pursue through the project, i.e., what the perceived value is, and how to achieve that value. Management resources such as experience and information are the source of values and abundant sources are the driving force of value creation. There are various processes for converting a value source to a form to provide the value, many examples and knowledge obtained through best practice are useful for this.

Value management refers to a value circulation process where knowledge and experiences deriving from aforementioned typical and project activities of enterprises are accumulated as value sources and are used as feedback for projects (i.e., new value creation). Hereafter are described value management and relevant knowledge by classifying it into three stages: "Value Recognition and Evaluation," "Value Source" and "Value Provision."

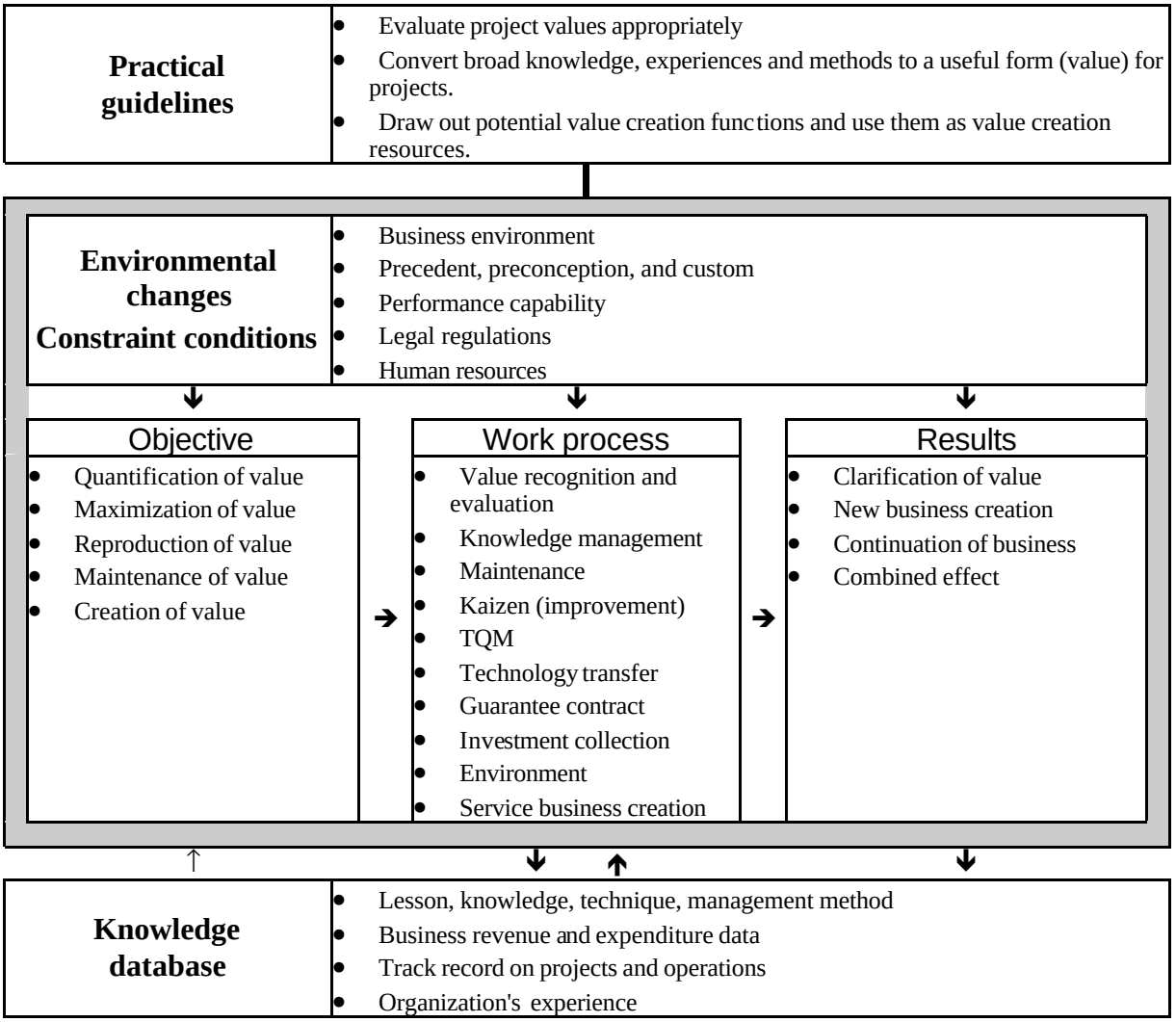


Figure 4-10-1: Overview of Value Management

1. Recognition and Evaluation of the Value

● Definition of Value

The value of a project means value for the stakeholders of the project, that is, stakeholders' satisfaction. The overall satisfaction of stakeholders based on the process of achieveing them and its results shows the value generated by a project.

Corporate activities usually mean value creation activities, and are not so different from projects in that value generated by an enterprise in steady corporate activities are to the satisfaction of stakeholders, centering on the client. However, there is a value specific to a project as it has basic attributes such as uniqueness, temporariness and uncertainty. Uniqueness regards as a value the process itself where a project raises a problem and tries to solve it in order to achieve individual missions. In addition, the reduction and solution of problems caused by uncertainty may become a major value for a project.

● Evaluation of Value

Since the value of a project is evaluated according to stakeholders' satisfaction, its contents are multiphasic and it should be comprehensively evaluated according to multiple evaluation indicators as described later. Although quantitative evaluation methods have not been established in some indicators, it is critical to evaluate from the following viewpoints.

1) Utilize evaluation results for generation and planning of a new project (new project, subsequent project).
2) Intend to decide propriety of project execution or to optimize or increase efficiency of mobil resources by evaluating project drafting / planning.
3) Improve the performance of an entire project and eventually provide a function to enhance customer satisfaction by evaluating how much of the deliverables (output) of the project were obtained from resources (input) mobilized for project execution and establishing a management system to reflect the deliverables of the project operation.
4) Aim at raising the level of knowledge management by learning and accumulating information and know-how obtained through continuous evaluation and using it for the formation of a project or practical capability.

● Evaluation Indicators

The indicators of the five Es (Efficiency, Effectiveness, Earned Value, Ethics, Ecology) and two As (Accountability, Acceptability) explained as Balanced Total Value Indicators (refer to P.40) in "Ⅲ Program Management" are the indicators for evaluating the value of a project. A project should be comprehensively evaluated in conformity with its objective / goal, and by balancing these indicators according to the time of the evaluation in a project cycle or the objective / goal of evaluation.

Case ◆ Balance of Evaluation Indicators

There are some cases where a project fails due to a problem in social acceptability despite its high effectiveness. There can be cases as well where the profitability of a project has to be sacrificed in order to solve environmental problems.

● Evaluation Period

Value evaluation is classified into the following four stages according to implementation periods in a project cycle.

(1) Prior evaluation: Initial phase, prior to the decision on a plan
(2) Midterm evaluation: Midterm phase
(3) Post evaluation: Final phase, completion / management of the project
(4) Follow-up evaluation: Follow-up phase, confirmation of the effect of the project

The position of evaluation in a general project cycle is shown in Figure 4-10-2.

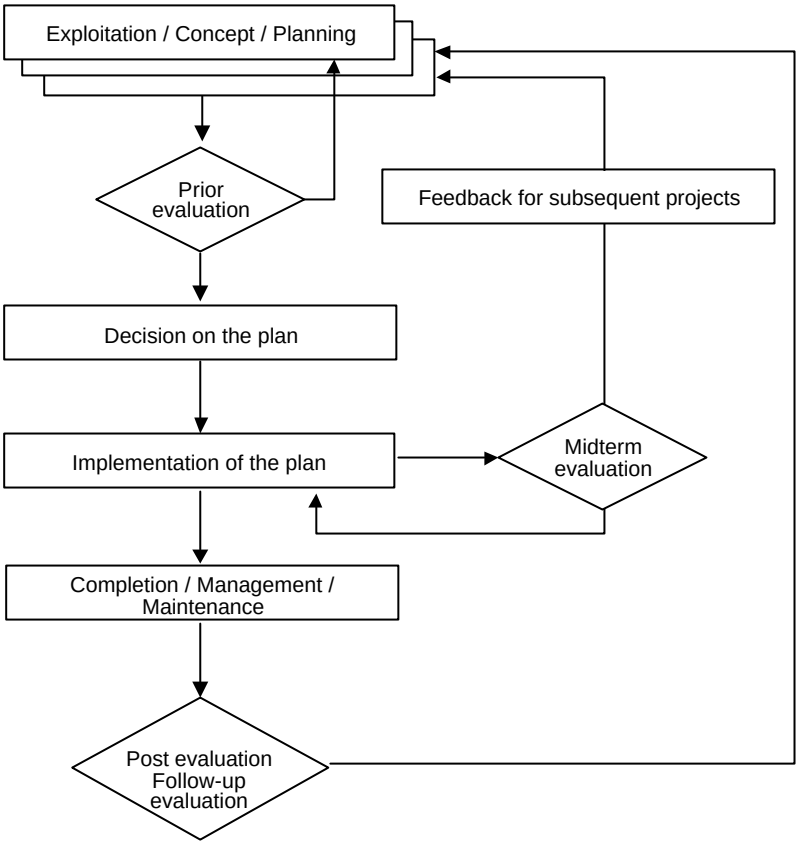


Figure 4-10-2: Process and Evaluation of Project

(1)PRIOR EVALUATION

In prior evaluation, materials are provided for judging the propriety of project implementation or project selection by examining the validity and feasibility of project planning, and by conducting absolute evaluation of individual projects and relative evaluation of multiple projects. Refer to "Evaluation System for Strategic Project, Chapter 1 (P.75)," for critical viewpoints for evaluation.

(2)MIDTERM EVALUATION

To be used for examining the necessity of revising / correcting a plan or as a material to judge whether a project itself should be continued by recognizing the progress / achievement in the middle of the project.

(3)POST EVALUATION

The purpose of post evaluation is to assess the degree of achievement by comparing the implementation so far or the operation and maintenance after completion with the contents of the initial plan when a project is completed. Post evaluation is also significant in verifying the difference between the results and the original plan and the main factors for success or failure as feedback for subsequent projects.

In addition, post evaluation is intended not only for merely judging the feasibility of a project and reflecting it on plan review and proposal / planning for a new project. Examining / learning what results the prediction in prior evaluation appeared was also enables verification of prior evaluation. This leads to improvement in prior evaluation methods necessary for project drafting or selection.

(4)FOLLOW-UP EVALUATION

Since some projects take a long time until their effects appear, it is necessary to investigate the effect the outcome of a project has had to the industry and society when a certain period (e.g., not less than ten years) has passed after their completion in order to totally evaluate the projects from a present viewpoint based on the results of the investigation. In addition, follow-up evaluation is also useful to verify the validity of post evaluation. Moreover, we can sustain the outcome of projects or further facilitate the effect by examining necessary measures and taking actions.

Case ◆ Follow-up Evaluation in the Medical Industry

In the medical industry, there is a follow-up evaluation after sale, and an investigation of adverse and beneficial effects is required for all new drugs. If a "serious adverse effect" or "no beneficial effect" is found in this phase of the follow-up investigation, the approval of relevant medicine is withdrawn, and all the investments made so far in the project become redundant.

● Evaluation Method

For quantitative evaluation, a certain measurable object must be defined for each evaluation indicator. Typical evaluation methods are shown below. It is essential to efficiently select and combine them to improve the quality of evaluation. In addition, as an appropriate quantitative evaluation method does not always exist for each indicator, search for and development of a new method indicator are desired.

■ Cost Benefit Analysis

This method is intended to provide materials for judging whether a project should be implemented by calculation a cost benefit indicator after calculating the cost (C) and benefit (B) of the project. In considering the comparison between benefit and cost, the indicator may be shown by the balance between them, i.e., either by the net benefit (B-C), or by the ratio (B/C).

■ VFM (Value for Money)

In planning a Private Finance Initiative (PFI) business, after the business to implement is selected with the cost benefit analysis or other measures, evaluation and judgment on VMF method is adopted concerning whether the business should be implemented in a conventional method for public work or in the PFI method.

VFM is one of the basic ideas of the PFI method, and is a concept intended to facilitate efficiency in undertaking infrastructure improvement based on the concept of "making the best use of financial funds for citizens." To be specific, when comparing a case in the PFI method with a case in a conventional public works method, if the former is more cost-effective, the PFI method will be adopted.

VFM can be assessed by calculating the life cycle cost during the entire period of a social infrastructure improvement project. This project evaluation analysis method using VFM is regarded as a concept that can be fully utilized for project evaluation in general enterprises.

■ Inter-Industrial Analysis (Demand Forecast Model)

Inter-industry analysis refers to the quantitative recognition or prediction of economic trends using an inter-industry table. It is utilized for predicting economic futures and analysis of economic ripple effects for public works projects and the like.

This analysis method can be utilized not only for predicting the demand at the time of project planning and its economic ripple effects but also comprehending andevaluating the change in effects with the change in social economic situations as well as the revision of contents after the implementation of the project.

Predicting demand is the most critical factor for evaluating the feasibility in prior evaluation. There are many cases in which a project breaks down due to an excessive demand prediction with less objectivity. Utilization of the demand forecast model with inter-industrial analysis etc. should be geared towards laying out a plan based on a precise demand prediction.

■ Balanced Score Card = BSC

A new management system with balanced score cards that has added a strategic dimension to management control is effective for both the evaluation of corporate activities and that of a project. Refer to "Balanced Score Card, Chapter 1, P.77" for how to utilize balanced score cards for project evaluation.

■ Indicator of Profitability Evaluation

With regard to the evaluation of investment profitability, there is a method mentioned previously in "Evaluation of Investment Profitability, Chapter 1, P.75." There is also a method of verifying and evaluating the safety in repayment of the principal and interest from the viewpoint of fund contributors. (Refer to " Financial Accounting Analysis / Evaluation, Chapter 2, P.108."

■ Principal Component Analysis

The principal component analysis is a method for contracting and simplifying multidimensional data for analysis into two- or three-dimensional data, reducing the loss of information included therein as much as possible.

The principal component analysis is used for the following purposes:

- To create a total indicator that integrates many indicators.

- To group objects of observation.
- To examine data for multiple regression analysis or discriminant analysis from a different point of view.

■ Discriminant Analysis

Discriminant analysis is a method for classifying objects based on the values of a number of the variables observed. For instance, the feasibility of a project can be discerned from the data on the delivery date observance rate, budget observance rate, scope observance rate and degree of customer satisfaction.

■ Others

There is also an approach for conducting multivariate analysis of data concerning a project, finding correlations in the data with multiple regression analysis, thereby supporting arguments for investment in improvements to raise value However, this is not utilized because it is physically difficult to handle enormous quantity of data to connect it to an effective judgment support.

2. Value Source

Experience and knowledge are accumulated in the process of corporate value activities whether they are steady or project activities. Knowledge and experience are a source of value since they serve as a foundation when an enterprise generates a product or service that provides customers with a new value.

However, to make knowledge and experience the source of value, a scheme is required where they are recognized as value and consciously accumulated, shared and efficiently reused. In this section, key words are described such as Knowledge management, Maintenance, Kaizen (improvement), and TQM (Total Quality Management) as knowledge concerning such schemes.

Knowledge management literally means a method of managing knowledge and experience in a reusable form, and it is obviously relevant to this section. In maintenance, the client's value evaluation of a project is shown at a stage where the outcome of the project is in operation, which means it is extremely critical to consciously accumulate knowledge and experience obtained at this stage. Improvement and TQM include many methodologies to extract value from corporate operation and improve the value source in an enterprise.

● Knowledge Management

■ Definition of Knowledge Management

Knowledge management is a series of activities used to sublimate information and knowledge in an organizational knowledge system and effectively utilize this knowledge for organizational management. This series of activities includes such processes as specification of information and knowledge, collection, adaptation, systematization, application, distribution and creation. Professor Nonaka, using four modes of knowledge transformation as shown in Figure 4-10-3, explains the process of creating knowledge in an organization through interaction between implicit knowledge (subjective knowledge, experienced knowledge, simultaneous knowledge, and analog knowledge), and formal knowledge (objective knowledge, rational knowledge, orderly knowledge, and digital knowledge).

The knowledge belonging to individuals is reused and utilized on a personal level but often is not shared. On the other hand, the knowledge held by an organization cannot be effectively utilized by individuals unless it is easily accessible for them. Therefore, knowledge management involves two aspects: the process of formalizing and sharing implicit knowledge held by individuals and the process of establishing a system to share knowledge organizationally and effectively. Also, it is necessary to consider incentives such as compensation for individuals who provide information in addition to reforming the corporate climate in order to facilitate information sharing.

Knowledge management has been adopted by various organizations in recent years, and it is beginning to play an important role as part of efforts to create value. As organizational management and business activities are shifting towards projects, knowledge management is becoming increasingly significant.

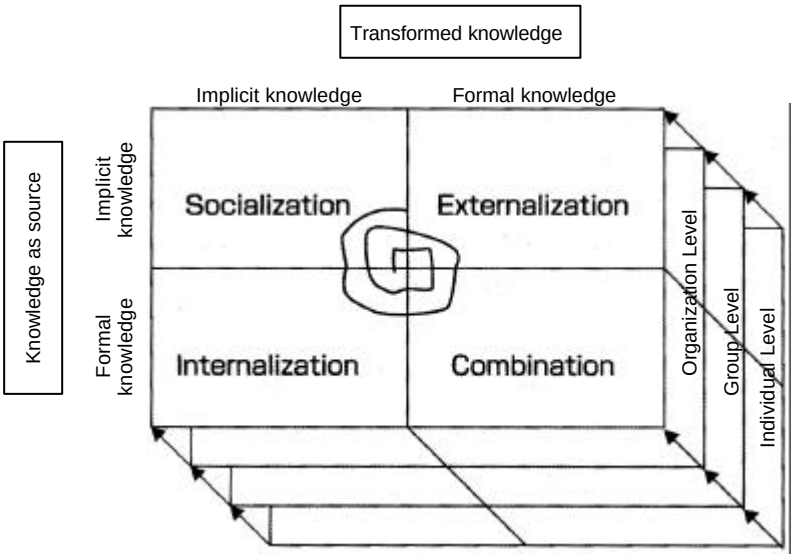


Figure 4-10-3: Four Modes 0f Knowledge Transformation

■ Establishment of Knowledge Database

Knowledge should be accumulated in a database to utilize it effectively. In a database, information from various aspects such as general information, past data, markets specific to the project and business type / category, products, service, people, technology, costs, best practice, risks, trade and judicial affairs can be collected and accumulated.

It is necessary to establish an efficient system to build up information and connect with databases both inside and outside the organization. A knowledge database should be constantly updated through the information derived from steady project or management activities, and be ready for immediate use. The speed of sharing and its quality has a major impact on efficiency. Also, since knowledge systems can change depending on organizations and environments, a dynamic form is required to correspond to changes.

■ Knowledge Management in a Project

Knowledge management should be considered as part of the project process since management activities and organizations are shifting to projects. Knowledge is utilized in planning and implementing a project. Network-type management generates a mixture of multiple knowledge and knowledge management activities specific to a project within the project organization. During the life of a project, accumulation of knowledge and its use on the project, and feedback for related organizations and enterprises are simultaneously conducted. The knowledge accumulated in a project will be further utilized for similar projects in multiple organizations and enterprises or creates a new project.

Case ◆ Accumulation and Utilization of Proposals for Improvement

In an international enterprise, when constructing similar buildings in various countries, they invite employees to report proposals for improvement that reduce cost to the construction department of the headquarters, and they accumulate proposals at the headquarters and post them on the company Intranet to use them on designing and construction thereafter.

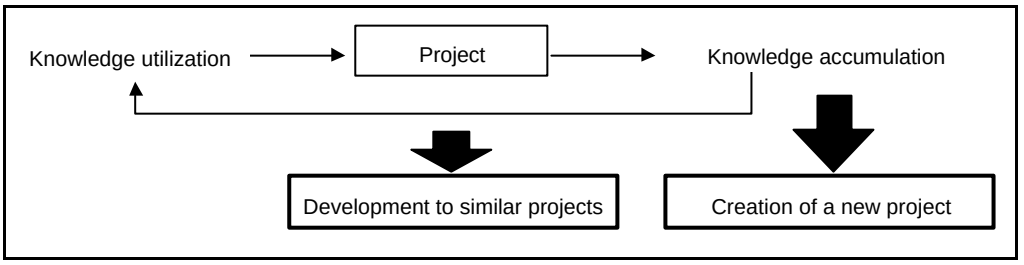


Figure 4-10-4: Relations between Projects and Knowledge Management

● Maintenance

Projects conventionally have phases such as starting, planning, implementation, control, and termination, and their main concern was how to manage these phases efficiently. These days, however, although some projects completely finish their life cycle at the termination phase, many projects move to a steady maintenance state (operation stage) after completion, and the value generated there has also become a primary purpose of projects. Maintenance indicates a phase of operation in the life cycle of a project, and means an action and management to sustain the operation.

During periods of high growth there is strong emphasis on investment without consideration of ongoing maintenance costs or maintenance as a focus for projects. However, in the near future, values brought by a project are expected to be recognized more clearly than ever, and the quality of performance and service at the maintenance phase is becoming increasingly important. At the same time, investment collection at the maintenance phase is expected to decide the success of a project as "life cycle cost (LCC)" will be taken into consideration at the planning stage and project finance will be commonly utilized. Therefore, it is increasingly required to accumulate information at the maintenance stage in an available form to use them effectively on project planning.

Projects that integrate the maintenance stage will be a key trend in a network-type society due to additional values brought by maintenance and after-sales services. Further, commercialization of services specialized in the maintenance phase and creation of projects are expected to become increasingly active.

■ Transition from Project Execution Stage to Maintenance Stage

In the conventional ending phase of a project, transition to maintenance is conducted through such actions as examination, trial run, relocation and moving. This stage is an important part to ensure project has been executed according to the plan. Promote the start of the maintenance stage according to the initial plan, and check the performance at the maintenance stage.

■ Evaluation at the Maintenance Stage

Evaluation of whether a project has shifted to the maintenance stage according to the plan can be assessed by measuring performance from various aspects qualitatively and quantitatively. Some performance can be evaluated by measurement at a point in time while other aspects of performance require continuous monitoring. In addition, automatic monitoring has become possible through utilizing information technology, and thus a prompt response, including maintenance and repair, has become possible in case of contingency.

In evaluation at the maintenance stage, attention should be paid to the fact that there are projects whose performance is affected by time and others whose performance becomes relatively low due to changes in social environments and technologies. Therefore, it is desirable to conduct successive measurement and benchmarking in comparison with other cases. Evaluation technology and diagnosis is expected to become diversified and increasingly critical in the near future.

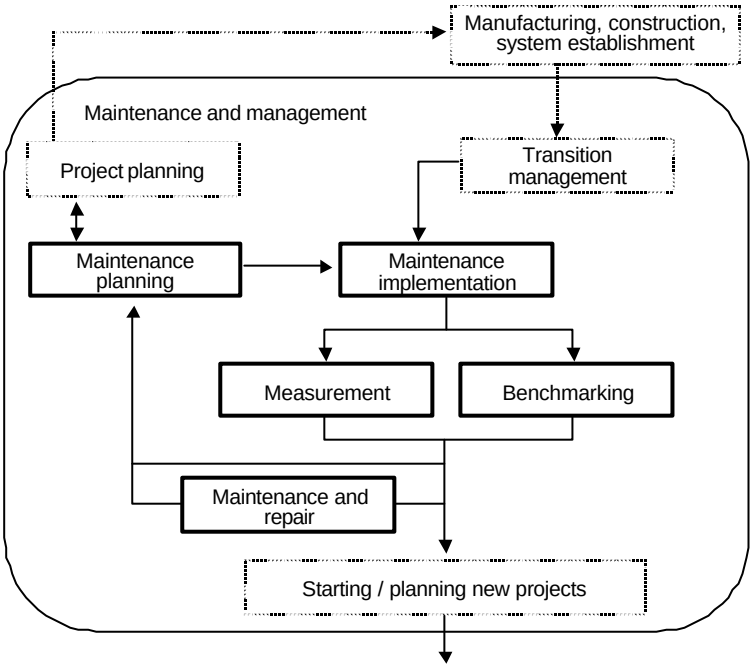


Figure 4-10-5: Flow of Maintenance and Management

● Kaizen (Improvement)

Kaizen means that all employees from top management down participate in constant promotion of improvement. Kaizen starts through recognition of problems. Complacence is the biggest enemy of kaizen. Therefore, kaizen puts emphasis on awareness of problems and provides a key to finding problems.

Once a problem is found, it must be solved. In this sense, kaizen is a problem solving activity. In fact, kaizen requires the use of various tools for problem solving.

Kaizen also reaches a higher level as each problem is solved. Therefore, kaizen needs to be standardized to maintain the new level.

Kaizen has been developed as a management method in Total Quality Control (TQC) activities. TQC has contributed to generating a process-oriented concept in enterprises through its activities and created an kaizen strategy that enables constant improvement involving all levels of people.

1) KAIZEN AND CUSTOMER-ORIENTED STRATEGY

What underlies the kaizen strategy is recognition that efforts to satisfy customers and contribute to their needs are required to continue business and make profits. To that end, improvements in various fields such as quality, cost and delivery date are essential. Therefore, all activities in kaizen are considered to finally result in greater customer satisfaction.

2) KAIZEN AND SOLUTION

The kaizen strategy has generated a systematic approach that is applicable for "providing better products at lower prices" and a solution method. Kaizen starts with a recognition that every company has a problem. Therefore, kaizen solves problems by creating a corporate culture that enables everybody to freely recognize and report problems.

3) KAIZEN AND PROPOSAL SYSTEM

An enterprise makes best efforts to have its employees participate in kaizen through proposals. Some of the main characteristics of Japanese management are that a company draws an extremely large number of proposals from its employees, that the management seriously considers those proposals, and that the proposal system is incorporated into a company-wide kaizen strategy.

Another important aspect of the proposal system is that once a proposal is implemented, the standard procedure is changed accordingly. Employees can play an important role in improvement of the standard by participating in kaizen of the work place through proposals.

4) KAIZEN AND PROCESS-ORIENTATION

Kaizen generates a process-oriented concept because a process should be improved firstbefore a result is improved. Furthermore, kaizen is human-oriented and thus aims at human efforts.

One of the characteristics of Japanese management is that a company has been consciously making efforts to establish a system that supports and encourages a process standard while at the same time paying sufficient attention to a result standard. If top management positively utilizes a process-oriented concept and further strengthens it with a kaizen strategy, the company's total competitive edge is sure to make great progress in the long run.

As a consequence, kaizen means that all members, with the goal of customer satisfaction, make unified efforts to implement improvement in various fields such as quality, cost and delivery date by repeating a PDCA cycle consisting of problem recognition → solution → new standard setting → maintenance. Further, kaizen means "new idea" or "new process", which is utilized in a project, contributes to a project, is tried in a project and whose effects are returned as feedback.

● TQM Activities

TQM is a management control technique that contributes to "quality" improvement in management of an enterprise and organization. It works in harmony with TQC and is used in accordance with the needs of the times. It can be considered as a sort of summarization of QC and TQC.

TQM aims at improving the quality of a corporation or its activities. For this purpose, it reasonably sets a vision based on a long-term perspective and strategies to achieve this vision. Therefore, this methodology can be applied to a process of value integration or a project strategy in project management and contributes to creation of a new project.

■ Application Scope

TQM focuses on quality improvement of management systems, that is, "management processes" and "management resources" in order to contribute to quality improvement of an enterprise. Therefore, the scope subject to application of TQM includes management processes (such as vision, strategy, planning, design, development, and after-sales service) and management resources (such as personnel, organizational structure, information, knowledge, technique and equipment).

■ Philosophy

TQM philosophy consists of quality, management, and respect for humanity. Although these elements have been already established in TQC, what is emphasized in the innovation to TQC is the following three points:

1) Improve not only processes and systems to generate products and service but also the quality of a corporation and of its activities (total "quality" of management).
2) Expand the concept of "management" to have a viewpoint of "strategy" "reform" and "prediction."
3) Establish human resource management according to a new "labor perspective" based on TQC.

■ Core management system

A management methodology for management systems and management resources to embody the above-mentioned philosophy (core management system) includes the following.

- Vision / strategy, leadership
- Management control system
- Quality assurance system
- Management element control system
- Resource management

■ Method

Various methods are used in practicing TQM,. Although there are some original TQM methods, many of them are created by sophisticating existing methods (including application methods). Such methods are listed below. Refer to the glossary at the end of this book for their outlines.

- Solution with QC story
- QC Seven Tools
- Statistical Quality Control = SQC
- New QC Seven Tools
- Product Planning Seven Tools
- Strategic Planning Seven Tools
- Other QC methods

TQM also adopts and utilizes many methods developed in fields other than the quality control field.

- QFD (Quality Function Development): Quality development and quality list
- FMEA (Failure Mode and Effect Analysis): Failure mode and influence analysis
- FTA (Fault Tree Analysis): Influence analysis
- DR (Design Review): Examination of designing contents and review of design process
- OR (Operation Research): Optimization method
- IE (Industrial Engineering): Work analysis, work design, etc.
- VE (Value Engineering): Value analysis

3. Provision of Value

A project provides its values as deliverables, and details of the value depend on specific missions of individual projects. This section explains about provision of values applicable to various forms of projects, not about individual values affected by such specific missions.

"Technology transfer," "guaranty agreement," "investment collection," "environment" and "creation of service business" are cited as keywords that might be used in providing value to the customer in addition to the products and services that each business provides as its core competence. Technology transfer is a method of enhancing knowledge and experience of values and providing those values by adding them to conventional products and services.

A guaranty agreement or investment collection includes an idea of providing values by reducing uncertainty specific to a project, i.e., risk, from the standpoint of the client.

The environment is a critical factor that affects value, as Ecology is included in the five Es as project evaluation indicators. In recent years, recognition of its importance has spread to the level of citizens in the world including developing countries, and negative factors in the environmental indicators have been excluded by all stakeholders as civil awareness, and positive consideration tends to be required. This shows that the environmental indicators serve as a viewpoint to provide common values to all projects.

In addition, as shift to service business is becoming a keyword for structural reform of the manufacturing industry, provision of values through service is expected to become a critical mission for projects more than ever.

● Technology Transfer

The following are the technologies related to project execution:

1) ENGINEERING TECHNOLOGY

Specific technologies such as engineering, physical science, and medical science, which exert a major impact on the technological aspect of project deliverables.

2) PRODUCTION TECHNOLOGY

Specific technologies needed for a process to generate deliverables in production, manufacturing, construction, system establishment and so on.

3) MANAGEMENT TECHNOLOGY

Management processes and techniques concerning scope, quality, cost, schedule, organization, procurement, risk and communication, which are applied in generating deliverables.

4) INFORMATION TECHNOLOGY

Information processing technologies concerning computers and networks.

5) FINANCE TECHNOLOGY

Planning and management technologies based on financial engineering.

6) TECHNICAL TECHNOLOGY

Technologies applied when people are directly involved in a process to generate deliverables, which have difficulty in mechanization.

Experience concerning these technologies should be systematically accumulated as knowledge management and effectively utilized.

Knowledge management of systemized technologies enables business development such as expansion of intellectual property rights and technology transfer service, and it raises project values through technical consultations. Thus, a favorable cycle is expected where feedback on education, training and human resource development becomes easier and competitive awareness is enhanced at enterprise, community or national level.

● Guarantee Agreement

A guarantee agreement means that a project executer secures a certain level of guaranty in an agreement with the client concerning deliverables such as products or services, and it usually constitutes a clause of an agreement between the project executor and the client.

Since excessive guaranty becomes a risk for the project executor, it should be avoided for the purpose of risk management. Meanwhile, if the project executor assumes more risks, it means risk reduction from the client's viewpoint.

Guarantee that is beyond control within a specific project may become possible if it is grasped within the framework of the client relationship at a higher level. For instance, even if it is impossible to

maintain a long-term guarantee for providing spare parts of a single product, the guarantee may be possible if all similar products of the company are integrated. Also, outsourcing of all or part of guarantee service itself is possible, which even enables the company to propose the guarantee that cannot be provided within its own business scope.

In this way, by considering guaranty not as risk but as an opportunity to create values for clients, various styles of guaranties are expected to increase in use in the future. Therefore, project executors need a flexible way of thinking from the client's viewpoint.

Case ◆ Definition of the Client-Oriented Value

At a mass merchandiser or mail-order business, we often see such conditions as "Those who have found a better product at a different store may return our product" and "You may return our product if you are not satisfied after trying it (for a certain period)." They indicate the quality of products or services, which should be clearly defined, as customer-oriented definitions, such as "being better than anything else" or "being satisfactory for a customer."

Case ◆ Performance Guaranty in Power Plants

In power generation plants or the like, for example, it is possible to guarantee the performance of electricity output etc. not only upon delivery but also for a long period and to prepare bonus or penalty each year depending on whether the guaranty is achieved.

Case ◆ Expansion of Guaranty Period / Reduction of Exemption Clauses

It is also possible to propose conditions more advantageous to the client such as expansion of a guaranty period (such as a period of warranty for latent deficit over five to ten years or a guaranty to provide spare parts during the product life span) or reduction of exemption clauses during the guaranty period (a guaranty to handle any trouble free of charge regardless of its cause and others).

● Investment Collection

In the case of a new investment, it is necessary to closely examine what sorts of values would be generated by it. It affects the scope of investment. When aiming an investment portfolio, a target market needs to be correctly set, and it is essential to consider various forms of collection according to the life cycle of investment.

For instance, if the market for investment is not limited to Japan but expanded to the world, the portfolio can be advanced. When developing and selling a new product, along with the product sale, the amount of investment can be increased by charging for after-sales service as well as the product to be sold. Then, unit price can be set at a lower level. In addition, in the case of complicated machines and equipment or system software, user education can be charged and proceeds added to the portfolio. There is also rental in addition to mere sales. Furthermore, once a product brand is established, business can be developed into various character goods using the brand.

Thus, it is critical to make an investment plan from the beginning while considering business development from time to time in accordance with characteristics or life cycles of products and services.

The capital invested can be collected in various forms by considering investment as a business, not as a mere investment, setting a target market and developing subsequent relevant services in addition to mere product sales along with the life cycle of business development.

Also, a sound methodology of investment can create opportunities for new business.

For instance, in the United States, the ESCO (Energy Service Company) business has successfully created a large market as a new business model. It is the kind of investment where a business owner that uses a large amount of energy is presented with a chance of investing in energy-saving equipment that provides low-cost energy and the business owner pays the difference brought by the cheaper energy charge as investment cost over several years. This enables the business owner to execute an energy-saving investment without investment funds to achieve reduction of energy costs.

In addition, building and construction based on the equivalent exchange method of land and a building is an example of creating business by proposing means for investment collection to a landowner who has no investment funds.

In this way, by considering frameworks for good investment collection, a constructor can propose a project to a business owner who has no funds, which generates a new business opportunity. Thinking of investment collection methods is also very important in creating business opportunities.

● Environment

The growing awareness of the environment is an international trend. With the advancement of specification of environmental factors, reinforcement of regulations, quantitative evaluation of environmental preservation activities, environmental accounting, and information disclosure, the impact of environmental problems on corporate activities, business and projects is expected to grow more than ever.

The present situation of environmental problems is diversified, such as global warming, destruction of the ozone layer, acid rain, destruction of the rain forest, and marine contamination. They affect human life in various ways such as increasing food demand, depleting resources, chemical substance issues, as well as waste.

In corporate management, due to its social responsibility, introduction of environmental management systems (EMS) such as ISO14001 is promoted. In the past level of project management, the environment had not been recognized as a field. However, since positioning of the environment has changed in corporate management, stakeholders have become strongly aware of environmental issues. Therefore, project management inevitably involves a comprehensive action in consideration of environmental problems.

EMS, which is closely connected with industrial safety and health, is systemized as management concerning the environment in broad corporate activities. Its composition is as follows in project environmental management.

1) Outline of project environmental management (Scope setting)
2) System of project environmental management
   - System (organization / conference body)
   - Role sharing (responsibility and authority)
3) Specification of environmental risk management
   - Setting up environmental aspects
   - Evaluation of environmental influence (Setting up remarkable environmental aspects)
   - Setting up environmental declaration
4) Creation of environmental management programs
   (Purpose/goal, 6W1H, process)
5) Environmental accounting plan
   - Setting up EMS operational cost
   - LC cost, LC effect
6) Administration of changes in environmental management programs due to a change in specifications
   - Monitoring, measurement, internal audit program and response to correction
7) Environmental accounting administration
   - Environmental accounting LC flow
   - Income forecast for environmental accounting
8) Management report
   - Report on project environmental management
9) Review of environmental performance and functional plans
   - Examination of environmental performance, alternative construction plans with environmental consideration
   - Evaluation of environmental efficiency plans
   - Review of environmental performance and functional plans
10) Administration of documentation
11) Administration of changes
12) Specification of emergencies and establishment of an action procedure
13) Planning of environmental education
14) Management review

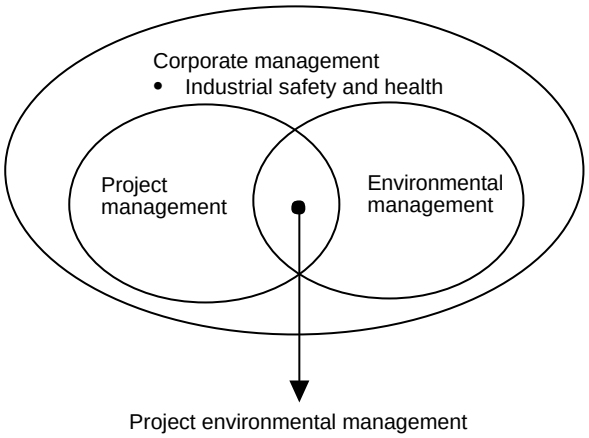


Figure 4-10-6: Project Management and Environmental Management

Further, in line with advancement of obligations of environmental protection /restoration and evaluation of corporate activities, environmental business concerning the evaluation, consulting, cleanup, energy saving (refer to Investment Collection, P.269), etc. would be created. The environment would become a factor in project values, and provide value to a project at the same time.

Case ◆ Right to Exhaust CO_2

In the case of CO_2 whose exhaustion is restricted on a global scale, a new market can be generated by bridging industrialized countries and enterprises that exhaust CO_2 and developing countries that absorb CO_2 in their forests. For instance, developing countries securitize their capacity of absorbing CO_2 and appropriate the proceeds to forest management and tree planting. Such markets that connect securing of a CO_2 exhaustion frame with forest protection could be created. Environmental problems used to be recognized economically through environmental management, environmental accounting, and environmental taxes.

Case ◆ Soil Pollution

In the United States, because of the Superfund Law as a law for reducing soil pollution, the level of present and future soil pollution is recognized as an important item of project management in fields such as construction and engineering, securitization of real estates, and REIT (Real Estate Investment) . In Japan, laws in this field are not finalised but the cost for restoring pollution of the nation's entire ground is estimated at ¥13 trillion.

● Service Business Creation

Creation of new service business is an essential action for an enterprise that is already involved in a field of service business in order to continue and develop its business. In addition, even the manufacturing industry is concerned with service. In fact, it is possible to say that the trajectory of their future business development is headed for nothing but service business.

The manufacturing industry no longer only provides the market with products with additional values generated from material processing. If a customer is satisfied just by purchasing a product without caring about service, and if there is no significant difference in the quality between similar product groups, the market is determined only by pricing.

Such fierce price competition is ongoing in many product fields, and business often has difficulty in making a profit just by providing products. Each enterprise is endeavouring desperately to differentiate its product, and then a product in competition exceeds the value of the product and is expanded to the integral value (for a customer) with the product as its core.

Such expansion of a product concept revealed itself at an early stage especially in mature product markets such as general industrial goods and consumer goods where the price of products has become lower and there is little reserve for differentiation. The main factor of differentiation is shifting to service. It includes pursuit of customer services such as customized specifications according to the client's preference, delivery on the same day, and around-the-clock customer support, or special guaranty such as a right to return products anytime.

These days, such situations are also seen in markets of custom-built large-scale equipment and project products (factories, power stations, large-scale computer systems, etc.). Manufacturers are

focusing on the development of service business centering on its products. For instance, the aviation industry creates business by providing passengers with such services as music and images through a satellite, or collects data of aircraft engines during flight to develop it as maintenance business.

The most critical point in value creation through service is conversion from the concept of providing products on a seller's standpoint to a concept of creating values thoroughly on a customer's standpoint. The efficiency of products provided by a seller can be seen as a value for a customer. Any function unnecessary for a customer cannot be recognized as a value however excellent it is.

Furthermore, a purchase price is only part of its lifetime cost for a customer. If the total cost involving use or disposal is high, the product is not appealing even if the price itself is low. In addition, the purchase or maintenance of a product should not be time-consuming even if its efficiency or cost is excellent. Easy communication and meticulous service become a value.

From such viewpoints, enterprises are now trying to develop their business in an attempt to realize satisfaction of more customers by centering on the products and services they provide and such resources as knowledge, experience, and personnel that support their products and services. For instance, they may provide life cycle management centering on their products that covers maintenance and disposal, or support improvement of efficiency in operation and maintenance based on product knowledge.

Case ◆ Reduction of Total Life Cycle Cost

All services to reduce total cost for a customer concerning present core products and services, such as costs of maintenance, physical distribution, materials, operation, disposal and environment, become a source to create customer value.

Case ◆ Pursuit of Convenience

All various devices to improve communications with customers and provide quicker and more convenient means for enquiries or complaints of customers has become a source to create service business.

Case ◆ Disclosure of Know-how

This means systematization of the knowledge owned by an enterprise in a form that can be provided to customers as a value and service. Such things as information service, training and consultation are considered.

Outline

In the twentieth century, with rapid globalization, we are now in the age of diversity. It has become increasingly common that, across the borders and generations, people from various cultural backgrounds and with different ideas and value standards are working in one same project. In this context, management of communication to promote better understanding among project members is one of the major factors in influencing project success. In addition, it is important to accurately keep track of real situations and solve various problems arising from a project through communication. Thus successful management of a project in a proactive manner is largely attributable to communication management.

In this chapter, focusing on "cross-cultural communications", we discuss basic matters of communication and involvement based on practical experiences. By respecting differences in cultures, and accepting each other, we can develop a hybrid type of communications that has characteristics of both cultures.

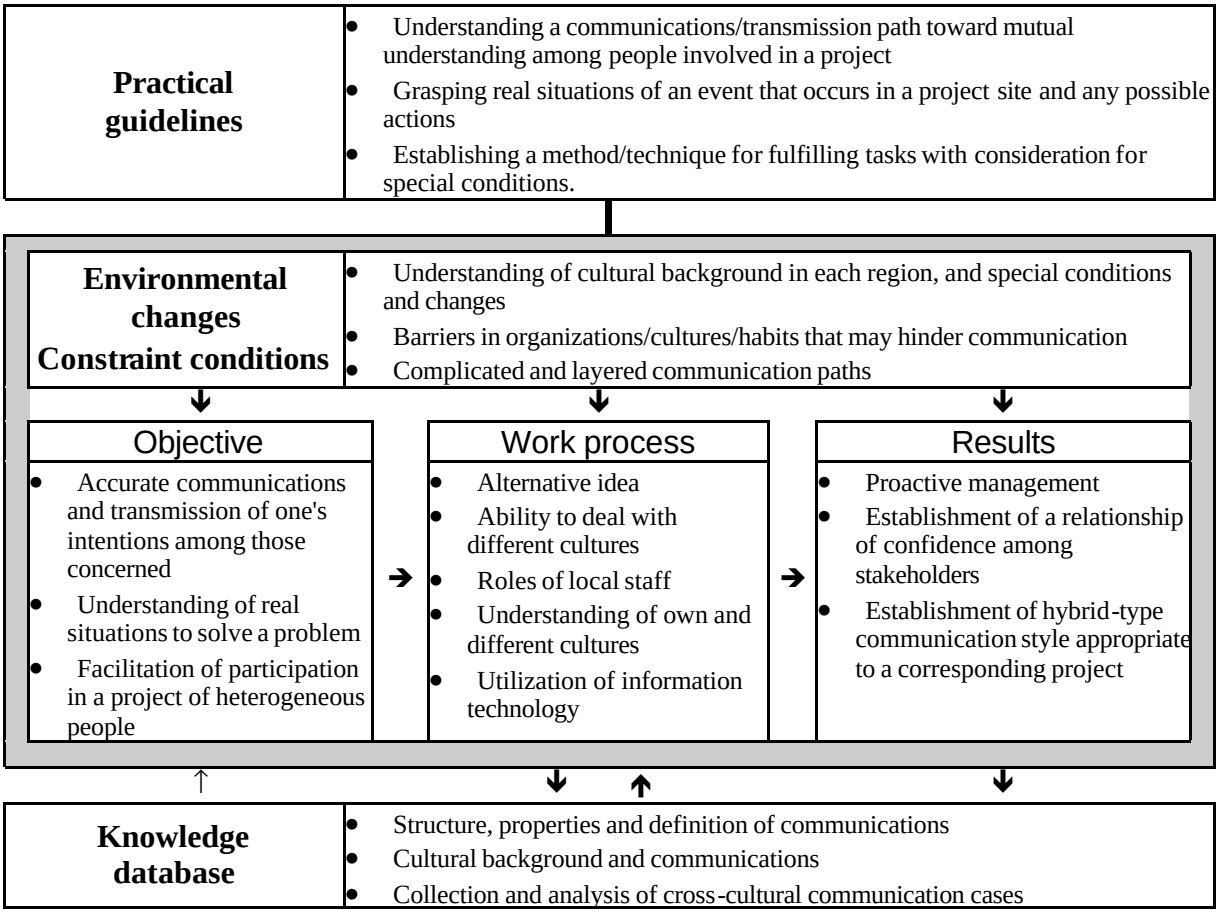


Figure 4-11-1: Overview of Project Communications Management

1. Significance of Communication Management

A project has a starting point and an end point. Every time a project is formed, it is composed of variety of people. Some members participate in a project over its entire period, while others are just involved, as necessary, for a limited duration. To fulfill a project under these circumstances, project members face the challenge of obtaining the necessary information in reliable and timely manner. It is communication management that should address this challenge. More often, a project fails due to a lack of communication ability, rather than by being short on technological ability. A project can succeed only when those involved in a project understand these facts, become aware of importance of communication, gain communication skills, and deepen their understanding of each other.

● Mutual Understanding among Project Members and Motivation toward Success

The most important challenges in fulfilling a project are as follows: participants must be able to obtain information necessary for operation of a project, including background information on the project; they should have a clear understanding of the purpose/target of the project; participants should increase confidence in each other through developing mutual understanding, and intentions should be communicated smoothly in a project team. Through meeting these challenges, conflicts among participants will be reduced, factors of uncertainty will be removed from the team, and motivation toward success can be encouraged. Communication management is a system of practical techniques for efficiently and systematically meeting these challenges. To this end, project members must have the ability to communicate, including understanding of the movement of different cultures toward globalization.

● Control of Distribution of Information

Every project starts from information, produces a result by processing entered information, and the result will be utilized as input by other parties, internal and external to the project. This flow of information promotes activities. The primary role of communication management is to transmit all kinds of information necessary for fulfillment of operations in an accurately and timely manner to all concerned parties.

● Holding Different Meetings

The basics of communication are the creation of documents necessary for the fulfillment of a project and holding meetings to distribute these documents. To deepen understanding, two-way conversation is necessary and is usually implemented in the form of a meeting, if more than one division is involved. During a project, different meetings should be held, as listed below:

1) Kick-off meeting
2) Meeting of a home office and site
3) Irregular meetings with customers, in-house members and cooperating companies
4) Regular meetings including process control

2. Communications in Routine Work

● Liaison

■ Centralization of Information

With development of information systems, disclosure of information and clarification of authorities for access to information have become more important. In order to reliably and efficiently execute a project, it is necessary to centralize information. All information can then be conveyed through a division in charge of project management. Information to be shared with a customer should, in principle, go through the project management division that serves as a liaison. Even when information is directly communicated with a customer, officially, information should be exchanged by way of the project management division (by means of a memorandum, document, drawing, and e-mail).

■ Instructions on Execution of Tasks and Implementation of Liaison Work

In order to centralize information, written instructions on flow of information, a list of information recipients, saving (filing system), and management of changes should be created in advance, and liaison work should be implemented in accordance with them.

■ Kinds of Information and Qualification of Authorization

Since information is the life blood of project tasks, the nature of the information and its use should be clarified. As an example, it should be made clear whether a document requires approval, an official document that will be executed, an informational document to produce a result, etc.. In addition, it should be made clear which documents are official and who has the authority to approve them.

● Coordination Task

In a project, experts with different areas of expertise work together toward one goal, and produce determined products. Usually, when products are made by people with different concepts, viewpoints and interpretations, products may lack integrity. In order to obviate this problem in the process of executing a project, coordination work should be done. This means the alignment or coordination, of coordinate axes, namely, adjusting the different coordinate axes of people in different positions so that integrity of products can be maintained, by following these 4 methods:

1) Clarifying scope of work of each division based on a WBS;
2) Offering all information necessary for work:
3) Understanding the different people contributing to the work and their positions
4) Ensuring coordination to maintain integrity of products.

● Integration Work

Integration work is to integrate some parts into a whole. There are usually two types of integration of tasks in a project :

1) One is integration work to achieve the project mission by reconciling contradictory requests from project stakeholders. This work extends from local optimization to global optimization
2) Secondly, looking at an example of a development project, we see a number of experts from different fields gather to execute a project. In this example, the objective is to create new ideas or conceptions. There are many methods of creating ideas, but a person in charge of a project should offer a "forum" in an atmosphere conducive to creation of ideas.

3. How Communication Should Be

Those who are involved in a project have different ideas and priorities for tasks. Because of this, coordination is always necessary for the operation of a project. Coordination may be between a whole project and individual divisions, or between individuals. The means of coordination is communication, which starts with mutual understanding. Project members should be familiar with communication techniques and should seek to improve their communication skills.

● Structure of Communications

Communications are composed of the following 4 components (Refer to Chart 4-11-2):

1) Communicator – A
2) Communicator – B
3) Message
4) Context

First of all, communicator A sends a message verbally or nonverbally. Receiving this message, communicator B interprets it and understands its meaning. Then, communicator B responds verbally or interacts with communicator A through nonverbal messages such as nodding, expressions on a face, etc. This is an interaction between a speaker and listener. In order to establish interaction between communicators, they should first understand the context of a message. Without this, intentions cannot always be communicated.

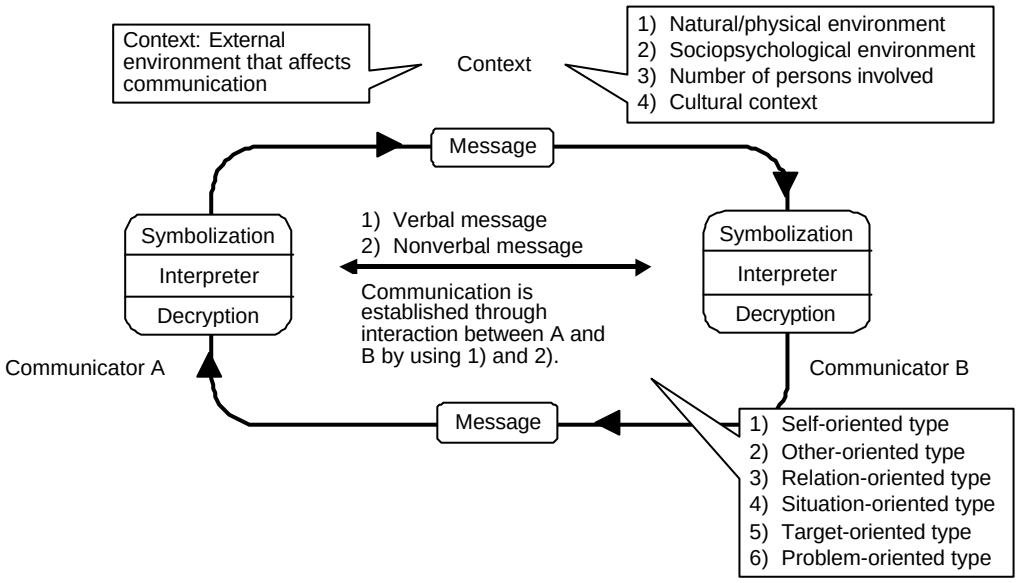


Figure 4-11-2: Structure of Communication

● Communication and Context

Generally, context means the external environment that affects communicators. External environments include the following:

1) PHYSICAL ENVIRONMENTS

Physical environments such as silent environment, crowded environment, etc., affect communications. When one wishes to persuade someone, he/she should choose a place appropriate to that purpose.

2) SOCIOPSYCHOLOGICAL ENVIRONMENTS

Communication is affected by whether a place of communication is a communicator's own company, or his/her customer's company. This means that communications are difficult in a psychologically disadvantageous place.

3) SCOPE OF COMMUNICATIONS

Success of communications depends on the number of people involved in a situation, i.e., whether communication is between two persons, in a group, or in the public.

4) CULTURAL INFLUENCE

To establish communications, cultural context is most important.

● Communication Ability

■ Ability to issue a message and ability to receive and understand a message

Communication ability means whether a communicator can issue a message appropriate to that purpose and whether he/she can make the message understood by the recipient. At the same time, communication can be established when a recipient is also able to correctly interpret the message.

■ Ability to support transmission of intentions

Communication is a process of two-way transmission of intentions. Abilities to support communications include verbal ability, nonverbal ability, role-playing ability and context ability.

■ Context ability

Although communications is a process in which a sender and recipient communicate their intentions, the former does not always send out all of his/her messages. Social, physical, psychological and historical backgrounds being understood by both communicators are sent/received implicitly, i.e., they are not included in a verbal message. In the homogeneous society, even a small message can send much information, by means of context. Context ability is the ability to perceive and interpret this important aspect in communications. It also includes the ability to understand a situation not explicitly stated in a message, and the ability to communicate well with others.

● Inter-personal communication

Human relations start, change, develop, stall and end through inter-personal communication. Human relations can be affected by any of the following 6 aspects of relationship in communication:

(1) SELF ORIENTED ISSUES

This type of communication involves participants expressing their personal opinions on some common subject, without taking the opinions or observations of the other participants into account.

(2) OTHERS ORIENTED ISSUES

This kind of interaction involves one person discussing some experience of interest, with a second person then discussing those same issues, often encouraging the first to divulge more information.

(3) RELATION ORIENTED ISSUES

Relation-oriented communication involves proposal for mutual action or discussion of the relationship between the participants. This kind of communication involves the assumption of a link between participants and is typified by the use of expressions such as ‘we’ and ‘us’.

(4) SITUATION ORIENTED STRATEGIES

Situation oriented strategies are coping strategies designed to allow the communicator to redefine a situation so that they no longer feel that they are a victim. Examples include the use of humour, withdrawing from conversation or ignoring statements.

(5) PURPOSE ORIENTED STRATEGIES

This involves communication designed to move the communicator closer to some goal. Purpose oriented strategies for communication usually involve the purpose of improving the quality, intensity or level of intimacy in a relationship.

(6) PROBLEM ORIENTED STRATEGIES

THESE STRATEGIES ATTEMPT TO EXERT SOME CONTROL OVER THE CONTENT OF INFORMATION OR THE FLOW OF INFORMATION BEING DISCUSSED. THESE STRATEGIES ADDRESS ANY POTENTIAL ISSUE RELATED CONTROVERSY, BY WAY OF CHALLENGE, AVOIDANCE,

PROVISION OF INFORMATION OR PROVISION OF RESOLUTION OR COMPROMISE.

4. Factors That Hinder Communications and Measures Against Them

● Factors That Hinder Communications

■ Complicated, Layered Communication Path

In the practice of project management, as information is conveyed through a layered communication path, information tends to be processed due to the positions of members and their interests. For this reason, it is a major challenge to communication management how accurately a real situation at the forefront, or changing conditions can be tracked.

■ Company Culture That Hides a Problem

As a factor behind failure to correctly convey a real situation, we can point out "company culture that hides a problem", prevalent in many companies. This makes proactive management difficult, and leaves a problem untouched till it manifests itself. In addition, lack of accurate analysis of a problem that has become manifest will lead to repetitions of the same failure. This company culture obstructs the project management and results in serious problems leading to potential failure of a project.

■ Solution of Communication Problem Using Information Technology

A company whose culture hinders project management usually does so as it has been deeply affected by the cultural and social backgrounds of individual companies. Hence, the fundamental problem is that "a real situation at the forefront of a site" was traditionally difficult to convey accurately. At present, however, utilization of advanced information technology has enabled us to keep track of these situations and changing conditions in real time. Thus, we can now expect problems that hinder communications will be cleared considerably.

● Communications and Culture

Humans use language in their lives to mutually communicate intentions. Therefore, language is deeply associated with culture. Usually, we become conscious of a culture only when we have contact with people from it. A project team is formed in a particular industry and a particular culture. Therefore, it is one of the major tasks for execution of a project in the global society that project members understand not only the different cultures of the people whom they contact but also the cultures of their own group.

Communications is a means whereby one can confirm and mutually convey information, intentions, emotion, etc., verbally or nonverbally. However, information gathering and interpretation vary depending on cultures, and thus we could not accurately communicate with each other, without understanding of cultural backgrounds. When we say a "culture", it refers to "a culture of a country", " a culture of a region" or "company culture" or "organization culture" of each company. In addition, there are cultural differences based on age, or "a culture of individuals". Thus, defining a culture, we can say it is "unconscious behavioural patterns, standards of value, and systems of thinking".

In the global society, understanding cultural background is indispensable to accurate communications.

5. Points to be Noted in Cross-Cultural Communications

In any society, there is a traditional culture from its historical background and a culture that has been mixed with the introduction of new other societies. We are usually unconscious of culture in our everyday lives.

- Problems in Cross-Cultural Communication

Problems in cross-cultural communications can be roughly divided into two groups: First, cultural environment contained as context, and secondly, a gap in information gathering, evaluation or behaviour.

(1)UNDERSTANDING OF CULTURAL ENVIRONMENT THAT MIGHT AFFECT BUSINESS ACTIVITIES

Cross-cultural communication largely differs from communication in general, in that communicators are usually not conscious of context in the latter, whereas in the former they encounter big differences in habits, logic, ideas and value standards. Then, communicators are often perplexed, and shocked. Cultural environments to be experienced in business are language, law, religion, political regime, social infrastructure, education level, science and technology, material culture, etc.

(2)PROBLEMS THAT ARISE IN INFORMATION GATHERING AND BUSINESS ACTIVITY

When someone who performed well domestically cannot do as well, , or fails in a foreign country, in most of the cases, he/she is not adequately competent in coping with different cultures. Problems here can be divided into those arising when a person gathers information (i.e. information gap) and those that arise when he/she takes action (i.e., behavioral gap).

(3)INFORMATION GAP AND BEHAVIORAL GAP DUE TO DIFFERENT CULTURE

Since information is scattered throughout society, it is a recipient's interest and sensitivity that infuences whether information will be utilized and in what way. Interests are driven by a purpose that varies depending on cultures in business, society, group, etc. In general, highest priority is given to business needs, but this seems different depending on the national character.

As gaps in communications are also generated by the people who intermediate in the process of transmission, it is important to always keep track of an actual situation of a site. For instance, checking images on a digital camera will provide a means of tracking how a product is completed.

(4)INFORMATION GAP

Information gap contains perception gap, interpretation gap and value/judgment gap. These differ in difference in individuals' needs, experiences, habits and cultural values.

1) PERCEPTION GAP

Perception gap means that information gathering is selective among people. Others who do not have interest in that overlook information that is valuable to some.

2) INTERPRETATION GAP

Depending on recipients, meaning and reasoning of same information are ambiguous or it may not be interpreted correctly. This interpretation gap may sometimes cause a problem of negative interpretation.

3) EVALUATION/JUDGMENT GAP

In determining value of information, information that has personal or cultural similarities tends to be positively evaluated, while that with no similarities are vulnerable to negative evaluation. This is called an evaluation/judgment gap.

Case ◆ Interpretation Gap

We instructed a worker to redo a welding fault of a product, and simultaneously requested them to review other parts according to the same standard and redo, if necessary. Nevertheless, the worker did redo only the part we pointed out. They do not think it is their job to point out a fault.

(5)BEHAVIORAL GAP

Due to existence of an information gap, behavior after someone obtains information may produce

an unexpected result. Also, in the negotiations of a project, such a result as concession, halt, or breakdown may be attributable to an information gap or cultural habits, etc.

● Ability to Cope with Difference in Cultures

■ Understanding of Conditions Specific to a Region

One of techniques used to cope with differences in cultures, is to conduct a preliminary survey as detailed as possible, of conditions related to a specialized area and specific to a partner's country, thereby fully understanding actual situations. Then, we should be always aware of conditions specific to a region, extensively conduct a preliminary survey of existing references/traditional methods of a partner, real situations of related industries, etc., and decide on economic and rational measures that suit their situations. Even when we encounter a problem that cannot be solved by existing knowledge, we will be requested to utilize general basic theory, methods, hypotheses and related knowledge, and to be able to think of an alternative that can fit a real situation in a site.

■ Effective Process for Acquisition of Ability to Deal with Differences in Culture

To gain the ability to deal with differences in culture, in general, we should follow the steps described below:

- When people have a contact with someone from a different culture, they are first surprised by differences in events that have surfaced.
-
- to break through this situation, they begin a process to understand the partner's culture. Basically, it is necessary to grasp value standards or generally accepted ideas as well as cultural/social backgrounds.
- To understand a different culture, we should first compare it with our own culture/habits. Then, we should understand not only the different culture/habits but also the meaning and characteristics of our own culture/habits.
- We should note that unless we are familiar with cultural background of a country we visit, we may experience problems.

Case ◆ Respect to Order of a Country We Visit

It is important to be aware of the fact that in many countries, there are strictly separated "classes". Usually, the number of university graduates is limited and they are regarded as "the elite". In the Western countries as well as Southeast Asia, in the technical field, engineers (university graduates), technicians (those who attended a technical high school or received specialized training), drivers and other workers are separated into respective "classes".

Case ◆ Classes Often Seen in Developing Countries

In some developing countries, engineers do not go to a production site and thus do not understand real situations. They do not even wear workers' clothes, and it is almost impossible that a plant manager and workers have the same meals in a same dining room.

■ Value Standard of Each Culture and Method of Identifying "Recognition of Differences in Culture"

We human beings act on own values and standards. These standards are divided into those common to a nation or group, and those depending on individuals. Although they should be separated, people with same cultural background have some commonality in standards on universal problems.

■ Individualism vs. Collectivism

It is now common on a global scale to buy out a company or establish a joint venture. Then, the problem is that depending on whether based on a social culture, a country involved is "individualism" or "collectivism", differences manifest and have various effects on social activities.

■ Ethnocentrism

Human beings tend to find identity (a sense of belonging) with a group they belong to (i.e., internal group) and give higher priority to an internal group than to an external group, in order to maintain identity. Ethnocentrism means herein that a person gives priority an internal group, and thus interprets and evaluates thinking/behavior of other group based on his own value standards.

■ Culture Relativism

When we say culture relativism, we mean "neutral thinking", according to which there are diverse

ideas and behaviors, and thus we cannot say which one is correct. Originally, every one is ethnocentric, but as his/her sensitivity to different cultures sharpens, he/she can recognize and become more accepting of differences, and gradually shift to culture relativism. In general, a person of culture relativism can accept others, establish positive human relations and thus can adapt to different cultures.

● Case in Cross-Cultural Exchange

■ Cases that companies encounter overseas

When a company starts business overseas, the biggest problems are often related to a contract with a local customer or supporting company. The second largest problem seems to arise from business habits or communication abilities. However, such problems attributed to inadequate cost management or schedule control.

Case ◆ Labor Situation

In some countries when a disaster occurs in a local plant, workers will go on a strike. If a supervisor himself is involved in actual work such as adjustment of a limit switch, workers will complain about it. Some conditions are just used as an excuse of a strike, and it is very difficult to make up for a delay.

■ Problems in Cross-Cultural Communications between Home Country and Local Site

One mistake in communications may lead to the failure of a project. Here we discuss "problems in communications between a home country and a local site".

Chart 4-11-3 shows relationships of communications between the headquarters and a local organization of an overseas affiliated company (or overseas local office) of a company that started business abroad, or an overseas supporting company.

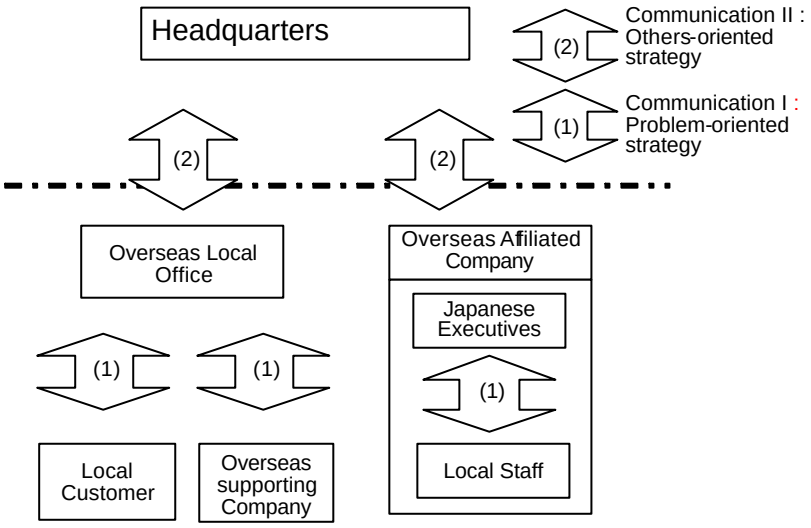


Figure 4-11-3: Problems in Cross-Cultural Communications

We refer to negotiations between organizations in a local site as communication I, and communications between overseas local offices and the headquarters in Japan as communication II. Communication I is cross-cultural type communication, while communication II is homogeneous type communication.

(1)COMMUNICATION I OF OVERSEAS LOCAL OFFICE

It goes without saying that communication I involves cultural differences. Before and after opening a local office there are always difficulties that have the overseas local office running around trouble shooting day and night. For this reason, cross-cultural communications at the stage of Communication I should be learned.

Local communication I should concentrate on trouble-shooting and problem-oriented communications as shown in Interpersonal Communications. For problem-oriented communication surrounding a problem a certain process is required to solve the problem: information is exchanged, questions are asked, objections and endorsement are discussed and a compromise is sought for. In most cases according to this process information is exchanged and understanding is gradually formed to come to a conclusion at an overseas local office. This is an integral process for cross-cultural communications.

(2)ROLES OF LOCAL STAFF FOR MUTUAL UNDERSTANDING OF CROSS CULTURES

In an ad-hoc organization for a limited timeframe like a project team, local staff plays an important role as an assisting force to eliminate gaps arising from cultural differences in actual communication activities and to enhance mutual understanding of and respect for heterogeneity. Roles of local staff at an overseas local office are exemplified as follows.

Case ◆ Categories of Roles for Overseas Local Staff and Points to be Noted

Category	Major Tasks	Points to be Noted
1. Senior staff (A) • Responsible for prior machinery and equipment of ex-customers All-around human resources familiarized to overall performance of international projects 2. Senior staff (B) • Young elite engineers dispatched from a local technical consultant 3. Responsible for local procurement and labor (C) • All-around field engineers 4. Inspectors (D) 5. Construction design and site supervision (E) 6. Secretary (F) 7. Messenger boy, and others (G)	1. Staff to the general manager of a local office in overall project performance (A) 2. Expenditure for local procurement, progress report and quality assurance activities (A,B,C) 3. Correspondence with customers and cooperation companies (A,B,C) • Primary check of importance and urgency of correspondence received in foreign languages • Issue correspondence as instructed by the local general manager 4. Attend regular meetings with customers (A,B) • Make supplementary explanations and promote mutual understanding 5. Area untouchable or extremely inefficient area if touched • Various ordinances, labor law, etc. (A) 6. Construction design (E) 7. Check attendance and sedulity of local workers (A,C)	1. Identify the role 2. Identify specifics of allowances • Treat staff appropriate for the status 3. Immediate decision-making is an important basis of capability assessments for a manager. 4. Shortage of workload implies low assessment of the staff 5. Prior notice for discontinuation of employment and explanation of reasons should be made in a timely manner 6. Behavioral examples of Japanese generally difficult to understand • Ambiguous expressions • Unclear cut of classes • Difference between appearance and reality 7. Overseas local staff played an important role in terms of communications and conveyance of deeper intention beyond verbal languages

(3)COMMUNICATION BETWEEN OVERSEAS LOCAL OFFICE AND HEAD OFFICE IN JAPAN

An overseas local office must explain the local situation and differences in cultures to gain understanding. In most cases, however, Communication II (Fig. 4.11.3) cannot promote solution of problems. The problems with this include:

1) The head office is in a senior position to give instructions to an overseas local office and approval authorization.
2) As many people misunderstand that communication should be "reporting, notification and consultation", the attitude of the head office is "report and wait for approval".
3) The head office replies to a report from the overseas local office that the customs or precedents practiced in its country are "right" instead of considering the local culture and situations.
4) The overseas local office usually explains cultural customs and situations occurring locally that have led to the current situation, and tries to redirect the intention of the head office.
5) However, there is a custom in some countries that the opinion of a superordinate is right. Even if someone feels that "the opinion of the superordinate is not right", they are not allowed to directly point out that "your assertion is wrong".
6) In the end the local opinion is not accepted and the general manager of the overseas local office faces difficulties. As a result overseas local staff create distrust in their supervisors.
7) Head office may be unwilling to face and discuss the reality of any difficult problem incurred. The communication network among decision makers may not function properly and decisions are made in a top down manner. Many people believe that the intention of a head office should always be given priority, which does not allow a problem to be solved properly.

The above cases are serious problems many people experienced with overseas projects have suffered from.

6. Business and Organizational Behavioral Power Between Cross-Culture

● View for Cross-cultural Exchange

It appears that business proceeds with an unimpassioned principle but, as a matter of fact, consists of human relationships between people involved in the business. This principle remains the same in all cultures. Following in this section, cultures will be classified from the viewpoints of high or low context culture as a basis for awareness in business.

● Specific Differences between High and Low Context Cultures

A high context culture means that in a society with steady human relationships, information is widely shared and even a simple message implies a deeper meaning. In these cultures very sophisticated communications are conducted in which an unspoken meaning or intention will be inferred and understood. Characteristics of these cultures include sticking together and resisting changes. A certain code of conduct has been established traditionally and a communication format has clearly been defined. Project management in the society, therefore, relies on dense personal relations and has a cultural background that generates implicit awareness.

As a contrast to this culture, a low context culture in which individualism is developed and individual alienation and breakups are typical, has a limited area of assumptions shared among members. Therefore, through communication individuals must build clear messages. In a low context culture a language code that does not depend on the context is expected and in the area of project management body of knowledge and practice guides that are available as international standards have been developed from an early stage and are well accepted.

Awareness of high and low context cultures is important to communicate between different cultures. Do not simply take your counterpart for someone from a different culture but be aware of the difference in context, high and low. It is necessary to take time filling in the gaps.

● Management Organization and Operation in High and Low Context Cultures

If different cultures are classified into either high or low context cultures for analysis of behavioral patterns, it is improves understanding of most cultures. In a low context culture it would be expected that roles would be clearly delineated and defined. Undefined areas of role or responsibility are likely to generate business error as operatives will adhere to their role descriptions. On the other hand, in a hierarchy of a company with high context culture, general division of duties for a manager, section chief and group leader is defined with large room for ambiguity. Filling these areas of ambiguity can be called the Green Area that exists within an organization. Every member shares objectives of a group and details of performance. If there is a gap in the objectives of the group, someone voluntarily takes responsibility. This kind of automatic conditioning action occurs within the Green Area. Professional activities and purpose of life may probably be found in this area. This area accommodates attitudes that are comfortable with ambiguity and encourage initiative.

■ Structure and Functions of Management Organization in High Context Culture

- STRUCTURE OF ORGANIZATION OPERATION AND PRESENCE OF "GREEN AREA"

Lifetime employment and slow position advancement with periodical transfer within a certain company as well as long-term human development; comprehensive and flexible management style that enables ambiguity of directives and responsibility/authorization has developed a group mentality and approach to decision-making (Ouchi: Theory Z) that emphasizes consensus of all members involved although it may at times appear to sacrifice efficiency..

- FUNCTIONS OF GREEN AREA

Directives in the form of a defined job description , concerning scope and content of work, are not given in high context culture. Companies in high context culture are operated with without giving detailed directives to employees because it is perceived experientially that having employees think and do their jobs accordingly is more effective than being highly prescriptive.

- REASON FOR GENERATION OF GREEN AREA AND ITS FUNCTIONS

In high context culture, importance of communal life is accepted as life style. It is a society in

which by accepting the culture of a group one will be accepted as a member of that group. Members of a group understand the common background, are capable of taking mutually trustworthy action in absence of a manual or specific directions and understand each other without a lot of words involved. The relationship within a group is based on belief in essential good intent.

• ANALOGICAL IDEA

People living in high context culture think analogically. Being analogical means that all aspects of surrounding environments are considered in order to arrive at a well-balanced idea. Jjudgment, visual and intellectual interpretation and persuasion are in favor. Concurrently analog is desirable to compile a huge amount of information and give balanced explanations. Digital approaches are not favored.

• BEHAVIORAL PRINCIPLES IN GROUP (GREEN AREA)

A dynamic group possesses common objectives and issues and employees behave voluntarily in absence of directives, rarely losing an overall balance due to their shared understanding. Green Area gives a place for discussion/review and action by all group members. This has potential to achieve higher performance than an approach involving top down directives and/or job descriptions and can result in high efficiency.

• MANAGEMENT CAPABILITY WITHIN GREEN AREA

If individuals belonging to a group have shared understanding of surrounding situations, it is easy to act efficiently as a group. This means that individual management capabilities are high. If one understands a big picture beyond the range of assigned role and judges the balance between the environments in which the group is positioned and oneself, a group can take optimum individual activities.

■ Theory of "Ba"

• DYNAMISM OF “BA”

According to the definition borrowed from "Dynamism of Place and Companies", a "Ba" is a mental space in which people participate, observe and communicate with each other unconsciously, understand each other, encourage each other and share experience. There people exchange information in various forms and consequently change their awareness (grouping of information). This entire process is informative interaction and takes place in what might be termed a "container" of interaction.

• MANAGEMENT OF ORGANIZATION AND "BA"

People participating in physical space can automatically share information back and forth there. The space is filled with information carriers including dispatch of information from participating people and dynamism reacted by others. People also have desire to have some kind of connection to others that is called "desire for alignment". Through the “Ba” or mental space or containter of interations, information goes back and forth, and if a common area with others is found there is resonance and enhanced energy.

■ Structure of Management Organization and Functions in Low Context Culture

An organization comprised of people from diversified and culturally different background has a high turnover rate of labor based on an assumption that individuals will be active on the first day of employment. Such a society requires manual for performance of tasks. Advancing tasks without any shared cultural background requires definitions of terms, contracting, verbal instructions and exchange of opinions. All contracts and ideas are based on a belief in essential ill-intent. This belief can be considered a kind of risk management concept and view of personal relationship prepared that encourages a “better safe than sorry” attitude.

● Approach between High Context Culture and Low Context Culture

Even though companies in high context culture show high efficiency as groups, collapse of lifetime employment and seniority system, change in remuneration system and performance assessment system pose a threat to maintenance of the Green Area. Putting this issue aside, cross-cultural communication is a pending issue when companies in high context culture contact their counterparts in low context culture. In order to create a high context cultural system requires long-term development. For this reason people in another country cannot be approached in a way of high context cultural approaches. Therefore, people from high context cultures are urged to adopt low context approaches to ensure understanding of their requirements and intent.

■ Approaches between High Context Culture and Another High Context Culture

In case of exchange between high context cultures, cross-cultural exchange becomes more complex. Both communicate in a form of high context culture and are not accustomed to communications in a

different context. As it is difficult to understand the context of another party, use of low context culture-type communication approaches may form a bridge in global communications.

- Hybridization of High and Low Context Cultures

Although it may be necessary to employ low context communication approaches for cross-cultural communications the benefits of high context culture should not be lost or undervalued. Project management relies to a considerable extent on dense personal relationship, for conduct of activities, in a context where much understanding is implicit and analogical. However, in societies of low context culture, companies need manuals to guide their operation as well as definition of terms which clarify the purpose of operation implementation and establish a sound foundation for human relationship. What we should pursue is to correctly understand communication and involvement with different cultures, add analogue methods to digital methods, and realize hybridization of high context culture and low context culture because both make valid contributions. .

Glossary

In the Order of the Japanese Syllabary

- 0.6 Power Law

In general, when a production process is not changed in construction of production equipment, the construction cost changes in proportion to power indexes, not to production amounts. The index method is an estimate technique for totalization using this feature. As the power index n=0.6 is often adopted for production equipment, the index method is also known as the 0.6 power law.

- 6W1H Method

To specify and solve risks, it can be a useful method to draw out and implement a plan that has been mutually confirmed through inquiries about Who, Whom, What/Which, When, Why and How.

- Account Code

A code system to identify each composition work element of WBS.

- ACWP (Actual Cost of Work Performed)

Total cost that has actually accrued from commencement of a project to certain time.

- Agent Technology

The network agent is drawing attention. In addition to the same function as the object orientation such as concealment of data and procedures, asynchronous communication and component creation, the network agent is provided with a knowledge base to practice processes based on independent judgment by understanding intentions in each situation. In particular, it practices a process required by users and searches for information by moving on the network. It is also proposed as a concept of a man-machine-interface in the next generation.

- Analog Language

A communication method that focuses on a reception-type monologue based on homogeneity in consideration of the other party's opinion and feeling as well as a human relationship.

- Application Service Provider (ASP)

A business proprietor who provides customers with application software using the Internet on a contract basis during a certain period. Customers use application software including administration of drawings and ERP packages on the server owned by the application service provider through the Internet and pay charges. Customers may prevent software from becoming obsolete and use the latest software corresponding to technical innovation.

- Average Value and Erratic Pattern

The most typical value as a means to indicate a main stream tendency is an average value. Other values include a median (central value) and mode. Average values are used for distribution symmetrical or near-symmetrical, while medians are for colors etc. that can be classified but are difficult to measure, and modes are for extremely distorted distribution.

Measurements of erratic pattern consist of a range to indicate the maximum and minimum values of the data, and a deviation to indicate the difference from the average value.

- B2B (Business to Business)

A form of electronic commerce (EC) through the Internet, meaning transactions between businesses (B to B). (Transactions between businesses and consumers is called B2C). Although the conventional EDI system (for order placement and acceptance) had a problem of large cost due to the use of exclusive lines, electronic commerce has been rapidly expanding with the spread of the Internet. It contributes to reduction of procurement cost in such fields as personal computers, stationary products, and consumable goods used in factories.

- Balanced Score Card

A new management index developed by Robert S. Kaplan and David P. Norton. This concept has been gradually accepted by not only European / American companies but also by Japanese companies.

- Base Case and Sensitivity Analysis

Base case means evaluation of economic efficiency under reasonable preconditions, and is a fundamental case to be able to check business feasibility. Examination of influence caused by change in these preconditions on business feasibility or cash flow based on the base case is called sensitivity analysis. This means checking on the degree of influence on the entire situation caused by change in individual

preconditions.

- BCWP (Budgeted Cost of Work Performed)
  Total outputs that have been achieved from commencement of a project to certain time.

- BCWS (Budgeted Cost of Work Scheduled)
  Total planned budget from commencement of a project to certain time.

- BPR (Business Process Reengineering)
  A method for dramatically improving corporate productivity proposed by Michael Hammer and James Champy. An activity for improvement by fundamentally reviewing a corporate business process based on a zero base concept and drastically restructuring a business process to attain business purposes. "Process" "dramatically " "fundamentally" "drastically" are regarded as four keywords.

- Brain Storming Method
  The brain storming method is a way to notice (and record as a matter of course) a new issue with hints obtained by itemizing as many issues people are thinking as possible. A speaker is responsible only for accountability, and participants promise not to connect any remark to performance evaluation or merit rating. It should be conducted among a group of from several to a dozen people. It is a divergent method and useful at a stage for detecting problems or collecting ideas.

- Bulk Material
  Out of materials used for each engineering work for equipment construction, materials whose quantity cannot be precisely counted at the estimate stage, or whose place of use cannot be specified since materials of the same type are used in a large amount. In other words, materials without equipment number for each item such as cement and cable correspond to this.

- Cash Flow
  A concept of fund management in business activities. Business generally yields operating income, it is distributed to payment of various operational expenses, repayment of loans, tax payment and dividends to stockholders. A series of such monetary income and expenditure is called cash flow. In project financing, as cash flow arising from business is the sole source of loan repayment and its shortfall causes delinquency, its stability and fluctuation become a major element to judge qualification for loan eligibility.

- Chaos
  A system that follows a deterministic equation, and has no periodicity and seems to have an orbit showing irregular and disorderly behavior.

- Checklist Method
  Concerning traits of technical elements of a project and performance capability of personnel as risk source, a method of taking out issues by extracting assumed risks and summarizing them as a checklist in consideration of their importance and other factors. Since the checklist tends to be affected by the drafter's personal view, it is necessary to improve objectivity by demanding statement of reasons for decision and others. In addition, as the importance of risk changes in accordance with project phases, it is desirable to use the checklist by phase and repeatedly review it.

- CIF (Cost, Insurance and Freight)
  As is the case with FOB (Free on Board), one of the conditions defined in INCOTERMS (International Rules for the Interpretation of Trade Terms). It is called the "condition including the freight and insurance," meaning the condition in which the seller's cost bearing includes shipping cost, freight charge, and maritime insurance premium although the risk bearing is transferred to the buyer at the time of shipment.

- Communication
  Communication has several definitions according to viewpoints. 1) A movement in a process of understanding others and being understood by others. 2) A process of drawing a reaction through a human communication language symbol. 3) A process designed to allow a recipient to perceive the meaning a communicator intended by a communicator by selecting, creating and transmitting signals.

- Concession Agreement
  A contract type based on the idea of collecting costs for equity and debts from operational income of facility since the object of contract include design, construction, fund procurement of facilities and operation and maintenance of facilities over a long period. It is used, e.g., when entrusting to a private sector a project that should be originally undertaken by a public sector in light of its relationship with the public, and a certain project is achieved through contractual actions that are exclusively made pursuant to

the relationship of rights and obligations under the contract. PFI in Japan is also an example for this type of contract. It is characterized by in-depth contents and range of commitments by private business entities and their responsibility over a long period or an extremely long life cycle when a contract is regarded as a project.

- Context

All physical, social, psychological, and temporal environments that affect communications and exert an impact on the style and contents of communication.

- Contingency

In general, a reserve for risk included in the project budget to prepare for potential cost that has difficulty in quantification at that point due to uncertainty.

- Contingency Plan

A plan for preliminary measures against elicitation of risk factors. From the standpoint of entire project, there are various concepts such as taking measures for debt factors or equity factors as well as stakeholders constituting a project. If any precondition is given, such measures can be planned within its range, or they can be freely planned within the entire scheme if no precondition is given.

- Contract Type

In procurement management, it is common to adopt one or combination of the 1) lump-sum contract (all-in contract), 2) cost reimbursement contract, and 3) unit price contract. In addition, as contract types may differ according to individual equipment and materials or services, it is necessary to adopt the most appropriate contract type in consideration of pros and cons of each contract type.

- Corporate Finance

A type of loans when a business proprietor borrows funds from fund contributors including banks based on the credit of its business. For financial institutions, it is the act of lending funds based on corporate credit and general assets. They do not necessarily decide on loans solely based on the risk on individual projects and financial viability. Therefore, even if a project does not generate expected profits, the business is expected to bear the obligation of loan repayment to the loan fund contributor. The obligation of loan repayment is also applied to stakeholders. This concept is called the Full Recourse Debt.

- Correlation and Regression

A scatter diagram is made of two types of corresponding data (x and y) dotted around the vertical and horizontal axes. A method of quantitative judgment of whether those two types of data are related to each other is called correlation analysis. In addition, when these x and y have a functional relationship, x and y are considered to have a regression relationship, and calculation of this relational expression is called regression analysis.

- Cost Index

The price of each year (each month) compared to the price of the standard year (100) indicated in an index. The cost index is a non-dimension numerical value to correct price fluctuations in accordance with elapse of time.

- CPI (Cost Performance Index)

Value calculated by dividing work that has achieved by actually used budget amount at certain time. CPI shows productivity in terms of cost at the time.

$$CPI = \frac{BCWP}{ACWP}$$

- CPM (Critical Path Method)

This is used for finding an activity line that has the least allowance in the entire project (critical path), recognizing important items for supervising a project, considering a way to shorten a delivery date of a project and other purposes by setting a period for activities and ranking activities.

- CPO (Chief Project Officer)

A person responsible for controlling a project as an enterprise, which was advocated by Paul C. Dinsmoor. The person has an authority of deciding execution of a new project and cancellation of an existing project from a viewpoint of corporate management, and acts as an intermediary between corporate top management including CEO and project managers. CPO also has such duties as improving the capability of project management for the entire company as well as training project managers. CPO also means an executive officer who has all responsibilities for activities to create corporate values through

projects.

- CRM (Customer Relationship Management)

A generic term for schemes to establish a structure for unitarily control of information using advanced information technology and aim at consistent response to the same customer on the whole company basis. Many enterprises aim at quick response to customers by realizing CRM on the in-house network.

CRM has roughly two aspects: efficiency enhancement in business through systematization and adaptation to the Internet; and accumulation and analysis of information for maintenance and reinforcement of relationship with customers and for the use of information in marketing.

- CV (Cost Variance)

Numerical evaluation that has been compared with earned value of completed work and actually used cost at certain time. It is showed by CV=BCWP-ACWP. When there is ACWP>BCWP as the result, the difference is the overrun cost.

- CWBS (Contractual Work Breakdown Structure)

WBS used for defining the level of report the contractor submits to the client. It is usually less sophisticated than the WBS used by the contractor for its own management.

- Debt Equity Ratio

The ratio of the debt borne by a project enterprise to the equity in a certain project. The higher is the ratio, the higher will become the leverage degree. In addition, a higher degree of leverage is generally considered to make a company's financial structure unstable, so stability of cash flow generated by a project is required.

- Delfi Method

A method of collecting through questionnaire intuition, judgment, and opinions of relevant people concerning a given issue to gather wisdom of multiple "persons," practicing a process of anonymous-type discussion to freely exchange opinions, and effectively converging expert intuitions and judgments by utilizing statistical processing technology.

- Design Review

According to the JIS reliability terms, the meaning of "design review" is to "examine and improve performance, function and reliability of design at the stage of item designing by considering the price and delivery date. Experts of such fields as design, manufacturing, inspection and operation participate in the examination." There are indeed too many review matters for a designer alone to handle at the stage of design. Therefore, it is necessary to utilize knowledge and experience of as many experts as possible.

- Digital Language

A form of communication to consistently convey a solution to the other party by valuing digital language technology and logically analyzing a problem.

- Discount Cash Flow Net Present Value method

In the case of an investment premised on capital participation or business management, the "discount cash flow net present value method" is often used. This method is used for evaluation of the purchase price concerning for merger /acquisition, search for brands whose stocks are underestimated in the stock market, evaluation of business feasibility at the time when a business portfolio is planned and so on. Japanese companies have recently started using this method. In this case, the method is used by finding the present value of cash flow generated by business each year with the weighted average cost of capital (WACC) calculated in advance. In this method, either of the following is generally used. One is a method of finding business value by setting a period of investment collection as ten years. Another is a method of finding business value by setting a period of collection as infinite considering the business goes forever (Going Concern). The business value when business is considered as going concern is calculated on the assumption that the cash flow (residual value) of the tenth year and thereafter is the same as that of the tenth year. The business value when business is considered as going concern is higher than that when business is divided in ten years by 20 to 30 %, although it depends on values of capital cost.

- Dynamic Risk

A risk related to a change, especially a change of human desire or a progress in machinery and organizations.

- EAC (Estimate at Completion)

Cost prediction for work, a work group or the entire project when a designated scope of work is

completed. Most methods requiring cost prediction at completion are intended to correct the initial cost estimate by amplifying the cost efficiency up to that point. It is also called the cost prediction at completion.

- Earned Value

1) A sort of method to measure progress of a project. Measurement of whether the performance of cost and schedule is conducted according to the plan by comparing the budget value allocated to the work and the performance value. Refer to "Actual Cost of Work Performed (ACWP)" "Budgeted Cost of Work Scheduled (BCWS)" "Budgeted Cost of Work Performed (BCWP)" "Cost Variance (CV)" "Cost Performance Index(CPI)" "Schedule Variance (SV)" and "Schedule Performance Index(SPI)."
2) Completed volume for task (group) (BCWP).

- Economic Value Added

A management method index developed by Stern Stewart & Co. placing emphasis on capitalization for stockholders. It means a value created when business profit exceeds capital cost. A positive index of the economic value added means that more value than expected by stockholders has been created, and a negative index means that a value has not been created and the stockholders' value is being destroyed.
Economic Value Added

= (Profit ratio - Capital cost) × Capital invested

= NOPAT (Net Operating Profit After Tax) - Capital cost × Capital invested

- Electronic Commerce

Commercial trade on a network by electronically exchanging settlement information. As the Internet becomes prevalent, electronic commerce is rapidly expanding, although part of inter-company trade has been conventionally computerized with techniques such as EDI. Electric commerce is generally classified into inter-business trade or "B to B" (Business to Business), business-consumer trade or "B to C" (Business to Consumer), and inter-consumer trade or "C to C" (Consumer to Consumer).

- EPC (Engineering, Procurement & Construction) Contract, Turn-key Contract

Both of them are contract patterns used for plant construction and others. EPC means a contract pattern of assuming a certain range from designing, equipment procurement to installation work. Turn-key contract, stemming from the "completed status of equipment (ready for operation by turning the key on the operator panel)," means a contract pattern that delivers the entire plant ready for operation including the scope from design to installation work like EPC but this covers the entire plant and has a broader scope of responsibility.

- Escalation

Extra budget previously included in estimation for adjustment in case of change in performance cost which occurs after the initial estimation due to market factors beyond the contractor's control and the estimation is expected to differ from the cost when the project is completed.

- Estimating Allowance

A reserve fund or reserve quantity to be included in an estimate amount by multiplying a certain factor by each item such as design and construction because such reserves are expected to surely become necessary as a cost but it is difficult to clearly determine them in specification or quantity when estimating an initial cost.

- ETC (Estimate to Complete)

An estimate of the cost needed in future to complete work, a work group or a project. Most methods requiring prediction of the cost needed in future are intended to correct the initial cost estimate by amplifying the cost efficiency up to that point. It is also called the remaining work cost prediction.

- Exit, Close-out

From the standpoint of projects, ending of a project in a certain life cycle is called close-out, while, from the main entity that assume a project, it is called exit because there is an intention as the main entity. Exit also means capability of finishing a project at a certain point by the main entity's intention, and becomes a more dynamic concept.

- Expected Monetary Value = EMV

The probability (possibility) multiplied by the sum (result amount) when selecting an event through the sum evaluation from the logic tree (decision tree) of options.

- External Risk

A risk in a scope that is not subject to control or influence of a project. team (risks on market trend, government policy, etc.)

- Float

This refers to leeway not to affect others in case an activity (task) or a pass (connection between tasks) takes longer than the required period. In general, it is defined as the entire float (leeway throughout the entire schedule) and the free float (leeway for each activity).

- FMEA, FTA

1) FMEA (Failure Mode and Effects Analysis)
   According to the JIS reliability term, "a technique to analyze a failure mode of component parts and its influence on higher-line products to find out imperfect design or potential defects. When the rating of influence criticality is emphasized, it is called FMECA (Failure Mode Effects Criticality Analysis)." This is intended to prevent occurrence of failures and reduce its influence by finding out a failure that must not occur at the workfront when designing and by taking countermeasures in advance. Implementation of this method has been required in Reliability program Requirement of MIL and NASA.
2) FTA (Fault Tree Analysis)
   According to the JIS reliability term, "a technique to analyze occurrence channels, occurrence causes and occurrence probability of the events that should not occur in terms of reliability or safety by developing their tree diagram for tracing the passage of the occurrence with theory symbols." Compared with FEMA, which is a bottom-up analysis method of predicting use parts, circuit composition, assembly, system, component parts, their failure modes, and knowing their influence on higher-line products, FTA is contrastively a top-down analysis method of searching for causes by assuming failures of equipment and systems at the final function level.

- FOB (Free on Board)

It is called "free on board terms," meaning a condition on which a seller bears cost and risk (liability for damage such as loss of or damages to objects) until shipment, and a buyer bears cost and risk after shipment. These technical terms on trade including CIF (Cost, Insurance and Freight) are based on the definition of the International Rules for the Interpretation of Trade Terms (INCOTERMS) specified by the International Chamber of Commerce.

- Front End Schedule

It means plan drafting at the beginning of a project by screening work items to implement for the moment until a project control schedule as a base of schedule control is prepared. Usually indicated in a list form or bar chart form.

- Front End Planning

A project is a process of investing resources with the passage of time, and sequentially breaking down and embodying them from the stage of concept to planning / implementation in order to achieve goals. In addition, as time goes by, resources consumed geometrically grow while accumulated information and deliverables also grow. This means that the impact becomes greater with the passage of time when change is needed because matters previously decided become inconvenient.

One of the keys to success in a project is to clarify the project goal to the extent possible at an initial stage of the project and to specify the work range to attain the goal so as to minimize subsequent corrections and confusions of the plan. To that end, a method called front end planning is effective. It means formulation of a detailed plan and determination of specifications by investing resources including "persons" at an initial stage of the project.

- Function Points Method

An index to show the size of software. The software size is usually compared in terms of the number of lines of the source code described. From the viewpoint that the number of workers needed for development is closely related to the function to develop, it is calculated by using the number of entries to software (Pi), the number of outputs (Po), the number of inquiries from users (the number of online entries) (Pq), the number of files used as data (Pf) and the number of outside interfaces (Pe) as parameters, summing them up with appropriate weight according to each complexity, and multiplying them by the adjustment modulus (k) based on the program attribute. If the function points of certain software is indicated as FP, it is calculated with the formula: $FP = K \cdot (Pi + Po + Pq + Pf + Pe)$.

- FWBS (Functional Work Breakdown Structure)

A work breakdown structure chart that shows breakdown of tasks necessary for a project into appropriate management units according to corporate responsible organizations and work classification systems.

- GERT (Graphical Evaluation and Review Technique)

A technique that incorporates the concept of random variable to the network logic and the period required for work.

- Histogram

A diagram that clearly shows how the data on measured values (length, weight, time and so on) is distributed. Drawing a histogram helps to comprehend the whole figure that is not easily understandable with mere numerical values enumerated as measured data and to quantitatively understand the average value and size of erratic patterns.

- HSE (Health, Safety and Environment)

This refers to safety, health and environment of a project. In projects such as manufacturing facilities, infrastructure establishment, and environment protection, certain goals are commonly set these days as an object of a project in addition to schedule, cost and quality.

- IDEF (Integrated Definition)

IDEF is used to describe and comprehend work contents in restructuring a work process. This models a process as a group of activities interacting with each other and indicates the relationship between activities as well as the model and the external world with arrows. It is a system analysis technique by establishing a model of simulation systems, indicating them mainly with computer languages, and moving them to analyze and examine actions and efficiency in the system. The types of simulation models include physical /logical models, consecutive / discrete type models, and definite /stochastic models.

- Independent Estimate

In the case of procurement from outside the project executive organization, when deciding on whether to conduct independent estimate as basic materials for estimate evaluation, its policy should be clarified in consideration of the man power for that purpose and the cost impact of the equipment or service to be procured.

- Integrated Business Package, Enterprise Resource Planning (ERP) Package

An integrated information system supporting the basic business of an enterprise including a series of work from order placement to shipment including accounting, finance, and personnel affairs. Its purpose is to improve management efficiency through total control of funds, human resource and materials as data.

- Internal Rate of Return (IRR) Method

The internal rate of return is a method for evaluating how much earning capability is included in investment. For each year when investment is activated, the profit rate is calculated so that the sum of the present values of profits and the present value of the capital invested equal zero. That is, calculation is for the discount rate at which investment (cash out) and profit (cash in) are balanced. Propriety of a project is determined by evaluating its profit rate (IRR).

- Internal Risk

A risk within the scope controlled or affected by a project team. (risk on securing workforce or cost estimate)

- Interview with Intellectuals

To identify risks, it is considered an effective means to interview intellectuals who have various experiences and knowledge about past risk cases of their companies or others to understand main points. An attempt to interview various stakeholders about risk-related issues helps elicit "opportunities" and "threats" that tend to be overlooked in usual activity plans.

- Intranet

An in-house telecommunication network using TCP/IP, a telecommunication method for the Internet. This network can also be directly connected to the external Internet. Since outsiders can easily access the Intranet, it needs a security measure with a firewall (meaning a fire prevention wall, a security system installed between the Intranet and Internet to prevent unauthorized access from outside). Meanwhile, Extranet refers to a company-group intranet connecting each in-house telecommunication network of group companies or specific clients.

- Just-in-Time

A management method to clear parts inventory in manufacturing process. Developed by a Japanese car manufacturer, this concept is widely adopted these days by not only car manufacturers but also other industries.

- KJ Method

An "abduction" developed by Dr. Jiro Kawakida. It is generally accepted that the abduction is important as a method of science in addition to the induction and the deduction. Matters observed during fieldwork are written down one-by-one on KJ cards, and cards representing similar matters are collected when all cards are gathered, and in consideration of what similar matters represent, a KJ card representing a subject is created. By gathering such representative cards (cards symbolizing categories for classification) and repeating the same procedure, the meaning of matters observed will gradually come out. In Japan, the KJ method was popular as the Problem Ordering Technique in the 1970s. However, Dr. Kawakida warns that this obviously deviates from the essence of the KJ method.

- Learning Curve

When similar works are repeated, time required for each unit work becomes shorter due to so-called learning effect as both managers and workers gradually accumulate experience (learning). This reduction is called learning effect while a change of working time drawn on a graph with the number of accumulated tasks as the horizontal axis is called a learning curve.

- Leverage

A lever can generate a large physical power with a small power. Like this, the leverage in projects means a concept of enlarging the fund amount (capital + debt) invested into an entire framework by limiting the fund amount (capital) invested into a certain project while raising debts with the limited fund amount as a lever. In general, if the ratio of debts to the funds required for the entire project is larger than that of equity, the degree of leverage is considered high.

- Loan Life Debt Service Coverage Ratio = LLDSCR

An index to indicate how many times the present value of the sum of cash flow over the entire loan period before start of the principal and interest repayment is greater than the loan principal. The following formula is used for calculation:

LLDCR =

Σ (Present value of the sum of cash flow before start of the principal and interest repayment) $\div$ (Loan principal)

If the value is below 1, repayment of the loan principal is impossible. As it is an index to see the safety concerning cash flow fluctuation, a higher value means a higher safety for financial institutions.

- Location Factor

A factor (index) to estimate a cost using known cost data when implementing similar work in a different place. In this factor, obviously, all categories constituting project cost such as difference in productivity and the unit price for materials and personnel are compared.

- Lot Factor

Ordering ten pieces is sometimes cheaper in price than ordering one piece even if the same product is procured. In cost management, the influence the amount of procurement exerts on the cost is called the lot factor.

- Man-hour

A unit to indicate labor power needed for a designated work amount. For instance, if one person can complete one sheet of design drawing in 50 hours, it is regarded as a work amount of 50 man-hour. However, the factor of productivity difference underlies this concept.

- Market Place

A place of business to provide transaction intermediary service for inter-enterprise electronic trade on the Internet.

- Milestone

An event at the beginning or end of a project that is considered critical for project execution to recognize the level of interim achievement of a project.

- Monte Carlo Method

A powerful and simple method of performing simulations by using random numbers. In general, calculation is made with a computer. As randomness in sampling greatly affects reliability of the results, this method is widely used in the science field and other various fields that need samples such as risk

analysis. Selection of probability distribution causes a great impact on the result.

- Moral Hazard

In financial activities, a lender cannot precisely comprehend the borrower's information in general even if a loan contract provides for obligations of both parties. Although a loan contract is based on the borrower's reasonable repayment of principal and interest, the lender does not comprehend all information on the borrower's repayment for principal and interest. Moral hazard means a risk on the borrower's attempt to take a favorable action in financial borrowing and lending by taking advantage of its position when the information on the lender and the borrower are unsymmetrical as mentioned. In a broader sense, it is also called Moral Defect, which means taking an action in one's own favor due to no effect of reasonably expected self-discipline.

- Multi Office Organization, Virtual Office Organization

In project execution, there are different forms suitable to each work contents such as home office organization and manufacturing / workfront organizations. In the case of a project in cooperation with overseas enterprises, a multi office is frequently adopted for work execution at multiple places far away from each other. That is, a project team should be changed depending on time and places in pursuit of optimum form, chain of command, management stratum, job type and personnel allocation. With the development of information technology, operation without fixing time and place such as a virtual office has become possible.

- Multivariate Analysis

When many factors are complicatedly intertwined with each other, it is difficult to search for the essence. The following methods are examples to search for the essence from these complicated factors.

1) Principal component analysis / Factor analysis
   Want to know the outline of which factor is effective when various evaluation factors are complicatedly intertwined with each other.
2) Multiple regression analysis
   Want to find a relationship formula when many parameters seem to be concerned with an intended output. Want to know a parameter causing a major impact on the output.
3) Cluster analysis
   Want to reasonably classify a sample group.
4) Determination analysis
   Want to determine with high accuracy which group it belongs to. Good or bad, normal or abnormal, enterprise to go bankrupt or to survive, etc.

- Net Present Value = NPV

The present value means a converted value by replacing future value with present value. For instance, if ¥1,000,000 is deposited at the bank with a 5 % annual interest rate, the amount will be as follows one year later.

(Present) ¥1,000,000 × (1+0.05) = ¥1,050,000 (One year later)

In this case, ¥1,050,000 is called one-year after future value. On the contrary, the value of ¥1,050,000 one year later is only ¥1,000,000 at present as shown below.

(One year later) ¥1,050,000 = 1/ (1+0.05) = ¥1,000,000 (At present)

In this case, ¥1,000,000 is called the present value for one-year after ¥1,050,000, and 5% interest rate is called the discount rate. The net present value can be calculated by subtracting the initial investment amount from the present value. A positive net present value means that the investment applies more profitability than the discount rate.

- Net Quantity

Actual quantity such as the number of drawings, quantity of equipment/materials and quantity of construction work calculated from the standpoint of engineering and experience based on materials prepared at the estimate stage. It does not include allowance (quantity added for the purpose of supplementing imperfection of the estimate method adopted).

- New QC Seven Tools

A method used for language data analysis, and its essence lies in the support of Structuralizing, Visualizing, and Conception. (Association diagram method, Amicability diagram method, Schematic diagram method, Matrix diagram method, Matrix data analysis method, PDPC method, Arrow diagram method)

- Object Oriented

A software development technology designed based on the "abstract data type" advocated by Hoar

C.A.R. The object oriented technology creates models of actual entities in the real world consisting of discrete entitles and their behaviors, and then expresses the models as data and the (capsulated) "object" comprised of methods specific to the data. Some methods express how one entry approaches to the other. When an incident occurs in the real world, if a relevant object is called and activated (event driven), an online transaction process system will be completed which traces ever-changing situation in the real world. The object oriented technology has caused a revolution of programming methods as well. As each element is highly independent, the inner part of an object may be changed without affecting other objects. Therefore, it is possible to conduct the "progressive-type prototyping", which is to create a prototype first, and then gradually enhance the percentage of completion while running the prototype to check its validity.

- OBS (Organizational Breakdown Structure)

This is used to indicate to which department of an organization each component work element is allocated.

- Overrun, Underrun

Operation is performed in project management to be in conformity with the original planned process and budget. However, the process may be delayed or the cost may exceed the budget, or on the contrary the process may be advanced or the cost may become less than the budget. The former case is called overrun, and the latter, underrun.

- Payback Period Method, Simple Payback Method

A method of deciding investment according to an idea that project investment should be collected during a specific period. The payback period refers to the period during which the sum of expected cash flows equals to the initial investment. In the payback period method, only cash flow within the collection period is considered and subsequent cash flow is ignored, and the concept of money as time value is usually excluded from calculation. Since investment collection in a life cycle manner is also excluded, this method is used for calculation of very simple estimates for investment collection.

- PCWBS (Project Control Work Breakdown Structure)

A work breakdown structure chart that shows breakdown of physical deliverables of a project into appropriate management units according to equipment classification systems and installment place segments.

- Percentage of Completion

This refers to progress (percentage of completion) in a project. Major methods are as follows:

- Percent Complete Method
  A physical progress indicated on a percentage basis according to a previously set measure.
- 0-100% Complete Method
  Account for 100% only when each work package is completed.
- 50-50% Complete Method
  Account for 50% when work is initiated for each work package, and the remaining 50% when completed.

- PFI (Private Finance Initiative)

Concerning maintenance (design / construction) of public facilities and the like, procurement of funds required, and maintenance / operation of the facility after completion, this is a concept of entrusting such work in a lump to a private sector based on contracting by utilizing private funds, creativity, and managerial / technical skills with the aim to reduce financial burden on the public sector and provide users with high-quality public service. A private business entity is granted a long-term business right, and the creation of a business framework itself is subject to public subscription. In Japan, application of such methods has become possible according to the "Law Concerning Promotion of Construction and Improvement etc. of Public Facilities etc. by Utilizing Private Sector Funds etc." established in 1999.

This method is also called Public Private Partnership (PPP).

- Phased Termination Review

A review of deliverables of the phase conducted at the end of each phase of a project. It is important to smoothly move to a downstream phase.

- Pilot Program Method

Experiment is usually conducted for confirmation at a stage of research and development, and this is a method to efficiently deduce most effective result by obtaining simultaneously with the experiment much information on factors or levels that affect the result. The pilot program method uses variance analysis, two-way layout method, orthogonal charts and others.

- PM Theory

A leadership theory by Jyuji Misumi. Leadership is considered to have two functions: the issue executive function (P factor) including formation and achievement of group goals and the group sustaining function (M factor) including maintenance of social stability of the group. It is found that the PM-type leadership behavior having both the P-type issue executive function and the M-type group sustaining function is better than the behavior having a single function and is much better than the permissive leadership having neither of the both functions.

- Product Liability Law

Product liability means an issue of compensation for damage under the Civil Code when a defect in a product has caused damage or economic loss to life, human body or property of the user or a third person. Criminal liability may be brought up in some cases. Product liability could cause enormous total damage to an enterprise. It may exert a serious impact on corporate management in terms of not only direct liability for damage but also inspection fees for the incident, payment of the cost for collecting / scrapping defective products, and loss of public confidence. As a solution to such situations, individual enterprises are required to take measures by practicing quality assurance activities such as quality control, reliability control and inspection control, establishing an in-company crisis management system against contingency, and participating in insurance plans, etc.

- Product Planning Seven Tools

A group of seven methods to utilize in product planning from recognition of customer needs to a quality requirement chart. (group interview, questionnaire survey, positioning analysis, idea checklist, grid idea method, conjoint analysis, quality chart)

- Project Control Schedule

A schedule to manage contractual operations throughout all phases of a project which are comprised of work packages or their subordinate management units based on the project master basic schedule. This is usually indicated in a network form.

- Project Manager

A project manager is a person in charge of execution of a project that has been selected in order to generate specific project deliverables or results that fulfill requirements of project management such as scopes, technology (quality), cost and time, and to achieve profit goals as a business at the same time by consistently leading and supervising the project from the beginning to the end and utilizing available resources inside and outside the organization based on the concept of responsibility centralization.

- Project Master Schedule

This is a basic schedule for execution and management of a project, and a general schedule of contractual operations throughout all phases of a project. In general, this is collectively indicated in a network form or bar chart form.

- Project Office

It is established as a department to facilitate optimization of an organization for the purpose of smooth accomplishment of multiple projects concurrently running inside an organization. It is classified into supportive, administrative, line-type project offices according to coordination and authority.

- Project Team

The role of a project organization is to make the best use of the capability held by the executive organization in order to achieve the objective and goal of a project. It is formed as a temporary organization solely for the sake of a project aside from corporate functional organizations. This concept is called the project team system, and the organization thus formed is called a project team.

- Projectized Enterprise

It means recognition of all activities in an enterprise as project activities with a clear objective or goal in order to change corporate activities to more objective-oriented ones and obtain results. Business processes and structural forms of enterprises are also being changed to make the best use of the results of these project activities.

- Pure Risk

A risk arising when there is only loss and no chance of gain.

- QC Seven Tools

A series of basic methods used for recognition and analysis of problems and issues in solution (pareto diagram, cause and effect diagram, graph, check sheet, histogram, scatter diagram, control chart).

- RBS (Resource Breakdown Structure)

A type of OBS. Each element of component work is allocated to individuals.

- Real Option Method

Compared with the conventional net present value method, which tends to underestimate an investment item due to measurement only with the present value, the real option method has features of measuring as a value flexibility or options for decision making such as postponement, expansion/reduction, and withdrawal of investment, and evaluating the entire value of investment item. These days, the real option method has been increasingly adopted year by year. The difference between the net present value method and the real option method is shown in the example of the following diagram.

If the net present value is analyzed in consideration of occurrence probability (without considering an interest rate generated with the passage of time), the estimated expected value of this project investment is -¥4,000,000, that is, the expected value obtained from the project investment is negative, meaning there is no investment value in conclusion. In such a case, however, the enterprise does not need to take an option of selling products when equipment investment and manufacturing cost exceed the expected sales value, that is, the business obviously shows a deficit. In other words, deficit cases can be cut off. If the option is executed when the development is completed, further losses can be prevented. As a result, the expected value of the project becomes larger, and it is calculated as ¥11,500,000.

(Conditions)

Cost of the product development:

¥10,000,000 → Essential for development

Cost of equipment investment & manufacturing:

¥60,000,000 → Occur with the probability of 20%

¥90,000,000 → Occur with the probability of 30%

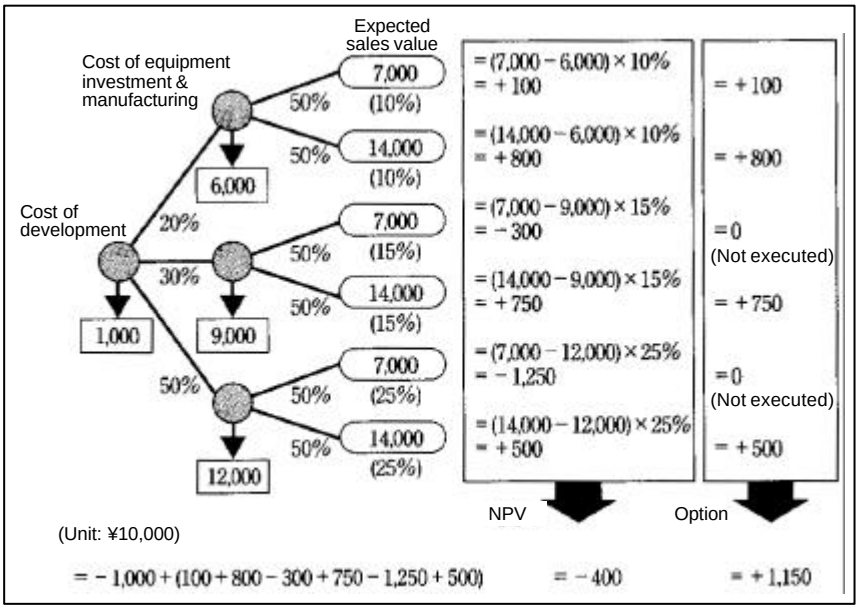
¥120,000,000 → Occur with the probability of 50%

Anticipated sales value:

¥70,000,000 → Occur with the probability of 50%

¥140,000,000 → Occur with the probability of 50%

The cost of equipment investment & manufacturing and the expected sales value become clear when the development is completed.



- Responsibility Matrix = RM

An Organization Breakdown Structure is made corresponding to the WBS of a project, and a responsibility matrix is made at the operation business level. The responsibility matrix specifies which department (sub-project team) performs which series of business and summarizes for which specific jobs each member of the project team has responsibility and authority at the detailed level.

- Return on Equity Method = ROE

Referred to as the net profit to net worth ratio as well. An index to judge to what extent the capital invested is efficiently managed. A management index that puts an emphasis on earning capitalization to

stockholders who provide investment capital. Although the ROE does not necessarily reflect precise business conditions, this index is generally used in the market due to simple calculation and high correlativity with actual conditions. The ROE is calculated according to the following formula:

ROE (Return on Equity) = After-tax profit ÷ Capital stock

- Return on Investment = ROI Method

The return on investment method is also called ROI, and the value calculated by dividing the profit generated from the capital invested by the invested capital. According to the above-mentioned project, the calculation is as follows:

ROI = The average of cash collection during four years / Investment amount = 75 / 200 = 37.5 %

Propriety of investment is decided by comparing this ROI with the company's profit rate or capital cost.

These two methods used to be prevalent in Japanese companies. Since these methods do not consider the attrition in value according to the elapse of time, the present ¥1,000 was equally treated with the ¥1,000 one year later. Then, evaluation methods that specify the concept of cash flow rather than collected profit for investment have become popular. With the increase in joint venture or merger / acquisition with American or European companies, more Japanese companies have begun to use the internal rate of return method or the DCF method following the evaluation methods of mainly American companies since around 1990. Both methods are based on cash flow and consider discount for the value according to the elapse of time by introducing the concepts of capital cost and present value.

- Review

Since most mistakes are spotted by a third party more easily than by the parties concerned, an objective review by a third party is considered essential to properly operate a project. Review is a method of utilizing various group forces by collecting a variety of "persons" such as intellectuals and managers according to objectives.

- Risk Protection Plan

A countermeasure to be considered when risk elements become obvious to evade or reduce their influence. It may consist of a multilayer structure depending on the degree of influence of risk elements.

- Scatter Diagram

A scatter diagram means a diagram where a pair of data (x, y) is indicated on a graph sheet to clarify whether there is a relationship between x and y.

- Scope

Deliverables and services generated as a project, consisting of scope of supply and scope of work.

- Security Package

When collateral for a loan on a certain project consists of various components, their organic relevance with the entire project determines loan eligibility. Overall components of collateral comprised in such manner and offered to financial institutions are called a security package.

- Sensitivity Analysis

Refer to "Base Case and Sensitivity Analysis".

- Six Sigma

This is adopted to improve a process system. A management method to improve profitability and ability in an attempt to improve corporate cost by improving a defective ratio from conventional 3σ or 4σ to 6σ. In 1987, Motorola, Inc. recognized that poor quality is the cause of deterioration in corporate management and worked on quality improvement, being convinced that quality improvement could reduce actual costs.

- Solution with QC Story

An empirical problem solving method based on data. The point of this method is to steadily follow the seven procedures, 1) Selection of the theme, 2)Recognition of the present situation and goal setting, 3) Action plan drafting, 4) Analysis of main factors, 5) Examination and implementation of measures, 6)Confirmation of effects, 7) Standardization and establishment of management.

- Speculative Risk

A risk that exists when there is a chance of both loss and gain. Also called business risk.

- SPI (Schedule Performance Index)

Value calculated by dividing work that has actually achieved by planned budget amount at certain time. SPI shows productivity in terms of schdule at the time.

$$\text{SPI} = \frac{BCWP}{BCWS}$$

- Stakeholder

The stakeholder originally meant a stake to tie cows to and people concerned such as cow owners and other animals that are included within the range of activity of cows tied to the stake. Deriving from this meaning, people concerned with business activities are called stakeholders, and specific people concerned with a specific project are called project stakeholders. For instance, the following individuals and organizations are included.

- Inside a company: Top management, employee, labor union, etc.
- Economic contractual relationship: Client, contractor, supplier (vendor), allied company, licenser, financial institution etc.
- Non-economic contractual relationship: Local resident, central and local governments, NPO (Nonprofit organization), mass media, etc.

- Static Risk

Risk on acts of God or damage caused by human errors and crimes.

- Statistical Quality Control = SQC

A method of conducting quality design, quality analysis and quality improvement in quality control. (certification and assumption, pilot program method, regression analysis, multivariate analysis, reliability data analysis, etc.)

- Strategic Business Unit = SBU

An organization segment for planning a strategy developed by Boston Consulting in the United States. Compared with business department organizations, which are an organizational unit as a managerial segment to effectively manage business from a managerial viewpoint, a strategic business unit is a organizational unit reorganized based on a business (or a product group) having the same characteristics from a viewpoint of realizing / achieving strategies as the whole company. To organize strategic business units, it is necessary to originally set up a clear mission, clear rival, person responsible for the business, control of management resources, formulation of a single strategy. In addition, a product portfolio is suitable for use by each strategic business unit.

- Strategic Planning Seven Tools

A method for supplementing basic management strategies or business strategic planning at a stage of planning a policy to achieve. (Environmental analysis, product analysis, market analysis, product / market analysis, product portfolio analysis, strategic factor analysis, resource allocation analysis)

- Stratification

Stratification means to divide collected data by factor, which helps to figure out which factor has caused influence.

- Structure, Structuring, Structured Finance

A scheme of a certain project is called a structure, and a process to generate a structure is called structuring. In addition, a form of finance in which a framework or scheme is generated and composed for each individual item or project is called structured finance. Project finance is a form of structured finance, and both of them are a method of asset-based finance in a broader sense. The process to realize this finance is sometimes called financial engineering.

- Structured Walk-through

A method of conducting a review. A meeting held by a person in charge of a deliverable who summon people concerned with a project and intellectuals in order to evaluate the validity of the deliverable.

- Subcontractor

When distinguishing the contractor of a main contract from the contractor of a secondary contract in project contracts, the former is called the "main contractor" or the "prime contractor" while the latter is called a " subcontractor."

- SV (Schedule variance)

Numerical evaluation that has been compared with amount of actually completed work and amount of planned work at certain time. It shows comparison in terms of cost at the time. SV=BCWP-BCWS.

- Taguchi Method

A kind of an experiment planning method. Causes of change in product quality are collectively called noise, and in the Taguchi method for quality design, products are designed to be resistant to this noise.

- Task Termination Review

A review conducted for deliverables of a task or its subordinate work when such a task or work is completed.

- Team Building

Various promotion and enlightenment activities with the aim to improve communications among team members, or to share the project goal in order to improve team performance since project work is performed by a team as a group of individuals.

- Tree Analysis

Concerning event analysis or problem solution, an effective method is to figure out the meaning for each node by dividing the entire event (problem) into elements (branches/leaves) with a tree-shaped branch structure. The following methods are examples for this.

1) Logic tree
2) Issue tree
3) Work tree, Theme tree
4) Decision tree

- UML (Unified Modeling Language)

A language for specification, visualization and establishment used for modeling a large and complex system.

- Vendor List

A list of equipment manufacturers and service providers adopted in a project is called a vendor list. The vendor list is generally managed by the functional organization that conducts procurement operations on the company-wide basis.

- WBS (Work Breakdown Structure)

A structure that hierarchically divides and breaks down all tasks such as scope and work items into the level necessary for effective planning or management, systematically stratifies them according to products, and indicates their relations in order to achieve the objective of a project.

- Work Design = WD

This presents an integrated method ranging from problem recognition to solution preparation including space setting, function development, function determination and component disassembling. G. Nadler developed this method in 1960s in the U.S. for designing machine tools. In Japan, a concept and method have been added to be used for information systems and others. This method helps to avoid pursuing a cause of a problem that cause discord among people, pursue the matters to be done with a bottom-up approach (functional development), specify issue regions by introducing a general system concept once a consensus is reached, make a technically workable ideal system (TWIS), and draw out a concrete system proposal fit for an actual environment. Although the portion added in Japan for information systems has become obsolete and the method is behind the present modeling technology, it may be called a kind of software system approach.

- Work Package

Work elements at the lowest WBS level are called a work package. One work package is implemented under the responsibility of one person within one organization, and it includes research, technology, report, experiment, test, design, specification, hardware elements, software elements, procurement, construction, and service, etc. This work package is further decomposed into "task (activities)".

- Working budget

When the procurement budget accounts for a large portion of the entire project budget, the quality of procurement management inevitably affects results of the project. Therefore, it is necessary to lay down a working budget to manage the order amount.

- Yearly Debt Service Coverage Ratio

An index to indicate how many times cash flow before the principal and interest payment for each fiscal year during a loan period is greater than the principal and interest to be paid during the relevant fiscal year. The following formula is used for calculation:

Yearly DSCR =

(The sum of cash flow before the payment of principal and interest for each fiscal year) ÷

(The principal and interest paid for the relevant fiscal year)

The calculation is made for both each fiscal year and the entire loan period because cash flow may fluctuate each fiscal year due to a certain element. When the value for a certain year becomes below one, payment of the principal and interest for the year is expected to become difficult.

Cooperators and Authors of "P2M"

Development and Authors of "P2M"

Part.I.	Project Management Entry	Shigenobu Ohara	University of Technology Sydney
Part.II.	Project Management	Shigenobu Ohara	University of Technology Sydney
Part III.	Program Management	Shigenobu Ohara	University of Technology Sydney
Part IV	Segment Management		
Chapter 1	Project Strategy Management	Yoshiaki Shibao	PricewaterhouseCoopers Consulting K. K.
		Ryoichiro Shimoda	Kajima Corp.
		Tetsuya Sekiya	Takenaka Corp.
		Osamu Masutani	NS Solutions Corporation
Chapter 2	Project Finance Managemnt	Toru Mihara	Mitsui Global Strategic Stadies Institute
Chapter 3	Project System Management	Hitoshi Furukawa	Previously FUJITSU LTD.
		Wataru Ohashi	Mitsubishi Heavy Industries, Ltd.
		Yasuhiro Horibe	Mitsubishi Research Institute, Inc.
		Yasushi Ishigai	Mitsubishi Research Institute, Inc.
		Yuzo Tejima	Business Information System Architect
Chapter 4	Project Organization Management	Susumu Miura	TOYO ENGEERING CORP.
		Yoshiaki Shibao	PricewaterhouseCoopers Consulting K. K.
		Tetsuya Sekiya	Takenaka Corp.
		Masayuki Ishikura	Chiyoda Corp.
		Kaoru Nakamura	Artemis International Ltd.
Chapter 5	Project Objective Management		
	1. Life Cycle	Akio Mitsufuji	EBARA CORP.
	2. Scope	Masao Motegi	Ishikawajima-Harima Heavy Industries Co., Ltd.
	3. Time	Hirotake Iwamoto	JGC Information Systems Co., Ltd.
	4. Cost	Hirotake Iwamoto	JGC Information Systems Co., Ltd.
	5. Quality	Masao Motegi	Ishikawajima-Harima Heavy Industries Co., Ltd.
	6. Earned Value	Susumu Miura	TOYO ENGEERING CORP.
	7. Report/Change	Masayuki Ishikura	Chiyoda Corp.
	8. Delivery	Masayuki Ishikura	Chiyoda Corp.
Chapter 6	Project Resource Management	Yasuhiro Horibe	Mitsubishi Research Institute, Inc.
		Yasuhi Ishigai,	Mitsubishi Research Institute, Inc.
		Motoyoshi Hashitani	JGC CORPORATION
		Masayuki Ishikura	Chiyoda Corp.
Chapter 7	Risk Management	Kazuhiko Hagihara	NKK Corporation
		Ryoichiro Shimoda	Kajima Corp.
		Susumu Miura	TOYO ENGEERING CORP.
Chapter 8	Information Management	Tametsugu Taketomi	SAP Japan
		Osamu Masutani	NS Solutions Corporation
		Kiyoomi Tsuruhata	Yokogawa Electric Corp.
		Yuzo Tejima	Business Information System Architect
		Shinichiro Tomikawa	YAMATO SCIENTIFIC CO.,LTD.
Chapter 9	Relationship Management	Masahito Yoshimura	Hitachi, Ltd.
		Tametsugu Taketomi	SAP Japan

	Takashi Shimomura	Yokogawa Electric Corp.
Chapter 10 Value Management	Masahito Yoshimura	Hitachi, Ltd.
	Tametsugu Taketomi	SAP Japan
	Tetsuya Sekiya	Takenaka Corp.
	Hisao Wataki	Kawasaki Heavy Industries, Ltd.
	Tsutomu Kounosu	Chiba Institute of Technology, Instructor
Chapter 11 Communication Management	Kensuke Koishihara	Kawaju Techno Service Corp.
	Mitsunari Watanabe	Engineering Advancement Association of Japan (ENAA)

Reviewers

Tadamasa Imaguchi	Keio University, Professor
Tomio Umeda,	Chiba Institute of Technology, Professor
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Takao Terano	Graduate School of Business Sciences, University of Tsukuba, Professor
Tsumeo Fujita	Fukuyama Heisei University, Professor
Suemitsu Asae	K con
Koji Asakura	Engineering Advancement Association of Japan (ENAA)
Makoto Asada	NS Solutions Corporation
Matsuo Uejima	Chiyoda Corp.
Toru Kozasa	Takenaka Corp.
Yoshiaki Kawakatsu	Gifu Prefecture Administration Officer
Hiroo Shiomi	Engineering Advancement Association of Japan (ENAA)
Yoshiyuki Takahashi	JGC PROJECT SERVICES CO., LTD.
Hiroshi Tanaka	JGC Corporation
Hajime Tsubioi	Environmental Engeering
Mikitoshi Nishihashi	IBM Japan, Ltd.
Ichiro Fujita	FUJITSU LTD.
Takashi Watanabe,	Mitsubishi Electric Corp.

Lecturers of "P2M" Workshop

Takaya Kishida	Takasaki City Universit y of Economics, Professor
Masaaki Kurosu	Shizuoka University, Professor
Tsutomu Kounosu	Chiba Institute of Technology, Instructor
Kenichi Suzuki	Meiji University, Assistant Professor
Makoto Tsutsumi	Fukuyama Heisei University, Instructor
Masatoshi Nishio	Chiba Institute of Technology, Professor

Cooperators and Authors

Kozo Akutagawa	TOYO ENGEERING CORP.
Takayuki Asada	Graduate School of Economics, Osaka University, Professor
Matsuo Uejima	Chiyoda Corp.
Shunji Nakamoto	NAKA Institute of Management
Masatsuyo Futami	JGC CORPORATION
Kenji Muramatsu	JGC CORPORATION
Kenichi Yoshihara	JGC CORPORATION
Tetsuya Yonezawa	TOYO ENGEERING CORP.
Takeaki Watanabe	Takenaka Corp.

Editors

Michio Takahashi	Engineering Advancement Association of Japan (ENAA)
Kanji Kouda	Engineering Advancement Association of Japan (ENAA)
Keisuke Fukuoka	Engineering Advancement Association of Japan (ENAA)

Committee for Introduction, Development, and Research on Project Management

Chairperson

Shigenobu Ohara	Adjunct ive professor of University of Technology Sydney

Advisors

Masaya Ichino	MASP Group
Kensuke Koishihara	Kawaju Techno Service Corp.
Yoshiaki Shibao	PricewaterhouseCoopers Consulting K. K.
Tametsugu Taketomi	SAP Japan
Yuzo Tejima	Business Information System Architect
Yoshimasa Hanasaki	Matsushita Electric Industrial Co., Ltd.
Osamu Masutani	NS Solutions Corporation
Toru Mihara	Mitsui Global Strategic Stadies Institute

Committee members

Yasushi Ishigai	Mitsubishi Research Institute, Inc.
Masayuki Ishikura	Chiyoda Corp.
Hirotake Iwamoto	JGC Information Systems Co., Ltd.
Wataru Ohashi	Mitsubishi Heavy Industries, Ltd.
Yasuhiko Okumura	NEC Corporation
Tsutomu Kounosu	Chiba Institute of Technology
Chihiro Samejima	JAPAN AIRLINES COMPANY, LTD.
Ryoichiro Shimoda	Kajima Corp.
Tetsuya Sekiya	Takenaka Corp.
Kiyoomi Tsuruhata	Yokogawa Electric Corp.
Shinichiro Tomikawa	YAMATO SCIENTIFIC CO.,LTD.
Kaoru Nakamura	Artemis International Ltd.
Kazuhiko Hagihara	NKK Corporation
Motoyoshi Hashitani	JGC Corporation
Hitoshi Fukukawa	Previously FUJITSU LTD.
Susumu Miura	TOYO ENGEERING CORP.
Akio Mitsufuji	Ebara Corp.
Masao Motegi	Ishikawajima-Harima Heavy Industries, Co., Ltd.
Masahito Yoshimura	Hitachi, Ltd.
Hisao Wataki	Kawasaki Heavy Industries, Ltd.
Toshio Iikura	Engineering Advancement Association of Japan (ENAA)

Observers

Yasushi Morishita	Ministry of Economy and Industry
Hideaki Endoh	Ministry of Economy and Industry
Masao Itoh	Ministry of Economy and Industry
Koh Aoki	Ministry of Economy and Industry
Norihiro Uchino	NTT Learning Systems Corporation
Koji Nakanishi	NTT Learning Systems Corporation

Hisashi Itoh	Chiba Institute of Technology, Instructor

Secretariat

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Kenji Katayama	Engineering Advancement Association of Japan (ENAA)
Keisuke Fukuoka	Engineering Advancement Association of Japan (ENAA)
Mitsunari Watanabe	Engineering Advancement Association of Japan (ENAA)

Representative Author : Shigenobu Ohara

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