INFORMATION ON COST CONTROL

FOR THE JAPANESE CONSTRUCTION INDUSTRY

by

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ABSTRACT

It is well known that the Japanese management system is quite different from that of the U.S. The Japanese construction industry also has different characteristics from its counterpart in the U.S., for example, the multi-storied subcontractor system and the fact that more than 95 percent of work is domestic. These traditional characteristics have prevented the industry from adopting a computer-based information system.

In this thesis, the discussion is focussed on the cost control system of the Japanese construction industry. The current cost control system has two main defects. One is that all the work for cost control depends on manual work and a large amount of man power is wasted in making calculations and writing reports. Another defect is that some reports are too detailed or lack important information. This means that management receives too much information or cannot gain access to the needed information.

Conceptual proposals for a computer-based information system are given in Chapter V. One proposal is for estimating and budgeting, and the other is for processing. These proposals are made based on the examination of the current cost control system and the analysis of the needed information level for different levels of management. The proposed systems will be able to solve the problems which the industry now faces and aid the industry in controlling their construction sites more effectively and efficiently.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

1.1. The Purpose of the Thesis

The main purpose of this thesis is to examine the current cost control system of the Japanese construction industry and to make a conceptual proposal of a computer-based information system for cost control.

Although the construction industry is one of the leading industries in Japan, it is relatively behind in the MIS field. Almost all large Japanese construction firms have a computer today. However, these computers have been used only for technical calculation, payroll calculation, and so on. Every large construction company manages from hundreds to thousands of on-going sites and a large number of documents and reports go back and forth between the head office and its construction sites.

The adoption of a computer-based information system seems to be very useful in reducing the time consuming manual work, report making, in both the head office and at the sites. It will also help managers to gain easy access to the needed information. However, a systematic effort to develop a computer-based information system has not been

made in this industry.

There are several reasons why the construction industry has been so reluctant to use computers for its management control purposes. One of the main reasons is that the current management system has a long history and has worked well -- at least many managers have believed so. The industry's main market has been domestic, not international, and the traditional management system has been accepted for a long time. The management has not felt the necessity to replace the traditional system with a computer-based one. Another reason is difficulty in standardization of the work. As every construction project is perceived to be unique, each site is independent and controlled separately. Managers have been reluctant to adopt a standardized computer-based system.

However, the circumstances surrounding the industry have been changing. There is internal and external reason to change the traditional and somewhat obsolete management system especially since the Arab oil embargo of 1974. A site has to be controlled by fewer site engineers and they can not spend much time on time consuming manual work, calculating and making reports. There is an increased necessity for managers to gain access to the needed information promptly. The traditional manual system cannot fully respond to these requirements. Also, the growth in the number and volume of overseas projects causes problems

of another dimension. Overseas projects cannot be managed by the traditional "Japanese" management system acceptable only in Japan.

It may not be in the far distant future that a computer-based information system will be introduced into the Japanese construction industry. The system would encompass all the problem areas of the construction industry; accounting, labor, materials, equipment, and so on. However, it is impossible for us to handle all of these problems in this thesis. Further discussion, then, will focus on the cost control system of the industry, which seems to be the central issue in the total information system.

1.2. Layout of the Thesis

A general description of the Japanese construction industry is presented in Chapter II to provide the necessary background for further discussion. First, a brief history of the industry is described and some of the industry's characteristics are discussed. One of the leading construction companies, referred to as KOST, is then picked up and its characteristics, size, and organization are discussed in more detail.

In Chapter III, management activities are broken down into three categories; strategic planning, management control, and operational control. General Information

needed for each category is examined first. Next, the information particularly needed for the construction industry is discussed.

The current cost control system of KOST is discussed in Chapter IV. The processes for and the characteristics of estimating, budgeting, and processing of the current system are explained. The prevailing reports are described and examples are shown.

The critique of the current system and some conceptual proposals for a comuter-based information system are given in Chapter V. The discussion first focuses on estimating and budgeting, then turns to processing.

Finally, all the previous discussions are summarized in Chapter VI where the conclusions and recommendations are presented.

CHAPTER II

THE JAPANESE CONSTRUCTION INDUSTRY

This chapter contains a general description of the Japanese construction industry. After a brief description, a specific construction company is chosen for a detailed analysis of the company's characteristics as related to its cost control system.

2.1. History

In Japan, there still exist a number of famous temples, shrines, and castles build several hundred years ago. However, the present Japanese construction industry started after the Meiji Restoration (1867). Japan opened the country and new architectural technology and management systems were introduced from the Western world. At that time, many construction companies, which ultimately came to dominate the present market, were practically established by master carpenters. These include the Kajima Construction Company, founded by Iwakichi Kajima, the Shimizu Construction Company, founded by Kisuke Shimizu, and others.

Since that time, the Japanese construction industry has grown steadily. At first investment in the construction industry was largely directed toward railroad and dam

construction, followed by building construction. However, the real expansion of the industry did not occur until after World War II.

After a few chaotic years immediately after World War II, the Ministry of Construction was established in 1947. In 1949, the code for the construction industry was proposed and was adopted in the following year. Since then, the Japanese construction industry has kept pace with Japanese economic growth. Construction investment increased from ¥1,309.8 billion ($3.6 billion at that time) in 1956 to ¥28,425.5 billion in 1974 just before the Arab oil embargo.

The oil crisis and resulting recession altered the Japanese economic environment. The Japanese could not expect the traditional 10 percent plus GNP growth which they had enjoyed in the 1960s tc continue. In order tc survive the depressed economic environment, the construction industry began to modify. It tried, among other things, to improve its traditional management system and increase its overseas' projects.

2.2. Characteristics

The principal function of the contractor is to act as an organizer. Once the contractor receives an order, he is responsible for every aspect of construction; buying materials, contracting with subcontractors, scheduling, and so on. The contractor has to organize these different tasks

and coordinate them into a single structure. He has to have 1) managerial ability to control planning, design, and construction; 2) a good grasp of technology; 3) purchasing discrimination to buy good and inexpensive materials; and 4) the ability to manage subcontractors and special contractors.

There exist several characteristics in the construction industry which distinguish it from other industries. The first is that the construction industry is an order-received industry. The contractor starts the production process after receiving the order from a client. This process is very different from other industries which produce their goods based on their own previous planning. In this sense, the construction industry is very passive and likely to be heavily affected by economic fluctuations.

The second characteristic is that the construction industry is a uni-production industry and is quite mobile. In general, every construction project is different in terms of design and size. The construction location also varies from project to project. This is substantially different from other industries which usually produce many of the same products in a fixed factory. This fact gives construction managers a feeling that their field is unique. In one respect, this kind of perception prevents standardization of technology and the introduction of new methods of management.

The third characteristic is that the construction industry is an outdoor industry. The structures built by the contractors are usually outside and work cannot be carried on in inclement weather. This makes it difficult for the contractor to provide a precise schedule in advance.

Another important characteristic in the Japanese construction industry is its multistoried subcontractor system. In general, 60 to 70 percent of the project is assigned by the general contractor to specialty trade contractors or subcontractors. These subcontractors in turn use their subcontractors, and so forth. Thus for a single project there are a general contractor, first subcontractor, second subcontractor, third subcontractor, etc. This system is called the multistoried subcontract system.

There are two main reasons for the existence of this system. One stems from the fact that because the construction industry is an order-received industry, the amount of work is unpredictable. It is very dangerous for the general contractor to retain his full capacity of labor and machines. The general contractor thus has to employ subcontractors to ensure his own safety.

Another reason stems from the construction industry's historical background. The labor forces needed for the construction industry have traditionally been supplied from rural areas. An unlimited number of workers were available

at any given time. The contractor did not need to keep his own labor forces at all. He simply asked the mediators to assemble workers. These mediators gradually have been structured into the multistoried subcontract system and now exist as subcontractors.

2.3. General Contractors

In the Japanese construction industry, there is a great gap between the top five contractors and the others. These top five are referred to as "The Big Five" (Ohte Gosha). The Big Five include Kajima, Taisei, Shimizu, Takenaka, and Ohbayashi. Table 2.1 shows the comparison among these five companies. Their annual contracts amount to approximately ¥500 billion ($2.3 billion) each. This amount is substantially larger than for any other country except the United States. Table 2.2 shows the world ranking in terms of construction contract amount. Every "Big Five" member is included in the top 15 in the world.

One of the characteristics of the Japanese construction industry is that the percentage of its overseas work is very low, around 5 percent. The Japanese construction companies thus have many construction projects in a relatively small domestic area.

2.4. Subcontractors

The Japanese subcontractors are classified roughly

TABLE 2.1

COMPARISON AMONG BIG FIVE[a]

(million yen)

	Date of Settlement	Sales	Profit After Tax	Contract Received	Contract Remained
KAJIMA	11/1975	560,417	15,105	586,470	929,547
TAISEI	3/1976	546,592	13,028	577,075	735,668
SHIMIZU	3/1976	461,303	10,337	451,303	608,604
TAKENAKA	12/1975	447,273	9,408	431,257	523,000
OHBAYASHI	3/1976	425,365	6,332	423,771	622,624

[a]Source : Kensetsu Gyokai

TABLE 2.2

WORLD RANKING OF CONSTRUCTION COMPANIES[a]

No.	Name of the Company	Contracts (in $ million)
1.	Fluor Corp.	6,795
2.	Brown & Root	5,993
3.	Daniel International Corp.	3,106
4.	Bechtel	3,079
5.	The Ralph M. Parsons Co.	2,502
6.	C-E Lummus	2,355
7.	Stone & Webster Engineering Corp.	2,100
8.	Kajima	1,955
9.	Taisei	1,923
10.	Sterns Roger Corp.	1,864
11.	J. Ray McDermott & Co.	1,600
12.	Shimizu	1,504
13.	Takenaka	1,437
14.	Ohbayashi	1,412
15.	The Rust Engineering Co.	1,225

($1 = ¥300)

[a]Source : Engineering New Record, April 1976

into four groups: 1) Ordinary Subcontractors who offer materials and labor forces; 2) Specialty Trade Subcontractors who specialize in mechanical work, e.g., electrical work, plumbing, and air conditioning; 3) Labor Intensive Subcontractors who supply skilled labor; and 4) Equipment Intensive Subcontractors who own bulldozers, trucks, and other construction equipment.

Some of these subcontractors, especially those in the specialty trades, have very high technical skills and in some projects make contracts directly with a client. However, their major work still comes through subcontracts. The business connections between these subcontractors and the general contractors are very strong. Each general contractor constitutes a so-called "Cooperative Subcontractors Association" and member lists are issued. For example, Kajima Corporation has Rokuei-kai and Shimizu has Kaneki-kai.*

2.5. KOST Corporation

In this section, the work and organization of one of the leading Japanese construction companies, hereafter referred to as KOST, will be discussed in more detail.

2.5.1. History

KOST Corporation, one of the largest construction

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*For a more detailed description of the Japanese construction industry, see Taro Takasaki, "A Comparative Study of American and Japanese Construction Management," S.M. thesis, M.I.T., Department of Civil Engineering, 1979.

companies in Japan today, was established at the end of the Edo era (19th century) by a master carpenter. In the early Meiji era, KOST built several famous buildings which blended Japanese and Western architectural styles and established their reputation. Since then, KOST has been leading the Japanese construction industry, especially in the architectural building field.

2.5.2. Type of Work

The projects that KOST undertakes cover almost all types of architectural and civil engineering work. Table 2.3 shows the breakdown of its building projects and civil engineering works.

In addition to ordinary construction work as a general contractor, KOST has its own design division and designs many of the buildings which it puts up. Recently, KOST has emphasized its development projects and proposed and executed redevelopment of the center of a local city. The company has substantial experience in industrialized (prefabricated) apartment housing construction. KOST also has its own research laboratory. It has been eager to develop new technology and enter new fields of work. These new fields include nuclear plant construciton, underground facilities for oil storage, and so forth. It has several big projects in the Middle East and Southeast Asia. However, the proportion of overseas projects to the total projects of the company is still less than 5 percent.

TABLE 2.3

BREAKDOWN OF BUILDING PROJECTS AND CIVIL ENGINEERING WORKS[a]

Building Project	Percentage
Office Buildings	36.3%
Shops and Department Stores	6.0
Theaters, Hotels, and Services	6.5
Plants and Warehouses	12.1
Houses and Apartment Houses	14.9
Hospitals and Athletic Facilities	7.0
Educational Facilities, Shrines, and Temples	7.1
Public Institutions and Others	10.1
Civil Engineering Works	
Power Plant Facilities	8.8%
Railways and Subways	18.3
Plant Industry Projects	8.0
City Water Works and Sewages	30.4
Land Reclamation	10.5
Rivers and Harbors	7.6
Highways, Roads, and Parking Areas	10.9
Others	5.5

(Construction completed in 1976, ¥472,126 million)

[a]Source: Annual Report of KOST.

2.5.3. Size

KOST Corporation as well as other construction companies expanded rapidly after World War II. Table 2.4 shows the expansion of capital and number of employees in the 20-year period from 1956 to 1976. During this period, the company's capital increased 30 times and the number of employees increased threefold. Construction completed in 1976 reached ¥472,126 million (about $2,146 million).

In order to understand its size more precisely, the architectural projects being handled by the Tokyo head office, which handles around half of the company's total projects, are shown in Table 2.6. This table indicates that more than 80 percent of the projects are less than ¥500 million ($2.27 million). The proportion of the projects which are more than ¥5,000 million ($22.7 million) is only 1.5 percent of the total projects, but its contribution to the total contract amount is more than 30 percent.

2.5.4 Organization

The overall organizational structure of KOST is shown in Figure 2.1. The departments included in every division are indicated in Figure 2.2. The organization is divided into two main parts, commercial and noncommercial. The noncommercial parts includes the research laboratory, the computer center, the corporate planning division, and so on.

TABLE 2.4

EXPANSION OF CAPITAL AND NUMBER OF EMPLOYEES OF KOST[a]

Year	Capital (million yen)	Number of Employees
1956	1,000	3,000
1959	1,250	3,300
1961	3,000	4,000
1962	6,000	4,600
1966	10,000	6,000
1970	16,200	6,700
1973	25,000	9,000
1976	27,500	9,800

[a]Source: Annual Report of KOST.

TABLE 2.5

THE ARCHITECTURAL PROJECTS IN TOKYO HEAD OFFICE OF KOST[a]

Range	Number of Projects	Contract Amount (million yen)	Percentage
Less than 100 million ($0.45 million)	402	12,682	2.5
100 million ($0.45 million) 500 million ($2.27 million)	453	104,809	21.0
500 million ($2.27 million) 1,000 million ($4.54 million)	127	91,407	18.3
1,000 million ($4.54 million) 2,000 million ($9.09 million)	49	68,792	13.8
2,000 million ($9.09 million) 5,000 million ($22.72 million)	21	60,297	12.1
More than 5 million ($22.72 million)	16	160,256	32.2
Total	1,070	498,246	100.0

[a]Source: The Computer Center of KOST.

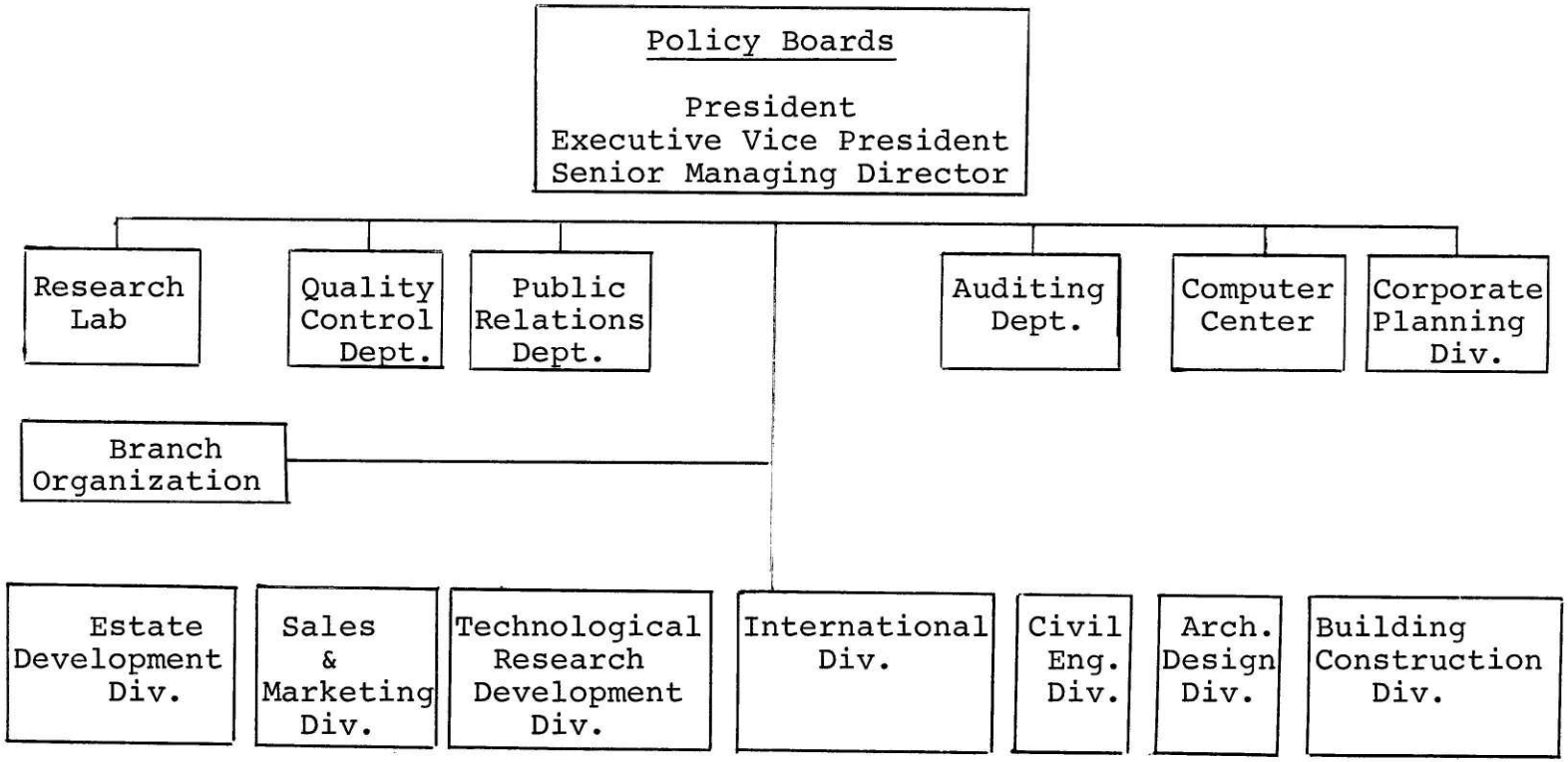

FIGURE 2. 1

ORGANIZATION STRUCTURE OF KOST

Estate Development Div.

Real Estate Dept.

Urban Development Dept.

Housing Dept.

Sales & Marketing Div.

Sales Dept.

Marketing & Sales Planning Dept.

Project Consulting Dept.

Technological Research & Development Div.

Technological Development Dept.

Engineering Dept.

International Div.

International Dept.

International Construction Dept.

Civil Engineering Div.

Civil Construction Dept.

Sales Promotion Dept.

Cost Control Dept.

Quantity Survey & Estimating Dept.

Engineering Development Dept.

Civil Design Dept.

Prepakt Dept.

FIGURE 2.2

DEPARTMENTS IN EACH DIVISION

Architectural Design Div.

Building Design Development Dept.

Building Design Dept.

Building Design Coordination Dept.

Building Design Information Center

Building Construction Div.

Building Construction Dept.

Industrialized Housing Dept.

Maintenance Service Dept.

Utilities Dept.

Cost Control Dept.

Quantity Survey & Estimating Dept.

Engineering Development Dept.

Administrative Dept.

Regional Offices

District Offices

FIGURE 2.2 (CONTINUED)

These sections are directly responsible to the executive boards.

The commercial part includes the Real Estate Development Division, Sales and Marketing Division, technological Research and Development Division, Internationa Division, Civil Engineering Division, Architectural Design Division, and Building Construction Division. Each division consists of several departments. Among these divisions, the Civil Engineering Division and Building Construction Division undertake actual construction works. These two divisions have quite similar organizational structures, but in KOST the Building Construction Division is larger than the Civil Engineering Division and far larger than the other divisions.

The organizations within the Building Construction Division are examined in more details here, in order that a discussion of the cost control system can be undertaken later. The Building Construction Division has seven building construction departments called the First, Second, Third, Fourth, and Fifth Building Construction Departments, the Housing Department, and the Industrialized Housing Department. All building construction sites belong to one of these seven departments. In order to support the work at the various sites, other departments, e.g., the administrative Department, the Utilities Department, the Engineering Development Department, and so forth, are situated at the head office.

Figure 2.3 shows the organization of the Construction Department. The top is a department manager who has several submanagers. Section managers are responsible to these submanagers and somethimes directly to the department manager. Each section manager has several project mangers. The project manager is usually responsible for a single project, but sometimes he may be responsible for several projects simultaneously if those projects are on a very small scale. If a certain project is a really big one, say more than $50 million, a section manager or even a department manager will hold a project manager's role in addition to his regular office.

Figure 2.4 shows a typical organization in a construction site, which was formed at a hotel project in Tokyo. This project scale was very large, with 30 to 40 KOST site engineers working on it. However, if a project is not that large, the organization would consist most likely of project manager, a chief for administration, a chief for construction, and several site engineers. If a project is really small, it is possible that a project manager and a site engineer would handle the whole project.

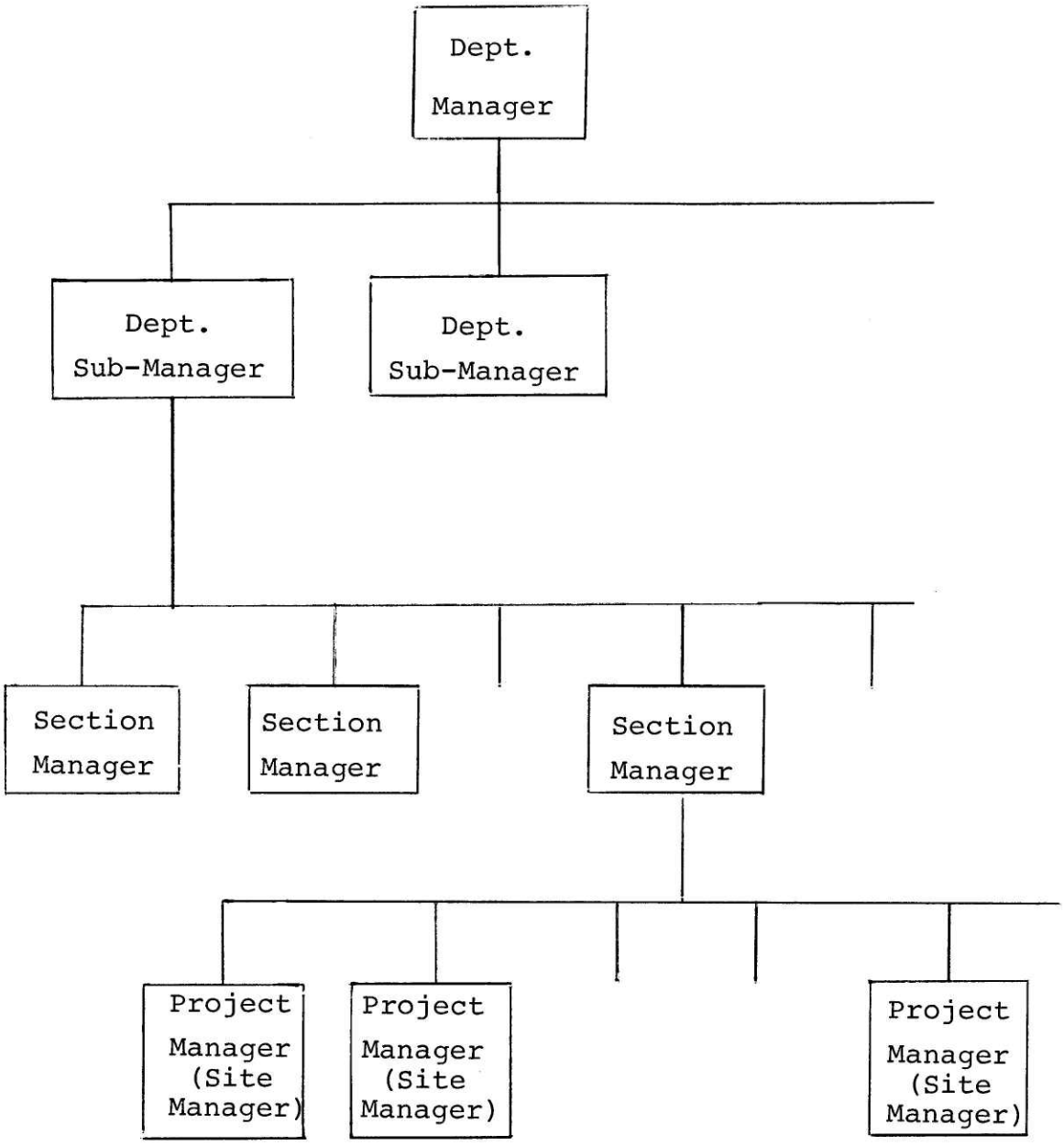

FIGURE 2.3

ORGANIZATION OF THE CONSTRUCTION DEPARTMENT

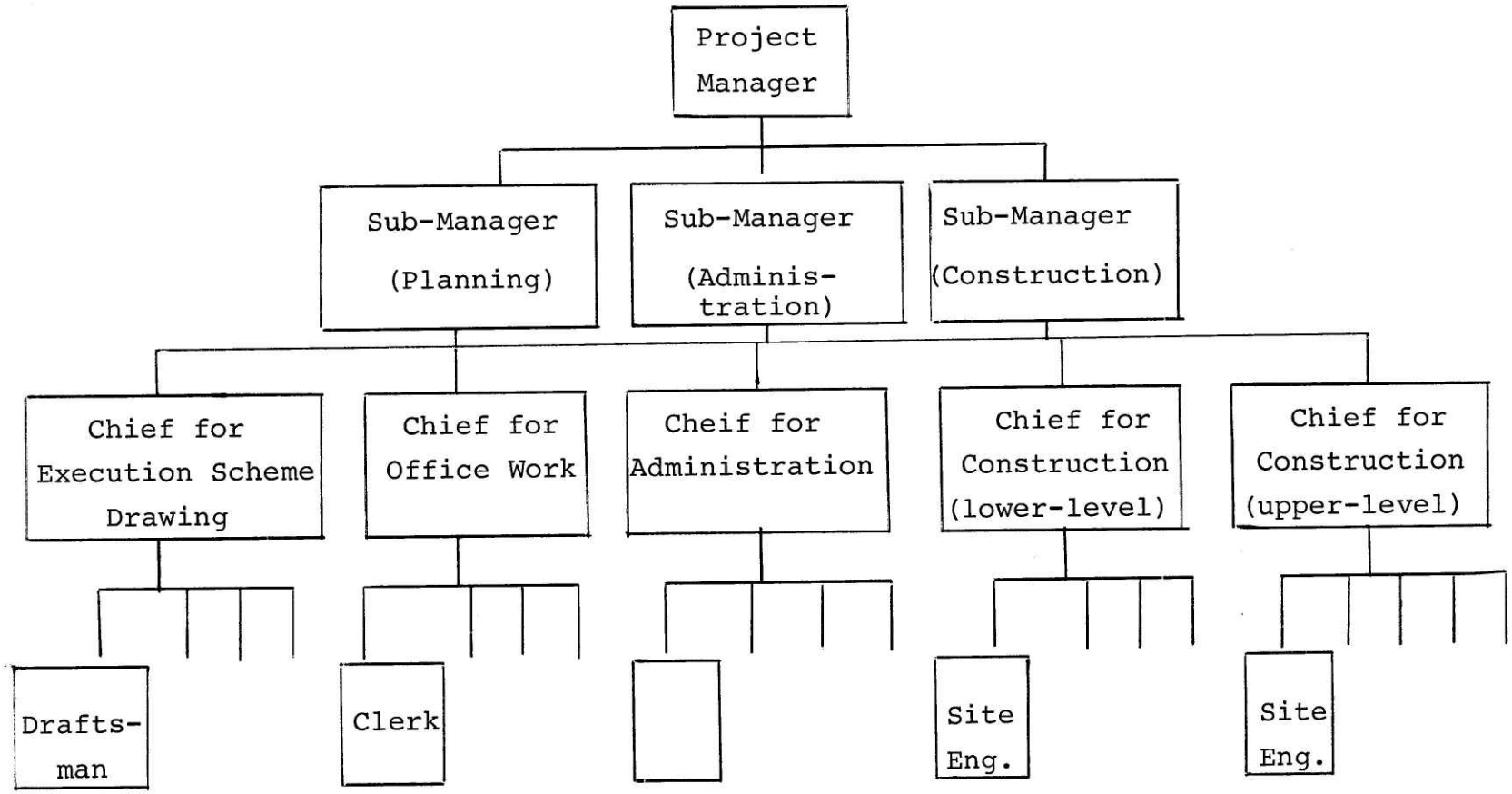

FIGURE 2.4

ORGANIZATION IN A CONSTRUCTION SITE

CHAPTER III

INFORMATION FOR MANAGEMENT ACTIVITIES

3.1. Framework

Knowledge of computer system alone is not enough to develop an effective and efficient information system. As an information system is a way to support decisions made in an organization, we have to fully understand characteristics of the organization in terms of the types of managerial activities and decisions. This avoids the development of a system which is later found to be ineffective and inefficient and the modification of which is very difficult.

To understand the managerial activities of an organization, Anthony's classification of managerial activities is very helpful. He breaks down managerial activities into three processes; strategic planning, management control, and operational control. He argues that these three processes are sufficiently distinct so that both the common characteristics of each process and the differences of those three processes are critical for the development of an effective information system.

Strategic planning is the process for establishing objectives for the organization and for choosing activities

and methods to attain these objectives. Anthony defines this process as follows:

> Strategic planning is the process of deciding on the objectives of the organization, on changes in these objectives, on the resources used to attain these objectives, and on the policies that are to govern the acquisition, use, and disposition of these resources.[1]

Thus, it can be said that strategic planning is a process of predicting and directing the future of the organization and its environment. It relies heavily on external rather than internal information. This process is essentially irregular and includes only a small number of high-level managers.

Management control is a process carried on within the framework established by strategic planning. This process is defined by Anthony as follows:

> Management control is the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of these organization's objectives.[1]

The purpose of the management control system is to encourage managers to pursue their goals as established in strategic planning. The management control system, then, must be an integrated system and communication throughout the entire organization is extremely important. The managers who are mainly involved in management control are middle managers rather than top management.

Operational control has a narrower meaning and is defined by Anthony as follows:

> Operational control is the process of assuring that specific tasks are carried out effectively and efficiently.[1]

The focus of this process is on individual tasks or transactions, scheduling and controlling individual jobs through a project. Management control, on the contrary, is concerned with measuring the performance of the project as a whole.

Table 3.1 developed by Gorry and Scott Morton shows us a clear difference between strategic planning and operational control.

Strategic planning focuses on establishing policies and goals for the organization. The nature of strategic planning is future oriented. The information needed for this process is an aggregate of information which is collected from the external world. The necessity for this information is infrequent and high accuracy is not required.

On the other hand, operational control needs information of a well-defined and narrow scope. The information needed for this process is mainly internal. This information is frequently used and must be accurate.

The information required for management control lies between that needed for strategic planning and that operational control.

Table 3.2 shows examples of activities included in the three main categories. You will find that the activities included in strategic planning are almost entirely planning

TABLE 3.1

INFORMATION REQUIREMENTS BY DECISION CATEGORY[6]

	Operational Control	Management Control	Strategic Planning
Source	Largely internal	---------->	External
Scope	Well-defined, narrow	-------->	Very wide
Level of Aggregation	Detailed	---------->	Aggregate
Time Horrizon	Historical	---------->	Future
Currency	Highly current	---------->	Quite old
Required Accuracy	High	---------->	Low
Frequency of use	Very frequent	---------->	Infrequent

TABLE 3.2

EXAMPLES OF ACTIVITIES IN A BUSINESS ORGANIZATION[2]

Strategic Planning	Management Control	Operational Control
Choosing company objectives	Formulating budgets	
Planning the organization	Planning staff levels	Controlling hiring
Setting personnel policies	Formulating personnel practices	Implementing policies
Setting financial policies	Working capital planning	Controlling credit extension
Setting marketing policies	Formulating advertising programs	Controlling placement of advertisements
Setting research policies	Deciding on research projects	
Choosing new product lines	Choosing product improvements	
Acquiring a new division	Deciding on routine capital expenditures	
Deciding on nonroutine capital expenditures	Deciding on plant rearrangement	Scheduling production
	Formulating decision rules for operational control	Controlling inventory
	Measuring, appraising, and improving management performance	Measuring, appraising, and improving workers' efficiency

activities, while those included in operational control are almost entirely control activities, and those included in management control are a mixture of both planning and control.

3.2. Information Systems in the Construction Industry

The major MIS applications in the U.S. engineering and construction industry are studies by Lazer and Rockart. Those application groups are summarized in Table 3.3 following Anthony's framework. The MIS applications in the Japanese Construction industry are almost negrigible, so our further discussion will be based on studies on the U.S. construction and engineering firms.

According to the inquiry, information systems for strategic planning, which are currently used by the U.S. engineering and construction firms, include econometric and systems dynamics models and venture analysis. The major purpose of these systems is to support top management's decision on a new venture or acquisition of new resources.

Anthony indicates several activities as strategic planning (See Table 3.2). Many of these example activities can be applied to the Japanese construction industry. Other factors which are peculiar to the Japanese construction industry may include information concerning private clients and public sectors. More than half of the

TABLE 3.3

ENGINEERING & CONSTRUCTION COMPANY SYSTEMS[9]

STRATEGIC PLANNING				
Econometric & Systems Dynamics Models				
Venture Analysis				
MANAGEMENT PLANNING & CONTROL				
Simulation Models				
Property Management				
Human Resources Management				
Cash Management				
Planning and Budgeting				
Management Accounting				
Bidding Strategy				
Project Monitoring				
OPERATIONAL INFORMATION, PLANNING & CONTROL				
Function	Phase of a Typical Project			
	Planning	Initial Engineering	Production Engineering	Construction
Engineering	Modeling	Design	Drafting	Rigging
Scheduling	Schedule	Diagram	Progress	Productivity
Procurement	Vendors	Bids	Purchase	Expedite
Cost	Estimate	Control	Trend	Trend
Accounting	Budget	Report	Payables	Billing
Construc-tion	Logis-tics	Site Pref.	Exc. & Fnd.	Fabr. & Erect

building construction projects in KOST are contracted through direct orders from clients, and not through bidding. It is very important for the company to keep track of these clients. The civil engineering projects, on the contrary, are mainly ordered by public sectors through bidding. It is also important to follow the activities in the public sectors.

According to the inquiry, U.S. engineering and construction companies have made considerable effort to develop information systems in the management control area. These include; simulation models, property management, human resource management, cash management, planning and budgeting, and project monitoring.

These information systems can be divided into two levels. One is management control for a project itself and the other is management control for the company as a whole. A construction project, especially a big project, consists of a large number of works which requires various materials, labor, and equipments. An effective information system is essential to organize these tasks and complete the project. On the other hand, a construction company is responsible for many on-going projects. Management control systems covering all those projects are also necessary to the company. For example, the Tokyo head office of KOST is responsible for more than one thousand on-going con-

struction sites. Each site requires an effective management control system to control that particular project. The head office, on the other hand, is in need of an effective management control system to manage all the on-going projects.

If we classify the contents of Table 3.3, property management, human resource management, cash management, and bidding strategy are classified into mangement control for a company as a whole. Simultation models and project monitoring are classified into management control for sites. Planning and budgeting are used for both levels, but the required information levels are very different.

Information systems for operational control have been stressed most by the U.S. engineering and construction companies. They have developed the largest number of computer applications in the operational control field. They are classified into engineering, scheduling, procurement, cost, accounting, and construciton. These systems can be applied to the Japanese construction industry.

CHAPTER IV

THE CURRENT COST CONTROL SYSTEM

4.1. Estimating

Estimating is a process of calculating a construction cost by picking up the needed amounts of materials, labor, and equipment and multiplying each unit cost. This process is very important because it determines whether the company wins a bid and whether the construction work is profitable.

In KOST, estimates are usually made by the Estimating Department at the head office. The estimate is checked by the executive vice president in charge and submitted to the client. Sometimes a project manager in the Building Construction Department estimates at the request of the Estimating Department.

The estimating calculation is done in detail as for example, in the budgeting calculation. Sekisan-Shiryo (Estimating Reference) is usually used for this calculation. Sekisan-Shiryo is a book which indicates almost all costs related to construction work and is published every month. This book is so popular for construction estimates that every estimating department and construction site has at least one copy. Thus actual estimating is done by reference

to Sekisan-Shiryo, supplemented by the company's internal historical information and the estimaters' experience. However, at KOST there is no systematic effort to collect historical information for estimating.

4.2. Budgeting

The budget is decided in light of an estimate with reviews of the several economic and project conditions. Thus the budget is not necessarily equal to the estimate because there exists a time lag between estimating and budgeting and more careful attention is paid to several construction conditions. If the difference between the budget and the estimate in the budgeting stage is very large, then permission to pursue the project would be given by the department manager and the executive vice president.

Budgeting is usually done in the construction department by a project manager. The project manager has to formulate the budgeting plan, with the department manager's advice, within ten days of the finalization of the construction contract. This plan is checked by the section manager and department manager and submitted to the administrative department.

The planned profit is defined by the contract amount minus the budget. In general, the planned profit is positive and the contract amount is larger than the budget. However, it is possible for the budget to be larger than the contract

amount and for the planned profit to be negative. This situation occurs when the contract is made based not on the estimate but, perhaps, on a certain business policy.

Classification of budgeting is shown in Table 4.1 and the formats for budgeting are shown in Table 4.2 and 4.3. These tables were originally written in Japanese and have been translated by the author.

4.3. Processing

A Construction Report (see Table 4.4) is submitted to the administrative department by the site immediately following the contract. When this report is submitted, the account for that project is opened and the whole cost control process begins. The account is closed when the project is finished and the final settlement of the account is determined.

After the project starts, cost control is processed by monitoring the budget and the actual payment. There are two kinds of payments: torikime (negotiated fixed price) and rinji (cost reimbursable plus profit). The contractor usually negotiates a price with a subcontractor before the start of each job. As the job proceeds, the contractor simply pays the subcontractor the predetermined amount. Thus the contractor does not need to pay attention to each worker's job content except when each works on a reimbursable cost basis. The format for torikime is shown in Table 4.5.

TABLE 4.1

BUDGETING CLASSIFICATION

1 A	Temporary Construction	Material
B		Labor
C		Subcontract Order
D		Overhead
2 A	Mechanical Equipment	Material
D		Overhead
3 A	Foundations, Excavation	Material
C		Outside Order
4 A	Pebbles, Cobblestones	Material
5 A	Cement Concrete	Material
6 B	Scaffolding, General Labor	Labor
C		Outside Order
7 A	Formwork	Material
B		Labor
C		Outside Order
D		Overhead
8 A	Reinforcing Bar,	Material
B	Struct. Steel	Labor
C		Outside Order
9 A	Carpentry	Material
B		Labor
C		Outside Order
10A	Roof, Waterproofing	Material
B		Labor
C		Outside Order
11A	Masonry	Material
B		Labor
C		Outside Order

TABLE 4.1
(CONTINUED)

12A	Tile Work	Material
B		Labor
C		Outside Order
13A	Miscellaneous Metal Work	Metal
B		Labor
C		Outside Order
14A	Millwork	Material
B		Labor
C		Outside Order
15A	Finish Carpentry	Material
B		Labor
C		Outside Order
16A	Glazing	Material
B		Labor
C		Outside Order
17A	Plastering	Material
B		Labor
C		Outside Order
18A	Painting	Material
B		Labor
C		Outside Order
19A	Miscellaneous Work	Material
B		Labor
C		Outside Order
20C	Equipment Work	Outside Order
21D	Transportaion	Overhead
22D	Site Overhead	Overhead
23D	Design	Overhead

TABLE 4.2

BUDGETING FORM

No. _____ Name of Site: _____

Date: _____

Code	Desc.	E.T.C	Expended to Date	Total
1A	Temp.Const. Material			
BC	Temp.Const. Labor, Outside Order			
D	Temp.Const. Overhead			
2A	Machine Material			
D	Machine Overhead			
3	Foundation			
4	Pebbles,Cobblestones			
5	Cement, Concrete			
6	Scaffolding, General Labor			
7A	Formwork Material			
BC	Formwork Labor, Outside Order			
D	Formwork Overhead			
8	Structural Steel			
9A	Carpentry Material			
BC	Carpentry Labor, Outside Order			
10	Roof, Waterproofing			
11	Masonry			
12	Tile Work			
13	Misc. Metal Work			
14	Millwork			
15	Wood Finish			
16	Glazing			
17	Plastering			
18	Painting			
19	Miscellaneous			

TABLE 4.2
(CONTINUED)

Code	Desc.	E.T.C.	Extended to date	Total
20	Equipment Work			
21	Transportation			
22	Site Overhead			
23	Design			
26	Other Income			
99	Out of Statistics			
	SUBTOTAL			
1A	Salvage (Temp.)			
2A	Salvage (Machine)			
7A	Salvage (Formwork)			
	Salvage (General)			
	SUBTOTAL			
	TOTAL BUDGET			

	E.T.C.		Extended to date		Total	
Budget						
Planned Profit		%		%		%
Contract Amount						
Planned Interest		%		%		%
Total Profit		%		%		%

Construction Report, Date: _____

Contract Form, Date: _____

TABLE 4.3

DETAILED BUDGETING FORM

Code: ____________ Desc: ______________________________ No. ________

No. Description	Budget			
	Unit	Quantity	Unit Price	Total

TABLE 4.4

CONSTRUCTION REPORT

Received Date:
Received No. : Date: No.

Office Location	Department	Name	Desc.	Amount of Money
Name of Project:			Former Contract	
			Total Contract	
Client:			Free Supplied Material	
Related Companies:				
Designer:			Current Work Start: End:	Total Project Start: End:
Location:				
Contract		Planned Profit Rate	Contract: Bidding or Special Order	

No.	Name of the Work	Contract	Structure	Stories	# Bldgs	Floor Area	Total Area

Use:	Start Date:	Notes:	
Type of Project:	Expected Finish Date:		
Structure:	Equipment Work: Y N		
	Client Supplied Material: Y N		
If JV, Share	Client Category:	Foreign, Public or Private	HQ Location of Client

TABLE 4.5

TORIKIME FORM

Date:

Dpt. 1 2 3 4	Account Name: Account #	No.	Work Code	Sub-Con Code	Document No.
Work:	Budget: ¥		Contract Amount: ¥		Difference: ¥
Sorting Code	No.	Transportation Cost	Method of Settlement		Work Duration:

Date	Sub-Contractor	Estimated Amount	Order	Exec. Vice Pres.	Purchasing Dpt. Mgr.	Purchasing Sec. Mgr.

	Material, Labor Code	Material, Labor Amount	Unit	Producer Code	Price
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					

Sub-Contractor Prefered	1. indicated by client 2. indicated by designer 3. continue 4. others

Notes

Amount Expected ¥	Explanation of Difference	Order form Issued Date

A contractor site has to compare its budget and the actual payment with revenue every month and summarize the result in the form of a Profit Forecast. Thus the profit forecast is the most important source for both the site and the head office to execute cost control. Further discussion will be held in section four concerning the profit forecast.

Cash management is one of the most important factors in corporation management. In the case of the contractor, cash management is based on the incoming and outgoing cash flow of each site. The Revenue/Expenditure Forecast, which forecasts the coming three months, is issued to the head office by each site every month in KOST.

Even if the contract amount is constant, a project can be either profitable or unprofitable in terms of the timing of revenue and expenditure. To solve this problem, the Net Present Value method is generally used in the United States. However, the NPV method is not popular in Japan. At KOST, "interest" is used instead of the NPV method. The balance of the account of each project is calculated at the end of every month. If the balance is positive, interest is paid to the site. If it is negative, interest is charged to the site. Interest calculation is made at the budeting stage and summarized as "Planned Interest." "Actual Interest" is calculated at the end of every month. "Unpaid Interest" is also calculated based on the future revenue/expenditure forecast by the site each month. "Increased Interest" is

calculated as follows:

Increased Interest = (Actual Interest + Unpaid Interest)
- Planned Interest

Quality control and accident treatment are also important factors for cost control. However, there are no formal channels to handle them in the current cost control system. These are executed case by case through informal channels.

4.4. Reporting

There are a number of reports which travel between the head office and the sites for cost control. These reports will be discussed individually.

Construction Report

This report (see Table 4.4) is submitted by the site to the administrative department immediately after the contract is made. Then the account of the project is opened. This report also has to be submitted when the project is modified or new construction work is added. The information included in this report is as follows:

- General description of the project (Name of the project, Code number, Location, Contract method, etc.)
- Contract amount, expected profit
- Client
- Designer

- Construction duration
- Building characteristics (structure, number of stories, area)

This information is now used for several statistics.

Profit Forecast

The report (see Table 4.6) is submitted to the department and division mamagers and to the administrative department every month. Every three months, more detailed reports must be submitted for the settlement of the account. The information included in this report is as follows:

- Budget
- Torikime (negotiated fixed price), paid amount for fixed and nonfixed, unpaid amount, forecast modification
- Aggregate expenditure, monthly expenditure
- Salvage value of materials
- Planned profit, increased profit, total profit
- Planned interest, increased interest
- Contract amount already finished
- Revenue (received, unreceived).

Revenue/Expenditure Forecast

This report is submitted as follows: (see Table 4.7)

TABLE 4.6
PROFIT FORECAST FORM

Code	Description	Budget	Torikime (Fixed)						Rinji (Non-Fixed)				Planned Fixed			A+D+H +J=R2	Former R2	Change in Expenditure
			S_1	T	T-A1=A	B	T-B	E=C+d	S_2	S_2-F=G	H	I=G+H	S_3	J	K=S_3+J			
1A	Temp.Const.Material																	
BC	" " Labor,Out.Order																	
D	" " Overhead																	
2A	Machine Material																	
D	" Overhead																	
3	Foundation																	
4	Pebbles,Cobblestones																	
5	Cement,Concrete																	
6	Scaffolding, General Labor																	
7A	Formwork Material																	
BC	" Labor,Out.Order																	
D	" Overhead																	
8	Structural Steel																	
9A	Carpentry Material																	
BC	" Labor,Out.Order																	
10	Roof,Waterproofing																	
11	Masonry																	
12	Tile Work																	
13	Misc.Metal Work																	
14	Millwork																	
15	Wood Finish																	
16	Glazing																	
17	Plastering																	
18	Painting																	
19	Miscellaneous																	
20	Equipment Work																	
21	Transportation																	
22	Site Overhead																	
23	Design																	
26	Other Income																	
99	Out of Statistic																	
	Subtotal																	
1A	Salvage (Temp.)																	
2A	" (Machine)																	
7A	" (Formwrok)																	
	" (General)																	
	Subtotal																	
	Total Budget																	

TABLE 4.6

(CONTINUED)

Content		
Profit	Planned	
	Increased	
	Total	
Interest	Planned	
	Increased	
	Total	
Completed		
Received		
Cost	E.T.C	
	Extended to Date	
	Salvage Value	
	Total	
Percentage of Completion		

Note:

S_1: Budget for Torikime

T : Torikime

A : The Difference between S_1 and T

B : E.T.C. for Torikime

C : Extended to Date (T-B)

D : Increase over Torikime

E : Total Extended to Date for Torikime (CTD)

S_2: Budget for Rinji

F : E.T.C. for Rinji

G : Extended to Date (S_2-F)

H : Increase over the Budget

I : Total Extended to Date for Rinji (GTH)

S_3: Budget for Planned Fixed

J : Increase over the Budget

K : Extended to Date for Planned Fixed (S_3+J)

R_2: Total Increase over the Budget (A+D+H+J)

TABLE 4.7

REVENUE/EXPENDITURE FORECAST FORM

Date:

Code	Desc.	Budget	/	/	/	/	/
1A	Temp.Const. Material						
BC	Temp.Const. Labor Outside Order						
D	Temp.Const. Overhead						
2A	Machine Material						
D	Machine Overhead						
3	Foundation						
4	Pebbles,Cobblestones						
5	Cement,Concrete						
6	Scaffolding, General Labor						
7A	Formwork Material						
BC	Formwork Labor, Outside Order						
D	Formwork Overhead						
8	Structural Steel						
9A	Carpentry Material						
BC	Carpentry Labor, Outside Order						
10	Roof,Waterproofing						
11	Masonry						
12	Tile Work						

TABLE 4.7

(CONTINUED)

Code	Desc.	Budget	/	/	/	/	/
13	Misc. Metal Work						
14	Millwork						
15	Wood Finish						
16	Glazing						
17	Plastering						
18	Painting						
19	Miscellaneous						
20	Equipment Work						
21	Transportation						
22	Site Overhead						
23	Design						
1A 2A 7A	Salvage						
	Planned Expenditure (Current Month)						
	Aggregate Expenditure						
	Planned Revenue						
	Aggregate Revenue						
	Balance						

	Description	When	To Where
A.	Construction scheduling and Revenue/Expenditure planning	Construction starts	Administrative Department
B.	Revenue/Expenditure Control Chart	Construction starts	Cash Management Department
C.	Revenue/Expenditure Planning (long term)	February, August	Cash Management Department
D.	Revenue/Expenditure planning (short term)	Every month	Cash Management Department

The report includes the following information:

- Revenue
- Expenditure
- Forecasted revenue and expenditure

CHAPTER V

CRITIQUE AND PROPOSAL

5.1. Overview

In this chapter, we will consider the current cost control system of KOST by breaking it down into the three processes discussed in Chapter III; strategic planning, management control, and operational control.

As explained in Chapter III, the information needed for strategic planning is mainly external. On the other hand, the information concerning cost or profit is one of the most important elements of internal information. The aggregate performance or the trend of profit might be useful for stragetic planning purposes, but this kind of information is required irregularly and infrequently. More frequent and formal processes are essential for the cost control system because cost and profit are the most important factors for the managers to consider in controlling the construction sites. Further discussion of the cost control system, then, will focus on its use in the fields of management control and operational control, which require more formal information systems.

5.2. Critique of the Current Estimating and Bugdeting System

The current cost control process discussed in Chapter IV can be divided into two stages. One stage, before the construction starts, included estimating and budgeting. The other, processing, comes after the construction starts. In this section, the discussion will be focused on estimating and budgeting. Processing will be discussed in the next section.

The purpose of operating control in estimating and budgeting is to make an accurate estimate and accurate budget. The process in estimating and budgeting for a certain project can be broken down into four steps; 1) enumerate needed quantities of material, labor, equipment, etc.; 2) investigate their unit costs; 3) make calculation; 4) issue reports.

There are two main defects in the current system. One is that all four steps now completely rely on estimators' manual work and require a large degree of man power. The other is that as there is no standard for each unit cost, unit cost may differ from estimator to estimator. It is known to be rather difficult to develop a computer-based model to aid in enumerating needed quantities in step one. However, after step one and two, step three and four are routine work and it is possible to reduce the time and man power if a computer-based system is introduced.

The unit costs of materials, labor, and equipment are

usually collected from Sekisan-Shiryo and from internal historical data. The cost data may be slightly different from the actual costs. It is not necessarily true that all the estimators use the same standard costs. If a computer-based system were developed and a common unit cost file were used, all the estimators could use the same standard cost data. The accuracy and the speed of estimating and budgeting would certainly increase.

The purpose of management control in estimation is to help to bid properly or give a reasonable price to a client if a project is a direct order from the client. In the current system, a bidding price and a suggested price are decided based on the estimate plus the manager's experience and intuition. If a bidding model, the clients's historical data, and successful/unsuccessful historical bidding data are available, managers can decide on a bidding and a suggested price more rationally. It is relatively easy for a computer-based information system to store and supply this kind of information.

The purpose of management control in budgeting is to measure and set the original profitability of a project. In the current system, profit is calculated by the contract amount, the budget, and the interest on the balance of a construction account during the construction period. The profitability ratio, the percentage of the profit to

the contract amount, is aslo calculated. The current profitability measures basically depend on the future value of a project. However, even if the profits are the same, say one million dollars, one a year later and one two years later should be evaluated differently.

There are several other methods to measure profitability. Net present value (NPV) and internal rate of return (IRR) are very popular and serve as good indicators. IRR might be especially helpful because it can be used as a common measure regardless of the scale of a project. It is not a bad idea to retain the traditional profitability measure, but it may be dangerous if the traditional measure is the only one used to evaluate a project. It is necessary to introduce NPV and IRR methods in order to evaluate the profitability of a project from various view points.

5.3. Critique of the Current Processing System

After the construction starts, referred to as "processing" in Chapter IV, the main role of operational control is bookkeeping. In each construction site, hundreds of transactions take place and many bills and receipts go back and forth everyday. A considerable amount of personnel energy is used, sometimes wasted, only to keep track of a large number of documents. The settlement calculation made every month is also exhausting work. We will introduce a simple accounting model, which can be readymade, to eliminate

this time-consuming work.

The management control in the construction stage can be broken down into two major levels. One level is that of a project manager and a section manager, whose major concerns are a single site or at most five or six sites. The second level is that of a department manager, who needs more aggregate information.

One of the major roles of the management control system for the project manager level is cost monitoring. In the current system, a project manager receives this information once a month when the settlement of the account is made and the Profit Forecast is drawn up. However, it is preferable for a project manager to be able to make comparisons between the budget and the actual payment whenever necessary. It is also desirable that a warning be issued whenever there is a difference in the budget and the actual payment. A project manager could react immediately under these circumstances. This is easily realized by the introduction of a computer-based information system.

Profit forecast or project evaluation is an important factor for the management control of both the project manager level and department manager level. However, information needed for one level is very different from that needed in the other. In the current system, Profit Forecast (see Table 4.6) is issued every month. This document contains

very useful information, but such detailed information is necessary only for a project manager, and maybe for a section manager. A department manager needs more aggregate information, for example; the contract amount, the budget, the expected profit, and the profit rate for a single project including the total expected profit and IRR for a department as a whole. Detailed information about a single project is not necessary for a department manager unless he demands it.

Another important role of the management control system for the department management level is cash management. There is nothing wrong with the current system for the purpose of cash management. In the current system, every site issues short-term and long-term forecasts of its revenue and expenditure in addition to actual payment. The head office can manage cash easily. However, if a computer-based information system is introduced, this same process-can be done without a flood of documents.

5.4. Proposal for a Computer-based Estimating and Budgeting System

Based on previous arguments, the estimating and budgeting system indicated by Figure 5.1 can be proposed. The inputs to the estimating and budgeting model, referred to as E&B model in Figure 5.1, are Unit Cost File, Historical Bidding/Client File, and Project Quantities. These

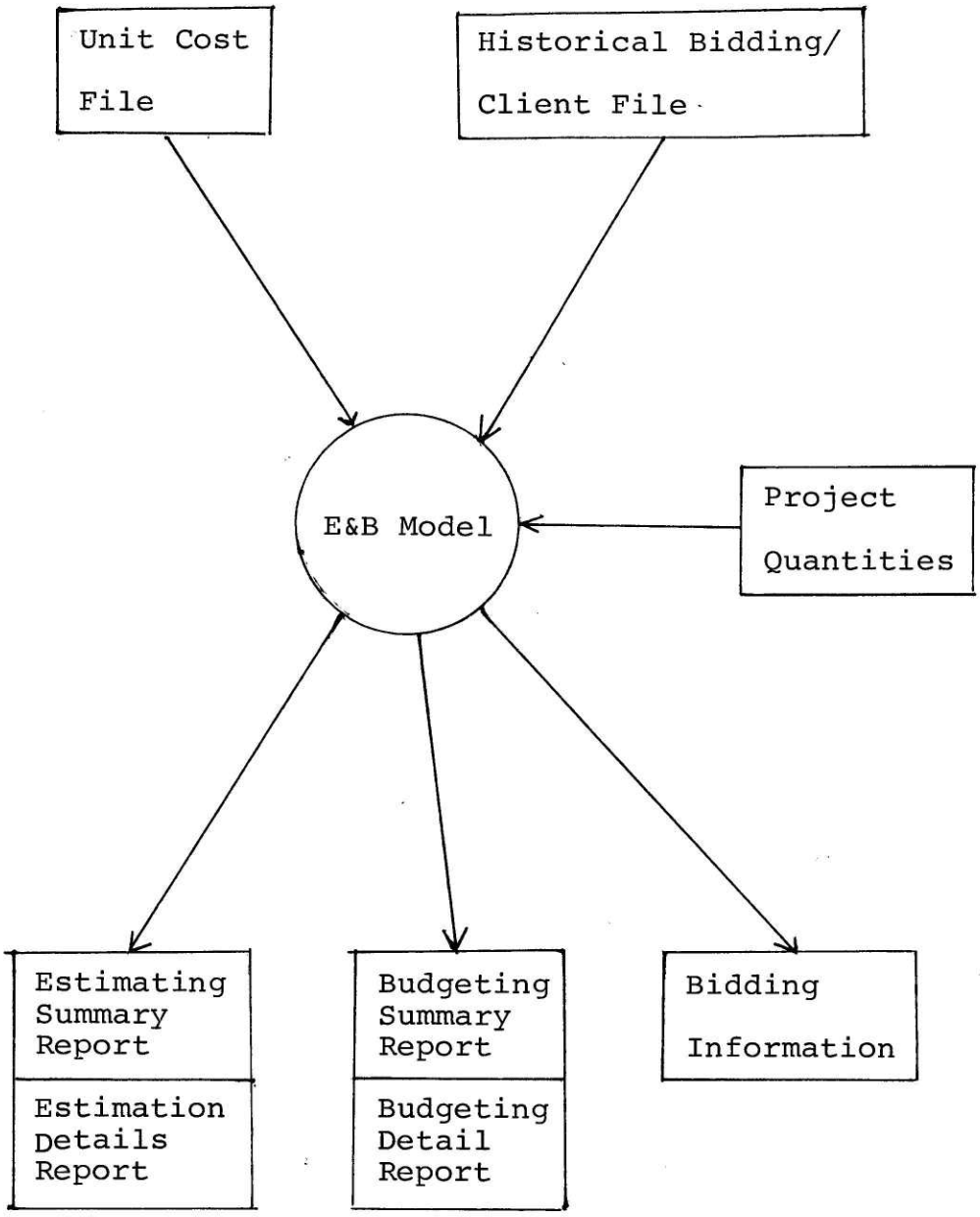

Figure 5.1

Brief View of Estimating and Budgeting System

inputs are processed by an E&B Model and several output reports are issued. Those reports include estimating and budgeting summary reports including project evaluation, detailed reports, and bidding information.

5.4.1. Input

Unit Cost File. This file must contain all of the data included in Sekisan-Shiryo and the internal cost data. According to Sekisan-Siryo, the number of necessary items is almost 50,000. Each item should be distinguished and referenced by a code number. The data included in this file are item code, name, size, general description, maker, dealer, and unit costs for materials, labor, and equipment.

The entire file should be continuously updated, for example once a month, in order to reflect the latest costs. The common standard cost data, thus, would be available for every estimator and consistent estimating and budgeting would be realized.

Historical Bidding/Client File. This file must contain all the projects in which the company has been involved. The order form can be either direct order or bid and even unsuccessful bidding must be included. These data give useful information for bidding strategy and price negotiations.

The information included in this file is Project Name,

Project Number, Description, Client, Bid or Direct Order, Bidding Price (if bidding), Successful or not (if bidding), Contractor & Bid Price (if unsuccessfully bid), Bidding Date, Construction Period, etc.

When the company is involved in a project, even if it is an unsuccessful bid, the data concerning the project should be added to this file. If the number of projects included in this file is too large, obsolete may be discarded.

Project Quantities. The quantities of labor, materials, and equipment are also necessary for project and budget estimating. These data are acquired from drawings and specifications. The quantities, weight, volume, or length must have specified item codes corresponding to the item codes in the Unit Cost File. The necessary calculation is made by multiplying the quantity by its unit cost. Salvage value of materials and equipment must also be supplied.

It is known to be very difficult to automate the process of picking up needed quantities from drawings and specifications. In the proposed system, this picking-up process is supposed to be done manually. However, it is not impossible to make a rough model which shows approximate quantities from drawings and specifications. This kind of rough model would not be helpful in the detailed estimating process, but might be helpful in the planning stage to decide

which construction method to employ.

In addition to the quantities' data mentioned above, we have to supply other external information to the E&B model. This includes; the inflation factor which indicates the rate of increase of unit cost when the project actually takes place, project overhead, and project profit rate.

5.4.2. Output

Estimating and Budgeting Summary Report. These two reports are similar except in the date when they are issued. The contents of the reports are almost identical to Table 4.2. Costs for individual works, salvage values, and total estimate (budget) are indicated.

In addition to the traditional profitability indicators NPV and IRR have to be indicated. This report is delivered and examined by both upper-managers (department manager and sub-manager) and lower-managers (project manager and section manager).

Estimating and Budgeting Detailed Report. These two reports may also be the same and the contents of the reports are almost the same as Table 4.3. The detailed estimate is shown with the name of the work, needed materials, labor, and equipment, their unit costs, sub-total, and total cost. This report is usually examined by only lower managers.

Bidding Information. The purpose of this report is

to help a decision maker to decide on a bidding strategy. The report has to include the historical bidding date for a particular client, that is, Project Name, Bidding Price, Profit Rate, Success, etc. The report also includes historical bidding data for a particular kind of project. If a project is a hospital, the same information for a hospital project - Project Name, Bidding Price, Profit Rate, Successful or not, etc. - is provided.

The bidding strategy is also suggested. As a number of bidding models have developed, it is relatively easy to indicate the relation between a profit rate and a successful bid rate. A decision maker can decide a profit rate and a bidding price based on this information and not on his intuition.

5.5. Proposal for a Computer-based Processing System

Based on the previous arguements of the current cost control system, the information system shown in Figure 5.2 is proposed.

There are two ways to configurate an information system of this kind. One is a centralized system in which all information is sent from the sites to the head office and processed by a central computer. The other is a decentralized system in which all information is independently processed by each site and summary reports are submitted to the head office.

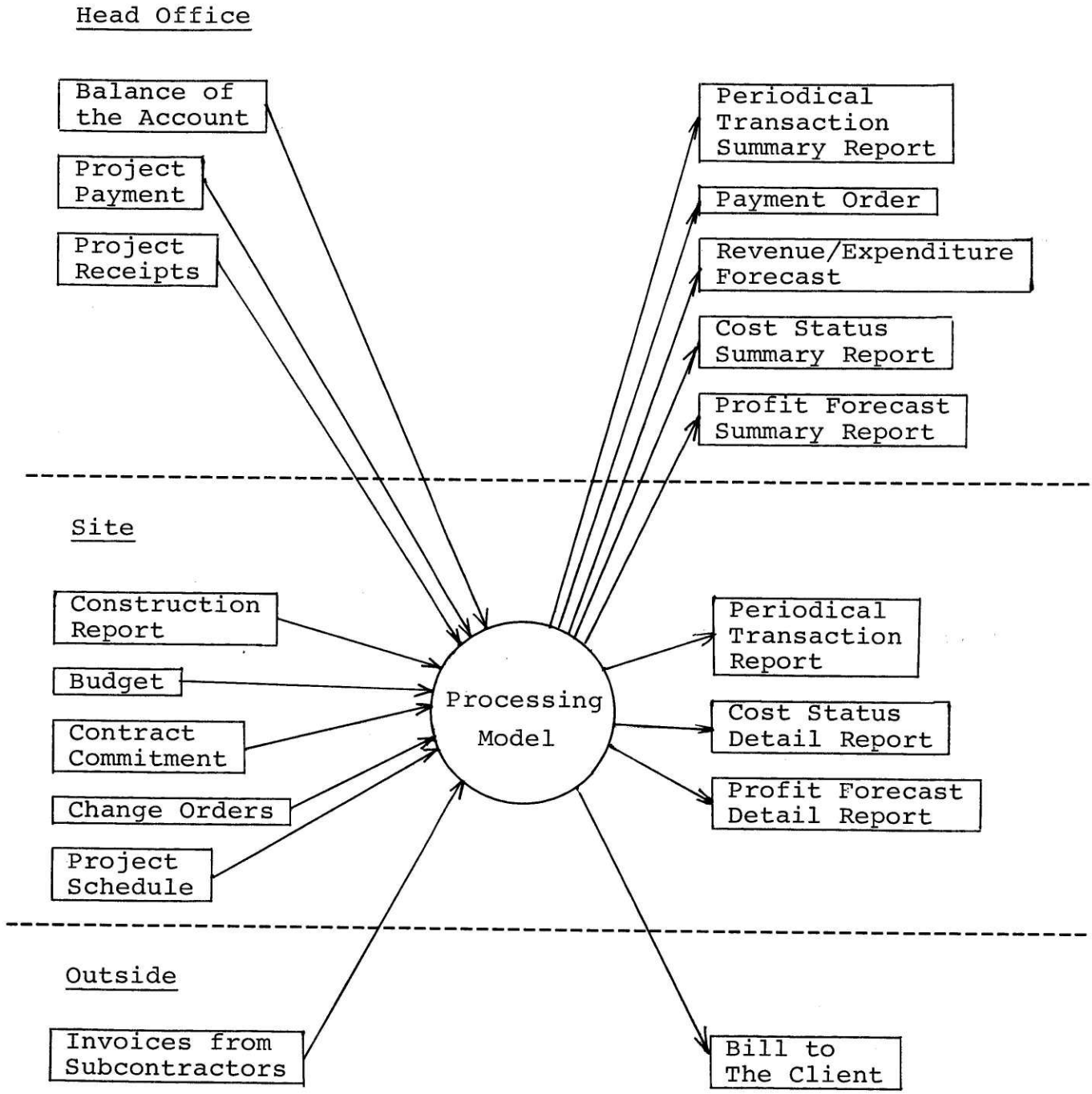

FIGURE 5.2

BRIEF VIEW OF PROCESSING SYSTEM

The proposed system is basically a decentralized system with the exception of cash management. Each site, sometimes several small sites combined together, has its own computer and deals with all cost information and issues necessary reports.

Next, we will investigate operational control and management control in the proposed system. Operational control in processing is mainly bookkeeping. Management control includes cost monitoring, profit forecast or project evaluation, and cash management.

5.5.1. Bookkeeping

This process begins when invoices are submitted to the site by subcontractors. These invoices are checked by the project manager with reference to the budget, torikime (negotiated fixed price), and project schedule. The payment orders are issued to the head office if these invoices are approved. Payment orders are collected at the head office for each subcontractor, not for each project, and the payment is made to each subcontractor every month.

When the payment takes place at the head office, the appropriate amount is subtracted from the account of each site. Each project manager is informed of the new balance of the account and payments made in that period.

On the other hand, bills are issued to the client by each site based on the contract commitment and actual

payments to subcontractors made by the site. The client makes payment to the head office and the balance of the site's account is increased by that amount. Notice of the new balance and the revenues in that period is given to each site.

In the process mentioned above, the summary reports indicate both revenues and expenditures for each department and the company as a whole. Top management, department managers and executives in charge, receive only these summary reports. On the other hand, each project manager receives a report which indicates revenues and expenditures in detail for his particular project.

The bookkeeping operation is routine work. There is no need for managers, both upper managers and lower managers, to receive those reports whenever a transaction takes place. Periodical reporting, for example once a month, is enough and sufficient in this process.

5.5.2. Cost Monitoring

Cost monitoring is a very important factor for management control of cost especially at the site. It indicates where the project stands financially. The project cost status report is issued periodically for this purpose.

The cost status report submitted to a project manager should include; the budget, current estimate, total commitment, change orders, payments made, and the difference

between the actual cost and the budget. From this report, the project manager can fully appreciate the current financial status and properly respond to potential problems.

The cost status report submitted to upper management should be different from the one a project manager receives. The report should be a summary report and should focus on the difference between the actual cost and the budget. If the difference is greater than a certain level, or the payment trend is quite different from the planning, upper management requires a project manager to submit a kind of red flag report which explains why that change occurred and how it can be delt with.

In addition to the periodical cost status report, the system should provide necessary information at any time that management requires it. By this function, a project manager can get needed information whenever he needs it and is able to respond to every condition immediately.

5.5.3. Project Profit Forecast

Although the cost status report focuses on the payments already made, the project profit forecast deals with the future of a project. This serves as an index of a project to be controlled. In the current system, the profit forecast shown in Table 4.6 is submitted from a site to the head office. However, this much detailed information is necessary only for the site or for a project manager. The

upper management required a more summarized report which focuses on the budget, the contract, and the profit rate amount.

The proposed system provides a project manager with a detailed profit forecast and provides upper management with a summarized report. It takes time and man power to make the report in the current system. The proposed system would eliminate the inefficiency.

In addition to the profit rate given in the current system, NPV and IRR should be given in the proposed system. These indices make it possible for upper management to evaluate a project more accurately.

5.5.4. Cash Management

Cash management is covered by the Revenue/Expenditure Forecast described in Chapter IV in the current system. The proposed system differs little from the current system in cash management.

When a project starts, the first forecast for Revenue/Expenditure is issued from the site to the head office based on the contract commitment. From then on, short-term and long-term forecasts are issued every month and every six months respectively based on the contract commitment, project schedule, the change orders, and so on. At the head office, the forecasts from all the sites are summarized and cash is controlled from the perspective of the company

as a whole.

Cash management is the only centralized part of the proposed system. Actual payments to subcontractors and receipts from clients are handled at the head office based on the information received from the sites. If cash management were handled separately by each site, the overall cash requirement would become too complicated to follow. This would make it impossible to retain efficient control on cash requirements.

CHAPTER VI

CONCLUSION

The Japanese construction industry started its steps towards modernization with the Meiji Restoration, about 110 years ago, when Japan opened to the outside world. Since then, the industry grew continuously, but true expansion took place after World War II. Now the Big Five of the construction industry are among the 15 biggest contractors in the world.

The Japanese construction industry has several unique characteristics. For example, it has a multistoried subcontractor system. Also, almost all the contracts are lump-sum, not cost plus fee. Although the Big Five are included in the top 15 in the world, almost all their work is domestic and less than 5 percent is overseas.

The large construction firms have used computers for more than 10 years. Although these computers have been used for complex technical calculations and payroll calculations, they have not been used for management control purposes. The reason why the construction industry is so far behind in the MIS field stems from its traditional characteristics mentioned above.

However, the environment surrounding the construction industry is changing. The proportion of its overseas' work has been gradually increasing. A stricter management control system is required under the current stagnated economic circumstances. It is necessary for the industry to modernize and internationalize its current management system.

In order to discuss the current management system, we focussed on the current cost control system. The current cost control system has two main defects. One is that it requires a large amount of manual work to complete routine work; bookkeeping, report making, and so on. The other defect is that the necessary information level for management is not well defined and management does not necessarily have easy access to needed information.

A computer-based information system has the potential to solve all of these problems. However, the introduction of a computer will not automatically accomplish the desired results. There have been a number of examples where the expected results were not achieved due to the lack of preparatory study.

It is most important to define the necessary functions for management activities and to find the necessary information for each management level. For this purpose, we have broken down management activities into three processes;

strategic planning, management control, and operational control. The necessary functions and informations for each process are discussed in Chapter III.

The current cost control system is examined in detail in Chapter IV. In Chapter V, the current system is critiqued and the conceptual proposals are given. However, these proposals are not the goal but the starting point. A considerable amount of time and energy would be necessary to realize an actual system based on the proposals.

The day when computer-based information systems are introduced to the Japanese construction industry may not be far in the future. The introduced systems would certainly contribute to a reduction in work needed to control the site and help management to gain access easily to their needed information.

It is the author's desire that this thesis will contribute to the early realization and healthy development of information systems in the Japanese construction industry.

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