Railway Project Management in South-East Asia*

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Synopsis:

Since 1987 Kawasaki Steel was successively undertaking integrated construction projects based on South-East Asian four railway projects in Indonesia and Philippines. Each railway project was an integrated system consisting civil engineering and building, railway tracks, an overhead contact system, substation, signal, power distribution and telecommunications, and the required management for the railway project includes not only the management of various fields of special techniques but also total control and adjustment of various fields of work. Kawasaki Steel has completed these projects based on cooperation by specialists outside of the company and with its excellent control engineering such as total adjustment, schedule control, procurement control, resource control, etc.

1 Introduction

With the economy of the South-East Asian countries developing rapidly, the increase in population has been remarkable, especially in metropolitan areas. This has resulted in constant traffic congestion, thus requiring immediate countermeasures. However, mass transportation by commutating in megapolises using roads that are the principal traffic system of today is not appropriate in terms of the cost of maintaining road networks, energy consumption, and environmental pollution. For this reason, it has been necessary to maintain and modernize existing railway networks and to divert an increasing traffic volume to railways. Japan's railway technology, including the Shinkansen, is among the best in the world, and Japan has been requested by different countries to provide various kinds of technical assistance related to railways. These requests are met by the organizations concerned, including government agencies, such as the Japan International Cooperation Agency (JICA). The Japanese government provides financial assistance to developing countries for the maintenance of existing railway networks through the Overseas Economic Cooperation Fund (OECF). Within the periof of five years since 1987, Kawasaki Steel has received orders for work related to railways in South-East Asia through international bids, including one railway project in Manila, the Philippines and three in Jakarta, Indonesia for which yen loans were awarded.

Photo 1 Completion part of central line track elevation

These four projects are:
(1) Depot and workshop improvement project of the Indonesian National Railways
(2) Maintenance depot construction project of the Philippine National Railways
(3) Central line track elevation project of the Indonesian National Railways
(4) Signalling project of the Indonesian National Railways[1] (**Photo 1**)

The construction periods of these projects are shown in **Fig. 1**.

As shown in **Fig. 2**, the present railway system used

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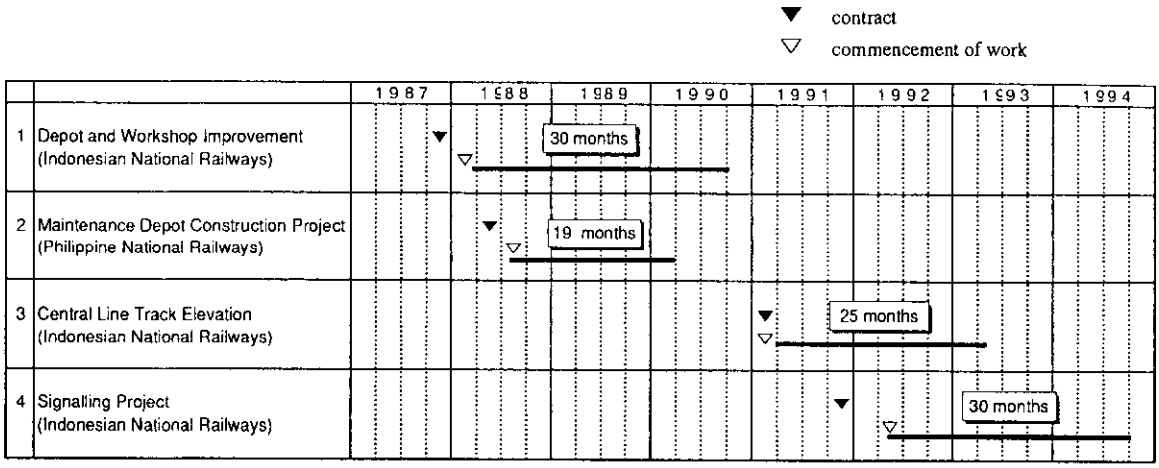

Fig. 1 Railway project undertaken by Kawasaki Steel

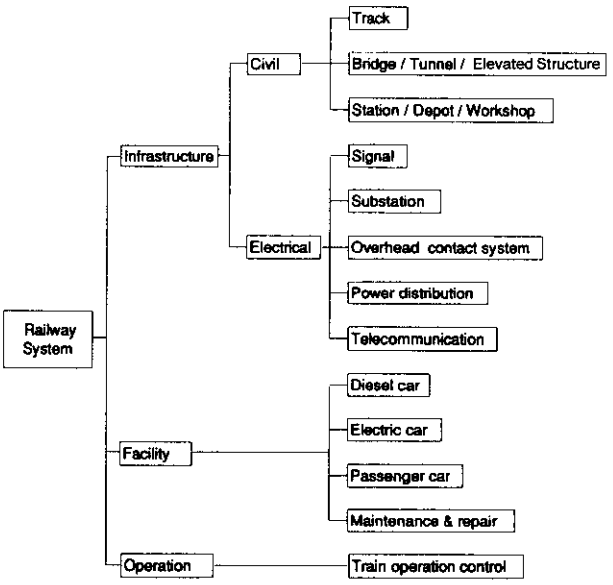

Fig. 2 Work elements for railways system

as a means of mass transportation is an integrated system consisting of a number of engineering elements, such as civil works, building works, railway tracks,[2] overhead contact system,[3,4] substations, signals, telecommunications, rolling stock, mechanical works, and train operation controls. The technical range of the railway system is wide, and each of the engineering elements has been developed in the limited field of railways, which is a very particular feature of this system. In railway construction works, therefore, it is common practice to place separate orders for each of the above engineering elements, and conversely, it is rare to place an entire subcontract order for the complete system.

The above projects for which Kawasaki Steel received orders and executed the construction works are examples of such rare cases of entire subcontract orders. In the execution of these integrated construction projects, the company has gained a high reputation with the owners for its construction techniques and management.[5] This report describes how these integrated railway construction projects were planned and managed, referring to the examples of the four railway projects in South-East Asia for which we received orders and executed the constraction work.

2 Features of Railway Construction

2.1 Features of Railway Modernization Projects in South-East Asia

In planning a railway project, a general plan is first formulated based on the expected traffic volume in the planned area. In the process of formulating the plan, a decision is made in consideration of the present transportation capacity, present conditions of transportation, the finally required railway network functions, preservation of existing functions during the construction period, etc., as to whether it is more realistic to improve and expand the existing facilities or to construct new ones. In many South-East Asian countries, it is usually more realistic and inexpensive to expand and modernize the existing facilities which were constructed in the former era.

The purpose of railway modernization, in a word, is to expand the transportation capacity, which can be achieved by introducing high-speed operation of rolling stock and increasing the number of railway trains. In a railway system consisting of a large number of engineering elements, total expansion of existing facilities is necessary in order to address these issues.

The following measures are necessary to meet the above requirement:

(1) Increase in the speed of railway trains and purchase of new railway trains and repair parts
(2) Maintenance and inspection of railway trains and improvement and expansion of repair equipment

(3) Installation of double-track lines, repair and modification of existing railway tracks, and change of track arrangements
(4) Electrification of railways and expansion and stabilization of the power supply capacity
(5) Automation of signal systems (including railway crossings) and enhancement of telecommunications systems
(6) Improvement of station buildings

2.2 Forms of Work Order Placing

Even if a general plan is formulated and procedures for carrying out the plan are determined, it is difficult to carry out the work at a stretch in terms of funds, securing manpower, and the level of skill in the use of operation systems, and it is common practice to set milestones and carry out the work gradually by checking the progress status of the work.

In the Indonesian National Railways railway network modernization project in the metropolitan area of Jakarta (Jabotabek Railway Project), we received orders for three individual projects, as mentioned above. This general project, shown in **Fig. 3**, was carried out in the order: ① purchase of railway cars, ② repair of depots, ③ Central Line track elevation, ④ Central Line track addition, ⑤ Bekasi Line electrification, ⑥ Kampung Bandan Station improvement (loop line installation), ⑦ Signalling of the Central Line, Bogor Line and Bekasi Line, ⑧ improvement of the line arrangement within stations, ⑨ signalling of the Western and Eastern Lines.

In the examaple of the double-track line and electrification work for the Malaysian National Railways, orders

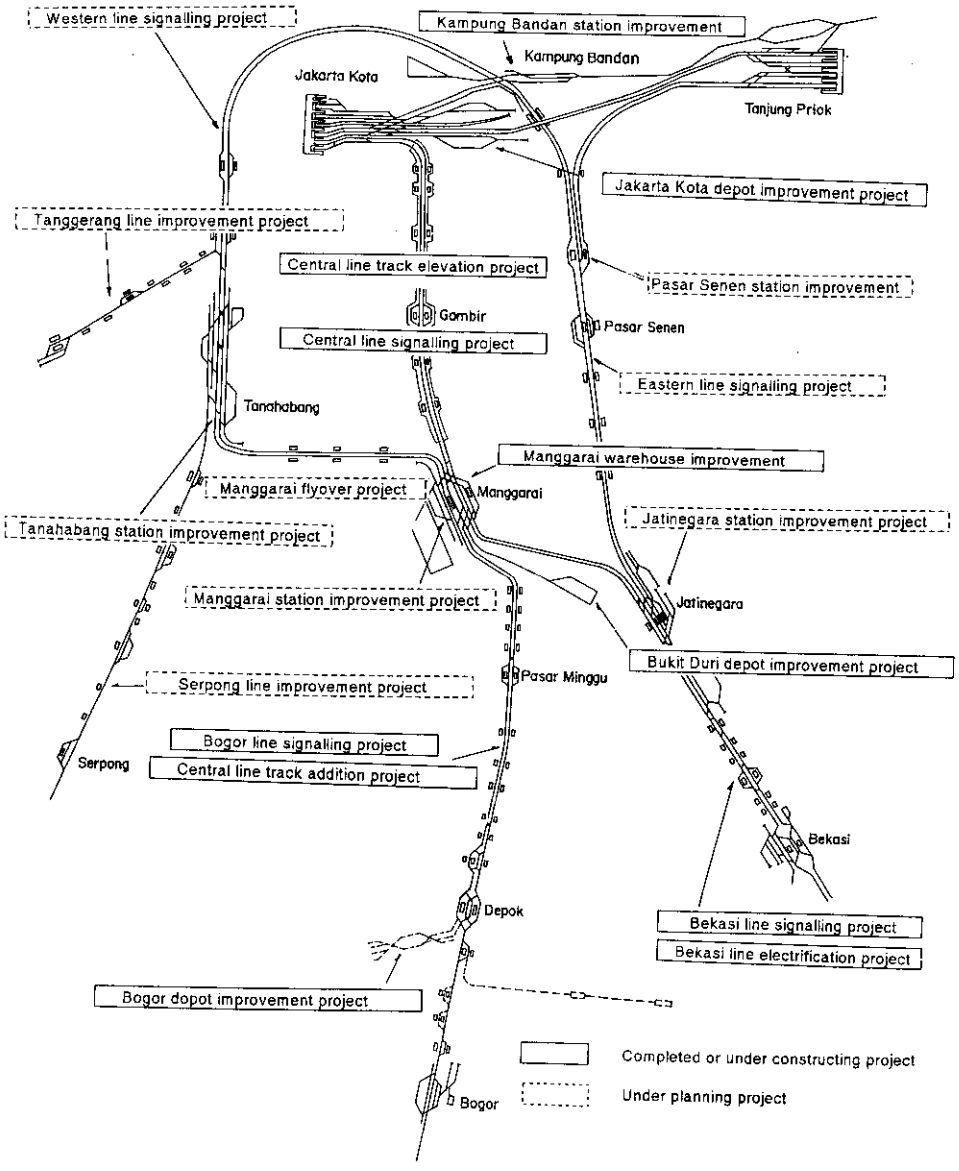

Fig. 3 General plan for Jabotabek project

were placed in six separate packages for each field of work, i.e., ① railway tracks (double tracks), ② station buildings, ③ bridges, ④ signals and telecommunications, ⑤ electric cars (purchase of cars) and ⑥ overhead contact systems. In the example of the Indonesian National Railways, however, orders in package form were placed for each major unit of construction area work. Thus, the preferred form of order placing varies from country to country.

3 Management of Railway Work

3.1 Features of Railway Work

As shown in **Table 1**, railway work is carried out by an organization consisting of two groups, the special technical group, characterized by specialties such as track and overhead contact work, signalling, and other electrical work and mechanical work, and the coordination group, which takes charge of coordination between works and of the whole project. In the present four projects, specialist engineers were obtained from outside Kawasaki Steel, while common work and overall coordination and management were conducted by the company's engineers.

Kawasaki Steel has vast experience in plant construction, including the construction of steelworks both domestically and abroad, and has great resources in integrated construction projects consisting of civil works, building works, railway tracks, electrical works, instrumentation mechanical works, and utilities. The quality of the company's engineers in these fields is high, and the number of such engineers is large.

3.2 Management Points in Railway Construction Work

In South-East Asian countries, there are few examples of large-scale construction in the fields of rail tracks, electrical engineering, mechanical engineering, and telecommunications, except in general civil engineering and building construction. The number of engineers, subcontractors, and manufacturers competent in design, fabrication, and execution of work in these fields is small. It is also difficult to procure locally construction machinery and tools for railway work, as well as construction materials.

The following are six important points to consider for railway work management in South-East Asia:

(1) Technical Control (Quality Control):
The quality control consciousness of local engineers and contractors is not yet adequate, although high-speed railways are to be constructed. Therefore, technical and quality control must be carried out mainly by Japanese engineers. However, because the execution of work is carried out by local subcontractors, their guidance, quality control system, and quality assurance are important.

(2) Procurement and Control of Materials and Machinery:
Not only materials for railway tracks and overhead contact systems, but also materials for electrical and telecommunications works that conform to specifications must be procured from Japan or other foreign countries. This requires skillful material control, ranging from sea transportation to customs clearance and land transportation, and also an expert knowledge of local customs clearance and transportation conditions.

(3) Schedule Control:
Materials for Construction works are mainly procured from overseas, and the use of machines is generally difficult in executing work; moreover, there are many restrictions on schedule control. Furthermore, the management of subcontractors and local staff is also important because their consciousness of schedule observance is different from

Table 1 Work contents of railway project undertaken by Kawasaki Steel (%)

Work / Project	General work	Civil work	Building work	Civil & building work	Demolition work	Track work	Electrical work	Catenary work	Substation work	Power distibution work	Telecommunication work	Signal work	Machine equipment	Temporary work	Others
Depot improvement project		14	22		7	22	3	8					11		
Central Line track elevation project						23		10	21	2	5	30		7	2
Signalling project at Central, Bogor, and Bekasi lines	8			8		45		2	10	15	12				
Philippines National Railway depot improvement project				40		10					3	2	45		

that of Japanese.

(4) Manpower Control
Although Japanese engineers are desirable in terms of techniques and quality, this is difficult in terms of cost. Therefore, technical and quality control is conducted by a combination of local engineers and a minimum number of Japanese engineers. The training and management of local engineers are the key to the successful execution of work.

(5) Management of Subcontractors
The number of subcontractors is large because railway work involves a variety of engineering fields. Furthermore, close mutual contact is required in some kinds of work, and coordination among subcontractors with respect to schedules etc. is important. In countries whose customs related to contracts, language and culture are different from those of Japan, verification by documents is requested for the contents of the contract, scope of application, etc.

(6) Material Control
Because of the diversity of the content of work, the kinds of construction materials also become diverse. Construction materials must be carried into the site under an appropriate schedule in order to ensure smooth progress of the work, and inventory control and custody control for this purpose are indispensable. Furthermore, because theft and loss during the progress of work are feared, it is necessary to take strict measures in providing security.

The important items in management were described above. The management techniques used by Kawasaki Steel are described below, referring to actual examaples.

4 Examples in Signalling Project of Indonesian National Railways

4.1 Outline

The signalling project of the Indonesian National Railways involved the conversion of manual mechanical signal systems to automatic electrical ones in the Central Line, Bogor Line, and Bekasi Line in the metropolitan area of Jakarta. How this project was managed with respect to the management points described in the preceding section is described below.

4.2 Formation

The formation of the project is shown in **Fig. 4**. We formed a consortium which is composed of a signal

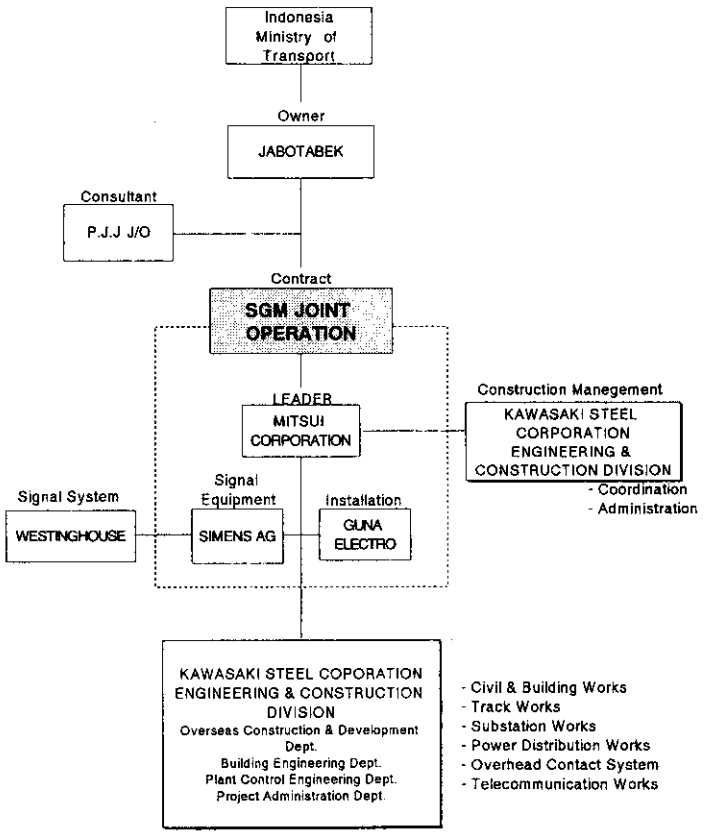

Fig. 4 Contract formation of signalling project (Jabotabek Three Line Signalling System Project Organization)

equipment group and a nonsignal equipment group. The former group is composed of Siemens AG (Germany) and Guna Elektro (Indonesia) and carries out the design, procurement, installation, and commissioning of signal equipment. The latter is composed of Kawasaki Steel and Mitsui & Co., Ltd. and carries out work other than the signal equipment work, such as the construction of buildings, railway tracks, power distribution equipment, overhead contact systems, and telecommunications systems. Kawasaki Steel, which has previous experience in international work in Indonesia, is in charge of the general coordination of this multinational consortium.

4.3 Management and General Coordination of Multinational Consortium

4.3.1 Outline of general coordination

According to the general definition of a consortium, the joint operation executes the construction work, and each member company is solely and wholly responsible for its allotted work. At the same time, however, each member company takes joint responsibility for the whole work. In this case, it is necessary to have a function serving to coordinate technical problems and schedules among the member companies of the joint operation and dealing with jobs that should be done in a unified manner as a joint operation, such as the submission of reports and data to the owner and consultant. The contents of the general coordination work, above mentioned, is described below:

(1) Preparation of a general work schedule, monitoring of the progress status, and reporting to the owner.
(2) Recording of the receipt and delivery of documents and drawings within and outside the consortium and control of such documents and drawings.
(3) Customs clearance, land transportation, and custody of materials and machinery for work.
(4) Procedures for requesting piecework payments, receipt of money, distributions within the consortium, etc.
(5) Work insurance and related procedures.
(6) Construction, maintenance, and control of site offices.
(7) Obtaining and renewal of visas and permits necessary for the stay and work of foreigners.
(8) Tax procedures related to the business of the whole joint corporation in Indonesia (value-added tax).

The management techniques related to items (1) to (3) above in this multinational consortium consisting of three enterprises from Japan, Germany and Indonesia with different languages, cultures, and management techniques are described below.

4.3.2 Schedule control

Although each member company of the consortium is responsible for controlling the schedule of the scope of work allotted to it, it is necessary to have a general work schedule prepared jointly by all member companies. Furthermore, because function-requiring ordering is conducted for electrical work and mechanical work, such as work for signal equipment, electrical equipment, and telecommunications systems, offsite operations and work, such as the design and fabrication of the equipment itself, account for the greater part of work base on the amount-of-money involved. For this reason, control of the progress status in these fields is important. In order to incorporate this design and fabrication in the schedule control system, the system was so built as to always show the difference between the planned and actual schedule by setting milestones, such as (a) site investigation, (b) submission of standard drawings and material samples, (c) submission of drawings for approval, (d) approval of drawings, (e) completion of fabrication, (f) shipping of materials, (g) field installation and (h) testing and delivery. Commercial software called "Primavera" is used for the schedule control system to monitor the progress of the whole work. At consortium management meetings, which is held every week, the schedule is reviewed once a month, the progress status of the project is checked by all member companies, and the pertinent member company carries out measures for the work which is delayed.

4.3.3 Control of drawings and documents

The submission of drawings for approval, approved drawings, construction drawings and as-built drawings was required for each work. Drawing numbers were systematized, assigned to drawings according to the system, and input into a data base each time drawings were submitted and returned in order to permit uninterrupted, proper filing of the drawings. A similar system to that used for the above progress status control was used for the approval of materials. Similarly, a registration system is also being used for documents in order to control the delivery and receipt of documents.

4.3.4 Material control

The greater part of materials for electrical works, telecommunications works, and signal works are procured from overseas and stored near the site for a certain period after arrival; control of this material is therefore closely related to procurement control. However, as severe control of security for material stored is highly requested, security guards on two-shift or three-shift duty are stationed in the storage place for this purpose. A material inventory control system capable of controlling the delivery and receipt of each item of material is used. This system is used to automatically extend insurance on materials when necessary due to corrections in the work schedule and prolonged storage in the warehouse by identifying inventory conditions and warehousing schedules.

4.4 Management of Construction Work (Nonsignal Equipment)

4.4.1 Outline of work

The work extends over the whole area shown in **Fig. 5**. The contents of the work are as follows:

(1) Building Works
Installation of 12 new signal cabins and modification of substations.

(2) Track Works
Renewal of 106 turnouts and installation of insulated rail joints.

(3) Substation Works
Expansion of existing substations and installation of new transformer equipment for signals.

(4) Catenary Works
Repair of existing overhead contact systems.

(5) Power Distribution Works
Installation of distribution equipment for signals and laying of a 60-km power distribution line.

(6) Telecommunications Works
Laying of a 30-km communication cable between stations and installation of new equipment.

4.4.2 Organization for work management

The organization for the above work is shown in **Fig. 6**. Two work management methods are adopted. Under one method, specialist engineers from outside the company are allocated to the track and catenary works. They conduct the site investigation and design and give technical guidance to local engineers and local subcontractors. Under the other method, a general

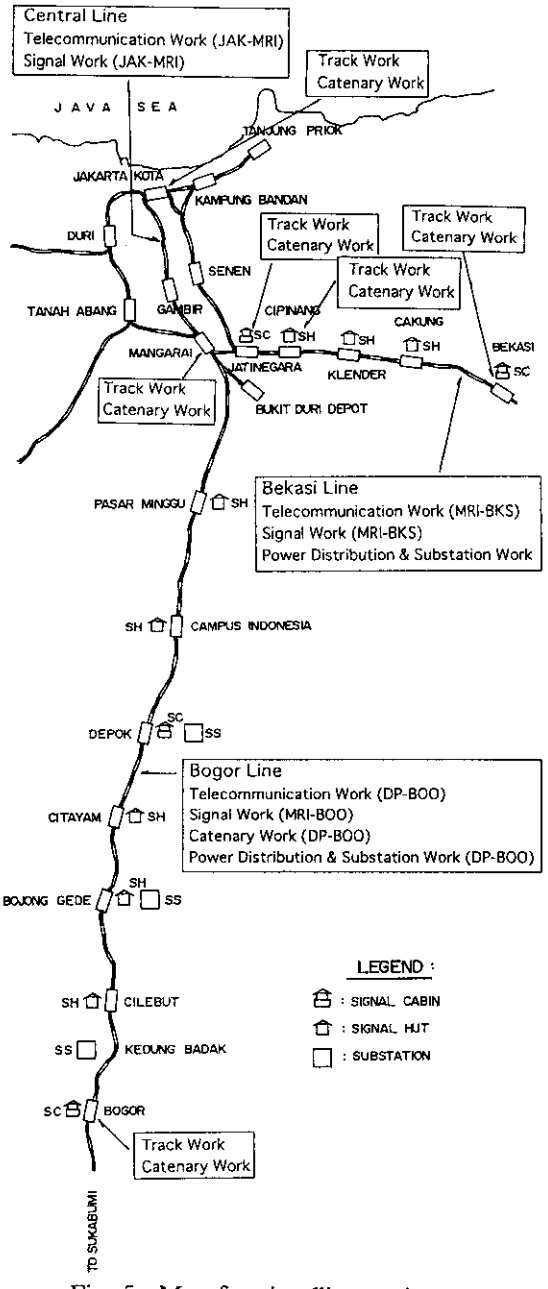

Fig. 5 Map for signalling project

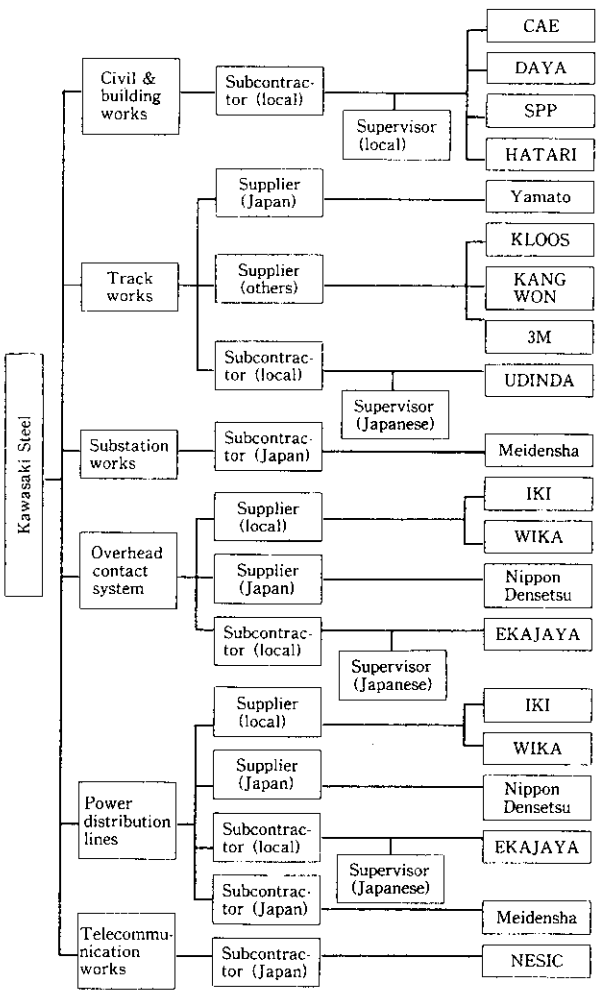

Fig. 6 Internal formation for signalling project

order on a turnkey basis is placed for the substation and communication works that involve the installation of equipment, including the investigation and repair of existing equipment, and cable laying.

As mentioned above, the special technical group conducts the management of site work, and the coordination group manages indirect functions, such as the general schedule, amount of piecework, material procurement, transportation, storage, negotiations with the owner and the National Railways, and control of documents and drawings. Mutual understanding between the two groups is important for ensuring smooth coordination, and opinions are exchanged at opportunities aside from daily morning meetings.

4.4.3 Management of wide-scope work

As is apparent from Fig. 5, the scope of work to be covered is very wide. Therefore, the establishment of work bases (site offices and warehouses), means of transportation, and communications networks was the problem to be solved first.

Offices were provided on each site shown in Fig. 5 in consideration of the scale of work. Field management is conducted from each site office, and general coordination is carried out from the central work office. Communication between site offices is conducted by radio, and service vehicles are used for transportation between sites. Radio equipment is installed in these vehicles and also used during stops and recovery of substations for electrical work.

5 Conclusion

This report describes Kawasaki Steel's systematic manner of application of construction management using as examples the results of railway construction projects in South-East Asia. These techniques are:

(1) General coordination of a consortium
(2) Technical and quality control by Japanese engineers
(3) Guidance of local subcontractors, mainly in quality control
(4) Careful material distribution management and procurement management of materials and equipment based on a good knowledge of the local customs clearance and transportation conditions
(5) Schedule control, including the management of subcontractors and local staff
(6) Manpower management giving importance and priority to the training of local engineers
(7) Subcontractor management based on the verification of documents
(8) Material control that requires inventory and quality control

As it is difficult to evaluate construction management quantitatively, the authors would like to leave the judgment of whether the examples described here can be directly applied to other projects to the readers of this report.

As partly described in this report, Kawasaki Steel has developed strategies for managing integrated works by combining various techniques based on its previous experience with the construction of steel works and plants. Furthermore, there are projects that require such techniques around the world. As a consequence, Kawasaki Steel has received orders for integrated construction projects, and has been able to complete the projects within the agreed construction periods.

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