

# Construction Management Approaches during the Economic Crisis

## Project Management of the Governmental Housing, Thailand

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### Acknowledgement

I would like to express my sincere appreciation and gratitude to following organisations and persons:

- The Swedish International Development Agency (SIDA) for its financial support throughout the training.
- Lund Centre for Habitat Studies (Lund University) and its staffs, especially Mr. Johnny Åstrand, Mr. Jan Söderberg, Ms. Annette Wong Jere, Mr. Janis Kursis, Mr. Kristian Widen, for organising the course and providing all assistance as needed.
- The National Housing Authority of Thailand (Ministry of Interior) and its staffs, especially Mr. Kiatchai Aryuwattana and his staffs at the Nonthaburi Housing Project Phase 4, for providing information as requested. Their creativity in the construction supervision and the monitoring program has proved to be valuable.
- My colleagues at Waltzen Enterprise Co., Ltd. who put up with my works during my absence. Special thanks to my senior colleagues, especially Mr. Thien Sukhumthanakul, Mr. Piti Manumaporn, Mr. Suphachai Nimmarnnorathep who I have learned a great deal through their experiences and continual advice. Without their suggestions, I would not be able to understand many complexities of construction management.

In particular, I would like to thank my family for their perpetual supports, especially my mother who is my most important mentor and who always provides me with the endless opportunities. I would not have been here without her support.

### Summary

The economic crisis in Thailand broke out in 1996. The severity of the crisis provided the Government with no choice except to float the nation currency and joins the International Monetary Fund program, which in turn, frame the Government to cut down its spending. As a result, most of the governmental construction projects were inevitably forced to slow down. The crisis proved to have a large impact on all sectors. For many governmental authorities, since the country spending was framed, in order to achieve their objectives they must find way to sustain themselves. The National Housing Authority is one of the many governmental authorities who shifted some of its projects toward the middle income people by adjusting certain designs to focus on both functional usage and aesthetic. For the private sector, many actors were unable to pay their contractors. These companies turned to bid the governmental projects in search of cash flow thus created a very highly competitive bidding environment. Most of the system being used is the competitive bidding system, which has a loophole. Because the system focuses on the lowest lump sum price, which in turn provides a fault incentive for many contractors to unreasonable and unpredictable cut in construction price. Both factors allowed only a small room for the contingency costs and for the management errors.

With a small amount of the contingency cost, the Contractor must carefully lay out all plans. The Contractor management team decided to hire one major subcontractor in order to reduce number of manpower and resources required. For the pre-construction management process, three major steps were taken place. First, the Project planning and scheduling were laid out by setting up the work break down structures for each building to be constructed. The work break down structures were put into the detail plans in order to provide the construction sequencing. Then the Master plan was laid out along with

the schedule in order to provide the over planning of the Project. Second, the Project payment schedule was being set up by breaking down all costs to match work break down structures. Third, the Project organisation chart was being set up. There were three parties involved with this project namely: the Authority, the Contractor and the major Subcontractor, therefore the organisation chart was quite complicated. There was a communication problem due to the inexperienced of on site staffs. The problem was resolved through relocating certain resources.

For the Construction management process, three major processes were taken place in order to assure and maintain a high quality standard. First, the monthly implementation plan was set up. The most important content in the monthly implementation plan was details and schedules of all activities that had to be finished each month. It relied mainly on the Master plan and the detail plan. The second process was quality assurance. The system was being set up through series of paper works and materials testing. Third, the Project monitoring program was being set up, mainly on the daily and monthly basis. The important contents in both programs were details of work progress and cost to be reimbursed each month. All of these plans had been redefined many times so that they provided realistic and achievable objectives.

Although carefully planned, the Project suffered from the economic crisis when the Authority asked the Contractor to hold up and reduce the momentum of the Project. As a result, the Contractor had redefined the Master plan three times. The Contractor had to put up with the running over head cost. It decided to cut down all unnecessary costs and absorbed certain lost in exchanging of laying off its staffs. The Contractor was among minorities who were successfully and solidly withstand the impact of the crisis. The main tactic that it used was through the human resource management skill. It managed to create co-operation from all of its staffs.

The paper reviewed all management and administrative scheme undertaken by the Contractor to over come the crisis. It was an example of a company who successfully created the opportunities through the crisis.

## Introduction

Once ranked as one of the five new “Tiger” of Asia, along with Japan, South Korea, Taiwanese, Singapore and Malaysia, Thailand enjoyed its constant development in all aspects. It evolves itself steadily, not only in terms of economy but also politics and social. It moved closer toward the western country, with the aim of becoming a newly industrialised country (NIC). Many new governmental policies were adopted in order to comply with free trade analogy. Enormous amount of money were lent, especially by private sector, and brought into the country with no limit. Without a full understanding of its people and lack of effective monitoring program, Thailand is now encountering the worst economic crisis. The government has no choice but to float the national currency (Baht) and joins the International Monetary Fund (IMF) program which, in turn, frame the government to cut down most of its spending. As a result,

most of the governmental construction projects were inevitably forced to slow down.

Many said that contractors who construct the public projects are secured from any crisis because the government always pays the construction fee. Thus every contractor in Thailand always finds a way to work on the governmental projects. However, the subject of this paper is one of the governmental housing projects, which was affected directly by the cut down of the government spending. The paper is divided into four parts: Design and Tendering stage, Pre-construction Management stage, Construction Management stage, and the Effect of the Economic Crisis. The objective of the paper is; firstly, to look into the general construction management skills of the Construction Company who managed successfully to float through the economic melt down. Secondly, to analyse some of the management approaches undertaken to re-define the construction schedule due to the budget cut down. Thirdly, to examine how the Construction Company handled all costs and expenses incurred during the extension of the project. The paper will also review the role and responsibility of each player under the crisis.

## The Country Background

### General Background

Founded in the 13<sup>th</sup> century, the Kingdom of Thailand was known until 1939 as “Siam”. Once referred to as Siamese, the people of Thailand are now called “Thai” which means, “free” and Thailand being “The Land of Freedom”.



Figure 1: The geographical location

Thailand is located in the heart of South East Asia region, surrounded by Laos, Cambodia on the north and east, Myanmar on the west, and Malaysia on the south. The country as its name suggested, is the only country in the region that has never been colonised by any European

country. Thailand is approximately 507,172 square kilometres, the shape of which resembles the head of an elephant. It measures approximately 24,848 kilometres from north to south and 1,242 kilometres from east to west. The country has a population of 60 million, of which 10 million live in the capital city, Bangkok.

Thailand has a warm, tropical climate affected by an annual monsoon. The average temperature is 23- 40 degree centigrade. The official language, spoken by almost 100% of the population, is Thai. Buddhism is the faith of 95% of the population.

Thailand's governmental structure has undergone gradual and practical evolution in response to the changing environment. Since 1932, it has been a constitutional monarchy with a parliamentary form of government. The bicameral parliament is composed of elected representatives and appointed senators.

Thailand boast a complex exported-led economy which embraces the latest technology and includes tourism, agricultural, manufacturing, and communication industry.

## Economic Background

Of all the Asian countries, for the past 15 years, Thailand has once produced the most dramatic shift in economy. It enjoyed the constant economic growth on the average of 8% annually for the past 10 years, until 1997, when the country faced with the worst economic crisis ever encountered.

In an era where phases such as "Information Technology" and "Globalisation" are stereotype to everyone life, Thailand's economy, in its own way, was connected to the world through investment in hard-core industry sector, real estate sector and etc. Its private sector-oriented business policy has been fiscally and monetarily conservative and based on a close co-operation between the public and private sectors. Growth in the financial sector has paralleled that of industry and commerce. The country leaders aimed toward their goals of establishing the country as a regional financial and manufacturing industry centre. Along with the free trade analogy, the Government opened the country's door by reducing many restrictions on monetary policies. Without an effective monitoring program, thus allowed large funds to flow in and out of the country freely. The economic booming brought in many foreign investors and soon acted as a "two sided knife".

Under the economic booming environment, combined with the lack of understanding of its people, everyone in the country spent more than what one could produce. People took advantage from the ease of monetary policies and the ineffective monitoring program by lending large amount of money from foreign banks and investing mostly in the real estate sector. Within the last 5 years before the crisis, the number of construction companies founded to serve the need of the real estate sector increased tremendously.

The economic booming soon turned into the bubble economic. In 1996, the economy faced a sudden drop in exports from 13 % in 1995 to -0.2% in 1996. This put a break to a continuously high growth rate and weakened the economic stability. In addition, out of the country's

total debt of USD 90 billion in 1996, the private sector debt amounted to USD 70 billion, of which 40% were short-term loans. Furthermore, there was an influx of cheap foreign capital, the majority of which was channelled to the oversupplied property sector and a short-term investment in the volatile stock market. The state of the economy had led to speculative attack on the currency. The reality emerged in 1997 when the situation was ripe for the foreign hedge funds to launch an attack, since the country also had a precarious political situation to complement it. Many rounds of attacks were made on the currency, causing a severe damage to the economy. Unable to withstand, the Government had no choice but to devalue the currency by changing from basket system to managed float system. As a result, the Baht slumped from Baht 26: USD 1 to Baht 37: USD 1. At the peak of the crisis, the country saw an over 100% devaluation of its currency. Large amount of money borrowed by the private sector double up due to the devaluation of the currency. Although the problem was originated largely by the privates sector, the government had to intervene and take responsibility to these debts as well. Moreover, the decision to join the International Monetary Fund (IMF), in August 1997, worsened the situation. IMF announced that it would assist Thailand by granting USD 17.2 billion package to be accompanied by several reform measures. One of the reform measures requires that tight monetary and fiscal policies must be maintained in order to meet the austerity targets. Since the Government has to follow IMF instruction, all unnecessary expenses were cut down. The Government spending was framed by IMF.

Unfortunately, at the peak of the crisis, the Government subsidised low-income housing projects were considered to be unaffordable. As a result, these types of projects were automatically forced to delay. The governmental contractors were asked to redefine all project scheduling, the planning, and the construction process.

## The Project Background

### The Project Characteristics

The National Housing Project at Nonthaburi Phase 4, hereafter called "the Project", belongs to the National Housing Authority of Thailand, hereafter called "the Authority". The Project is located in a residential area in the out-skirt of Bangkok, approximately 20 kilometres from the business centre of Bangkok. Although far from the business centre, the Project is considered to be situate in a prime location. Since it has an easy access through a major express way and major roads with many department stores, super markets and etc. The Project is built on 38,060-m<sup>2</sup> plot of land with the total of 700 residential units. The Project costs approximately USD 11,000,000 and comprises of:

- 9 condominiums each with 8 stories, with the total of 540 apartment ranging from 41 m<sup>2</sup> to 58 m<sup>2</sup>.
- 104 row houses type D consists of 2 bedrooms, 1 bathroom and 2 stories, ranging from 64 m<sup>2</sup> to 76 m<sup>2</sup>.

- 56 row house type E consists of 3 bedrooms, 2 bathrooms and 2 stories, ranging from 96 m<sup>2</sup> to 108 m<sup>2</sup>.
- Complete infrastructure i.e. water supply and drainage system, sanitary system, wastewater treatment system, roads, pedestrian walkways, landscape work and etc.

The land was turned over to the contractor on December 12, 1996 along with the Notice to Proceed document. The original contract period was 600 days and was scheduled to end on August 3, 1998. The contractor has to provide 730 days guarantee to the Authority after the Project is handed over back to the Authority. The Project was put out to bid on September 17, 1996 before the economic crisis broke out. The bidding system used is a competitive bidding system.

Due to the short project duration, flat slab reinforced concrete cast in situ was adopted for the construction of the condominium. Conventional beam-column and prefabricated floor slab is used for row houses.

## Parties Involved

### **Owner: The National Housing Authority of Thailand**

Similar to other developing countries, the gap between rich and poor is widely spread. Thus, the Government continually implements many plans and policies to subsidise needs of the low-income people. Many governmental authorities have been set up to operate and administrate these subsidising plans and policies. Housing is one of the human basic needs and is one of the major sectors being subsidised by the Government each year aiming at the low-income people.

The National Housing Authority is under the umbrella of The Ministry of Interior. Since founded in 1973, the Authority's main objective is to produce housing for the low-income people. The Authority focuses on constructing new infrastructures i.e. flat as well as renovating a highly populated area i.e. slump. Most of its projects are subsidised and/or funded by the Government. However, its management and administrative policies continue to shift in order to comply with each different governmental cabinet policy.

Due to the change in the governmental policies and the economy environment, the Government cut down its spending and was unable to fully support the Authority. The Authority Board has foreseen that in order to function efficiently and maintain its objective to assist the low-income people, it must be able to sustain itself. Therefore, it adjusted its own policy to include the middle-high income people as part of the target group. To be able to compete successfully against the private sector and attract the new target group, the authority changed its many formal designs. The subject of the paper is one of the projects targeted at the middle and middle-high income people.

### **Contractor: Waltzen Enterprise Co., Ltd.**

The Project was awarded to the Construction Company named Waltzen Enterprise Co., Ltd.; hereafter called "the Contractor". The Contractor was founded in 1969. It has a long highly respective history and maintains a notable standard as being one of the most dignified medium size construction companies. It has been working with the National Authority of Thailand for more than 20 years. Waltzen Enterprise Co., Ltd has earned the solid reputation through its many projects with the Authority. It specialises in building construction and has been working mainly with the governmental sector. At the moment, the company employs 10 engineers, 30 technicians and foremen, and 30 administrative staffs full time. Their believe in all employees' abilities create trust, loyalty and strong bond, which prove to be the most important element in helping the company to withstand all difficulties through out its 30 years history.

## Design of the Project

This paper is written from the Contractor's point of view. Therefore the design concept will be discussed only briefly.

The Project was originated and owned purely by the Authority. As aforementioned, the Authority possesses abilities to design and supervise its projects effectively. It is well equipped with teams of engineers, architects, technicians, draftsmen, as well as all supporting equipment and personnel needed in design work.

The Authority's normal building design focuses on space and functional usage, more than aesthetic. It designs to maximise the usage area with the given available budget i.e. construct as many units as possible. The normal characteristic of condominium (flats) aimed toward the low income group is a very simple 5-7 stories reinforced concrete building with a flat roof. Each unit is a studio style; one room with all facilities i.e. cooking, living and etc. The normal characteristic of row house is a 1-2 bedroom with one bathroom. However, due to the fact that the Authority must be able to sustain itself economically, it shifts some of its projects toward the middle income people. Therefore, the architectural design of these projects must justify needs of this new target group as well. One of the main considerations, other than an appropriate functional space, used by the middle income group to decide whether to buy the project or not is the attractiveness of the building. The architect made many adjustments from the standard design to accommodate the new target group. For this Project, major adjustments for condominium were:

- Providing a large balcony for leisure purpose.
- Installing the television satellite system.
- Providing electronic access door control system for security purpose.
- Providing elevators.

In terms of row houses, there were no major changes. However, the Authority increased the choice by offering houses consist of 3 bedrooms with 2 bathrooms. Other

minor adjustments to enrich attractiveness were increasing yard area and balcony for plants.

aboard? Which sub-contractors should we approach? etc.

## Project Tendering Process

### The Bidding Process

Once the Authority finished all detail design works, the Project was put out to bid. The tender documents included blueprints, specifications, and the bill of quantity. The Authority sets up certain pre-qualifications in which contractors have to satisfy before being able to buy the bidding document. Once the Contractor obtained the blueprints, it had 3-4 weeks to prepare the cost estimate. Similar to most of the construction companies in Thailand, the cost estimate is done manually. Computer or other information technology is hardly adopted. While the Contractor's engineers and quantity surveyors carried out quantities estimate of materials to be used, the purchasing department surveyed costs of each material and their availability on the market. After quantities and material costs were completed, the Contractor's management team decided upon the management fee, the percentage of profits, the overhead costs, and the contingency costs to be included in the final bidding cost.

Theoretically, the decision above depends upon many factors. The Contractor management team needs to answer questions raised in each following criteria, which in turn affect the decision making. Some of the major criteria and questions being asked routinely when making such a decision are

- Competitors: Who are our competitors? What are their former histories, competitiveness, and credibility? How many companies will bid? What is our chance compares to other competitors? etc.
- Site condition: What is the site condition? What are the geological conditions? What is the ground level compares to the reference level? Is the site situated in the flooding zone? etc.
- Location: How easy is it to get to the site? How big is the access road? How far and what is the distance from the major supplier to the construction site? How sensitive is the surrounding community? Where are the public electrical and the main water supply source? etc.
- Capability : Do we possess the ability in terms of equipment and human resources? What kind of equipment is needed? What existing materials can be reused? What is the available manpower? If we need more resources, how are we going to invest? etc.
- Experience: Have we ever built a project with similar character? If we do, what kind of problems did we encounter before? Are there ways to prevent these problems? If we have never experienced such a project before, what kinds of problems are likely to occur? What would be our approach? etc.
- Connection: What kind of suppliers and sub-contractors do we need? Does the project require special materials, which need to be ordered from

Another important factor affected the Contractor decision is the bidding system being used by the Government. The bidding system used in most of the governmental projects, including this Project, is a competitive bidding system with a combination of lump sum and unit price contract. Contractors participating in the bidding must fill out the bill of quantity, which included in the tender documents, and submits along with the lump sum amount. However, this bill of quantity is used only as a reference of how each contractor comes up with the lump sum price. The successful contractor is bounded to use and provide all materials as indicated in the bill of quantity. In any case that the contractor miscalculates or preclude some material as shown in the tender document, the contractor is obliged to provide such materials in the actual construction. The submission of the final bidding price shows only the net construction cost, the overhead and the profit cost, and the Value Added Taxes (VAT). The governmental authority will pay only the fixed lump sum price unless there is a necessary change order, which will be deal during the construction period. The contract usually is awarded to the contractor with the lowest bidding price.

Normally, the governmental authority does its own estimation of the project as well, called the balance bid. The price appearing in the balance bid is the amount that the governmental authority seeks for the Parliament Cabinet's approval. The balance budget will be granted to the governmental authority accordingly, if the Parliament Cabinet endorses the plead. If the lowest bid contractor submits the price, which is higher than the approved budget, the governmental authority will negotiate and ask the contractor to lower the construction price. The balance bid is used as a reference to compare with the contractor price.

In reality, sometimes the balance bid done by the governmental authority is lower than the real market price. Moreover, the competitive bidding system has a loophole, which all organisations using this system should take into consideration. The fact that the contract is to be awarded to one with the lowest budget provides a fault incentive for all contractors to unreasonable cut down their prices. During the perpetuate economic crisis, most of the actors in the private sector were unable to pay their contractors, as a result those contractors who previously worked on the private sector projects struggle to find work and cash flow to feed the company. They turned to bid on the governmental sector projects. Many who were desperately in search of cash flow would include only VAT into the net cost. While many others would unreasonably cut down 20 %-30% of the net cost in order to win the bid. By wining the bid, the governmental agency will provide an advance payment of 5-15%, depending on the size of the project. The successful company would uses this advance payment to subsidise loss in its previous projects provoked by the economic crisis. Continually, these contractors would cover up loses incurred in their previous projects by bidding a new one, thus repeating the cycle over again. This loophole of the

competitive bidding makes it difficult for many professional contractors to enter and win the bid.

To prevent the unreasonable bidding, the governmental authority should make use of the bill of quantity. By comparing details of the unit cost submitted by each contractor to the balance bid done by the governmental authority, the governmental authority is able to estimate whether the lowest bid contractor provides a reasonable cost or not. All organisations using a lump sum bid system should recognise risks and costs which may incur in hiring unreasonable low cost contractor who is unable to finish and hand over the project. Many other economic factors should be taken into consideration other than making decision based purely on the final lump sum cost.

As a result of the unreasonable and unpredictable cut in price by many competitors, as aforementioned, it proved to be burdensome for any construction management team to employ all of the mentioned criteria when considering the additional costs. The Contractor management team faced with similar challenges when deciding the percentage to add on top of the net cost. Prior to conclude the bidding price of the Project, The Contractor management team discussed and went through many of the above concerned criteria. To consider all factors, the bidding price would be much higher compared to other competitors. Not to consider nor include the contingency cost, the Contractor has to risk on lost. The Contractor management team saw a sign of the economic crisis but did not expect that it would hit the country as hard, therefore decided not to put in a large amount of the contingency cost. Combining with the understanding of the competitive bidding loophole and the need to win the bid, the Contractor management team decided to take the risk by adding on a small amount of contingency. Eventually, it came up with the additional 10.96% to cover the management fee, the overhead cost, the contingency and the profit. The Contractor won the bid and was awarded the contract in December 1996.

## The Project Contracting Process

Once the Authority and the Contractor agreed on the contract price, the contract was signed. The main issues of the contract were:

- The period of construction which may not exceed 600 days, otherwise 0.023% of the contract price will be fined for everyday of delaying.
- The Authority will take out 0.5% of the contract price as a performance guarantee. This guarantee will be taken out of the last three payment periods before the hand over of the project. The work retention period is 2 years.
- Within 60 days after the Notice to Proceed, the Authority will provide an advance payment of 10% of the contract price. The contractor must provided the bank guarantee of the equivalent amounts to the Authority in exchange. As the construction proceeds, the contractor has to re-pay the advance payment to the governmental authority at the rate of 15% of the amount reimbursed each period until the advance payment even out.

- The main contractor must not sell the whole project out in form of sub-contracting to one other party.

One of the most important characteristics of the governmental contract is the adjustment index “Escalation Factor (K)”. This adjustment index is crucial for projects with a long construction period, since these lengthy projects are more vulnerable to the unsteady economy. This adjustment factor was first introduced during the oil crisis in 1974, when costs of all construction materials skyrocketed due to the rise of oil price. Contractors who signed contracts before the oil crisis could not afford nor absorb the rise of all materials costs. Therefore, the Government adopted the K factor as an adjustment index to assist the construction sector. The factor takes into consideration the unsteady of economic environment through the use of consumer index price. Each month, the Ministry of Commerce issues the consumer indexes prices including construction materials. The consumer index of each monthly payment schedule and the consumer index of the contract-signing month are put into the K-formula. In the case that prices of construction materials increase from a contract signing month, by using the formula, an additional amount the governmental authority has to pay a contractor on top of a reimbursement amount is calculated. On the contrary side, if cost of construction materials on a month of reimbursement decrease from a contract signing month, the governmental authority is entitled to ask for money back from a contractor. Note that a contractor has to absorb approximately 4% of an increase or decrease amount. However, not all of the construction materials are included or eligible to receive the adjustment. For example, movable parts and machines such as elevators, computers, pumps, ventilation fans, air conditioning device and etc. are excluded in the adjustment K factor.

When the Government devalued the Thai currency, all of the construction materials costs increased tremendously. Some materials were tripled their original costs, especially those imported. The consumer index also increased accordingly. Therefore, the Contractor was able to reclaim some of the unexpected high construction material costs. However, the major lost manifested itself not in the common construction materials but in the machinery and equipment parts. The fact that this machinery is expensive in general and mainly imported; the devaluation had a much larger impact than typical construction materials. Moreover, the construction specifications usually approve of certain imported manufacturers, thus the Contractor was unable to provide an alternative cheaper machines or equipment. The only best solution for the Contractor was to find the cheapest supplier and negotiate on the best term of payment. The construction sector has continually push for changes in the escalator factor categories such that it included imported machinery and equipment. This problem is of the larger scale and can only be resolve through the change in the government regulation.

After signing the contract, the Contractor had time to plan and organise before the contract period start. The validity of the contract officially started when the Notice to Proceed was issued and the construction site was

turned over to the Contractor. The Contractor was required to submit project planning, organisation chart, detail of scheduling payment and work scheduling within 60 days after signing the contract.

## Pre-Construction Project Management

After winning the project, the Contractor went through many management and administrative options i.e. whether it should use its own labour force or subcontracting, and in which form should the subcontracting be. The usual approach the Contractor undertakes is to completely subcontract mechanical and electrical work to a M&E contractor, which means that the M&E contractor is also in charge of purchasing and procuring all M&E equipment. For the remaining construction part, the labour work is subcontracted out partially and the Contractor uses its own labour force on the remaining part. The Contractor purchases and procures all construction materials aside from M&E materials. The common characteristic of labour subcontractor is a group of labour ranging from 5 people up and provides only labour service. Thus, there are usually large numbers of subcontractors in one project.

Due to the fact that the Contractor was undertaking another large scale project at that time, the Contractor management team needed to find an option which required the least man power. If the Contractor carries out the Project in its normal manner, it has to bring forward a team to oversee procurement, inventory, material scheduling, planning, supervision and etc. A large team of engineers, technicians, draft men, foremen, skill and unskilled labour would be required. Therefore, the Contractor management team decided to subcontract out as much work as possible. However, with subcontracting, numbers of manpower needed to supervise the Project also increase in proportion to number of subcontractors in the Project. By having large number of subcontractors, the Contractor still has to send in many engineers and technicians. The question then was how to subcontract in a way that contact persons between the main contractor and subcontractors are as fewer as possible, thus reduce number of supervisors necessitate. The only solution was to subcontract as much work as possible to only one major subcontractor and set up fewer contact persons between the Contractor and the selected subcontractor.

The Contractor management team carefully screened which subcontractors to employ. Many criteria had been used and major one were:

- Credibility: How reliable the subcontractor is, especially in term of financial stability? What is its past history?
- Ability: Does the subcontractor have enough labour force to provide the service? What kind of equipment does it possess?
- Personal: What are the qualifications of its staffs that would be put in the Project?

- Reference: What kind of reputation does it have in the construction market?
- Performance: Does the subcontractor have previous experiences with building construction and technique, which would be used in the Project?

There were many subcontractor companies that fit all of the above profile with different weak and strong points. The Contractor management team was aware that the economic environment was unstable and vulnerable to melt down. The subcontractor must be financially strong enough i.e. having enough cash flow to generate work and to withstand the economy crisis. Thus, the Contractor management team decided to select one with the best reference and the strongest financial credibility. The important details of the contract signed between the Contractor and the Subcontractor were similar to the one signed between the Contractor and the Authority. However, the addition condition on the term of payment was included. It indicated that the Subcontractor would receive the payment for its services one week after the Contractor received the reimburse payment from the Authority.

Although carefully selected the strongest financial credibility subcontractor, nonetheless during the peak of the economy crisis, the Subcontractor was unable to solidly tolerate the crisis and could not absorb the economic impact. Therefore it asked to be paid right after the Authority Board acknowledged work done in each reimbursed period. The Contractor agreed to assist and had to re-plan its cash flow.

Once the subcontractor was selected, the detail management schemes were done co-operatively between the Contractor and the Subcontractor. The team carefully laid out tasks required for the pre-construction management. Three major tasks necessary were:

1. Project planing and scheduling
2. Project organising (organisation chart)
3. Project payment schedule

### Project planning and scheduling

Project planing is considered to be one of the most important stepping stones in construction process. Before planning, the Contractor went out to collect basic data. For example, the actual site condition, the shape of the land, the surrounding existing buildings, the width of the access road, the meteorology information and etc. Other data involved details of materials testing, environmental concerns, the existing infrastructure, the sensitivity of the surrounding community and etc.

The basic data were used as factors affecting the construction process. The construction period was only 600 days (20 months period) which considered to be short for such a project. Therefore the Contractor team had to pay attention to all and every detail aspects of the Project. The steps undertaken were:

- Firstly, setting up work break down structures (WBS) for each building, row houses, and infrastructure. This task was done by identifying all activities needed along with time required to complete each

activity. The Project consists of 9 buildings with similar character, 2 types of row houses with different number of houses in each row, and completes infrastructures. The Contractor management team listed out in details activities and times required for each building and each row houses. For example, foundation work for row house type E row number one takes 1 week, foundation work for row house type D row number three takes 4 weeks and etc. Note that the actual starting and finishing date of each activity was not included in the detail plan.

- Secondly, sequencing all of the above-identified activities within each type of building and row houses. The sequencing order provided a construction schedule and a detail plan of how long it takes to build each building and each row house separately. It also provided the order of which work should be done first i.e. starting from an excavation work, a foundation work all the way to the detail finishing of each building and each row houses. For example, within row house type E row number one, the Contractor team linked up all works sequence e.g. foundation takes 1 week, first floor structure takes 4 weeks, prefabricate floor slab takes 1 week and etc. This task is somewhat similar to CPM.
- Thirdly, setting up the Master plan and schedule, which combined all buildings and row houses together. It provided the total length of time required, the starting and finishing dates of each building and row houses in relative to the Project contract period. The Master plan also indicated how each building and row house related to each other as well as to the whole construction plan and in which orders should the object be built.

All of the above plans were done using bar chart (Gantt chart diagram). By setting up the Master plan, the Contractor team had a clearer picture of which approaches to take in order to minimise risks of delaying. The first Master plan took into consideration only the available resources within all involved companies. It appeared that the Project had a high risk of being delayed since the lag time was too small and resources were limited. Therefore the Contractor team revised the Master plan by considering a new methodology, adopting new techniques and adding in more resources to fasten the construction process. Through out this planning process, the Contractor team still did not take into consideration the unstable economy environment. Because the governmental project is normally much more secure than those of the private sector are.

In order to successfully and accurately set up the master plan, the construction team must have a full understanding of construction techniques, which include equipment and machinery, materials handling and scheduling as well as having experiences and expertise. The most important thing is that the plan must be achievable and realistic. Taking the above concept into consideration, The Contractor team asked for inputs from staffs who would be sent to station on site and one who would implement the plan. The Subcontractor also had its

own implementation plan that it must submitted to the Contractor. The Contractor compared both plans, made certain adjustments and redefined the Master plan. The Contractor and the Subcontractor continued to make many adjustments through out the construction period in accordance to the actual construction progress.

Other planning undertook at this stage were; materials handling and scheduling plan i.e. when, where and how to keep materials that arrived on site; plant and equipment plan i.e. which equipment to be used and how to maintain; labour force plan i.e. how many skilled and unskilled labours needed and during which period; and administrative plan i.e. what kind of report, form and paper works were required and etc.

## Project Payment Schedule

The payment schedule depended largely on the Master plan and the detail plan above. The Contractor broke down the total construction cost to match each broke down activities for each building and each row house.

No.	Description	Total cost	F1	F2 and etc.
1	Foundation			
1.1	Piling	17,036,183	1,892,910	1,892,910
1.2	Caisson work	7,058,475	784,275	784,275
2	Structural work			
2.1	1st Flat slab	5,715,000	635,000	635,000
2.2	2nd Flat slab (so on)	5,715,000	635,000	635,000
3	Roofing			
3.1	Main roof struct.	3,937,320	437,480	437,480
3.2	Sub. roof struct.	301,32	33,480	33,480
3.3	Main roof tile	1,152,000	128,000	128,000
3.4	Sub. roof tile.	90,000	10,000	10,000
3.5	Touch up	1,421,253	157,917	157,917

Table 1 Example of Schedule Payment

For example as referred to the above table, the foundation work was broken down to 2 detail activities: the piling and the caisson work. The total foundation cost was also divided up to 2 parts, which were the cost of piling and the cost of concrete caisson. Another example, the structural work was broken down into the construction of each floor. The total cost of structure work was also divided up accordingly. For the roof, the roof structure was broken down to 5 parts: the main roof structure, the minor roof structure, the installation of the main roof tiles, the installation of the minor roof tile, and the touch up work. The total costs of the roof was also broken down to the cost of the main roof structure, the cost of minor roof structure and so on.

By breaking down all construction costs, the payment schedule was set up. Referred to the Master plan and the detail plan of each building and row houses, the breaks down costs were mapped into each activity. For example, the Master plan indicated that within the first month, piling works for building F1-3 and row house E1-E4 must be finished. The payment schedule for the first month would be the break down costs of piling work F1-3 plus row house E1-E4 and so on. By mapping the payment schedule with the Master plan, the Contractor management team was able to predict cash flows for each payment period in advance. The S-curve was the last



management tool adopted in the project management. It used as an indication of how realistic the planning was.

The payment schedule adopted in this project proved to be more effective than the conventional one. The methodology used to set up the Project schedule payment provided relative precise details and pictures of cash flows the Contractor needed in a certain period of time. With the conventional payment schedule method which indicate work payment in term of the percentage of work done for each period, the contractor may invest more money than it could reimburse if part of the work included in that payment schedule is delayed. For example, the conventional method may indicate that, in the 18<sup>th</sup> month, the contractor is entitled to bill 34% of the Project wastewater treatment structure which includes all pilings, all foundation works, all structural work. However in reality, the upper lid of the treatment could not be completed because the aerators have not been installed yet. Therefore, with the conventional method, the contractor cannot reimburse any money since a small part of the structural work is not completed, even though it has invested in most of the structural work already. Using the new methodology adopted in this project, the contractor would be able to reimburse all piling and foundation works without linking them to the structure work.

The weak point of the payment schedule adopted in the Project was that there were a large number of costs and details of work break down structures involved. Therefore, the used of information technology to keep track of all data was essential.

## Project Organisation

### The Authority

The organisation hierarchy in this project was more complex than what the Contractor usually has. The Authority's organisation chart is indicated below with an abbreviation "NHA". As mentioned above that the Authority has its own highly qualified engineers, architects and technicians, thus it uses its own manpower to supervise and oversee the Project. Being a responsible governmental organisation, the Authority maintains a high standard of its projects by focusing on safety of people who will live in the house. Therefore, it is a usual practice to send out a senior site manager, a mechanical and electrical engineer, a structure engineer and technicians to be located on site through out the construction period. Their major responsibilities on the Project were to make sure that the Contractor constructed the building according to the construction procedures, followed the blueprints and the construction codes, and used materials as indicated in the specifications. The Authority's on site staffs reported directly to the senior site manager. The Authority's project manager and the Contractor's project director were not stationed on site, but instead visited the site weekly.

### The Main Contractor

On the Contractor side, as aforementioned that in order to reduce manpower, the Contractor management team subcontracted a large portion of its structural labour

works to one major subcontractor. However, in order to maintain its high quality standard performance, the Contractor management team sent in 5 staffs; 2 of who are engineers, to station on site through out the construction period. The Contractor's staffs are indicated here with an abbreviation "MC". The role of the Contractor team was similar to that of the consultant. It must be noted that both engineers were new to the Contractor management team. At the appointed time, the Contractor management team was unable to fully access their abilities. The two engineers held the title of the Project co-ordinator engineer and the Project engineer. All staffs have the common task of checking the construction work progress and closely supervising the Subcontractor. Normally there were always changes in engineering designs. The Project engineer was responsible for examining these changes, defining shop drawings and modelling of certain complex components, and working with the site engineer to find the best technical approaches and checking on the construction progress.

It is also quite common that the blue prints, engineer drawings and architecture drawings provided during the bidding stage are not perfectly complete. Often, there are some disagreements between the client and the contractor i.e. the client might indicated its needs in the specifications but not in the engineering drawing, where as the contractor mainly follows the blue prints and the drawings. In order to provide and satisfy the client needs, the contractor may involuntary has to pay more and eventually may lead to a dispute. This is where the project co-ordinator comes in. The Contractor's Project co-ordinator engineer was appointed at the very early stage. The Project co-ordinator engineer main responsibility was to be the contact person, to fulfil needs of all parties, to prevent and reduce any risk of dispute among all involved parties. Since this is a governmental project and no official consultant was appointed as a middleman, it was vulnerable that both the Contractor and the Authority might act to maximise their benefits resulting in contradictions. Moreover since the Subcontractor also involved, the management and communication among all parties were even more complicated. Although working for the Contractor, the Project co-ordinator engineer was required to be a middleman and worked to maximise benefits of all parties.

### The Subcontractor

The Subcontractor's staffs are indicated above with an abbreviation "SC". Unlike any other project, the Project manager was under the Project co-ordinator engineer and the Project engineer. The reason was mainly because he comes from the Subcontractor side. Due to the fact that most labourers and manpower used in the Project were the Subcontractor's employees, the Contractor decided that it was more efficient to appoint one of the Subcontractor's senior engineer to be the Project manager. Thus, it would be easier to control the majority labourers. His main responsibility was to manage the construction site, plan and relocate his labour forces in order to meet the work schedule dead line set by the Contractor. His responsibility within his own organisation

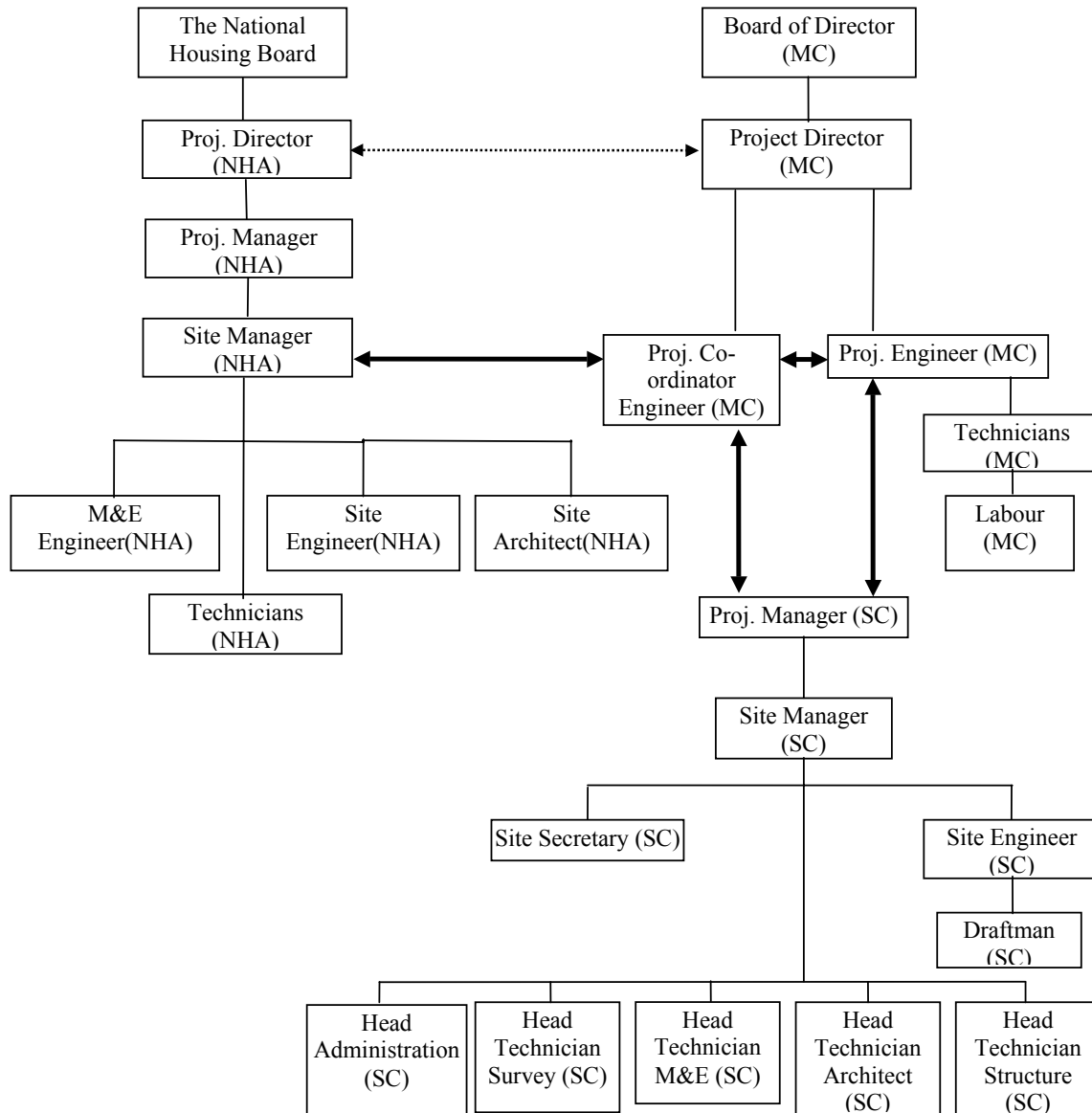


Figure 2 The Project Organisation Chart

was planning and setting up working policies. Another significant position on the Subcontractor side was the site manager. The site manager main responsibility was to control and supervise all construction technicians and focused mainly on actual technical parts of the Project.

**The Communication Linkage**

Referred to the organisation chart, the Authority’s Project manager and the Contractor’s Project director communicated mainly on the policies and planning issues. In certain cases, when the on site staffs could not agree on some controversy issues, the higher level talked would be carry out at the Project director level.

To simplify the line of communication and management hierarchy of the on site team, all parties agreed that the Project co-ordinator engineer was to be the contact person. All information from the Authority to the front line site technicians or vice versa would be done through the communication channel between the

Authority’s site manager, the Contractor’s project co-ordinator engineer, and the Subcontractor’s project manager. It was crucial that the Contractor knew all movements and changes occurred within the Project.

When problems raised in the construction site i.e. the Subcontractor workers failed to follow engineering or construction codes, the Contractor’s technician would report directly to the Project engineer or the Project co-ordinator engineer. The Contractor’s engineers would examine the drawings and determine which approaches to take. Then passed the solutions down to the Subcontractor project manager. Similarly, if the Authority’s staffs oversaw something inappropriate, or construction misconduct, they would report to the Authority’s site manager who informed the Project co-ordinator engineer. The Contractor on site management team would make assessment of the problems and pass the solutions down to the Subcontractor project manager.

Occasionally, the Authority’s staffs and the Subcontractor’s staffs have a direct disagreement i.e. the Authority expected the technical work to be done in a

certain way that the Subcontractor could not conform with. The Subcontractor project manager would report to the Contractor's engineers who would make assessment and negotiate with the Authority if the Contractor and the Subcontractor were unable to do such tasks.

Although, the Contractor management team tried to simplify and set up a clear line of communication and management, in reality it did not go as plan. There were no line of communication or order between the Authority's staffs and the Subcontractor's staffs, but practically they communicated directly with the Subcontractor site manager or its head technicians. As a result, the Contractor team was left out or not being notified of some important information. This problem prolonged through out the project duration and was worsened as the construction progress to a more complex part. The Contractor did not have a full control over the Subcontractor as many informations arrived at its hands later than the Subcontractor did.

The communication problem genuinely proved to be insignificant but it was important to mention when analysing the Project mismanagement scheme. The reason contributed to the miscommunication and the complicated administration, despite the simple set up, was due to two main reasons. First, because this project employed only one major subcontractor. In normal other projects there are a large number of small subcontractors and have no clear contact person. The client usually does not have enough staffs to order or supervise every subcontractor on what tasks to do. Therefore, all information and orders go through the main contractor. But this project has only one major subcontractor with a clear contact person e.g. the Project manager; thus many information and solutions went directly from the Authority to the Subcontractor. Secondly, because both engineers on the Contractor team were not strong enough and lacked of experiences to effectively deal with the Subcontractor. Although both engineers have strong engineering backgrounds but they proved to lack the management skilled required in a large-scale project. They had foreseen the communication problem at the very beginning of the Project but did not take any serious action. They failed to report to the Project director, thus it was quite difficult to regain control. The Contractor management team acknowledged it misused of its staffs toward the closing phase of the Project. The closing phase is always considered to be the most difficult since many engineering and architectural details have to be in place. Once recognised the problem, the Contractor immediately took responsibility and relocated its staffs by sending in one senior engineer and one senior technician who recently finished their supervision works from another project. Both staffs have solid experiences in the construction field as well as possess management skills needed. They proved to provide a strong contribution to the Project.

In fact having one major subcontractor was quite efficient. Since the Contractor required putting in fewer staffs, the overhead cost was also reduced. The communication with the Subcontractor was also simpler because information was being sent to only one person, the Subcontractor project manager. The only thing the Contractor should have done was to send in one senior

staff with a great deal of experience to station onsite. This senior staff should hold a position of a project manager and move to a higher order. The Project co-ordinator engineer and the Project engineer should receive order and report directly to this project manager. The Subcontractor project manager should hold a position of the site manager and report directly to the Contractor staffs.

## Construction Project Management

Construction is a complicated work process. It is easily affected by both internal and external factors. In order to be successful, the management team must continuously and regularly collects all data, information and progress of the project. These data should be used to update the master plan and detail plan. When dealing with a large-scale project, another plan should be developed. This is called the implementation plan or production plan. During the construction process, quality and budget controls are also vital factors.

### Production Plan (Implementation Plan)

For this project, the Contractor was scheduled to submit work done to the Authority every month. Therefore, it adopted the implementation plan on monthly basis. By referring to the Master plan and the detail plan, the Contractor management team examined in detail which tasks had to be finish within each month, then laid out the implementation plan. The implementation plan acted as an actual execution date of each activity. It was a monthly objective for all parties. For example, the Master plan indicated that within the first month, the piling works for building F1-3 and row house E1-E4 must be finished. The detail plan indicated that the piling for each building takes 3 weeks and for each row house takes 1 week. The Contractor team then set up the implementation plan which indicated the actual starting and finishing date of the piling works for each F1-3 building and each E1-E4 row houses within that first month. Since the piling work for each building take 3 weeks and to be able to finish according to the Master plan, the Contractor would need 3 piling drills. Each row house piling work take only 1 week, the Contractor needed only 1 piling drill. However, hiring 3 piling drills were too expensive, thus other alternatives and resources were being considered such as lag times, share facilities and etc. Then, the Contractor management team set up the actual sequencing i.e. which buildings or row houses should start first and which order should the drilling machine move. Before issuing the implementation plan, the Contractor management team also thoroughly examined and analysed other alternatives by taking into consideration budgets and manpower available. Once the implementation plan was finalised, it was being distributed to all onsite staffs including technicians and foremen. The implementation plan was also being used to measure progression of the Project. Theoretically, the Contractor's technicians were required to record the Subcontractor progress daily and compared

the progress to the implementation schedule. They had to provide these update information to the Project co-ordination engineer or the Project engineer who would updated and adjusted the implementation plan as needed.

The project implementation plan is essential in a large-scale project. It is a detail construction management tool. To be able to successfully use the implementation plan, accurate data and information must be fed to the management team. The management team must put in enough time to process all data and analyse to find the best approach possible. Planning the implementation plan is a time consuming process since every construction element is taken into consideration. In reality, technicians regularly miss recording the work progress while the management do not have enough time to process all information daily. Thus, sometime resulting in an unnoticed slip or delayed of the project activity. In order to prevent delays, better tool is needed to help the management team process all data on daily basis. The use of information technology should be adopted more in the management level and probably more staffs should be added to technician's level.

## Quality Assurance

The quality control of this project had been done on various levels before any action was taken place. Referred to the organisation chart, all works done by the Subcontractor were being closely checked and supervised by the Contractor's technicians. The higher level up was the Project engineer who constantly stayed out to check on all construction works. His responsibility was to assure that all works were complied with the construction codes. On top of the Contractor were the Authority's staffs who made the final approvals. In some other project, the main contractor may acts to maximise its benefits and ignores the subcontractor misconduct. Therefore, it is important that the client's staffs are present.

Many forms of paper works have been used to assure that a high quality construction was to be achieved. The Contractor was obliged to test all construction materials as indicated in the contract and the specifications. All materials to be used onsite must be sent to and approved by the Authority head office before being able to use in the project. Extra assurance was required for works related to the critical structure. Since this project was a reinforced concrete building, the concrete structure was critical. Every time before pouring concrete, the Subcontractor's structural technician would check all positions, length, and number of reinforce steels required as well as scaffoldings and form-works. The Subcontractor's M&E technician would check all block out positions for mechanical and electrical parts. The Subcontractor's surveyor technician would check levels and accuracy of all elements. Then the Subcontractor's technician who was in charge of that zone would fill out a requesting form for concrete pouring. The request form was submitted to the Contractor, who in turn, sent out one of its own staffs to re-check the readiness before approving. Once the Contractor approved, the form then would be submitted to the Authority's staffs for a final approval.

It proved to be a long lengthy process, especially when the Contractor or the Authority did not have enough on site staffs. Often, there were many locations ready to be checked at the same time. At the beginning of the project, the Subcontractor had to wait until the Contractor and the Authority approved of the quality i.e. until the form was signed. The approval form went through all channels as mentioned above. However, as the project progress, the Contractor had shown its determination of maintaining a high quality performance. Thus, it earned the respect and trust from the Authority. Moreover, the Subcontractor skilled and expertise were developed and recognised by all parties, as a result flexibility was established.

## Project Monitoring Program

The Project monitoring program had been set up on daily and monthly basis. On the daily basis, the monitoring program was through the daily report. Everyday, the Contractor's technicians was required to submit a written description of work being done in their supervision territories, as well as the number of the Contractor's own labour forces and equipment being used. The climate data was recorded daily since rain might affect the speed of work. The storage/inventory staff would summarise which materials were delivered and in what amount. The Subcontractor was required to categorise and submit the number of its manpower and equipment it used to the Contractor on a daily basis as well. The Contractor's staffs would summarise all of the above information recorded in a daily report. The daily report was being distributed to all parties.

There was no official weekly monitoring program. Normally, the Project co-ordinator engineer and the Project engineer would do their own summary of work progress. This task was done on the implementation plan bar chart. The actual starting and finishing date of each activity was recorded on the bar chart. The Contractor's engineers would compare and analyse the actual recorded bar chart to the Master plan and the detail plan charts. They would determine each particular activity whether it was slower or faster than the plan. If it were slower, they would examine causes and effects on the overall progress of the Project. Then tried to find the best approaches and solutions with the co-operative of the Authority and the Subcontractor.

Since the main contractor usually submitted the work done to the Authority on the monthly basis, the monthly report was the most important one. It contained details information of works done and costs of finished works within that month. The monthly report also summarised history of the Project i.e. the percentage of actual completed works in comparison to the percentage of planned works, the amount of money being reimbursed, the amount of money left to be reimburse. The monthly climate information was recorded. The Master plan bar chart and S-curve were presented with the attached detail comparison of the actual work progress, the planned work progress, the actual accumulation of work done in comparison to the accumulation of the planned work progress. The comparisons provided an over all picture of whether

the actual progression of the Project is faster or slower than the plan.

The monitoring program adopted by the Contractor is quite common in the construction industry. It has proved to work successfully and effectively.

## The Effect of Economic Crisis

The Project really suffered from the impact of the economic crisis in the 13<sup>th</sup> month after the construction started. As mentioned that the Government was unable to support the Authority financially due to the monetary framed set forward by the IMF, thus the Authority asked the Contractor to hold up and reduce the momentum of the Project. As a consequence, the construction period was inevitably extended. The Authority solicited that the Contractor should not reimburse more than 1.5% of the contract cost monthly. In contrast, the Contractor planned to reimbursing on an average of 6-8% of the contract cost after all parties involved in the Project were rectified, which was expected to be from the third month onward. Moreover, no one was able to neither predict nor have a clear answer when the Project could be resumed at its normal rate. The sudden retardation of the Project raised many difficulties, especially in term of managing the overhead costs. As previously mentioned about the highly competitive bidding environment, the Contractor planned for the overhead cost and the management fee to cover only 20 months construction period. It did not add on a large contingency cost or the profits. Therefore to be able to withstand the Project extension period, the Contractor tried to save costs as much as possible. The Contractor asked every party and every single staffs to co-operatively reduce the administrative cost i.e. used recycle paper, saved water and electricity, made less phone call and etc. It also asked the on site technicians to instruct labourers to produce less waste as much as possible i.e. to be more careful with materials handling and to collect waste that could be reused such as form works, wires, nails and etc. Although all of the above measures contributed to an ineligible small fraction of the overhead costs but co-operation was there. As the matter of fact, the only effective way the Contractor could really cut down the overhead costs was through reduction of wages and eventually laid off if the economic crisis did not improve. However, the Contractor's Management Board always beliefs in its philosophy that it is willing to absorb lost in exchange of its employee's well being. As it turned out, the Contractor was one of the very few construction company who successfully withstand the crisis without reducing its employees wages nor laying off one single staff.

The Contractor made adjustment to the Master plan the first time in March 1998, 3 months after the Authority requested to stall the Project. The first adjustment was made following the governmental agreement to extend the construction periods to all governmental projects under construction. The Government understood that most its projects were stalled because it could not afford to pay its contractors during the peak of the economic crisis. By

extending the construction period, the Government reduced cash flows pressure for all construction companies who worked with the governmental organisations. The period of extension was 6 months. The second adjustment came directly from the Authority. The Authority undertaken the responsibility of stalling the Project by granting an extra 5 months extension period. With the total extension period of 11 months, the Contractor had a clearer picture and was able to plan its cash flow accordingly. By granting the construction extension period, the Contractor also has no pressure on time limited and was able to utilise and maximise it available resources. When revised the Master plan, the Contractor planned pessimistically to use up all 11 months. In the actual work environment, all parties and staffs have been trying to finish up the Project before the end of the extended contract in order to save on the overhead costs.

With the trust that the Contractor has gained and the co-operative of all parties and all staffs, the Contractor is expecting to even out on the Project which will be handing over to the Authority in June 1999.

## Conclusion

The Project difficulties were originated from 2 sources: internally and externally factor.

Such internal difficulties were:

- The mismanagement in term of organisational set up which resulted in lost of information and communication linkage. The factor contributed to the difficulty was lack of management skills exhibited by the Contractor on site personnel. The Contractor resolution was to send in 2 senior staffs both of whom possess an interminable experience in the construction field as well as a superb management skill.
- The minimal use of the information technology. Most of the computers were being used for collecting data and information but not for analysing purposes. The factors contributed to this difficulties were due, firstly, to human resistance to adapt and change their original ways of working and, secondly, to a high cost of construction management software. The Contractor management team must continue to force on changes.

Internal difficulties were insignificant and could easily be resolved within the Contractor organisation. However, the significant difficulties were originated from the external factor:

- The economic crisis that strongly affected the whole construction industry, thus resulting in the retardation of the Project, which in turn led to the re-scheduling and the extension of the construction period. The Contractor had to absorb all management costs incurred accordingly.
- The devaluation of the currency that tremendously affected construction materials costs. The Contractor had to find the cheapest way to buy materials through

negotiating on term of payment. The longer term of payment would decrease the cash flow pressure.

- The highly competitive bidding trade which consists of large number of actors, thus resulting in an unreasonable and unpredictable bidding environment.

Unlike difficulties aroused internally, the Contractor was unable to resolve these external aroused intricacies. The roots of the problems came from a much larger scale i.e. the whole construction industry environment, the national crisis, the governmental regulation and etc, that it could not be reach or resolve by one contractor. Being able to successfully survive the harsh crisis, the Contractor tried its best to solve each and every individual problem as it came up. Every day when the Government announced new information, which might affected the construction industry, the Contractor management team analysed, determined and tackled each issue immediately. It was a day by day resolution and there was no way to predict or to prevent. These external difficulties were not raised from the mismanagement or misconduct of the Contractor management team. In fact, there was no other way that the Contractor could have done better. The Master plan, the detail plan and the implementation plan were laid out and re-defined many times as new information emerged.

For any construction company, it is crucial that the management team has an up to date information. It must consistently and continually analyse these up-dated informations. It is also significant that the management team closely supervise all activities within the company. From the past and up to the present, the most essential factor contributed to the success of the Contractor is its human resource. All plans are constructed and all resolutions to problems are achieved through its staffs' long years of experiences and co-operation. Finally, the Contractor management team understands that its staffs are one who will implement all plans, thus it seriously takes into consideration inputs from its employees. Thus, all of its plans and solutions are realistic and achievable.