CHAPTER 4

RESULT AND COMPARISON

The implementation and the results of the existing model and the proposed model will be presented in this chapter. The existing and the proposed model will be implemented for the projects of MD, which are Ratchaburi Thermal Power Plant Project Construction (RTPP) and Krabi Thermal Power Plant Project Construction (KTPP) under the assumption mentioned in Chapter 2. The projects are independent, which means that there is no relation between job activities of the projects while the MD's resource which is pooled resource is used for both projects.

4.1 The Results of Existing Model

The exiting model consists of Demand, Planning, and Allocation. The results of the existing model are shown below. Relevant information which will be used for this model came from daily report. The daily report records all necessary data of work such as name of job activity and its duration, contractor, name and number of inspector, starting and finishing time, etc. The daily report form is shown in Appendix C.

4.1.1 Result of the STEP 1

The job activity, milestone and duration, and budget of the project schedules are reviewed based on the starting and finishing mechanical work schedule. The demanded resource, which usually consists of Chief of mechanical project department (CMPD), Head of project section (HMPS), engineer (ENG.), foreman (FORE.), administrators (ADM.), some inspectors (INS.) were identified in unit and name. CMPD, HMPS, ENG. and FORE, ADM. and some inspectors of the projects were assigned and planned to work along the project schedules. However, there were some remaining inspectors who would be allocated to either project. Therefore, the cost of human resource was estimated due to demand. The cost could be grouped into two types: Standard Rate, and Overtime Rate. The standard rate was an average rate consisting of salary, electricity allowance,

providence allowance, position allowance, fringe benefit and travel cost. The overtime rate was an expenditure occurring when the human resource worked on extra time, e.g., in the morning, at noon, in the evening and during holidays. The multiplying of unit and cost was the estimation of the budget. All cost data come from the Account and Treasury Department and then the cost is calculated to be an averaged cost. The actual numbers of resource allocation demand and allocation are collected from the daily report of the old projects.

4.1.2 Result of the STEP 2

The human resource allocation was planned regarding to the demand by CMPD. The demand caused some resources including the locked resources for the projects, some inspectors, to be assigned to the projects while some remaining resources could still be allocated to either project. However, some inspectors had already been planed to allocate to the project 1 as the first priority because it started before the project 2. Then remaining resources were allocated to the project 2. Later on, when there was additional resource demand for the project 2, some resources that had returned from project 1 to MD after its demand has decreased can be allocated to project 2.

4.1.3 Result of the STEP 3

The resource was allocated following and depending on the projects' demand which was the demand from CMPD. The allocation between MD and the projects occurred when CMPD required or decreased the resource. There were two types of allocation: from MD to the Projects and from the Projects to MD. According to the daily report and verbal interviewing of CMPD and CMPD of old projects of MD, the allocation in this step is a pattern of a practical allocation of MD.

- **MD to Projects**

Typically, the resource was allocated from MD to both projects at the beginning of the projects. First, the locked resource, some inspectors were allocated to project 1 and the allocation of the remaining resource who were inspectors increased when the demand

increased. The resource included the locked resource for the project 1 and the remaining resource for both projects. This method of allocation resulted in lack of resource, the inspectors, for Project 2 when the two projects were overlapping and when the resource demand of project 1 decreased but its CMPD did not allocate the resource back to the MD following the plan. The problems that occur were over supply of resource for the project 1 and shortage of resource for the project 2. The budget of the project 1 was higher than that of the plan. CMPD of the project 2 solved the problems by increasing overtime. During the project construction, relevant information of work was recorded in the daily report. If the resource shortage occurred, over time was established in order to finish work. This caused the extra cost. The shortage of resource was derived from the daily report.

- **Projects to MD**

The resource was allocated from both projects to MD when demands decreased and/or the projects had been finished. In general, the resource of the projects should be allocated to MD when the projects' demand decreased. In this case, although the demand of the project 2 increased, during the overlapping of both projects, the resource was still assigned in project 1 because CMPD of the project 1 did not return the resource to MD. The main reason of the resource assignment was that CMPD considered the finishing date of the last activity as the first priority. Therefore, CMPD's idea is that the more resources, the higher quality of work. That resulted in over supplying of resource in the project 1 after the demand had already decreased and, at the same time, there was already shortage of resource in the project 2 when the demand was higher than the resource available at the project. In addition, the resource was lately allocated to MD because the CMPD still assigned them work in the projects.

According to the results of existing model, chief of mechanical project department, engineer, foreman and administrator were worked from starting to finishing projects. Only inspectors were varied in unit working in the projects. Therefore, the allocation data in terms of unit and cost of the inspector will be used to study.

The actually work and overtime of inspector of each section during the projects' construction is also collected from the daily report. Working time of the resource are

seven days per week (Monday to Friday) and seven hours per day (8 a.m. to 4 p.m.). The unit of the resource is converted into workload value in hour before putting into Microsoft Project Program.

Actual cost of the resource is calculated by multiplying the workload with the averaged cost. Then the actual cost will be compared to the one of the proposed model. The averaged cost of the inspectors: Steam Generator Inspector (SGI), Mechanical Machine Inspector (MMI), Piping Inspector (PI) and Mechanical Equipment Quality Inspector (MEQII) are presented in Table 2.

Table 4.1: Averaged cost of the resources

Item	Position			
	SGI	MMI	PI	MIQII
Salary (Baht/month)	28,000.00	27,000.00	27,500.00	29,000.00
Average Salary (Baht/hr)	133.33	128.57	130.95	138.10
Site Allowance (Baht/day)	500.00	500.00	500.00	500.00
Site Allowance (Baht/hr)	71.43	71.43	71.43	71.43
Providence Fund (Baht/day)	300.00	300.00	300.00	300.00
Providence Fund (Baht/hr)	42.86	42.86	42.86	42.86
Fringe Benefit (Baht/day)	168.00	162.00	165.00	174.00
Fringe Benefit (Baht/hr)	24.00	23.14	23.57	24.86
Standard Rate (Baht/hr)	273.76	268.14	270.95	279.38
Overtime Rate (Baht/hr)	200.00	192.86	196.43	207.14

The result of over supplying of resource did not cause the project 1 to delay because the starting and finishing dates of its job activity was fixed and the activity could be finished on the project schedule by MD's contractor. However, the over supplying resulted in higher cost for project 1. On the other hand, the shortage of resource caused over time

cost occurs in project 2. The actual workload in hour and cost of the plan and allocation of the old projects are put into the Microsoft Project Program.

4.2 Results of Proposed Model

The implementation of the proposed model consists of five steps: Work Scheduling, Resource Assignment, Allocation Plan, Allocation and Monitoring. The results are as follow.

4.2.1 Result of the STEP 1: Work Scheduling

This step starts with Gantt chart which shows job activities in task. Then, the resource demand will be identified in group and number.

Gantt chart which shows the activities of both projects are shown in Appendix A. As the MD is responsible for the project1 and 2, scope of work for the Mechanical Project Department (MPD) is described in Appendix B.

MD has four sections: Steam Generator Section (SGS), Mechanical Machine Section (MMS), Piping Section (PS) and Mechanical Equipment Quality Inspection Section (MEQI). The organization chart of MD is shown in Figure 3.3. Gantt chart which shows the mechanical work schedules of MD is presented in Figure 3.4.

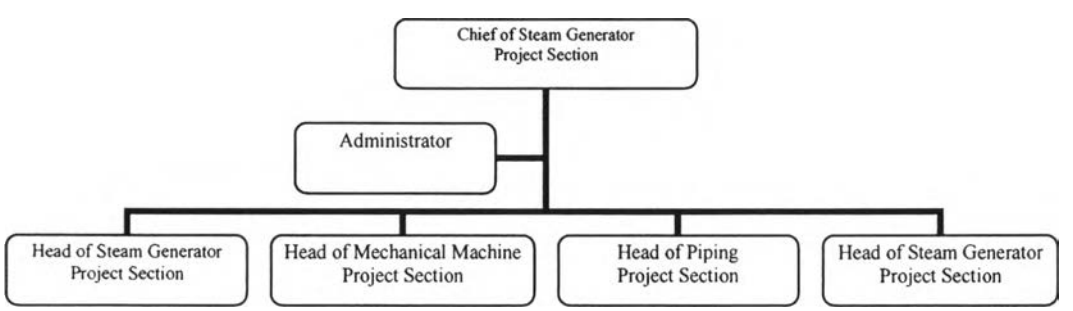
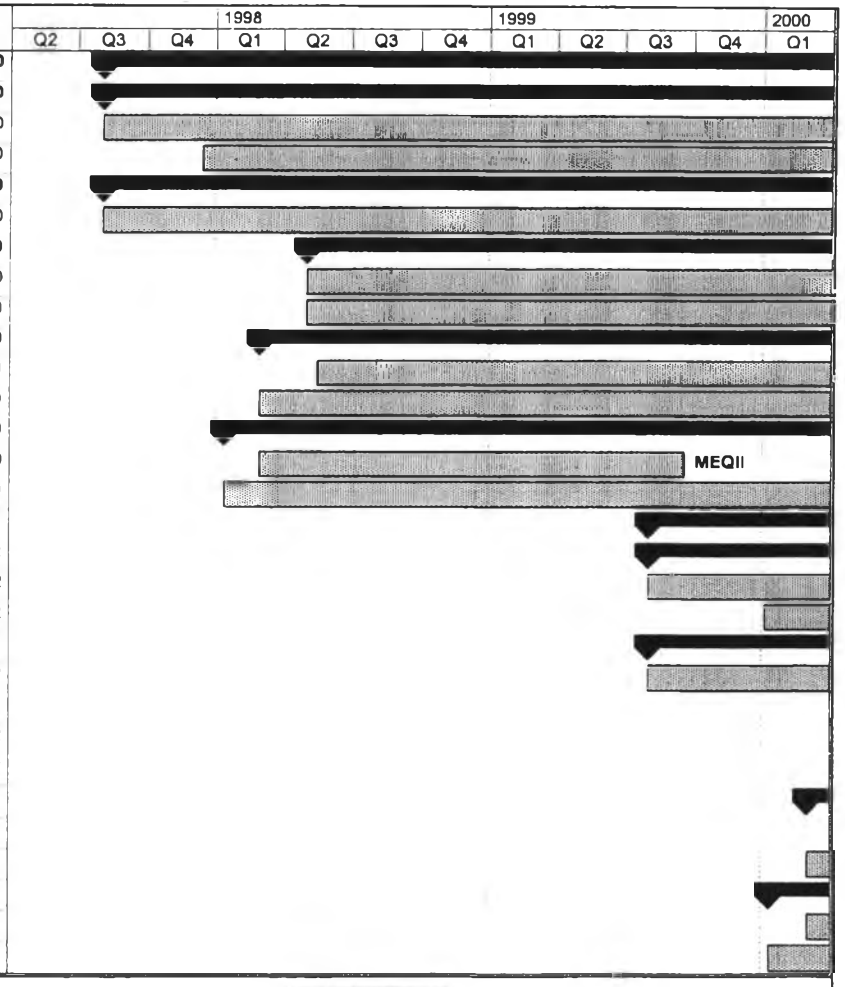


Figure 3.3: Organization chart of MD

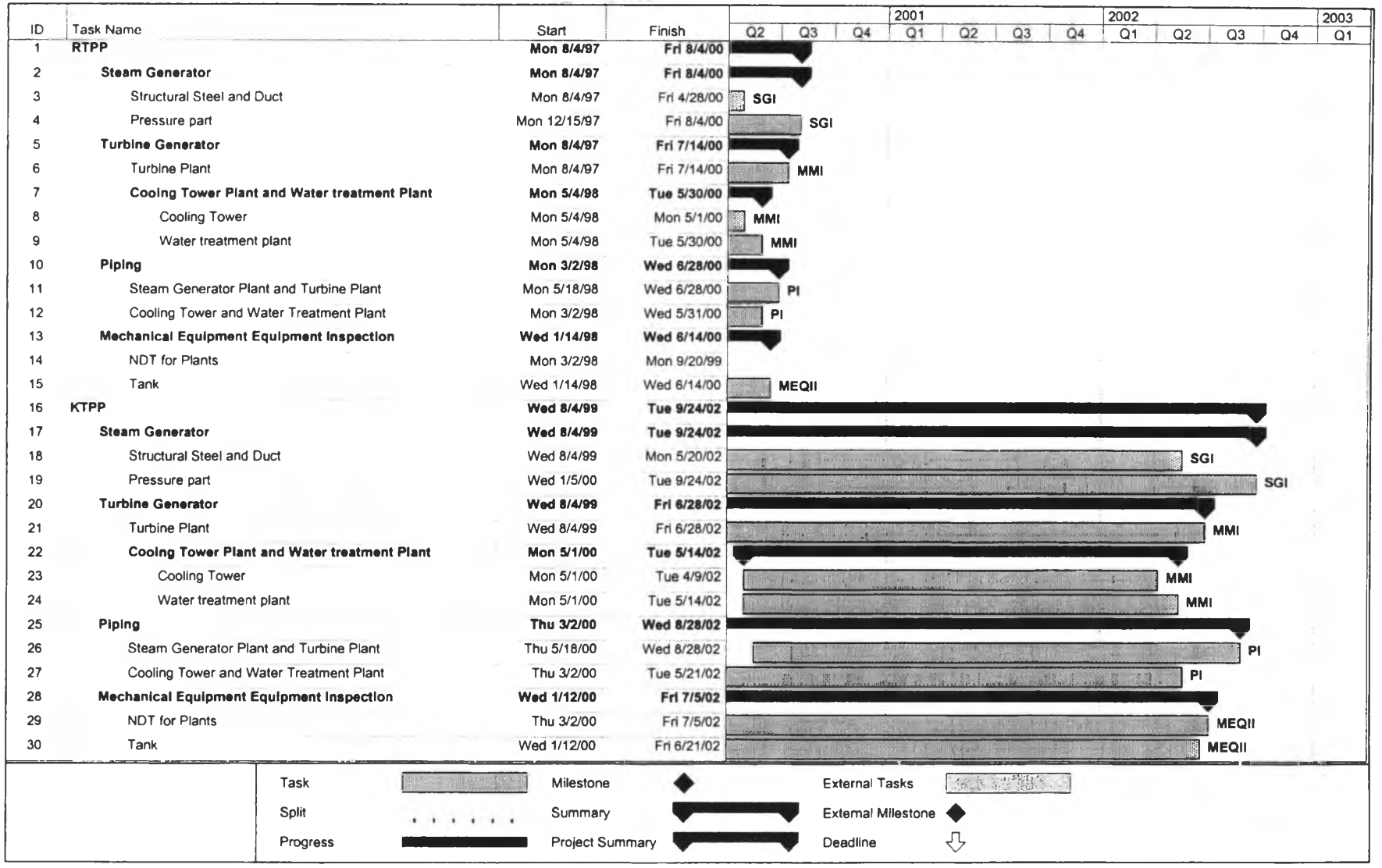
Figure 3.4: Gantt chart of RTPP and KTPP

ID	Task Name	Start	Finish
1	**RTPP**	**Mon 8/4/97**	**Fri 8/4/00**
2	**Steam Generator**	**Mon 8/4/97**	**Fri 8/4/00**
3	Structural Steel and Duct	Mon 8/4/97	Fri 4/28/00
4	Pressure part	Mon 12/15/97	Fri 8/4/00
5	**Turbine Generator**	**Mon 8/4/97**	**Fri 7/14/00**
6	Turbine Plant	Mon 8/4/97	Fri 7/14/00
7	**Cooling Tower Plant and Water treatment Plant**	**Mon 5/4/98**	**Tue 5/30/00**
8	Cooling Tower	Mon 5/4/98	Mon 5/1/00
9	Water treatment plant	Mon 5/4/98	Tue 5/30/00
10	**Piping**	**Mon 3/2/98**	**Wed 6/28/00**
11	Steam Generator Plant and Turbine Plant	Mon 5/18/98	Wed 6/28/00
12	Cooling Tower and Water Treatment Plant	Mon 3/2/98	Wed 5/31/00
13	**Mechanical Equipment Equipment Inspection**	**Wed 1/14/98**	**Wed 6/14/00**
14	NDT for Plants	Mon 3/2/98	Mon 9/20/99
15	Tank	Wed 1/14/98	Wed 6/14/00
16	**KTPP**	**Wed 8/4/99**	**Tue 9/24/02**
17	**Steam Generator**	**Wed 8/4/99**	**Tue 9/24/02**
18	Structural Steel and Duct	Wed 8/4/99	Mon 5/20/02
19	Pressure part	Wed 1/5/00	Tue 9/24/02
20	**Turbine Generator**	**Wed 8/4/99**	**Fri 6/28/02**
21	Turbine Plant	Wed 8/4/99	Fri 6/28/02
22	**Cooling Tower Plant and Water treatment Plant**	**Mon 5/1/00**	**Tue 5/14/02**
23	Cooling Tower	Mon 5/1/00	Tue 4/9/02
24	Water treatment plant	Mon 5/1/00	Tue 5/14/02
25	**Piping**	**Thu 3/2/00**	**Wed 8/28/02**
26	Steam Generator Plant and Turbine Plant	Thu 5/18/00	Wed 8/28/02
27	Cooling Tower and Water Treatment Plant	Thu 3/2/00	Tue 5/21/02
28	**Mechanical Equipment Equipment Inspection**	**Wed 1/12/00**	**Fri 7/5/02**
29	NDT for Plants	Thu 3/2/00	Fri 7/5/02
30	Tank	Wed 1/12/00	Fri 6/21/02



Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

Figure 3.4: Gantt chart of RTPP and KTPP



At present, there is no framework document of the human resource management. Therefore, the framework should be created to identify the resource groups. However, the framework of MD can be clarified from information of the previous projects. The framework used in this study consists of four groups which conform to the working sections.

- **Steam Generator Project Section (SGPS)**

This section takes the responsibility of construction, supervision and installation of steam generator plant including structural steel, ducting, boiler and high pressure vessels which is pressure part such as tube and non pressure part such boiler components and insulation.

- **Mechanical Machine Project Section (MMPS)**

This section is responsible for mechanical equipment construction, supervision and installation of mechanical equipment for thermal power plant, e.g., steam turbine and generator, water treatment plant, cooling tower and (HVAC) system.

- **Piping Project Section (PPS)**

The scope of work of this section consists of construction, supervision and installation of piping system for thermal power plant including steam piping, water piping, oil piping and gas piping systems.

- **Mechanical Equipment Quality Inspection Project Section (MEQI)**

This section provides services in nondestructive testing of welding work in compliance with international code and standard in the field of thermal power plant construction work.

Resource demand

There are six groups of MD's personnel: Chief of Mechanical Project Department (CMPD), Head of Project Section (HPS), Engineer, Foreman, Inspector and

Administrator. The personnel of the resource demand MD is combined and look for the resource usage. Number of the resource is arranged following the combined resource usage of the projects. It means the resources are constrained. Moreover, the resource usage of the combined projects for the proposed model is the same group and number and its cost as of the exiting model. Therefore, it can be said that the environment in term of the resource usage is not different between both models. Details of the personnel in unit and their costs are the same as that of the existing model.

- **Chief of Mechanical Project Department (CMPD)**

This person is a mechanical department leader who creates and also manages a mechanical project department tentative time schedule in order that it meets the target goals in terms of time and cost. The chief also has control of resource management, e.g., manpower, money, equipment and materials, and management process of MD. Therefore, the chief should have both managerial and technical knowledge and experiences relating to MD's scope of work.

- **Head of Project Section (HPS)**

This person is responsible for a section under CMPD. The head creates and manages a section's tentative time schedule conforming to MD's schedule. The head works under CMPD and manage the work of engineers, foremen and inspectors in the section. The head should have knowledge and experience on the project section work.

- **Administrator (ADM.)**

This person has a supporting role in the office including documentation, inventory, transportation and overhead costs, which are mainly staff costs of the personnel in MD such as salary, benefits, overtime cost, travel cost, etc.

- **Engineer (ENG.)**

This person supervises specific disciplines of section's work to ensure that the mechanical equipment is assembled and installed in accordance with the relevant drawing and specification obligations. The engineer is under HMPS and manages the work of foremen and inspectors so that he should have knowledge and experiences, especially technical, in the section's work.

The engineer reports to HPS and reviews data and drawings, calculations, layouts, and other requirements related to mechanical aspects as to be submitted by the contractors and as required by the project. In addition the engineer provides recommendations and preparation of contract variation and change orders, if any.

- **Foreman (FORE.)**

This person follows an engineer's plan and manages inspectors' work whose job is always working on site. Foreman should have knowledge and experiences in mechanical assembly, installation inspection and managing inspectors.

- **Inspector (INS.)**

This person works by following an engineer's plan under a foreman and has direct contacts to MD's contractors at site. Therefore, the inspector should have knowledge and experiences in mechanical equipment assembly and installation inspection.

4.2.2 Result of the STEP 2: Resource Assignment

The resource demand in position and unit of each project is determined. Then the resource availability is group and number. Finally, the resource availability will be assigned for the projects according to the demand.

4.2.3 Result of the STEP 3: Allocation Plan

In this step, the CMD and CMPDs are involved in planning so that the plan closely represents the demand. There are four types of allocations which are from MD to Project 1 and 2, Internal Allocation, Project 1 and Project 2, and Project 1 and 2 to MD.

1. **MD to Project 1 and 2**

At the beginning, the resource is planed to allocate to Project 1 and the allocation will be increased as the Project proceeds and its allocation increased according to the demand. The resource is also planed to allocate to Project 2 when there is demand at the beginning of Project 2. Therefore, CMPD, HMPS, ENG., FORE., ADM., who are fixed for both projects, some inspectors are planed to allocate to the projects when their demands occurred.

2. **Project 1 and Project 2**

During the overlapping of Project 1 and Project 2 and when demand of Project 1 decreases, the resource who is inspector will be allocated from Project 1 to Project 2. The decrease of demand for inspectors resulting in reduction of their number from Project 1 and allocation of some as needed to Project 2.

3. **Internal Allocation**

When the work activities changed the resource who is inspector will be allocated from one to the other activities within Project.

4. **Project 1 and 2 to the MD**

When the demand of both projects decrease after the job activity or the Projects have been finished, the resource will be allocated back to MD. The CMPD, HMPS, ENG., FORE., ADM., the inspectors, who finish their job activities and there are not inspector's

demand from Project 2, of Project 1 and the resource of Project 2 who finish their job activities will be allocated to the MD.

4.2.4 Result of the STEP 4: Allocation

The resource is allocated according to the allocation plan. Most of the resource is allocated to Project 1 and then to Project 2 when the demand of resource for Project 1 has decreased and the job activity is over. Chief of Mechanical Project Department (CMPD), Head of Mechanical Project Section (HMPS), engineer (ENG.), foreman (FORE.) and administrator (ADM.) are allocated to the projects specifically in name and number at the very early stage of planning whereas the name and number of inspectors do not have to be fixed until later on. The fixed resources are necessary to manage and work throughout the projects from the projects' starting to finishing dates. Inspectors of each section can then be allocated to the projects accordingly.

4.2.5 Result of the STEP 5: Monitoring

The allocation is monitored all the time against the change of demand in case the mechanical schedule changed. Changes occur when demand is changed and the allocation is adjusted following the allocation step. Number of the resource allocation is evaluated comparing to the demand.

4.3 The result of Existing and Proposed Model Implementation

The results of implementation for the existing and the proposed model has shown the resource demand and actual allocation includes an actual data of human resource demand and cost of the finished projects, which are from 4 August 1997 to 4 August 2000 and from 4 August 1999 to24 September 2002 of RTPP and KTPP, respectively. The resource allocation and cost of both models are different. Actual resource allocation and cost of the existing model are illustrated in Table 4.2 and 4.3, respectively. The demand, the allocation and their costs of the proposed model implementation are the same as that of the existing model because a maximum peak which is the highest number of the resource usage at each time could be allocated to fulfill the demand by following the proposed

model. Therefore, the resource allocation and cost of the proposed model is the same as the demand in position and unit as presented in Table 4.4 and 4.5, respectively.

Table 4.2: The resource utilization of the existing model

	Jul '97	Aug '97	Sep '97	Oct '97	Nov '97	Dec '97	Jan '98	Feb '98	Mar '98	Apr '98	May '98	Jun '98	Jul '98
Steam Generator Inspector		3	3	3	5	9	11	11	11	11	14	15	15
Structural Steel and Duct		3	3	3	5	5	5	5	5	5	6	6	6
Pressure part						4	6	6	6	6	8	9	9
Structural Steel and Duct													
Pressure part													
Mechanical Machine Inspector		3	8	8	8	8	8	8	11	11	15	26	32
Turbine Plant		3	8	8	8	8	8	8	11	11	7	14	17
Cooling Tower											3	4	6
Water treatment plant											5	8	9
Turbine Plant													
Cooling Tower													
Water treatment plant													
Piping Inspector									5	5	11	20	22
Steam Generator Plant and Turbine Plant											6	12	13
Cooling Tower and Water Treatment Plant									5	5	5	8	9
Steam Generator Plant and Turbine Plant													
Cooling Tower and Water Treatment Plant													
MEQI Inspector							4	4	9	12	12	19	21
NDT for Plants									3	4	4	7	8
Tank							4	4	6	8	8	12	13
NDT for Plants													
Tank													
Total		6	11	11	13	17	23	23	36	39	52	80	90

Table 4.2: The resource utilization of the existing model

	Aug '98	Sep '98	Oct '98	Nov '98	Dec '98	Jan '99	Feb '99	Mar '99	Apr '99	May '99	Jun '99	Jul '99	Aug '99
Steam Generator Inspector	17	17	17	20	20	20	20	20	20	20	20	20	22
Structural Steel and Duct	7	7	7	9	9	9	9	9	9	9	9	9	9
Pressure part	10	10	10	11	11	11	11	11	11	11	11	11	11
Structural Steel and Duct													2
Pressure part													
Mechanical Machine Inspector	37	39	41	44	46	46	48	48	48	48	48	48	48
Turbine Plant	19	20	21	22	23	23	24	24	24	24	24	24	24
Cooling Tower	8	8	8	8	9	9	9	9	9	9	9	9	9
Water treatment plant	10	11	12	14	14	14	15	15	15	15	15	15	14
Turbine Plant													1
Cooling Tower													
Water treatment plant													
Piping Inspector	25	25	28	29	31	31	31	31	31	31	31	31	31
Steam Generator Plant and Turbine Plant	14	14	16	17	18	18	18	18	18	18	18	18	18
Cooling Tower and Water Treatment Plant	11	11	12	12	13	13	13	13	13	13	13	13	13
Steam Generator Plant and Turbine Plant													
Cooling Tower and Water Treatment Plant													
MEQI Inspector	21	22	23	23	23	23	23	23	23	21	21	21	21
NDT for Plants	8	8	9	9	9	8	8	8	8	6	6	7	7
Tank	13	14	14	14	14	15	15	15	15	15	15	14	14
NDT for Plants													
Tank													
Total	100	103	109	116	120	120	122	122	122	120	120	120	122

Table 4.2: The resource utilization of the existing model

	Sep '99	Oct '99	Nov '99	Dec '99	Jan '00	Feb '00	Mar '00	Apr '00	May '00	Jun '00	Jul '00	Aug '00	Sep '00
Steam Generator Inspector	22	22	23	23	26	27	27	24	19	20	19	18	10
Structural Steel and Duct	9	9	9	9	9	9	9	9					
Pressure part	11	11	11	11	11	11	11	8	10	10	8	6	
Structural Steel and Duct	2	2	3	3	3	4	4	4	4	4	5	5	5
Pressure part					3	3	3	3	5	6	6	7	5
Mechanical Machine Inspector	52	52	51	50	46	42	40	34	36	32	30	27	30
Turbine Plant	24	24	24	23	20	18	18	14	14	12	7		
Cooling Tower	8	8	8	8	8	7	6	5	1				
Water treatment plant	14	14	13	13	12	10	9	7	6				
Turbine Plant	6	6	6	6	6	7	7	8	8	8	9	10	12
Cooling Tower									3	5	7	9	9
Water treatment plant									4	7	7	8	9
Piping Inspector	31	31	31	31	31	31	35	29	29	24	16	18	19
Steam Generator Plant and Turbine Plant	18	18	18	18	18	18	18	14	12	10			
Cooling Tower and Water Treatment Plant	13	13	13	13	13	13	13	11	9				
Steam Generator Plant and Turbine Plant									4	8	9	10	10
Cooling Tower and Water Treatment Plant							4	4	4	6	7	8	9
MEQI Inspector	21	21	21	21	20	16	21	21	16	16	15	16	17
NDT for Plants	7												
Tank	14	21	21	21	18	14	14	12	6	4			
NDT for Plants							4	6	6	8	9	10	10
Tank					2	2	3	3	4	4	6	6	7
Total	126	126	126	125	123	116	123	108	100	92	80	79	76

Table 4.2: The resource utilization of the existing model

	Oct '00	Nov '00	Dec '00	Jan '01	Feb '01	Mar '01	Apr '01	May '01	Jun '01	Jul '01	Aug '01	Sep '01	Oct '01
Steam Generator Inspector	13	14	15	15	15	15	15	15	15	15	15	15	16
Structural Steel and Duct													
Pressure part													
Structural Steel and Duct	5	5	6	6	6	6	6	6	6	6	6	6	7
Pressure part	8	9	9	9	9	9	9	9	9	9	9	9	9
Mechanical Machine Inspector	32	33	34	36	37	39	39	39	39	39	39	39	39
Turbine Plant													
Cooling Tower													
Water treatment plant													
Turbine Plant	14	15	15	15	15	16	16	16	16	16	16	16	16
Cooling Tower	9	9	9	9	9	10	10	10	10	10	10	10	10
Water treatment plant	9	9	10	12	13	13	13	13	13	13	13	13	13
Piping Inspector	20	23	26	27	27	27	27	27	28	28	28	28	28
Steam Generator Plant and Turbine Plant													
Cooling Tower and Water Treatment Plant													
Steam Generator Plant and Turbine Plant	10	12	14	14	14	14	14	14	15	15	15	15	15
Cooling Tower and Water Treatment Plant	10	11	12	13	13	13	13	13	13	13	13	13	13
MEQI Inspector	18	19	20	20	20	20	20	20	20	19	19	19	19
NDT for Plants													
Tank													
NDT for Plants	10	11	12	12	12	12	12	12	12	11	11	11	11
Tank	8	8	8	8	8	8	8	8	8	8	8	8	8
Total	83	89	95	98	99	101	101	101	102	101	101	101	102

Table 4.2: The resource utilization of the existing model

	Nov '01	Dec '01	Jan '02	Feb '02	Mar '02	Apr '02	May '02	Jun '02	Jul '02	Aug '02	Sep '02	Total
Steam Generator Inspector	16	16	16	16	15	15	14	8	7	6	4	970
Structural Steel and Duct												240
Pressure part												313
Structural Steel and Duct	7	7	7	7	6	6	5					172
Pressure part	9	9	9	9	9	9	9	8	7	6	4	245
Mechanical Machine Inspector	39	38	32	29	23	18	15	5				1,940
Turbine Plant												605
Cooling Tower												185
Water treatment plant												299
Turbine Plant	16	16	16	15	11	9	9	5				399
Cooling Tower	10	9	7	6	5	2						197
Water treatment plant	13	13	9	8	7	7	6					255
Piping Inspector	28	28	28	28	26	19	15	9	4	2		1,336
Steam Generator Plant and Turbine Plant												416
Cooling Tower and Water Treatment Plant												306
Steam Generator Plant and Turbine Plant	15	15	15	15	15	12	10	9	4	2		334
Cooling Tower and Water Treatment Plant	13	13	13	13	11	7	5					280
MEQI Inspector	18	17	16	15	14	13	9	5	3			974
NDT for Plants												134
Tank												387
NDT for Plants	11	10	10	9	9	9	6	3	3			272
Tank	7	7	6	6	5	4	3	2				181
Total	101	99	92	88	78	65	53	27	14	8	4	5,220

Table 4.3: Cost of the existing model

	Jul '97	Aug '97	Sep '97	Oct '97	Nov '97	Dec '97
Steam Generator Inspector		131,404.80B	144,545.28B	151,115.52B	219,008.00B	365,743.36B
Structural Steel and Duct		131,404.80B	144,545.28B	151,115.52B	219,008.00B	251,859.20B
Pressure part						113,884.16B
Structural Steel and Duct						
Pressure part						
Mechanical Machine Inspector		128,707.20B	377,541.12B	394,702.08B	343,219.20B	394,702.08B
Turbine Plant		128,707.20B	377,541.12B	394,702.08B	343,219.20B	394,702.08B
Cooling Tower						
Water treatment plant						
Turbine Plant						
Cooling Tower						
Water treatment plant						
Piping Inspector						
Steam Generator Plant and Turbine Plant						
Cooling Tower and Water Treatment Plant						
Steam Generator Plant and Turbine Plant						
Cooling Tower and Water Treatment Plant						
MEQI Inspector						
NDT for Plants						
Tank						
NDT for Plants						
Tank						
Total		260,112.00B	522,086.40B	545,817.60B	562,227.20B	760,445.44B

Table 4.3: Cost of the existing model

	Jan '98	Feb '98	Mar '98	Apr '98	May '98	Jun '98	Jul '98
Steam Generator Inspector	529,999.36B	481,817.60B	529,999.36B	529,999.36B	643,883.52B	722,726.40B	755,577.60B
Structural Steel and Duct	240,908.80B	219,008.00B	240,908.80B	240,908.80B	275,950.08B	289,090.56B	302,231.04B
Pressure part	289,090.56B	262,809.60B	289,090.56B	289,090.56B	367,933.44B	433,635.84B	453,346.56B
Structural Steel and Duct							
Pressure part							
Mechanical Machine Inspector	377,541.12B	343,219.20B	519,119.04B	519,119.04B	658,551.84B	1,227,008.64B	1,578,808.32B
Turbine Plant	377,541.12B	343,219.20B	519,119.04B	519,119.04B	315,332.64B	660,696.96B	838,741.92B
Cooling Tower					128,707.20B	188,770.56B	296,026.56B
Water treatment plant					214,512.00B	377,541.12B	444,039.84B
Turbine Plant							
Cooling Tower							
Water treatment plant							
Piping Inspector			238,436.00B	238,436.00B	357,654.00B	953,744.00B	1,096,805.60B
Steam Generator Plant and Turbine Plant					130,056.00B	572,246.40B	648,112.40B
Cooling Tower and Water Treatment Plant			238,436.00B	238,436.00B	227,598.00B	381,497.60B	448,693.20B
Steam Generator Plant and Turbine Plant							
Cooling Tower and Water Treatment Plant							
MEQI Inspector	116,222.08B	178,803.20B	442,537.92B	590,050.56B	563,230.08B	934,246.72B	1,079,524.32B
NDT for Plants			147,512.64B	196,683.52B	187,743.36B	344,196.16B	411,247.36B
Tank	116,222.08B	178,803.20B	295,025.28B	393,367.04B	375,486.72B	590,050.56B	668,276.96B
NDT for Plants							
Tank							
Total	1,023,762.56B	1,003,840.00B	1,730,092.32B	1,877,604.96B	2,223,319.44B	3,837,725.76B	4,510,715.84B

Table 4.3: Cost of the existing model

	Aug '98	Sep '98	Oct '98	Nov '98	Dec '98	Jan '99	Feb '99
Steam Generator Inspector	781,858.56B	819,089.92B	819,089.92B	919,833.60B	1,007,436.80B	919,833.60B	876,032.00B
Structural Steel and Duct	321,941.76B	337,272.32B	337,272.32B	413,925.12B	453,346.56B	413,925.12B	394,214.40B
Pressure part	459,916.80B	481,817.60B	481,817.60B	505,908.48B	554,090.24B	505,908.48B	481,817.60B
Structural Steel and Duct							
Pressure part							
Mechanical Machine Inspector	1,666,758.24B	1,840,512.96B	1,934,898.24B	1,982,090.88B	2,269,536.96B	2,072,185.92B	2,059,315.20B
Turbine Plant	855,902.88B	943,852.80B	991,045.44B	991,045.44B	1,134,768.48B	1,036,092.96B	1,029,657.60B
Cooling Tower	360,380.16B	377,541.12B	377,541.12B	360,380.16B	444,039.84B	405,427.68B	386,121.60B
Water treatment plant	450,475.20B	519,119.04B	566,311.68B	630,665.28B	690,728.64B	630,665.28B	643,536.00B
Turbine Plant							
Cooling Tower							
Water treatment plant							
Piping Inspector	1,137,990.00B	1,192,180.00B	1,335,241.60B	1,320,068.40B	1,545,498.80B	1,411,107.60B	1,343,912.00B
Steam Generator Plant and Turbine Plant	637,274.40B	667,620.80B	762,995.20B	773,833.20B	897,386.40B	819,352.80B	780,336.00B
Cooling Tower and Water Treatment Plant	500,715.60B	524,559.20B	572,246.40B	546,235.20B	648,112.40B	591,754.80B	563,576.00B
Steam Generator Plant and Turbine Plant							
Cooling Tower and Water Treatment Plant							
MEQI Inspector	985,652.64B	1,081,759.36B	1,130,930.24B	1,079,524.32B	1,182,336.16B	1,079,524.32B	1,028,118.40B
NDT for Plants	375,486.72B	393,367.04B	442,537.92B	422,422.56B	462,653.28B	375,486.72B	357,606.40B
Tank	610,165.92B	688,392.32B	688,392.32B	657,101.76B	719,682.88B	704,037.60B	670,512.00B
NDT for Plants							
Tank							
Total	4,572,259.44B	4,933,542.24B	5,220,160.00B	5,301,517.20B	6,004,808.72B	5,482,651.44B	5,307,377.60B

Table 4.3: Cost of the existing model

	Mar '99	Apr '99	May '99	Jun '99	Jul '99	Aug '99
Steam Generator Inspector	1,007,436.80B	963,635.20B	919,833.60B	963,635.20B	963,635.20B	1,051,238.40B
Structural Steel and Duct	453,346.56B	433,635.84B	413,925.12B	433,635.84B	433,635.84B	433,635.84B
Pressure part	554,090.24B	529,999.36B	505,908.48B	529,999.36B	529,999.36B	529,999.36B
Structural Steel and Duct						87,603.20B
Pressure part						
Mechanical Machine Inspector	2,368,212.48B	2,265,246.72B	2,162,280.96B	2,265,246.72B	2,265,246.72B	2,325,310.08B
Turbine Plant	1,184,106.24B	1,132,623.36B	1,081,140.48B	1,132,623.36B	1,132,623.36B	1,132,623.36B
Cooling Tower	444,039.84B	424,733.76B	405,427.68B	424,733.76B	424,733.76B	424,733.76B
Water treatment plant	740,066.40B	707,889.60B	675,712.80B	707,889.60B	707,889.60B	660,696.96B
Turbine Plant						107,256.00B
Cooling Tower						
Water treatment plant						
Piping Inspector	1,545,498.80B	1,478,303.20B	1,411,107.60B	1,478,303.20B	1,478,303.20B	1,478,303.20B
Steam Generator Plant and Turbine Plant	897,386.40B	858,369.60B	819,352.80B	858,369.60B	858,369.60B	858,369.60B
Cooling Tower and Water Treatment Plant	648,112.40B	619,933.60B	591,754.80B	619,933.60B	619,933.60B	619,933.60B
Steam Generator Plant and Turbine Plant						
Cooling Tower and Water Treatment Plant						
MEQI Inspector	1,182,336.16B	1,130,930.24B	985,652.64B	1,032,588.48B	1,032,588.48B	1,032,588.48B
NDT for Plants	411,247.36B	393,367.04B	281,615.04B	295,025.28B	344,196.16B	344,196.16B
Tank	771,088.80B	737,563.20B	704,037.60B	737,563.20B	688,392.32B	688,392.32B
NDT for Plants						
Tank						
Total	6,103,484.24B	5,838,115.36B	5,478,874.80B	5,739,773.60B	5,739,773.60B	5,887,440.16B

Table 4.3: Cost of the existing model

	Sep '99	Oct '99	Nov '99	Dec '99	Jan '00	Feb '00
Steam Generator Inspector	1,059,998.72B	1,011,816.96B	1,180,453.12B	1,234,110.08B	1,376,465.28B	1,379,750.40B
Structural Steel and Duct	433,635.84B	413,925.12B	433,635.84B	453,346.56B	413,925.12B	413,925.12B
Pressure part	529,999.36B	505,908.48B	529,999.36B	554,090.24B	505,908.48B	505,908.48B
Structural Steel and Duct	96,363.52B	91,983.36B	216,817.92B	226,673.28B	206,962.56B	183,966.72B
Pressure part					249,669.12B	275,950.08B
Mechanical Machine Inspector	2,524,806.24B	2,410,042.32B	2,477,613.60B	2,540,894.64B	2,139,757.20B	1,891,995.84B
Turbine Plant	1,132,623.36B	1,081,140.48B	1,132,623.36B	1,134,768.48B	900,950.40B	810,855.36B
Cooling Tower	377,541.12B	360,380.16B	377,541.12B	394,702.08B	360,380.16B	315,332.64B
Water treatment plant	660,696.96B	630,665.28B	613,504.32B	641,390.88B	540,570.24B	450,475.20B
Turbine Plant	353,944.80B	337,856.40B	353,944.80B	370,033.20B	337,856.40B	315,332.64B
Cooling Tower						
Water treatment plant						
Piping Inspector	1,478,303.20B	1,411,107.60B	1,478,303.20B	1,545,498.80B	1,411,107.60B	1,411,107.60B
Steam Generator Plant and Turbine Plant	858,369.60B	819,352.80B	858,369.60B	897,386.40B	819,352.80B	819,352.80B
Cooling Tower and Water Treatment Plant	619,933.60B	591,754.80B	619,933.60B	648,112.40B	591,754.80B	591,754.80B
Steam Generator Plant and Turbine Plant						
Cooling Tower and Water Treatment Plant						
MEQI Inspector	907,426.24B	985,652.64B	1,032,588.48B	1,079,524.32B	954,362.08B	821,377.20B
NDT for Plants	219,033.92B					
Tank	688,392.32B	985,652.64B	1,032,588.48B	1,079,524.32B	844,845.12B	657,101.76B
NDT for Plants						
Tank					109,516.96B	164,275.44B
Total	5,970,534.40B	5,818,619.52B	6,168,958.40B	6,400,027.84B	5,881,692.16B	5,504,231.04B

Table 4.3: Cost of the existing model

	Mar '00	Apr '00	May '00	Jun '00	Jul '00	Aug '00
Steam Generator Inspector	1,511,155.20B	1,182,643.20B	1,108,180.48B	1,108,180.48B	942,829.44B	808,139.52B
Structural Steel and Duct	453,346.56B	394,214.40B				
Pressure part	554,090.24B	350,412.80B	503,718.40B	481,817.60B	367,933.44B	52,561.92B
Structural Steel and Duct	201,487.36B	175,206.40B	277,045.12B	264,999.68B	229,958.40B	327,416.96B
Pressure part	302,231.04B	262,809.60B	327,416.96B	361,363.20B	344,937.60B	428,160.64B
Mechanical Machine Inspector	2,047,517.04B	1,587,388.80B	1,790,102.64B	1,651,742.40B	1,456,536.48B	1,628,146.08B
Turbine Plant	888,079.68B	600,633.60B	690,728.64B	566,311.68B	150,158.40B	
Cooling Tower	296,026.56B	214,512.00B	2,145.12B			
Water treatment plant	444,039.84B	300,316.80B	283,155.84B			
Turbine Plant	419,370.96B	471,926.40B	394,702.08B	448,330.08B	608,141.52B	789,404.16B
Cooling Tower			222,019.92B	306,752.16B	382,903.92B	444,039.84B
Water treatment plant			197,351.04B	330,348.48B	315,332.64B	394,702.08B
Piping Inspector	1,736,247.60B	1,257,208.00B	1,407,856.20B	1,172,671.60B	796,593.00B	1,046,950.80B
Steam Generator Plant and Turbine Plant	897,386.40B	606,928.00B	598,257.60B	433,520.00B		
Cooling Tower and Water Treatment Plant	648,112.40B	476,872.00B	448,693.20B			
Steam Generator Plant and Turbine Plant			86,704.00B	381,497.60B	409,676.40B	498,548.00B
Cooling Tower and Water Treatment Plant	190,748.80B	173,408.00B	274,201.40B	357,654.00B	386,916.60B	548,402.80B
MEQI Inspector	1,147,693.04B	1,072,819.20B	899,603.60B	900,721.12B	844,845.12B	976,712.48B
NDT for Plants						
Tank	719,682.88B	536,409.60B	308,435.52B	89,401.60B		
NDT for Plants	196,683.52B	268,204.80B	308,435.52B	393,367.04B	422,422.56B	514,059.20B
Tank	231,326.64B	268,204.80B	282,732.56B	417,952.48B	422,422.56B	462,653.28B
Total	6,442,612.88B	5,100,059.20B	5,205,742.92B	4,833,315.60B	4,040,804.04B	4,459,948.88B

Table 4.3: Cost of the existing model

	Sep '00	Oct '00	Nov '00	Dec '00	Jan '01	Feb '01	Mar '01
Steam Generator Inspector	735,866.88B	698,635.52B	891,362.56B	827,850.24B	906,693.12B	788,428.80B	939,544.32B
Structural Steel and Duct							
Pressure part							
Structural Steel and Duct	298,945.92B	313,181.44B	385,454.08B	344,937.60B	377,788.80B	328,512.00B	361,363.20B
Pressure part	436,920.96B	385,454.08B	505,908.48B	482,912.64B	528,904.32B	459,916.80B	578,181.12B
Mechanical Machine Inspector	1,554,139.44B	1,722,531.36B	1,769,724.00B	1,801,900.80B	2,072,185.92B	1,909,156.80B	1,982,090.88B
Turbine Plant							
Cooling Tower							
Water treatment plant							
Turbine Plant	743,284.08B	802,274.88B	778,678.56B	810,855.36B	888,079.68B	836,596.80B	896,660.16B
Cooling Tower	405,427.68B	495,522.72B	566,311.68B	540,570.24B	592,053.12B	514,828.80B	471,926.40B
Water treatment plant	405,427.68B	424,733.76B	424,733.76B	450,475.20B	592,053.12B	557,731.20B	613,504.32B
Piping Inspector	933,151.80B	1,025,274.80B	1,168,336.40B	1,251,789.00B	1,346,079.60B	1,170,504.00B	1,287,554.40B
Steam Generator Plant and Turbine Plant							
Cooling Tower and Water Treatment Plant							
Steam Generator Plant and Turbine Plant	455,196.00B	476,872.00B	572,246.40B	637,274.40B	697,967.20B	606,928.00B	667,620.80B
Cooling Tower and Water Treatment Plant	477,955.80B	548,402.80B	596,090.00B	614,514.60B	648,112.40B	563,576.00B	619,933.60B
MEQI Inspector	868,313.04B	885,075.84B	934,246.72B	938,716.80B	1,028,118.40B	894,016.00B	983,417.60B
NDT for Plants							
Tank							
NDT for Plants	469,358.40B	491,708.80B	540,879.68B	563,230.08B	616,871.04B	536,409.60B	590,050.56B
Tank	398,954.64B	393,367.04B	393,367.04B	375,486.72B	411,247.36B	357,606.40B	393,367.04B
Total	4,091,471.16B	4,331,517.52B	4,763,669.68B	4,820,256.84B	5,353,077.04B	4,762,105.60B	5,192,607.20B

Table 4.3: Cost of the existing model

	Apr '01	May '01	Jun '01	Jul '01	Aug '01	Sep '01
Steam Generator Inspector	896,837.76B	906,693.12B	827,850.24B	867,271.68B	906,693.12B	788,428.80B
Structural Steel and Duct						
Pressure part						
Structural Steel and Duct	344,937.60B	377,788.80B	344,937.60B	361,363.20B	377,788.80B	328,512.00B
Pressure part	551,900.16B	528,904.32B	482,912.64B	505,908.48B	528,904.32B	459,916.80B
Mechanical Machine Inspector	1,824,424.56B	1,998,179.28B	1,824,424.56B	1,911,301.92B	1,924,172.64B	1,673,193.60B
Turbine Plant						
Cooling Tower						
Water treatment plant						
Turbine Plant	788,331.60B	863,410.80B	788,331.60B	825,871.20B	789,404.16B	686,438.40B
Cooling Tower	450,475.20B	493,377.60B	450,475.20B	471,926.40B	493,377.60B	429,024.00B
Water treatment plant	585,617.76B	641,390.88B	585,617.76B	613,504.32B	641,390.88B	557,731.20B
Piping Inspector	1,229,029.20B	1,346,079.60B	1,274,548.80B	1,335,241.60B	1,395,934.40B	1,213,856.00B
Steam Generator Plant and Turbine Plant						
Cooling Tower and Water Treatment Plant						
Steam Generator Plant and Turbine Plant	637,274.40B	697,967.20B	682,794.00B	715,308.00B	747,822.00B	650,280.00B
Cooling Tower and Water Treatment Plant	591,754.80B	648,112.40B	591,754.80B	619,933.60B	648,112.40B	563,576.00B
MEQI Inspector	938,716.80B	1,028,118.40B	938,716.80B	934,246.72B	976,712.48B	849,315.20B
NDT for Plants						
Tank						
NDT for Plants	563,230.08B	616,871.04B	563,230.08B	540,879.68B	565,465.12B	491,708.80B
Tank	375,486.72B	411,247.36B	375,486.72B	393,367.04B	411,247.36B	357,606.40B
Total	4,889,008.32B	5,279,070.40B	4,865,540.40B	5,048,061.92B	5,203,512.64B	4,524,793.60B

Table 4.3: Cost of the existing model

	Oct '01	Nov '01	Dec '01	Jan '02	Feb '02	Mar '02	Apr '02
Steam Generator Inspector	881,507.20B	843,180.80B	804,854.40B	881,507.20B	766,528.00B	689,875.20B	722,726.40B
Structural Steel and Duct							
Pressure part							
Structural Steel and Duct	352,602.88B	337,272.32B	321,941.76B	352,602.88B	306,611.20B	275,950.08B	289,090.56B
Pressure part	528,904.32B	505,908.48B	482,912.64B	528,904.32B	459,916.80B	413,925.12B	433,635.84B
Mechanical Machine Inspector	1,924,172.64B	1,840,512.96B	1,711,805.76B	1,578,808.32B	1,244,169.60B	785,099.17B	849,656.55B
Turbine Plant							
Cooling Tower							
Water treatment plant							
Turbine Plant	789,404.16B	755,082.24B	720,760.32B	789,404.16B	643,536.00B	495,522.72B	424,733.76B
Cooling Tower	493,377.60B	471,926.40B	405,427.68B	345,364.32B	257,414.40B	122,271.84B	94,410.96B
Water treatment plant	641,390.88B	613,504.32B	585,617.76B	444,039.84B	343,219.20B	167,304.61B	330,511.82B
Piping Inspector	1,395,934.40B	1,335,241.60B	1,274,548.80B	1,395,934.40B	1,213,856.00B	1,183,509.60B	906,056.80B
Steam Generator Plant and Turbine Plant							
Cooling Tower and Water Treatment Plant							
Steam Generator Plant and Turbine Plant	747,822.00B	715,308.00B	682,794.00B	747,822.00B	650,280.00B	682,794.00B	572,246.40B
Cooling Tower and Water Treatment Plant	648,112.40B	619,933.60B	591,754.80B	648,112.40B	563,576.00B	500,715.60B	333,810.40B
MEQI Inspector	976,712.48B	885,075.84B	797,909.28B	822,494.72B	670,512.00B	657,101.76B	639,221.44B
NDT for Plants							
Tank							
NDT for Plants	565,465.12B	540,879.68B	469,358.40B	514,059.20B	402,307.20B	422,422.56B	442,537.92B
Tank	411,247.36B	344,196.16B	328,550.88B	308,435.52B	268,204.80B	234,679.20B	196,683.52B
Total	5,178,326.72B	4,904,011.20B	4,589,118.24B	4,678,744.64B	3,895,065.60B	3,315,585.73B	3,117,661.19B

Table 4.3: Cost of the existing model

	May '02	Jun '02	Jul '02	Aug '02	Sep '02	Total
Steam Generator Inspector	606,652.16B	350,412.80B	352,602.88B	289,090.56B	148,903.54B	49,442,129.14B
Structural Steel and Duct						11,390,606.08B
Pressure part						14,592,503.04B
Structural Steel and Duct	153,305.60B					9,521,372.80B
Pressure part	453,346.56B	350,412.80B	352,602.88B	289,090.56B	148,903.54B	13,937,647.22B
Mechanical Machine Inspector	740,054.35B	214,512.00B				93,341,841.35B
Turbine Plant						28,079,620.80B
Cooling Tower						8,571,899.52B
Water treatment plant						13,932,554.40B
Turbine Plant	444,039.84B	214,512.00B				21,083,311.92B
Cooling Tower						9,921,205.68B
Water treatment plant	296,014.51B					11,753,249.02B
Piping Inspector	661,118.00B	390,168.00B	199,419.20B	86,695.87B		63,213,710.67B
Steam Generator Plant and Turbine Plant						19,447,707.20B
Cooling Tower and Water Treatment Plant						14,438,383.60B
Steam Generator Plant and Turbine Plant	498,548.00B	390,168.00B	199,419.20B	86,695.87B		15,595,873.87B
Cooling Tower and Water Treatment Plant	162,570.00B					13,731,746.00B
MEQI Inspector	462,653.28B	201,153.60B	33,525.60B			47,836,561.12B
NDT for Plants						6,405,624.64B
Tank						18,624,588.32B
NDT for Plants	308,435.52B	134,102.40B	33,525.60B			13,086,159.20B
Tank	154,217.76B	67,051.20B				9,720,188.96B
Total	2,470,477.79B	1,156,246.40B	585,547.68B	375,786.43B	148,903.54B	253,834,242.28B

Table 4.4: The resource utilization of the proposed model

	Jul '97	Aug '97	Sep '97	Oct '97	Nov '97	Dec '97	Jan '98	Feb '98	Mar '98	Apr '98	May '98	Jun '98	Jul '98
Steam Generator Inspector		3	3	3	5	9	11	11	11	11	14	15	15
Structural Steel and Duct		3	3	3	5	5	5	5	5	5	6	6	6
Pressure part						4	6	6	6	6	8	9	9
Structural Steel and Duct													
Pressure part													
Mechanical Machine Inspector		3	8	8	8	8	8	8	11	11	15	26	32
Turbine Plant		3	8	8	8	8	8	8	11	11	7	14	17
Cooling Tower											3	4	6
Water treatment plant											5	8	9
Turbine Plant													
Cooling Tower													
Water treatment plant													
Piping Inspector									5	5	11	20	22
Steam Generator Plant and Turbine Plant											6	12	13
Cooling Tower and Water Treatment Plant									5	5	5	8	9
Steam Generator Plant and Turbine Plant													
Cooling Tower and Water Treatment Plant													
MEQI Inspector							4	4	9	12	12	19	21
NDT for Plants									3	4	4	7	8
Tank							4	4	6	8	8	12	13
NDT for Plants													
Tank													
Total		6	11	11	13	17	23	23	36	39	52	80	90

Table 4.4: The resource utilization of the proposed model

	Aug '98	Sep '98	Oct '98	Nov '98	Dec '98	Jan '99	Feb '99	Mar '99	Apr '99	May '99	Jun '99	Jul '99	Aug '99
Steam Generator Inspector	17	17	17	20	20	20	20	20	20	20	20	20	22
Structural Steel and Duct	7	7	7	9	9	9	9	9	9	9	9	9	9
Pressure part	10	10	10	11	11	11	11	11	11	11	11	11	11
Structural Steel and Duct													2
Pressure part													
Mechanical Machine Inspector	37	39	41	44	46	46	48	48	45	45	45	45	43
Turbine Plant	19	20	21	22	23	23	24	24	23	23	23	23	22
Cooling Tower	8	8	8	8	9	9	9	9	8	8	8	8	7
Water treatment plant	10	11	12	14	14	14	15	15	14	14	14	14	12
Turbine Plant													2
Cooling Tower													
Water treatment plant													
Piping Inspector	25	25	28	29	31	31	31	31	31	31	31	31	31
Steam Generator Plant and Turbine Plant	14	14	16	17	18	18	18	18	18	18	18	18	18
Cooling Tower and Water Treatment Plant	11	11	12	12	13	13	13	13	13	13	13	13	13
Steam Generator Plant and Turbine Plant													
Cooling Tower and Water Treatment Plant													
MEQI Inspector	21	22	23	23	23	23	23	23	23	21	21	21	21
NDT for Plants	8	8	9	9	9	8	8	8	8	6	6	7	7
Tank	13	14	14	14	14	15	15	15	15	15	15	14	14
NDT for Plants													
Tank													
Total	100	103	109	116	120	120	122	122	119	117	117	117	117

Table 4.4: The resource utilization of the proposed model

	Sep '99	Oct '99	Nov '99	Dec '99	Jan '00	Feb '00	Mar '00	Apr '00	May '00	Jun '00	Jul '00	Aug '00	Sep '00
Steam Generator Inspector	22	22	24	24	29	29	23	22	17	16	15	15	14
Structural Steel and Duct	9	9	9	9	9	9	6	5					
Pressure part	11	11	11	11	11	11	8	8	6	4	3	1	
Structural Steel and Duct	2	2	4	4	4	4	4	4	5	5	5	6	6
Pressure part					5	5	5	5	6	7	7	8	8
Mechanical Machine Inspector	48	48	48	45	37	33	33	28	29	32	32	34	36
Turbine Plant	22	22	22	21	16	14	14	12	11	9	3		
Cooling Tower	7	7	7	6	6	5	4	2	1				
Water treatment plant	12	12	12	11	8	7	7	4	3				
Turbine Plant	7	7	7	7	7	7	8	10	6	9	12	14	15
Cooling Tower									4	6	8	9	9
Water treatment plant									4	8	9	11	12
Piping Inspector	31	31	31	31	30	29	32	23	26	24	18	22	22
Steam Generator Plant and Turbine Plant	18	18	18	18	18	17	17	11	9	8			
Cooling Tower and Water Treatment Plant	13	13	13	13	12	12	11	8	7				
Steam Generator Plant and Turbine Plant									5	9	10	12	12
Cooling Tower and Water Treatment Plant							4	4	5	7	8	10	10
MEQI Inspector	21	21	21	20	17	14	19	20	15	20	18	18	19
NDT for Plants	7												
Tank	14	21	21	20	14	11	11	9	4	4			
NDT for Plants							4	6	6	9	10	10	11
Tank					3	3	4	5	5	7	8	8	8
Total	122	122	124	120	113	105	107	93	87	92	83	89	91

Table 4.4: The resource utilization of the proposed model

	Oct '00	Nov '00	Dec '00	Jan '01	Feb '01	Mar '01	Apr '01	May '01	Jun '01	Jul '01	Aug '01	Sep '01	Oct '01
Steam Generator Inspector	14	17	17	17	17	18	18	17	17	17	17	17	17
Structural Steel and Duct													
Pressure part													
Structural Steel and Duct	6	7	7	7	7	7	7	7	7	7	7	7	7
Pressure part	8	10	10	10	10	11	11	10	10	10	10	10	10
Mechanical Machine Inspector	38	39	41	41	43	42	40	40	40	40	38	38	38
Turbine Plant													
Cooling Tower													
Water treatment plant													
Turbine Plant	16	16	17	17	18	18	17	17	17	17	16	16	16
Cooling Tower	10	11	11	11	11	10	10	10	10	10	9	9	9
Water treatment plant	12	12	13	13	14	14	13	13	13	13	13	13	13
Piping Inspector	25	26	28	28	28	28	28	28	28	28	28	28	28
Steam Generator Plant and Turbine Plant													
Cooling Tower and Water Treatment Plant													
Steam Generator Plant and Turbine Plant	14	14	15	15	15	15	15	15	15	15	15	15	15
Cooling Tower and Water Treatment Plant	11	12	13	13	13	13	13	13	13	13	13	13	13
MEQI Inspector	20	20	20	20	20	20	20	18	18	18	18	18	18
NDT for Plants													
Tank													
NDT for Plants	12	12	12	12	12	12	12	11	11	11	11	11	11
Tank	8	8	8	8	8	8	8	7	7	7	7	7	7
Total	97	102	106	106	108	108	106	103	103	103	101	101	101

Table 4.4: The resource utilization of the proposed model

	Nov '01	Dec '01	Jan '02	Feb '02	Mar '02	Apr '02	May '02	Jun '02	Jul '02	Aug '02	Sep '02	Total
Steam Generator Inspector	17	17	17	17	13	11	9	5	5	4	1	972
Structural Steel and Duct												233
Pressure part												290
Structural Steel and Duct	7	7	7	7	5	5	4					189
Pressure part	10	10	10	10	8	6	5	5	5	4	1	260
Mechanical Machine Inspector	38	34	27	22	20	16	15	3				1,894
Turbine Plant												567
Cooling Tower												165
Water treatment plant												271
Turbine Plant	16	14	14	12	11	9	9	3				424
Cooling Tower	9	8	7	4	3	1						199
Water treatment plant	13	12	6	6	6	6	6					268
Piping Inspector	28	28	27	26	24	16	14	8	1	1		1,331
Steam Generator Plant and Turbine Plant												406
Cooling Tower and Water Treatment Plant												297
Steam Generator Plant and Turbine Plant	15	15	15	14	14	10	9	8	1	1		343
Cooling Tower and Water Treatment Plant	13	13	12	12	10	6	5					285
MEQI Inspector	18	16	16	12	10	10	6	3	2			953
NDT for Plants												134
Tank												371
NDT for Plants	11	10	10	7	7	7	4	2	2			266
Tank	7	6	6	5	3	3	2	1				182
Total	101	95	87	77	67	53	44	19	8	5	1	5,150

Table 4.5: Cost of the proposed model

	Jul '97	Aug '97	Sep '97	Oct '97	Nov '97	Dec '97
Steam Generator Inspector		131,404.80B	144,545.28B	151,115.52B	219,008.00B	365,743.36B
Structural Steel and Duct		131,404.80B	144,545.28B	151,115.52B	219,008.00B	251,859.20B
Pressure part						113,884.16B
Structural Steel and Duct						
Pressure part						
Mechanical Machine Inspector		128,707.20B	377,541.12B	394,702.08B	343,219.20B	394,702.08B
Turbine Plant		128,707.20B	377,541.12B	394,702.08B	343,219.20B	394,702.08B
Cooling Tower						
Water treatment plant						
Turbine Plant						
Cooling Tower						
Water treatment plant						
Piping Inspector						
Steam Generator Plant and Turbine Plant						
Cooling Tower and Water Treatment Plant						
Steam Generator Plant and Turbine Plant						
Cooling Tower and Water Treatment Plant						
MEQI Inspector						
NDT for Plants						
Tank						
NDT for Plants						
Tank						
Total		260,112.00B	522,086.40B	545,817.60B	562,227.20B	760,445.44B

Table 4.5: Cost of the proposed model

	Jan '98	Feb '98	Mar '98	Apr '98	May '98	Jun '98	Jul '98
Steam Generator Inspector	529,999.36B	481,817.60B	529,999.36B	529,999.36B	643,883.52B	722,726.40B	755,577.60B
Structural Steel and Duct	240,908.80B	219,008.00B	240,908.80B	240,908.80B	275,950.08B	289,090.56B	302,231.04B
Pressure part	289,090.56B	262,809.60B	289,090.56B	289,090.56B	367,933.44B	433,635.84B	453,346.56B
Structural Steel and Duct							
Pressure part							
Mechanical Machine Inspector	377,541.12B	343,219.20B	519,119.04B	519,119.04B	658,551.84B	1,227,008.64B	1,578,808.32B
Turbine Plant	377,541.12B	343,219.20B	519,119.04B	519,119.04B	315,332.64B	660,696.96B	838,741.92B
Cooling Tower					128,707.20B	188,770.56B	296,026.56B
Water treatment plant					214,512.00B	377,541.12B	444,039.84B
Turbine Plant							
Cooling Tower							
Water treatment plant							
Piping Inspector			238,436.00B	238,436.00B	357,654.00B	953,744.00B	1,096,805.60B
Steam Generator Plant and Turbine Plant					130,056.00B	572,246.40B	648,112.40B
Cooling Tower and Water Treatment Plant			238,436.00B	238,436.00B	227,598.00B	381,497.60B	448,693.20B
Steam Generator Plant and Turbine Plant							
Cooling Tower and Water Treatment Plant							
MEQI Inspector	116,222.08B	178,803.20B	442,537.92B	590,050.56B	563,230.08B	934,246.72B	1,079,524.32B
NDT for Plants			147,512.64B	196,683.52B	187,743.36B	344,196.16B	411,247.36B
Tank	116,222.08B	178,803.20B	295,025.28B	393,367.04B	375,486.72B	590,050.56B	668,276.96B
NDT for Plants							
Tank							
Total	1,023,762.56B	1,003,840.00B	1,730,092.32B	1,877,604.96B	2,223,319.44B	3,837,725.76B	4,510,715.84B

Table 4.5: Cost of the proposed model

	Aug '98	Sep '98	Oct '98	Nov '98	Dec '98	Jan '99	Feb '99
Steam Generator Inspector	781,858.56B	819,089.92B	819,089.92B	919,833.60B	1,007,436.80B	919,833.60B	876,032.00B
Structural Steel and Duct	321,941.76B	337,272.32B	337,272.32B	413,925.12B	453,346.56B	413,925.12B	394,214.40B
Pressure part	459,916.80B	481,817.60B	481,817.60B	505,908.48B	554,090.24B	505,908.48B	481,817.60B
Structural Steel and Duct							
Pressure part							
Mechanical Machine Inspector	1,666,758.24B	1,840,512.96B	1,934,898.24B	1,982,090.88B	2,269,536.96B	2,072,185.92B	2,059,315.20B
Turbine Plant	855,902.88B	943,852.80B	991,045.44B	991,045.44B	1,134,768.48B	1,036,092.96B	1,029,657.60B
Cooling Tower	360,380.16B	377,541.12B	377,541.12B	360,380.16B	444,039.84B	405,427.68B	386,121.60B
Water treatment plant	450,475.20B	519,119.04B	566,311.68B	630,665.28B	690,728.64B	630,665.28B	643,536.00B
Turbine Plant							
Cooling Tower							
Water treatment plant							
Piping Inspector	1,137,990.00B	1,192,180.00B	1,335,241.60B	1,320,068.40B	1,545,498.80B	1,411,107.60B	1,343,912.00B
Steam Generator Plant and Turbine Plant	637,274.40B	667,620.80B	762,995.20B	773,833.20B	897,386.40B	819,352.80B	780,336.00B
Cooling Tower and Water Treatment Plant	500,715.60B	524,559.20B	572,246.40B	546,235.20B	648,112.40B	591,754.80B	563,576.00B
Steam Generator Plant and Turbine Plant							
Cooling Tower and Water Treatment Plant							
MEQI Inspector	985,652.64B	1,081,759.36B	1,130,930.24B	1,079,524.32B	1,182,336.16B	1,079,524.32B	1,028,118.40B
NDT for Plants	375,486.72B	393,367.04B	442,537.92B	422,422.56B	462,653.28B	375,486.72B	357,606.40B
Tank	610,165.92B	688,392.32B	688,392.32B	657,101.76B	719,682.88B	704,037.60B	670,512.00B
NDT for Plants							
Tank							
Total	4,572,259.44B	4,933,542.24B	5,220,160.00B	5,301,517.20B	6,004,808.72B	5,482,651.44B	5,307,377.60B

Table 4.5: Cost of the proposed model

	Mar '99	Apr '99	May '99	Jun '99	Jul '99	Aug '99
Steam Generator Inspector	1,007,436.80B	963,635.20B	919,833.60B	963,635.20B	963,635.20B	1,051,238.40B
Structural Steel and Duct	453,346.56B	433,635.84B	413,925.12B	433,635.84B	433,635.84B	433,635.84B
Pressure part	554,090.24B	529,999.36B	505,908.48B	529,999.36B	529,999.36B	529,999.36B
Structural Steel and Duct						87,603.20B
Pressure part						
Mechanical Machine Inspector	2,368,212.48B	2,123,668.80B	2,027,138.40B	2,123,668.80B	2,123,668.80B	2,020,703.04B
Turbine Plant	1,184,106.24B	1,085,430.72B	1,036,092.96B	1,085,430.72B	1,085,430.72B	1,038,238.08B
Cooling Tower	444,039.84B	377,541.12B	360,380.16B	377,541.12B	377,541.12B	330,348.48B
Water treatment plant	740,066.40B	660,696.96B	630,665.28B	660,696.96B	660,696.96B	566,311.68B
Turbine Plant						85,804.80B
Cooling Tower						
Water treatment plant						
Piping Inspector	1,545,498.80B	1,478,303.20B	1,411,107.60B	1,478,303.20B	1,478,303.20B	1,478,303.20B
Steam Generator Plant and Turbine Plant	897,386.40B	858,369.60B	819,352.80B	858,369.60B	858,369.60B	858,369.60B
Cooling Tower and Water Treatment Plant	648,112.40B	619,933.60B	591,754.80B	619,933.60B	619,933.60B	619,933.60B
Steam Generator Plant and Turbine Plant						
Cooling Tower and Water Treatment Plant						
MEQI Inspector	1,182,336.16B	1,130,930.24B	985,652.64B	1,032,588.48B	1,032,588.48B	1,032,588.48B
NDT for Plants	411,247.36B	393,367.04B	281,615.04B	295,025.28B	344,196.16B	344,196.16B
Tank	771,088.80B	737,563.20B	704,037.60B	737,563.20B	688,392.32B	688,392.32B
NDT for Plants						
Tank						
Total	6,103,484.24B	5,696,537.44B	5,343,732.24B	5,598,195.68B	5,598,195.68B	5,582,833.12B

Table 4.5: Cost of the proposed model

	Sep '99	Oct '99	Nov '99	Dec '99	Jan '00	Feb '00
Steam Generator Inspector	1,059,998.72B	1,011,816.96B	1,156,362.24B	1,208,924.16B	1,311,857.92B	1,333,758.72B
Structural Steel and Duct	433,635.84B	413,925.12B	433,635.84B	453,346.56B	413,925.12B	413,925.12B
Pressure part	529,999.36B	505,908.48B	529,999.36B	554,090.24B	505,908.48B	505,908.48B
Structural Steel and Duct	96,363.52B	91,983.36B	192,727.04B	201,487.36B	183,966.72B	183,966.72B
Pressure part					208,057.60B	229,958.40B
Mechanical Machine Inspector	2,265,246.72B	2,162,280.96B	2,265,246.72B	2,220,199.20B	1,666,758.24B	1,486,568.16B
Turbine Plant	1,038,238.08B	991,045.44B	1,038,238.08B	1,036,092.96B	720,760.32B	630,665.28B
Cooling Tower	330,348.48B	315,332.64B	330,348.48B	296,026.56B	270,285.12B	225,237.60B
Water treatment plant	566,311.68B	540,570.24B	566,311.68B	542,715.36B	360,380.16B	315,332.64B
Turbine Plant	330,348.48B	315,332.64B	330,348.48B	345,364.32B	315,332.64B	315,332.64B
Cooling Tower						
Water treatment plant						
Piping Inspector	1,478,303.20B	1,411,107.60B	1,478,303.20B	1,545,498.80B	1,365,588.00B	1,320,068.40B
Steam Generator Plant and Turbine Plant	858,369.60B	819,352.80B	858,369.60B	897,386.40B	819,352.80B	773,833.20B
Cooling Tower and Water Treatment Plant	619,933.60B	591,754.80B	619,933.60B	648,112.40B	546,235.20B	546,235.20B
Steam Generator Plant and Turbine Plant						
Cooling Tower and Water Treatment Plant						
MEQI Inspector	907,426.24B	985,652.64B	1,032,588.48B	1,028,118.40B	750,973.44B	657,101.76B
NDT for Plants	219,033.92B					
Tank	688,392.32B	985,652.64B	1,032,588.48B	1,028,118.40B	657,101.76B	516,294.24B
NDT for Plants						
Tank					93,871.68B	140,807.52B
Total	5,710,974.88B	5,570,858.16B	5,932,500.64B	6,002,740.56B	5,095,177.60B	4,797,497.04B

Table 4.5: Cost of the proposed model

	Mar '00	Apr '00	May '00	Jun '00	Jul '00	Aug '00
Steam Generator Inspector	1,158,552.32B	963,635.20B	856,321.28B	770,908.16B	689,875.20B	713,966.08B
Structural Steel and Duct	302,231.04B	219,008.00B				
Pressure part	402,974.72B	350,412.80B	302,231.04B	192,727.04B	137,975.04B	8,760.32B
Structural Steel and Duct	201,487.36B	175,206.40B	251,859.20B	240,908.80B	229,958.40B	302,231.04B
Pressure part	251,859.20B	219,008.00B	302,231.04B	337,272.32B	321,941.76B	402,974.72B
Mechanical Machine Inspector	1,628,146.08B	1,201,267.20B	1,377,167.04B	1,510,164.48B	1,370,731.68B	1,677,483.84B
Turbine Plant	690,728.64B	514,828.80B	542,715.36B	424,733.76B	64,353.60B	
Cooling Tower	197,351.04B	85,804.80B	2,145.12B			
Water treatment plant	345,364.32B	171,609.60B	141,577.92B			
Turbine Plant	394,702.08B	429,024.00B	296,026.56B	424,733.76B	540,570.24B	690,728.64B
Cooling Tower			197,351.04B	283,155.84B	360,380.16B	444,039.84B
Water treatment plant			197,351.04B	377,541.12B	405,427.68B	542,715.36B
Piping Inspector	1,586,683.20B	997,096.00B	1,155,330.80B	1,109,811.20B	819,352.80B	1,096,805.60B
Steam Generator Plant and Turbine Plant	847,531.60B	476,872.00B	448,693.20B	346,816.00B		
Cooling Tower and Water Treatment Plant	548,402.80B	346,816.00B	348,983.60B			
Steam Generator Plant and Turbine Plant			108,380.00B	429,184.80B	455,196.00B	598,257.60B
Cooling Tower and Water Treatment Plant	190,748.80B	173,408.00B	249,274.00B	333,810.40B	364,156.80B	498,548.00B
MEQI Inspector	967,772.32B	894,016.00B	771,088.80B	876,135.68B	844,845.12B	925,306.56B
NDT for Plants						
Tank	565,465.12B	402,307.20B	205,623.68B	89,401.60B		
NDT for Plants	196,683.52B	268,204.80B	308,435.52B	442,537.92B	469,358.40B	514,059.20B
Tank	205,623.68B	223,504.00B	257,029.60B	344,196.16B	375,486.72B	411,247.36B
Total	5,341,153.92B	4,056,014.40B	4,159,907.92B	4,267,019.52B	3,724,804.80B	4,413,562.08B

Table 4.5: Cost of the proposed model

	Sep '00	Oct '00	Nov '00	Dec '00	Jan '01	Feb '01	Mar '01
Steam Generator Inspector	643,883.52B	674,544.64B	819,089.92B	781,858.56B	856,321.28B	744,627.20B	867,271.68B
Structural Steel and Duct							
Pressure part							
Structural Steel and Duct	275,950.08B	289,090.56B	337,272.32B	321,941.76B	352,602.88B	306,611.20B	337,272.32B
Pressure part	367,933.44B	385,454.08B	481,817.60B	459,916.80B	503,718.40B	438,016.00B	529,999.36B
Mechanical Machine Inspector	1,621,710.72B	1,793,320.32B	1,840,512.96B	1,846,948.32B	2,022,848.16B	1,844,803.20B	1,982,090.88B
Turbine Plant							
Cooling Tower							
Water treatment plant							
Turbine Plant	675,712.80B	755,082.24B	755,082.24B	765,807.84B	838,741.92B	772,243.20B	849,467.52B
Cooling Tower	405,427.68B	471,926.40B	519,119.04B	495,522.72B	542,715.36B	471,926.40B	471,926.40B
Water treatment plant	540,570.24B	566,311.68B	566,311.68B	585,617.76B	641,390.88B	600,633.60B	660,696.96B
Piping Inspector	1,001,431.20B	1,192,180.00B	1,239,867.20B	1,274,548.80B	1,395,934.40B	1,213,856.00B	1,335,241.60B
Steam Generator Plant and Turbine Plant							
Cooling Tower and Water Treatment Plant							
Steam Generator Plant and Turbine Plant	546,235.20B	667,620.80B	667,620.80B	682,794.00B	747,822.00B	650,280.00B	715,308.00B
Cooling Tower and Water Treatment Plant	455,196.00B	524,559.20B	572,246.40B	591,754.80B	648,112.40B	563,576.00B	619,933.60B
MEQI Inspector	891,780.96B	983,417.60B	983,417.60B	938,716.80B	1,028,118.40B	894,016.00B	983,417.60B
NDT for Plants							
Tank							
NDT for Plants	516,294.24B	590,050.56B	590,050.56B	563,230.08B	616,871.04B	536,409.60B	590,050.56B
Tank	375,486.72B	393,367.04B	393,367.04B	375,486.72B	411,247.36B	357,606.40B	393,367.04B
Total	4,158,806.40B	4,643,462.56B	4,882,887.68B	4,842,072.48B	5,303,222.24B	4,697,302.40B	5,168,021.76B

Table 4.5: Cost of the proposed model

	Apr '01	May '01	Jun '01	Jul '01	Aug '01	Sep '01
Steam Generator Inspector	827,850.24B	856,321.28B	781,858.56B	819,089.92B	856,321.28B	744,627.20B
Structural Steel and Duct						
Pressure part						
Structural Steel and Duct	321,941.76B	352,602.88B	321,941.76B	337,272.32B	352,602.88B	306,611.20B
Pressure part	505,908.48B	503,718.40B	459,916.80B	481,817.60B	503,718.40B	438,016.00B
Mechanical Machine Inspector	1,801,900.80B	1,973,510.40B	1,801,900.80B	1,887,705.60B	1,874,834.88B	1,630,291.20B
Turbine Plant						
Cooling Tower						
Water treatment plant						
Turbine Plant	765,807.84B	838,741.92B	765,807.84B	802,274.88B	789,404.16B	686,438.40B
Cooling Tower	450,475.20B	493,377.60B	450,475.20B	471,926.40B	444,039.84B	386,121.60B
Water treatment plant	585,617.76B	641,390.88B	585,617.76B	613,504.32B	641,390.88B	557,731.20B
Piping Inspector	1,274,548.80B	1,395,934.40B	1,274,548.80B	1,335,241.60B	1,395,934.40B	1,213,856.00B
Steam Generator Plant and Turbine Plant						
Cooling Tower and Water Treatment Plant						
Steam Generator Plant and Turbine Plant	682,794.00B	747,822.00B	682,794.00B	715,308.00B	747,822.00B	650,280.00B
Cooling Tower and Water Treatment Plant	591,754.80B	648,112.40B	591,754.80B	619,933.60B	648,112.40B	563,576.00B
MEQI Inspector	938,716.80B	925,306.56B	844,845.12B	885,075.84B	925,306.56B	804,614.40B
NDT for Plants						
Tank						
NDT for Plants	563,230.08B	565,465.12B	516,294.24B	540,879.68B	565,465.12B	491,708.80B
Tank	375,486.72B	359,841.44B	328,550.88B	344,196.16B	359,841.44B	312,905.60B
Total	4,843,016.64B	5,151,072.64B	4,703,153.28B	4,927,112.96B	5,052,397.12B	4,393,388.80B

Table 4.5: Cost of the proposed model

	Oct '01	Nov '01	Dec '01	Jan '02	Feb '02	Mar '02	Apr '02
Steam Generator Inspector	856,321.28B	819,089.92B	781,858.56B	856,321.28B	744,627.20B	597,891.84B	529,999.36B
Structural Steel and Duct							
Pressure part							
Structural Steel and Duct	352,602.88B	337,272.32B	321,941.76B	352,602.88B	306,611.20B	229,958.40B	240,908.80B
Pressure part	503,718.40B	481,817.60B	459,916.80B	503,718.40B	438,016.00B	367,933.44B	289,090.56B
Mechanical Machine Inspector	1,874,834.88B	1,793,320.32B	1,531,615.68B	1,332,119.52B	943,852.80B	900,950.40B	722,905.44B
Turbine Plant							
Cooling Tower							
Water treatment plant							
Turbine Plant	789,404.16B	755,082.24B	630,665.28B	690,728.64B	514,828.80B	495,522.72B	424,733.76B
Cooling Tower	444,039.84B	424,733.76B	360,380.16B	345,364.32B	171,609.60B	135,142.56B	15,015.84B
Water treatment plant	641,390.88B	613,504.32B	540,570.24B	296,026.56B	257,414.40B	270,285.12B	283,155.84B
Piping Inspector	1,395,934.40B	1,335,241.60B	1,274,548.80B	1,346,079.60B	1,127,152.00B	1,092,470.40B	762,995.20B
Steam Generator Plant and Turbine Plant							
Cooling Tower and Water Treatment Plant							
Steam Generator Plant and Turbine Plant	747,822.00B	715,308.00B	682,794.00B	747,822.00B	606,928.00B	637,274.40B	476,872.00B
Cooling Tower and Water Treatment Plant	648,112.40B	619,933.60B	591,754.80B	598,257.60B	520,224.00B	455,196.00B	286,123.20B
MEQI Inspector	925,306.56B	885,075.84B	750,973.44B	822,494.72B	536,409.60B	469,358.40B	491,708.80B
NDT for Plants							
Tank							
NDT for Plants	565,465.12B	540,879.68B	469,358.40B	514,059.20B	312,905.60B	328,550.88B	344,196.16B
Tank	359,841.44B	344,196.16B	281,615.04B	308,435.52B	223,504.00B	140,807.52B	147,512.64B
Total	5,052,397.12B	4,832,727.68B	4,338,996.48B	4,357,015.12B	3,352,041.60B	3,060,671.04B	2,507,608.80B

Table 4.5: Cost of the proposed model

	May '02	Jun '02	Jul '02	Aug '02	Sep '02	Total
Steam Generator Inspector	374,503.68B	219,008.00B	251,859.20B	192,727.04B	37,225.88B	45,989,484.44B
Structural Steel and Duct						11,064,284.16B
Pressure part						13,677,049.60B
Structural Steel and Duct	122,644.48B					8,918,005.76B
Pressure part	251,859.20B	219,008.00B	251,859.20B	192,727.04B	37,225.88B	12,330,144.92B
Mechanical Machine Inspector	572,733.63B	128,707.20B				88,029,276.03B
Turbine Plant						26,402,136.96B
Cooling Tower						7,645,207.68B
Water treatment plant						12,636,901.92B
Turbine Plant	444,039.84B	128,707.20B				19,747,974.72B
Cooling Tower						9,256,192.80B
Water treatment plant	128,693.79B					12,340,861.95B
Piping Inspector	611,263.20B	346,816.00B	49,854.80B	43,346.58B		62,333,667.78B
Steam Generator Plant and Turbine Plant						18,986,008.40B
Cooling Tower and Water Treatment Plant						14,017,869.20B
Steam Generator Plant and Turbine Plant	448,693.20B	346,816.00B	49,854.80B	43,346.58B		15,999,050.18B
Cooling Tower and Water Treatment Plant	162,570.00B					13,330,740.00B
MEQI Inspector	308,435.52B	122,927.20B	22,350.40B			45,871,960.96B
NDT for Plants						6,405,624.64B
Tank						17,853,499.52B
NDT for Plants	205,623.68B	89,401.60B	22,350.40B			12,838,069.76B
Tank	102,811.84B	33,525.60B				8,774,767.04B
Total	1,866,936.03B	817,458.40B	324,064.40B	236,073.62B	37,225.88B	242,224,389.22B

4.4 Comparison and discussion between the existing and the proposed models

The number of the resource usage of the existing and the proposed model are the same but their allocations and utilizations are different. The resource demand of the existing model depends on CMPD whereas the demand of the proposed model depends on CMD and CMPDs. However, the resource demands in unit of both models are the same. For the existing model, the resource is allocated between MD and the projects and finally from the projects back to MD. As for the proposed model, the resource is allocated among MD and the projects, and internal of the projects by following with the plan. The monitoring and adjustment of the proposed model's allocation can help to fulfill the demand of the resource all the time. There is the resource problems occur of the existing model whereas the problems will less occur in the proposed model. The resource allocation in terms of demand, supply, plan and allocation of the existing model is controlled by CMPD using manual but the allocation of the proposed model is controlled by CMPD using Microsoft Project programme. The proposed model, thus, enables the MD to allocate the resource at each time and with a lower cost and number than the existing model. Therefore, this provides MD with human resource utilization efficiently and there are remaining resources available from the proposed model for other projects of MD. Table 4.6 shows the comparison of details of the resource allocation between the allocations according to the existing model and the proposed model. It indicates that the allocation following the proposed model helps MD to allocate the resource more efficiently and allows exceed resource for other projects.

Table 4.6: Comparison of both models

	Existing Model	Proposed Model
Allocation management	Depends on CMPD	Depends on CMD
Allocation plan	Not concerned on resource demand	Concerned on resource demand
Resource allocation	Between MD and the projects	Among MD and the projects
Monitoring	No	Controled by CMD
Tool	Manual	Software
Utilisation	Less remaining resource available	More remaining resource available
Nuber of resource	More or less than demand	Conforms to demand
Cost	Higher	Lower
Allocation problem	Hihger	Lower

4.5 Result comparison of the existing model and the proposed model

The results of the implementation of the existing and the proposed models for the projects concerning the human resource and cost are described below.

4.5.1 The existing model

For the existing model, there are resource problems: the over supply of resource and the resource shortage. The over supply of resource occurred on Project 1 because the resource was not reduced when jobs had been finished and the resource is locked to help with other jobs in the same project. As a consequence, this caused the resource shortage in Project 2. The problem lessens when the resource is reduced from Project 1. Besides, the over resource unit and the extra cost from the old model are different and higher than that of the proposed model, respectively.

4.5.2 The proposed model

For the proposed model, there are less resource problems according to the allocation. Moreover, there is remaining resource utilization which can be used for other projects. The comparison in terms of the resource utilization and extra cost of both models is described below.

- **The resource utilization**

The resource utilization is different even though they are under the same environment as mentioned in the resource usage consideration. Project 1 considered under the existing model and the proposed model will have the resource in the same demand in unit at time. The resource allocation causes the over resource in Project 1 and the resource shortage in Project 2 according to the existing model. Consequently, the resource allocation makes the resource is nearly the same amount of its demand at time of Project 1 and 2 regarding to the proposed model. Moreover, there is resource remaining. The proposed model helps MD allocate the resource closely its demand of Project 1 and 2 at time. Comparison of the resource allocation is shown in Figure 3.5. It indicates that the proposed model is better

than the existing model in helping the projects to allocate the resource to fulfill the demand at each time.

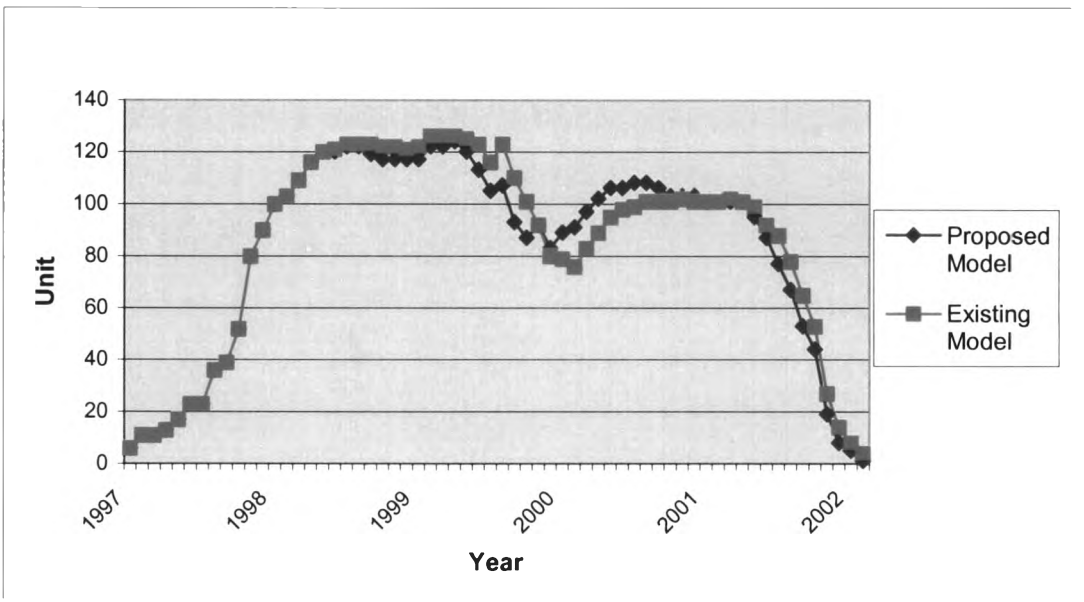


Figure 3.5: Resource utilization

- **The extra cost**

The costs of resource consist of salary, electricity allowance, providence allowance, position allowance, fringe benefit, overtime cost and traveling cost. Extra cost which is an expenditure causes from the over resource and the resource shortage was occurred only in the existing model. This means that the extra cost will be reduced by implementing the proposed model. Figure 3.6 shows the extra costs. This indicates that the proposed model can help MD save the cost.

As the results, the extra cost of the proposed model is smaller than the cost of the exiting model which are 242,224,389.22 Baht and 253,834,242.28 Baht, respectively. The cost of the existing model is higher in that of the proposed model. The proposed model can help MD save the cost as much as 11,609,853.06 Baht. It indicates that the proposed model help MD to save the extra cost.

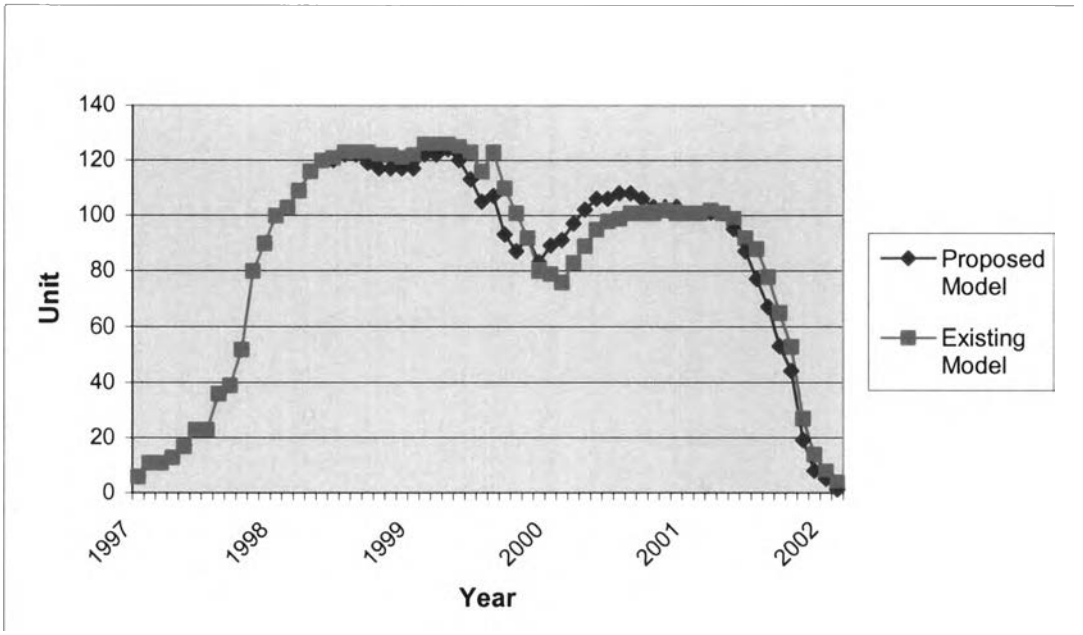


Figure 3.6: Cost of the resource

4.6 Results of the development

The purpose of the proposed model is to help MD develop its resource allocation plan. The development can be clarified by focusing on the resource allocation and its demand, and the extra cost.

The over supply of resource and resource shortage problems in the existing model have occurred more than that of implementing of the proposed model. Moreover, there is remaining resource in proposed model.

The benefit of this research is for MD to be able to use a model for human resource allocation planning in the future multi projects. It is expected to help MD allocate its human resource for future multi projects to fulfill their demand all the times by implementing the proposed model. Moreover, the proposed model can also help MD save the extra cost from the over and shortage resource problems.

4.7 Allocation plan for the future multi projects

It has been shown in the study that the proposed model can help fulfill the resource demand with lower cost. Therefore, the model will be adapted to create an allocation plan in the future projects of MD. In general, the responsibility and scope of work of MD for the future projects to the past projects in terms of job activities and inspection procedures. The process in the plan consists of the normal practice, which has been used for management in MD, and new practice for MD.

The allocation plan

The allocation plan for the future projects will be clarified into six steps: Work Scheduling, Resource Assignment, Allocation Plan, MD to Project 1 and 2, Monitoring, Internal Allocation and Adjustment. Flow chart of the plan is presented in the following figure.

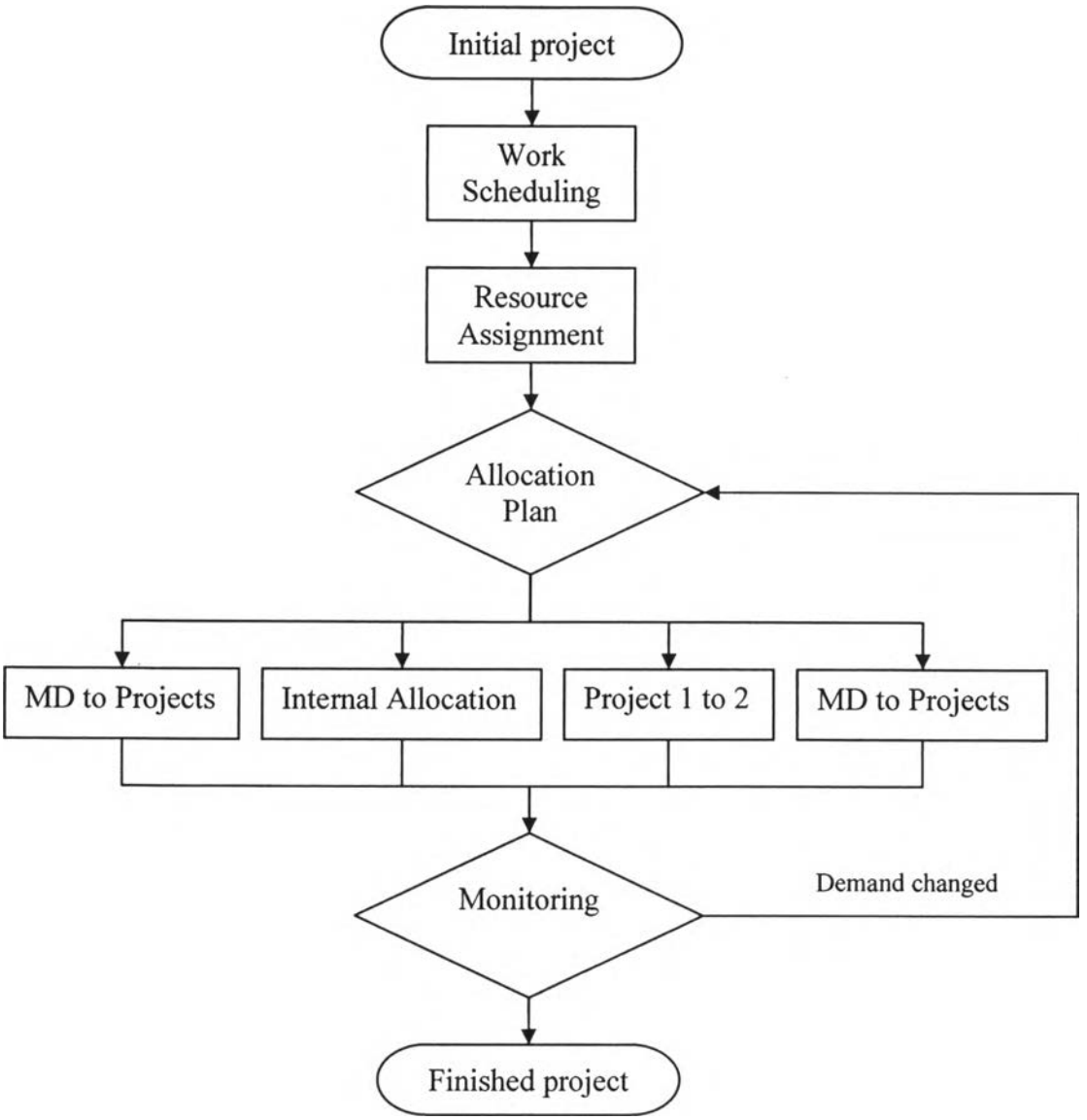


Figure 3.7: Allocation steps for MD

STEP 1: Initial project

Initial project is the first process which means the mechanical work of MD will be started. The human resource also will have started to be allocated and work conforms to the mechanical work schedule.

STEP 2: Work Scheduling

Work scheduling means the mechanical work schedule is reviewed and assigned the resource usage. The schedule consists of job activity, job duration and milestone. The schedule has already made by Engineering Division and then approved by Head of Thermal Power Plant Construction Division (TCD). The schedule is informed from TCD to CMD and then from CMD to CMPD.

After receiving the schedule, CMD reviews the schedule by checking and comparing the job activity, duration and milestone, and resource usage for each activity to the old database of MD. The database is which indicates the information of MD such as job activity, in terms of duration, milestone, its priority and their linkage, resource usage and allocation, time and cost of MD's project and so on, is recorded in a paper report. The reviewed schedule will be a final schedule for construction. Next, resource usage which is demand of the resource in position and unit at each time is considered by CMPD. And the resource demand is specified for the job activity at that time referring to the final schedule by CMPD. Finally, CMPD informs the demand data consisting of position and unit to CMD by a memorandum. This step is the normal practice of MD.

STEP 3: Resource Assignment

CMD combines the resource demand consists of position and unit of both projects and looks for the demand at each time. Next, the demand is converted into working hour and put into Microsoft project programme at resource usage view. CMD compares the demand from the programme with human resource availability of MD and then makes a decision to assign the human resource in position and unit for the demand. The assigned resource in position and unit is informed to CMPD using a memorandum by CMD. This step is a new practice for MD because at present, the resource is assigned by CMPD.

STEP 4: Allocation Plan

CMD makes the allocation plan regarding to the information in STEP 2. The allocation consists of four types of the allocation: MD to Project 1 and 2, Internal Allocation,

Project 1 and 2 and Project 1 and 2 to MD. The information in this step is sent to CMD by a memorandum. CMD will make a final decision for the allocation because CMPD has higher authority than CMPD in organization. This step is the new process because the plan is made by CMPD in practice.

STEP 5: Allocation

The resource is allocated following to the plan in STEP 3. CMD makes official letter for the allocation. This process is the old practice in MD because of all official letters in MD are made under responsibility of CMD. Lag time of the resource allocation is a duration time for the resource allocated from one to the other project and from MD to the project when the demand changed occurs. The allocation is begin with the changed demand in STEP 6 is informed to CMD by CMPD. Then CMD checks the resource availability and the changed demand at that time. The resource availability and demand, which is the peak unit, are indicated in resource usage view in Microsoft Project Programme. Different of the resource availability and demand in working hour will be converted into unit by divided with working hour per day. The different resource in unit shows the remaining resource in the project. Also the availability resource in MD will be checked. The remaining resources are considered to allocate referring to the workload demand in the project. Next, CMD makes official letter to CMD and to the remaining resource to allocate to the project where is required the resource. Finally, the resource is allocated. The checking time and allocation time spend one day of each. The total duration which is the checking time and the allocation time is two days. Therefore, the lag time of the allocation is two days. It means the resource will be allocated from one to the other project or MD within two days. According to an interviewing to the person who were been CMPD of the past projects, the resource was allocated from one to other project taking approximately two weeks. That is the old practice of MD. Therefore, the main reasons for CMD to allocate the resource within the lag time are CMD's authorize and Microsoft Project programme. In practice, CMD is the top management of MD so that all managements are run under responsibility of CMD. Therefore, CMD can easily manage the allocation by following the plan. Moreover, Microsoft Project programme is useful for CMD to collect data and look for the resource demand and requirement of the allocation. Due to the reasons, the resource can be allocated within the lag time.

STEP 6: Monitoring

The purpose of this step is to follow up the resource allocation and compare the resource workload with its demand at each time. This process is controlled by CMD. The monitoring consists of three items: Follow up. Comparing and Summarize (see Figure 3.8).

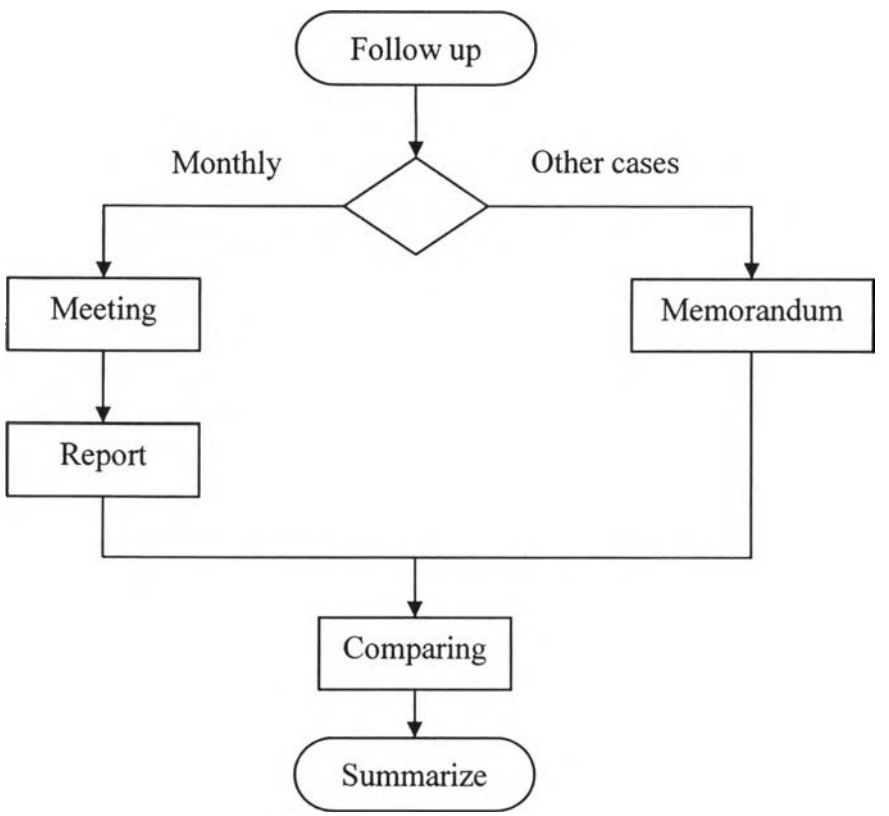


Figure 3.8: Monitoring process for MD

1. Follow up

This process is to follow up the allocation according to the plan in terms of resource unit and its position. The follow up can be divided into 2 types: Monthly and Other cases. CMD will consider selecting one of the types after allocation. Details of the follow up are described as follow.

1.1. Monthly

This process is an action once a month. In practice, there has a monthly meeting and report between CMD and CMPDs at the beginning of each month. Therefore, the meeting and report should be done to follow up the allocation. The meeting and report are presented as follow.

1.1.1. Meeting

The meeting is to look for the progress of work and the workload. The meeting between MD and CMPD or their representatives are set at site or MD in monthly at the beginning of the month in order to get the information of the project. The information consists of data in the project focusing on the work in progress and the resource in position and unit. The meeting has to be mentioned about the data of the previous, present and next month. After the meeting the report is made by CMPD and submitted to CMD. The meeting should be on between the first to the fifth of each month.

1.1.2. Report

CMD assigns CMPD to submit report of information of resource allocation and its workload information of the project after the meeting. The information consists of the mechanical work in progress and the resource workload in position and unit. The work and workload are clarified in Monthly Progress Report (see Appendix C). The schedule presents the job activity, duration and milestone, linkage and the resource workload in the previous, present and next month in the project. The previous, present and next month shows the month information in a month before, present month and next month, respectively. The report shows the work progress compared to the work schedule in that month. If the schedule is changed, it will cause the resource demand changed. Such changed schedule and changed demand are also identified in the information by CMPD. In the last, information consists of the position and unit, and the work progress from this process are submitted from CMPD to CMD.

1.2. Other cases

The other cases mean that the changed demand occurs between the beginning and the end of each month. The resource demand in position and unit are informed from CMPD to CMD by using a memorandum which is described as below.

Memorandum

In case demand changed in which the resource should be increased or decreased from the project within month, CMPD has to inform CMD by a memorandum. The memorandum is made to inform CMD of the required resource at first by calling, fax, and email and then officially submitted. In case the demand is changed, STEP 5 and STEP 6 will be considered. This process is similar to the old practice because a memorandum is used to communicate in MD.

2. Comparing

CMD compares the workload and demand from item 1 to that of the schedule plan and the old data of MD. Firstly, the progress work which is the actual work is compared to the work schedule to look for the remaining work. The remaining work and its demand identified by CMPD are collected by CMD as mentioned in item 1.1.2. When the changed schedule occurs, CMD revises to up date the schedule. Secondly, the demand in position and unit, and its workload are reviewed for matching to the revised schedule. CMD checks whether the unit conforms to its workload or not. The checking can be made by comparing the unit with the workload to the previous duration, in Monthly Progress report, or from one to the other project incase the work is similar. The demand is converted to be the workload in hour. Then the revised schedule and the workload are put into Microsoft Project programme at Gantt chart and resource usage view, respectively by CMD. CMD accesses whether the problems which are the over supply or the resource shortage occur or not. Therefore, the different unit for the project is made by CMPDs. This process is the new practice because there is no person who responsible for comparing the allocation to the demand in MD.

3. Summarize

The demand in position and unit in item 2 is summarized after comparing by CMD. In case the demand is changed, STEP 4 and STEP 6 will be considered. Incase the resource demand is equal to the resource allocation. CMD records the information of the job and workload to be the database of MD. This process is the new practice because there is no summarize in MD.

STEP 7: Internal Allocation

When the demand changed, the schedule has to change. It is responsibility of CMPD to manage the resource allocation within his/her project. Then the allocation information is sent to CMD and also if there is still being the changed demand, CMPD should inform that demand to CMD. A detail of the information is sent from CMPD to CMD by calling, fax of email of the memorandum. Then STEP 6 will be considered. In case the resource whether be idled in the project waiting for their work, CMD should consider focusing on the cost and demand of the other project. This step is normal practice of MD.

STEP 8: Adjustment

CMD puts the changed demand specified in STEP 5 into Microsoft project programme in resource usage view and accesses the resource problems which are the resource shortage or the over supply of resource. Then the process will be backed to the allocation plan in STEP 3. This step is new practice because there is no adjustment in MD.

STEP 9: Finished project

The human resource is allocated return to MD when the work finished under management of CMD. The allocation is informed to CMPD to allocate the resource by calling, fax or email and then the official letter is made for the allocation by CMD.

4.8 Possibility of the plan implementation

According to the steps, some steps are new for MD so that the new steps were considered to prove by involved personnel who are CMD and will be a CMPD of the future multi projects before implement to the future projects. For acceptance of the concern personnel, the explanation and interview in terms of the plan and Microsoft project programme are made. The possibility of the plan implementation can be explained in terms of management and Microsoft Project Programme as follow.

4.8.1 Management

In practice, CMPD controls the resource demand and plan the allocation because he will have authorized from CMD in order to manage the allocation. However, the official of the allocation is done by CMPD because he is the top management who has the highest authority in MD. As the allocation plan allows CMD controls the allocation, it is the same direction of the management in MD that the plan is run under CMD's management. Therefore, it is possible for changing the management personnel according to the plan from CMPD to be CMD.

4.8.2 Microsoft Project programme

The record data from Personal Department shows that the involved personnel have already been trained in Microsoft project programme. In addition, Microsoft project programme has just begun to use in MD. Therefore, CMD can easily use the programme as a tool for the plan.

As the result, CMD and CMPD agree with the plan that could help the allocation more effectively. In the last, CMD and CMPD are pleasured with the allocation of the resource by following the plan.