CHAPTER 4

Design and Testing of Project Management Process and Information System

4.1 Introduction

In the previous chapter, the background of the project, current practice, and current problems have been discussed. The previous chapter also mentions what are tools and techniques that can be used in managing projects for the company. This chapter will look further into developing a project management process for managing future projects based on company's current mechanical and electrical installation project. The process has been designed to manage projects according to project life cycle using appropriated tool, namely Microsoft Project. The project management process for each phase will be shown along with supporting information system.

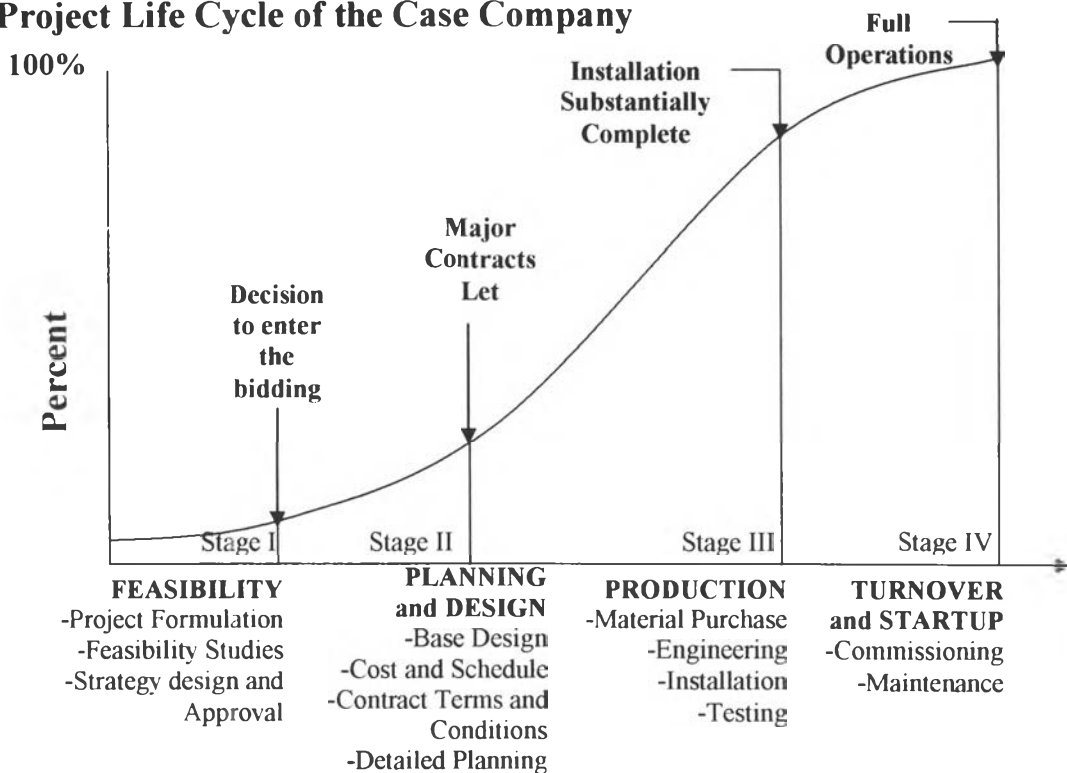### 4.2 Project Life Cycle of the Case Company

Figure 4.1 Project Life Cycle of the Case Company

The project life cycle by Duncan is used as a guideline for developing the company project life cycle. There are four major stages involve in the project.

4.2.1 Feasibility

The first stage in project life cycle is feasibility stage. The detail of feasibility stage includes project formulation, feasibility studies, strategy design and approval. The company first receives invitation to bid from contractor, then a feasibility study of the project is done by the company. Then, the company develops and formulates a project team which will be responsible for formulating a project. The case company has a commercial department which deals directly with contract-related issues so that other departments such as engineers do not have to deal with the contractor if there is problem about the project. When all is done, management team meets and designs to create a strategy for such project.

4.2.2 Planning and Design

Planning and Design is the second stage in project life cycle. Planning and design stage includes base design, cost and schedule, contract terms and conditions, and detailed planning. The responsibility for different areas in this stage can be divided into engineers responsible for base design and cost and schedule. This can be done via material and manpower take-offs. Commercial is responsible for contract terms and conditions, while everyone should be involved in detailed planning. The planning and design process will be discussed in detail later in the later sections.

4.2.3 Production

The third stage in project life cycle is production which includes manufacturing, delivery, civil works, installation, and testing. Production stage will differ from company to company depends on the nature of business. For the case company, production stage should include materials purchase, engineering, installation, and testing with extra attention on installation. These works are performed on the construction site and project manager, construction manager, and engineers are directly responsible for them.

4.2.4 Turnover and Startup

The last stage in project life cycle is turnover and startup. The detail activities include commissioning and maintenance. At this stage, the company is preparing to turnover or handover the project to the contractor, therefore it requires a close corporation between the case company and its contractor. After the handover, the contractor might request staffs from the case company to stay and help but this must be in accordance with the contract made at the beginning stage. Another important point is that at this stage, the case company is reducing the workforce so a plan must be made in advance for whom the company wants to let go or keep.

4.3 Project Map for Project Management Process

Project management process can be divided into 3 major steps, namely build project plan, track and manage a project, and close a project. Build a project step includes planning, scheduling, allocating resources, and costing. Track and manage a project involves how to control and manage a project. Lastly, close a project deals with closing a project before handing over.

Step 1 Build Project Plan
- Define a project
- Plan project activities
- Plan for and procure resources
- Plan project costs
- Plan for quality and risks
- Plan communication and security
- Optimize a project plan
- Distribute a project plan

Step 2 Track and Manage a Project
- Track progress
- Manage a schedule
- Manage resources
- Manage costs
- Manage scope
- Manage risks
- Report project status

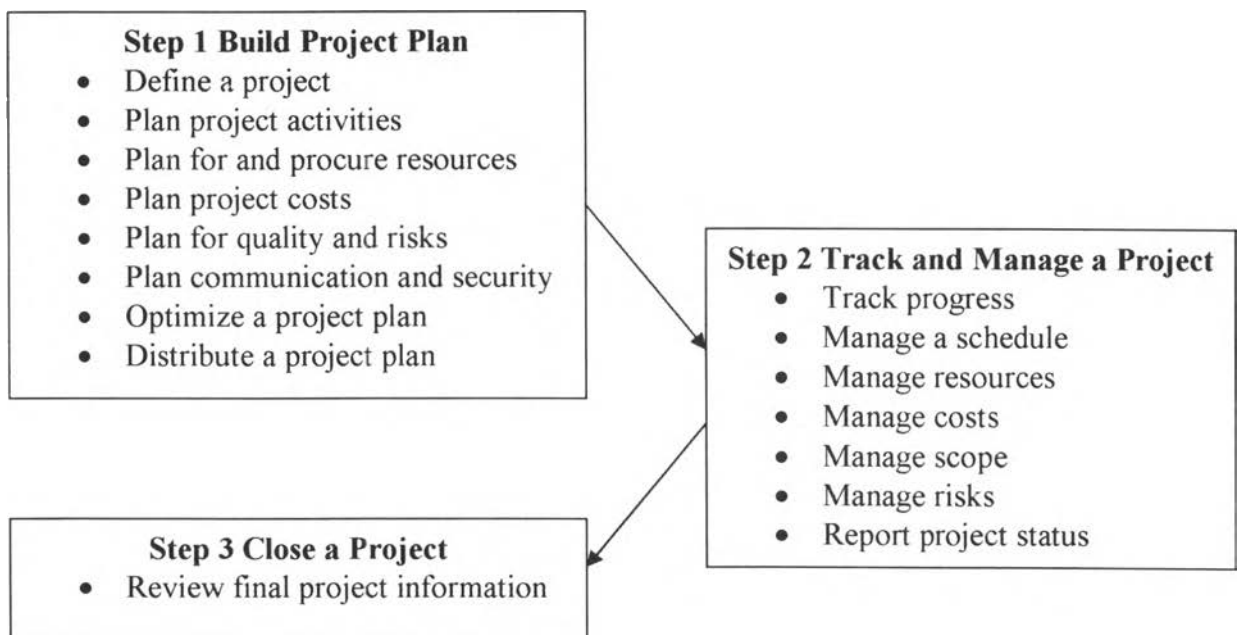**Step 3 Close a Project**
- Review final project information

Figure 4.2 Project Map for Project Management Process

The project map above shows common project management activities. Since all businesses are different, some of the activities may not apply to our case company. But overall, this project map will be used as a guide to setting up, managing, and completing our pilot project.

Combining company's project life cycle and the project map, project life cycle can be matched to project map by: Feasibility and planning and design are in build a plan step, production is in track and manage a project step, and turnover and startup is in close a project step.

4.4 Build Project Plan

The first two phases of company's project life cycle, feasibility and planning and design are in this step. The detail of feasibility phase is project formulation, feasibility study, strategies design and approval. For planning and design, there are base design, cost and schedule, contract terms and conditions, and detailed planning. These two phases happen before the actual work takes place at the construction site, therefore activities done in this step are mainly planning, scheduling, and assigning resources to the project. The focus of implementing information system lies mainly in this chapter because by improving the process of planning, scheduling, and allocating resource can benefit the company by reducing time and cost. This step in building project plan is divided into 8 subcategories.

4.4.1 Define a project

Defining a project is also divided into 3 sections, namely initiate a project, start a project plan, and define project deliverables.

1) Initiate a project – By initiating a project, this means the company must define objectives, assumptions, constraints to the project, prepare scope management plan, and feasibility study of the project. It is useful for project manager to create an objectives document which should contain project deliverables, deadline and milestones, quality criteria, and cost limits. More importantly, the objectives must

all be agreed by all project's stakeholders for them to be effective. This objectives document is then attach to the project file for future reference and easy access.

Project assumptions need to be defined in the planning stage because some information may not be available, therefore the company needs to make estimates. An example of one of the most important assumptions for this project is that the company assumes that they will receive handoffs from the contractor on time because the contractor is in charge of the civil works.

There are three major constraints that project manger needs to consider, schedule, resources, and scope. These three are known as project triangle and a change in one affects the other two. Project's stakeholders must be aware of them and be ready to make a trade off in case something happens.

Scope management plan contains project goals, tasks, and the work required to complete them. It also contains procedure in dealing with changes to the project. This turns out to be important in the project because there were many site instructions and engineering change orders issued during the project. Therefore, the company must plan ahead on how to handle these changes.

When performing feasibility study, project manager should model the project to verify best-case and worst-case scenarios. Microsoft has software called Microsoft Project Server which has modeling capabilities in which it can model different scenarios. Microsoft Project's formula capabilities provide project manager with a chance to implement what-if scenarios for costs.

2) Start a project – After initiating a project, now is the time to actually start a project on Microsoft Project. First step, the user has the options of creating new project or use one of the template. For the future projects, the company can use this worked out project as a template.
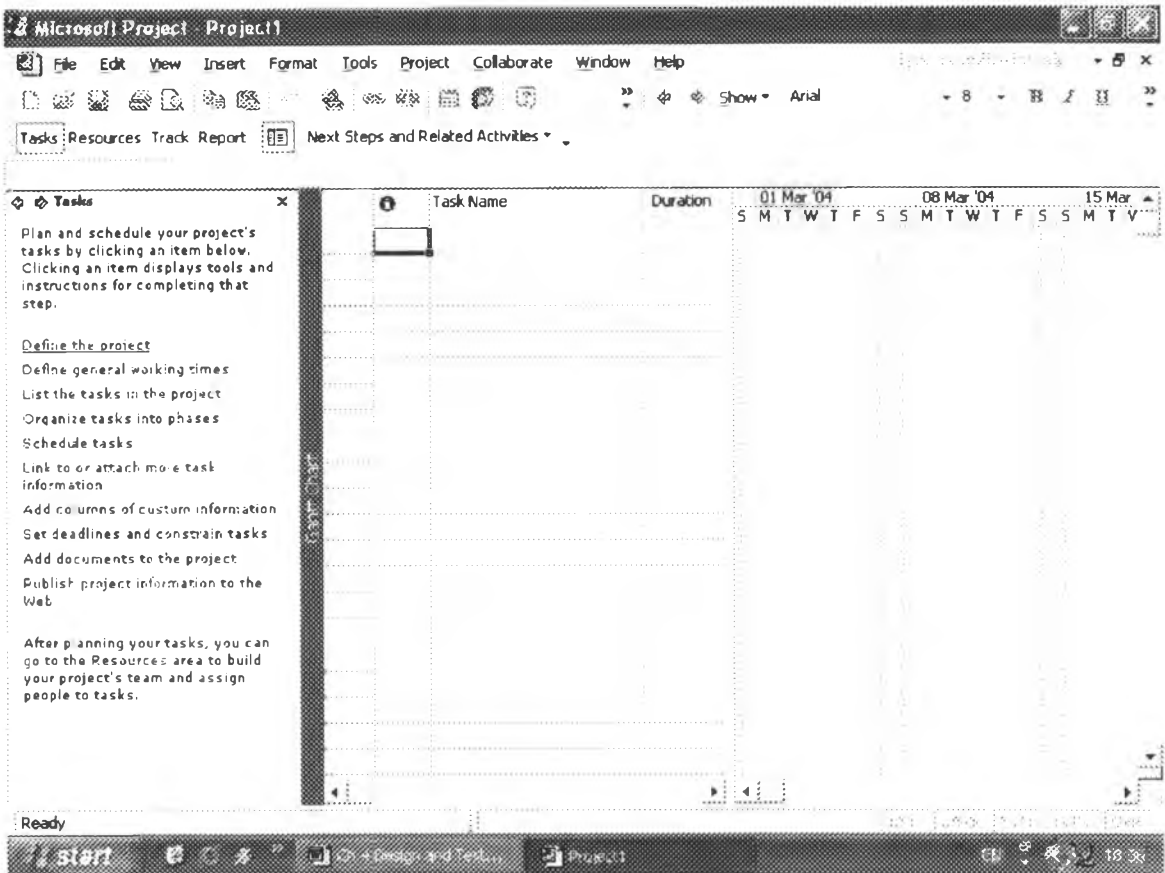
Figure 4.3 Creating New Project

Once at this screen, the user enters information about the project according to the instruction on the left-side window. Project start date is the first information that should be entered. Next user can choose to add properties such as title, subject, manager, and comments to the project. Now the related documents such as objectives document and scope management plan can be added, using hyperlink option, to the project under project summary task. The last step is to set the working time for project calendar by choosing *Change working time* under *Tools* from the menu.

3) Define project deliverables – Once the company defines its objective, the installation service, it becomes company's deliverable. But the deliverable can be divided into many deliverables such as different areas of work. The company can group those tasks within the same area together and create a milestone for each

area. This way the schedule can be created with a focus on deliverables and it ensures that the company will be able to deliver what it promises.

4.4.2 Plan project activities

Plan project activities contains 6 steps. There are define phases and create a task list, show the project structure, organize a project into a master project and subprojects, estimate task durations, task sequencing, and task dependence between projects.

1) Define phases and create a task – When project plan has been established, now a task list can be created. It can be done by listing all the tasks in Task Name column in the Gantt chart view. There are two types of tasks. First is single occurrence and second is recurring task. For single occurrence, it can be entered directly into the field. For recurring task, choose *Recurring task* from the *Insert* menu. Once all the tasks are listed, they should be divided into phases for ease of managing and control. This can be done by inserting a summary task above each phase, then highlight all the tasks in that phase and indent them. Next the user creates a milestone for the project. For simplicity, the milestones will be assigned at the end of each project phase. Milestone can be set by selecting on a task that defines milestone, then enter 0 day for duration. If a milestone task has a duration such as inspection and approval, it can be done by *Changing duration* under *Task information* and *Advanced* option. The project phases and project milestones are shown in figure 4.4.
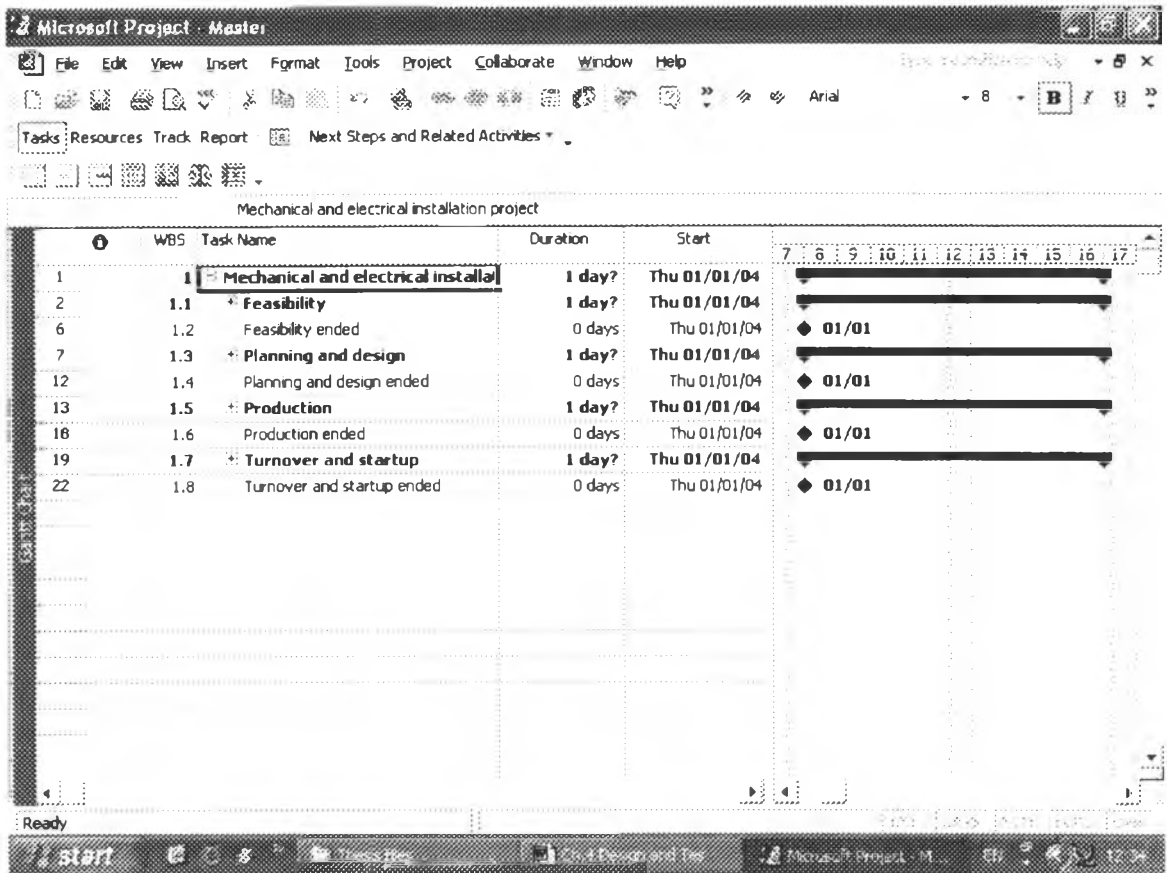
Figure 4.4 Phases of Project and Milestones

2) Show the project structure – Second step under plan project activities phase is show the project structure. Microsoft Project is designed so that various type of work breakdown structure (WBS) codes can be applied. Some company uses work breakdown structure (WBS) codes when they refer to tasks, so this functionality is helpful to them. The codes can also be created to match a particular style of the company. Outline codes which are code generated for tasks according to their hierarchy are also automatically generated by Microsoft Project. Outline codes can be use in the same way as work breakdown structure (WBS) codes. Task list and work breakdown structure (WBS) codes are shown in figure 4.5.
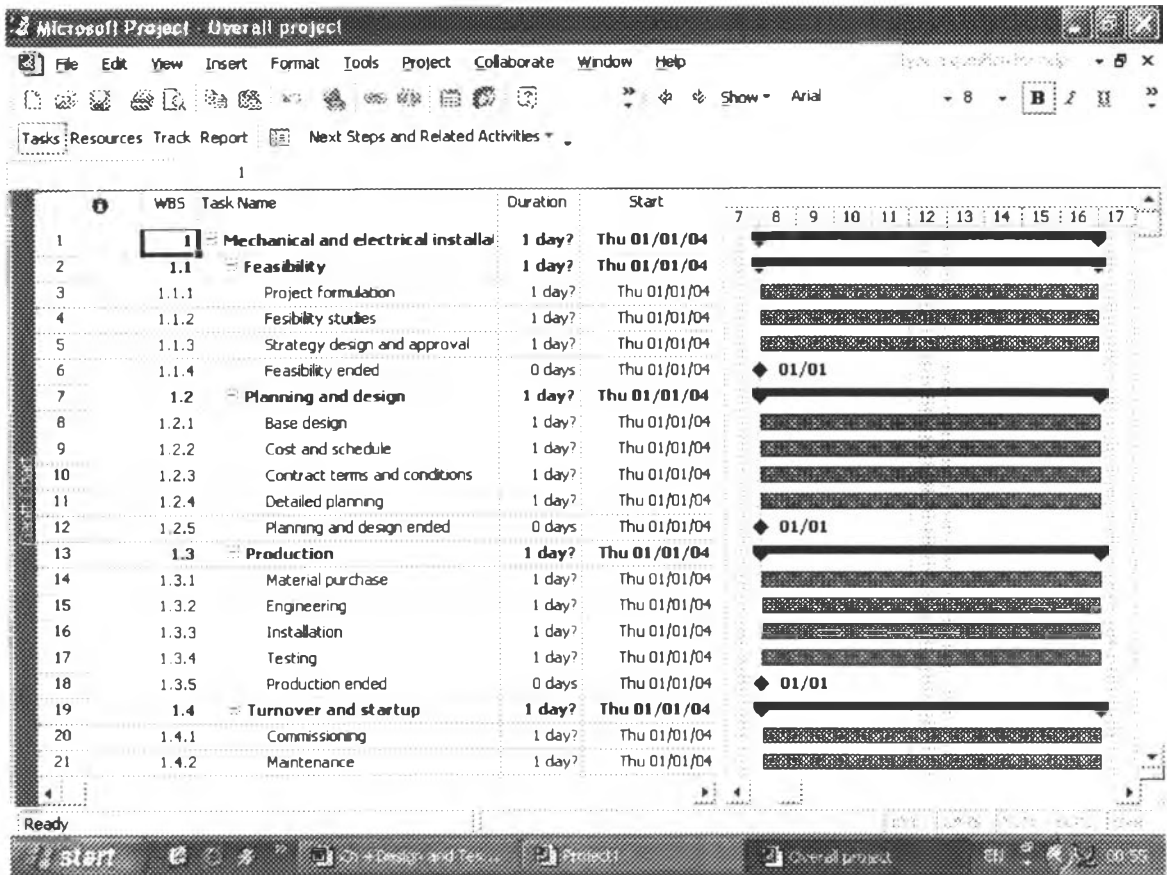
Figure 4.5 Task List with WBS codes

3) Organize project into a master project or subprojects – Microsoft Project allows the user to break down a large project into many small projects or insert one project into another. For the case company, it may be advisable to break down the production schedule into many small projects because it will be much easier to manage. To demonstrate this, the installation schedule will be entered into the master schedule. This can be done by select where the subproject should be inserted, in this case in place of installation under production phase. Then choose *Project* under *Insert* menu. The result is shown in figure 4.6. The benefit of this is, the master project can be viewed by management team without having to look at all the details. When the subproject is updated, that updated information also automatically updated in the master project as well. Therefore, each team can manage their own subproject while master project is monitored by project manager.
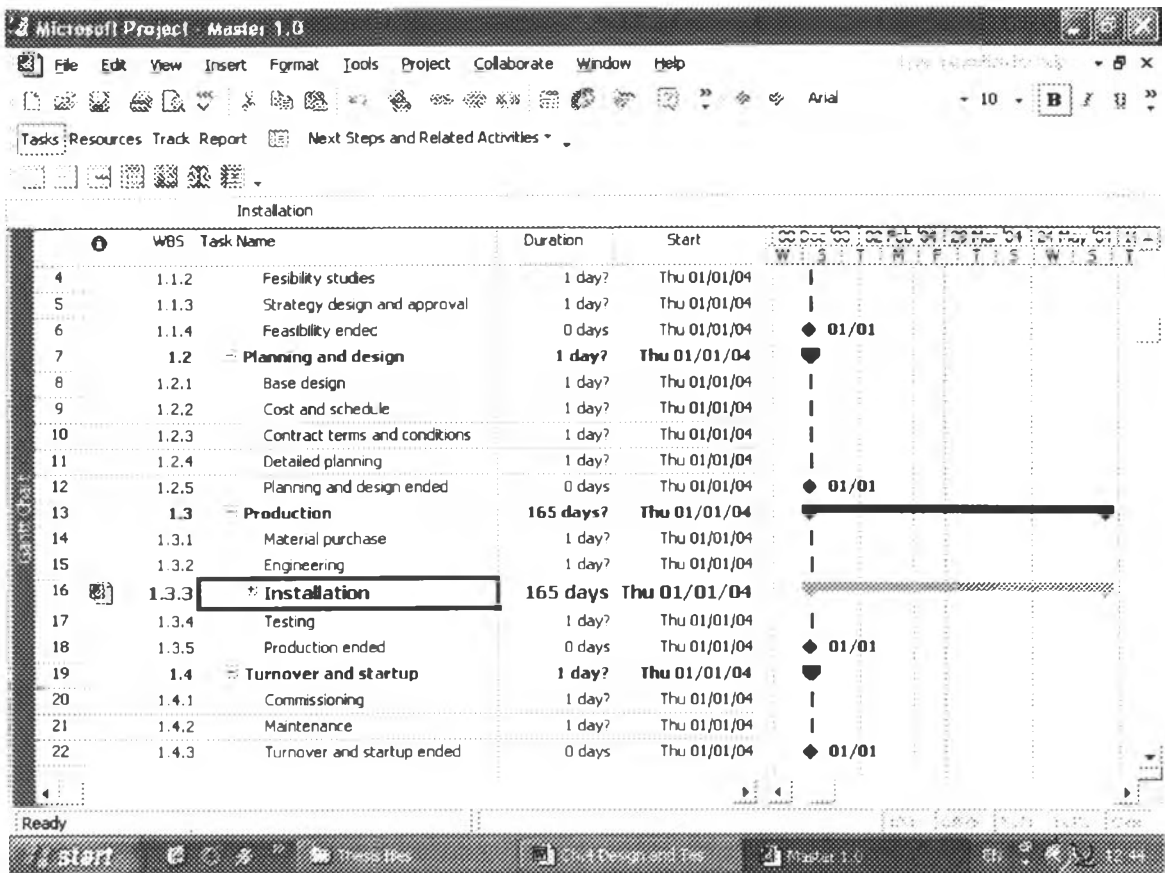
Figure 4.6 Master Project, Task List, and Subproject

4) Estimate task durations – It is time now for the user to enter task duration for the project. PERT analysis (Program Evaluation and Review Technique) can be used as a tool for estimating task duration. PERT theory has been discussed in the literature review but with the help of Microsoft Project, the user no longer requires to do the calculation by hand. PERT analysis calculates the probable outcome based on best-case, expected-case, and worst-case scenarios. This can be done by entering optimistic, expected, and pessimistic durations into the schedule and let Microsoft Project does the calculation based on the default weighted average (1-4-1). The PERT analysis gives project manager an idea of shortest, longest, and most likely project end date. Moreover, the estimated durations from PERT analysis can be used to enter in the duration field for each task.

During the project some task might be interrupted because the material did not arrive on time or resource conflict. That task can be split so the activity is

delayed until ready. This method will solve the problem of resource conflict for the case company. Additionally, task can be assigned its own calendar and working time because some tasks needed to be run on non-working time or resource that must work on Sunday and so on. PERT entry sheet is shown in figure 4.7.

	Task Name	Duration	Optimistic Dur.	Expected Dur.	Pessimistic Dur.
1	Mechanical and electrical installation project	261 days	165 days	165 days	180 days
2	Feasibility	9 days	3 days	4 days	5 days
3	Project formulation	2 days	2 days	2 days	3 days
4	Fesibility studies	4 days	3 days	4 days	5 days
5	Strategy design and approval	3 days	1 day	3 days	5 days
6	Feasibility ended	0 days	0 days	0 days	0 days
7	Planning and design	30 days	24 days	30 days	36 days
8	Base design	15 days	12 days	15 days	20 days
9	Cost and schedule	30 days	24 days	30 days	36 days
10	Contract terms and conditions	7 days	5 days	7 days	9 days
11	Detailed planning	30 days	24 days	30 days	36 days
12	Planning and design enced	0 days	0 days	0 days	0 days
13	Production	165 days	165 days	165 days	180 days
14	Material purchase	165 days	150 days	165 days	180 days
15	Engineering	84 days	75 days	84 days	90 days
16	Installation	165 days	0 days	0 days	0 days
17	Testing	165 days	150 days	165 days	180 days
18	Production ended	0 days	0 days	0 days	0 days
19	Turnover and startup	60 days	55 days	60 days	70 days
20	Commissioning	60 days	55 days	60 days	70 days
21	Maintenance	60 days	55 days	60 days	70 days
22	Turnover and startup ended	0 days	0 days	0 days	0 days

Figure 4.7 PERT Entry Sheet

5) Task sequencing – Another important step in planning project activities is to sequence the tasks. By sequencing the tasks, it means create task dependencies because tasks are related to others. These dependencies include Finish-to-start (FS), Start-to-start (SS), Finish-to-finish (FF), and Start-to-finish (SF). All these dependencies can be created by select 2 tasks that need to be linked. Then click the link button. Microsoft Project automatically link them with FS dependency. The dependency can be changed by double-click on the line joining 2 tasks and

click the link desired. Lead time and lag time can also be added to each task after creating all dependencies. To do this, choose task information and predecessor tab. Task sequencing is shown in figure 4.8.

While scheduling tasks, there maybe time that a task may need to start on a specific date. This can be set by go to *Task information*, *Advanced* tab, and set constraint type and date. This will tie a task to that date but it also reduces the flexibility to schedule for Microsoft Project.
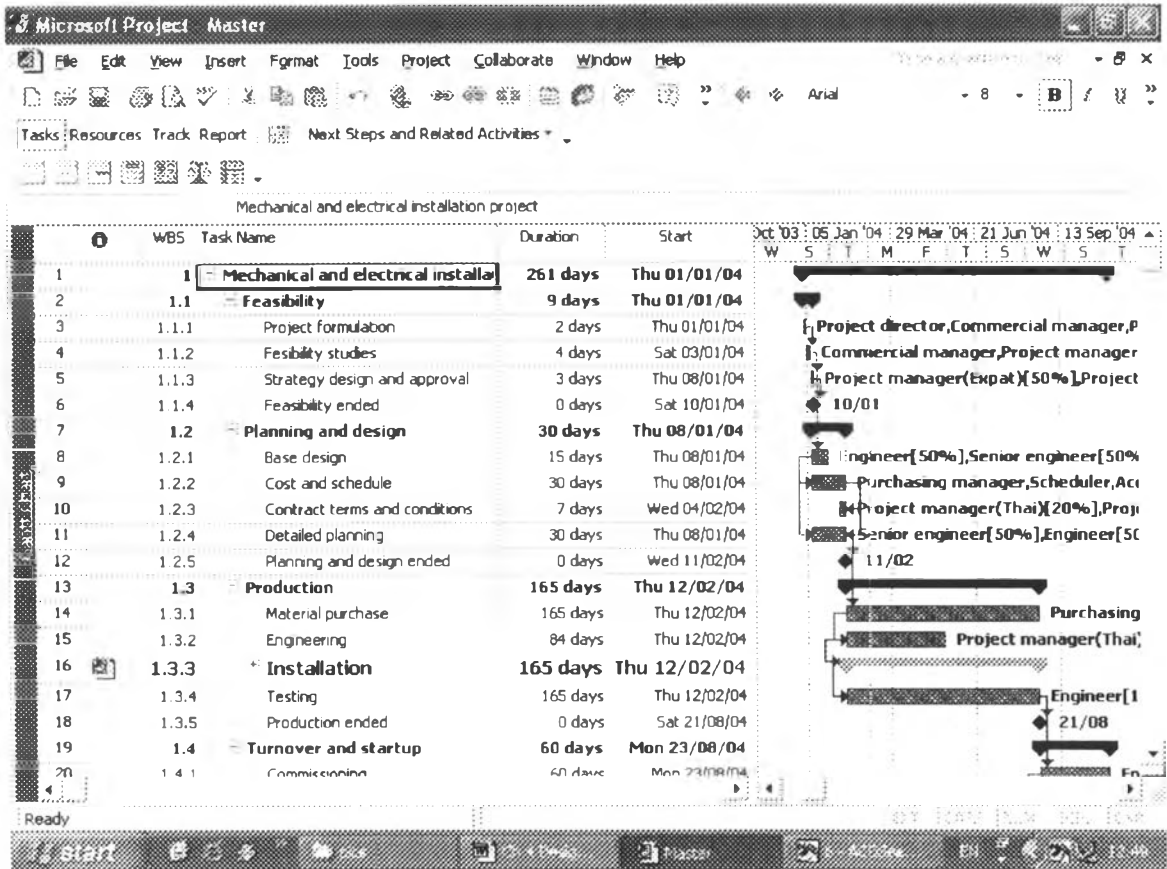

Figure 4.8 Task Sequencing

6) Task dependence between projects – Sometimes tasks are depended on other tasks that are not in the same project. This is possible for a large project where it contains many small subprojects. Microsoft Project provides the option of linking these tasks together. This task dependency allows user to see a clear picture of how projects are related and also keeps the project up to date.

4.4.3 Plan for and Procure Resources

After completing project scope, task list, and task durations, it is time to look at what resources are going to be needed. In this case resources refer to people, equipment, and materials. The steps in this phase include estimate resources needed, build the project team, share resources among projects, and assign resources to tasks.

1) Estimate resources needed – In this step, resource use will be estimated and resource management plan will be created. As for estimating durations, estimate resources use historical information from previous projects and experience of the staffs. While estimating resources, the company must keep in mind how number of resources affect durations, quality of resources, review duration estimates, identify resource types and numbers and so on.

During the process of estimating resources, the durations might need to be changed in order to resolve resource overallocations, cut costs, increase scope, or increase quality.

A preliminary resource list can be created by using resource sheet in Microsoft Project to enter resources such as people and materials required for the project. A placeholder such as engineer can be entered in the sheet and update later when that person has been acquired. This resource sheet will be submitted for an approval for staffing and procurement from the stakeholders. This is another area where the company should pay attention to since lack of procurement plan is one of its problems. Along with preliminary resource list, the company should also develop staffing strategy and procurement strategy based on the company's policies and procedures. Staffing strategy includes using existing team members, recruiting new staffs, using members from other departments and so on. The strategy should include interview and selection criteria. Procurement strategy should include procuring outside goods and services, choosing the best contractors, materials, and equipments and so on. These strategies along with preliminary resource list should be submitted to contractor for approval during the planning process. Once the approval has been granted, the preliminary resource list must be updated if there are any changes.

Once all resources are ready to be scheduled to tasks, the company must have resource management plan which should specify resource availability, assign resources where they are best used, assign project roles and responsibilities, and adhere to organization's HR and contract policies.

2) Build the project team – Assuming all resources have been identified, approved, and procured, now the resource information should be entered in the project plan. Microsoft Project provides online collaboration system to improve communication. The system such as Microsoft Project Server or e-mail-based team collaboration system can be used. This will improve the communication between project teams.

Next important point is to set resource rates and costs for materials. In resource view, enter the rate for resources both standard and overtime rate. The same thing can be done for materials. The resource sheet with resources rate is shown in figure 4.9.

Lastly, calendar and working time can be set for individual resource or a group of resources. If no change, the resources will use the same calendar and working hour of the project.

3) Share resources among projects – When one resource is working on more than one project (one file), its information and assignments need to be managed across multiple projects.

4) Assign resources to tasks – Major activities in this step are allocating resources to tasks and check to see if they are overallocated, underallocated. The purpose for assigning resources to tasks is to define responsibility and determine time and costs for each task. In Gantt chart view, click on each task and choose assign resources. Do it for all of the task then it is time to check whether resources assigned are overallocated or underallocated. Resource overallocation seems to be a problem more than underallocate. The solution to overallocation problem is to use leveling technique available in Microsoft Project.
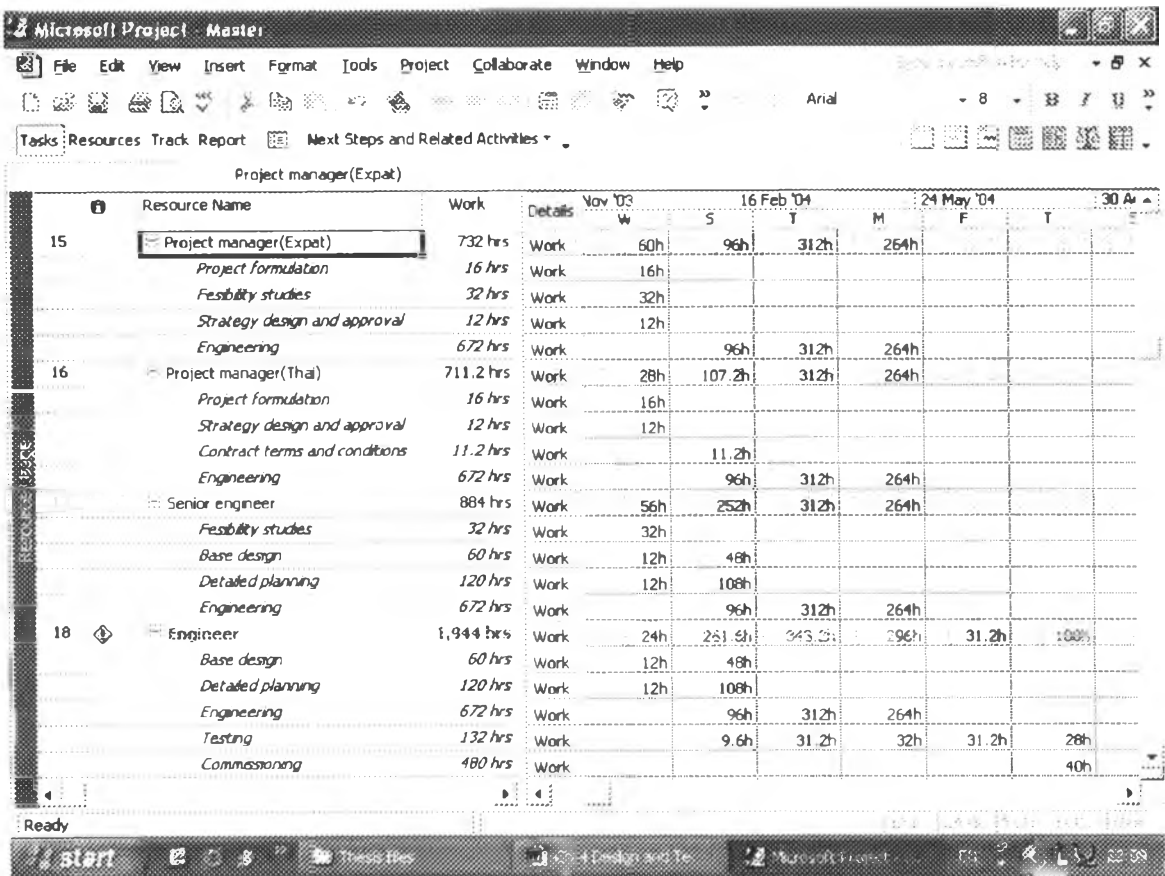
Microsoft Project - Master

File Edit View Insert Format Tools Project Collaborate Window Help

Tasks Resources Track Report Next Steps and Related Activities ▾

Project manager(Expat)

	❶	Resource Name	Work	Details	Nov '03 W	S	16 Feb '04 T	M	24 May '04 F	T	30 A
15		Project manager(Expat)	732 hrs	Work	60h	96h	312h	264h			
		Project formulation	16 hrs	Work	16h						
		Fesibility studies	32 hrs	Work	32h						
		Strategy design and approval	12 hrs	Work	12h						
		Engineering	672 hrs	Work		96h	312h	264h			
16		Project manager(Thai)	711.2 hrs	Work	28h	107.2h	312h	264h			
		Project formulation	16 hrs	Work	16h						
		Strategy design and approval	12 hrs	Work	12h						
		Contract terms and conditions	11.2 hrs	Work		11.2h					
		Engineering	672 hrs	Work		96h	312h	264h			
		Senior engineer	884 hrs	Work	56h	252h	312h	264h			
		Fesibility studies	32 hrs	Work	32h						
		Base design	60 hrs	Work	12h	48h					
		Detailed planning	120 hrs	Work	12h	108h					
		Engineering	672 hrs	Work		96h	312h	264h			
18	◈	Engineer	1,944 hrs	Work	24h	251.6h	343.2h	296h	31.2h	108h	
		Base design	60 hrs	Work	12h	48h					
		Detailed planning	120 hrs	Work	12h	108h					
		Engineering	672 hrs	Work		96h	312h	264h			
		Testing	132 hrs	Work		9.6h	31.2h	32h	31.2h	28h	
		Commissioning	480 hrs	Work						40h	

Ready

start

Figure 4.9 Resource Usage Sheet View

Figure 4.9 shows all the tasks each resource is responsible for. It also shows resource overallocations in red in which the user must level them to solve the problem.

Resource leveling reschedules by splitting and adding delay to tasks until the problem is solved. There are many options under leveling command to choose such as available slack, task priority, task dependencies, and task constraints. When leveling, user must consider the limitations of project, including budget, resource availability, finish date, and the flexibility available for scheduling tasks.

4.4.4 Plan project costs

Planning project costs include estimate costs by estimating costs for resource or task required to complete project activities, define and share cost information for management purpose, and prepare to manage costs so the project stays within budget.

Figure 4.10 Resource Sheet and Resource Rates

	●	Resource Name	Type	Material Label	Initials	Group	Max. Units	Std. Rate	Ovt. Rate	Cost/Use
1		Construction supervisor	Work		C	Manual	100%	฿250.00/hr	฿0.00/hr	฿0.
2		Construction foreman	Work		C	Manual	100%	฿190.00/hr	฿0.00/hr	฿0.
3		Technician	Work		T	Manual	100%	฿190.00/hr	฿0.00/hr	฿0.
4		Welder	Work		W	Manual	100%	฿185.00/hr	฿0.00/hr	฿0.
5		Pipe fitter	Work		P	Manual	100%	฿150.00/hr	฿0.00/hr	฿0.
6		Mechanical fitter	Work		M	Manual	100%	฿150.00/hr	฿0.00/hr	฿0.
7		Electrical fitter	Work		E	Manual	100%	฿170.00/hr	฿0.00/hr	฿0.
8		Instrument fitter	Work		I	Manual	100%	฿170.00/hr	฿0.00/hr	฿0.
9		Helper	Work		H	Manual	100%	฿90.00/hr	฿0.00/hr	฿0.
10		Laborer	Work		L	Manual	100%	฿65.00/hr	฿0.00/hr	฿0....
11		Mason	Work		M	Manual	100%	฿140.00/hr	฿0.00/hr	฿0.
12		Rigger/Scaffolder	Work		R	Manual	100%	฿140.00/hr	฿0.00/hr	฿0.
13		Crane driver	Work		C	Manual	100%	฿175.00/hr	฿0.00/hr	฿0.
14		Truck driver	Work		T	Manual	100%	฿125.00/hr	฿0.00/hr	฿0.
15		Project manager(Expat)	Work		P	Non Manual	100%	฿1,675.00/hr	฿0.00/hr	฿0.
16		Project manager(Thai)	Work		P	Non Manual	100%	฿650.00/hr	฿0.00/hr	฿0.
17		Senior engineer	Work		S	Non Manual	100%	฿575.00/hr	฿0.00/hr	฿0.
18		Engineer	Work		E	Non Manual	100%	฿475.00/hr	฿0.00/hr	฿0.
19		Project administrator	Work		P	Non Manual	100%	฿475.00/hr	฿0.00/hr	฿0.
20		Scheduler	Work		S	Non Manual	100%	฿525.00/hr	฿0.00/hr	฿0.
21		Draftman	Work		D	Non Manual	100%	฿425.00/hr	฿0.00/hr	฿0.
22		QC supervisor	Work		Q	Non Manual	100%	฿525.00/hr	฿0.00/hr	฿0....

1) Cost estimating – Microsoft Project helps estimating cost by providing estimating methods but which method is suitable to the company depends on scope of project, level of accuracy, and current practices. Cost estimation could be done by using historical data as a basis for estimating. First method is bottom-up estimating which is people responsible for tasks estimate their own costs. It can be done by entering per-use costs for resources and fixed costs for each task. This method should provide reliable and accurate result. Second method is top-down estimating in which the company currently practices. It is quick to implement but also less accurate than bottom-up estimating. This can be done by using historical information and past experience to estimate cost for all tasks. The last method is to use parametric model. For simple parametric model, such as pipe installation cost per meter can be done on Microsoft Project. But for more complex calculation, it should be done on Microsoft Excel. When the total costs are

obtained, it is practical to optimize them. This can be done by adjust resources, adjust costs, or adjust scope all this to reduce cost totals.

For the company, they should list resource rate in the resource sheet which is shown in figure 4.10. These costs then will be summed up by task which can be shown in the task list by choosing cost to be displayed in the table. Task sheet and total costs are shown in figure 4.11.

Figure 4.11 Task Sheet and Total Costs

2) Define and share cost information – When all costs have been entered in the previous step, now these costs should be saved as a baseline for project budget. This step also includes attach notes about cost information, print or publish cost totals, and export cost information to other financial program. Cost baseline that has been saved will be used for tracking and managing in the future.

3) Prepare to manage costs – The company needs to make necessary preparations for tracking and managing to ensure that the project stays within budget. Under *Tools* option, user can choose the option that actual costs be manually or automatically calculated. User can also determine when actual costs should be accrued such as at the start, at the end, or prorated by percent completed.

4.4.5 Plan for quality and risks

1) Plan for quality – Before the project begins, the company must plan for quality standards. The quality plan might require some adjustments to scope, resources, and schedule in order to achieve the level of quality desired. Examples of quality standards that should be considered are company quality policy, industry-wide standard, statement of project deliverables, and detailed description of service provided. To meet quality standards, the company may need to consider the impact of scope on quality, changing the scope of tasks, and changing the quality of resources.

2) Identify and plan for risks – Identifying, planning, and reducing risks during the project allows the company to keep project on schedule and within budget. This is another important area that the company is not currently practicing. Contingency plan should be created in case unexpected events happen. Microsoft Project suggests risks that should be considered including high-risk tasks, budget risks, and resource risks.

4.4.6 Plan for communication and security

Communication during in the project is another problem for the company. Microsoft Project provides tools to use to improve communication between teams.

1) Set up project communication – Microsoft Project has communication features such as using Microsoft Project Server or e-mail-based team collaboration system for communicating. But this may prove to be somewhat complex for the company. The company can choose to use other method that does not require

Microsoft Project. The company can use e-mail to send or route a project by using only Microsoft Outlook.

2) Protect project information – The security is also an issue. For Microsoft Project, it offers security for online collaboration such as in Microsoft Project Server. But for the company, not using Microsoft Project Server, security is also an issue to consider when dealing with e-mail and company network.

4.4.7 Optimize a project plan

Sometimes a project plan may need to be optimized. There are 3 cases that project plan should be optimized for, optimize project plan to meet finish date, optimize project plan for resources, and optimize project plan to meet budget. The optimization directly relates to project triangle by Microsoft Project. The project triangle is the relationship between time, money, and scope. Adjusting one will have effect on the other two.

1) Optimize project plan to meet finish date – If the plan does not meet targeted finish date, the company needs to adjust the plan but scope and costs will definitely change. Methods of adjusting the plan to meet finish date include change project start date, modify calendar, reduce scope, or adjust tasks on critical path. As discussed in chapter 2, adjusting the tasks on critical path is also called project crashing. With Microsoft Project, it is much easier to crash a project because critical tasks can be viewed and once crashed, it automatically calculates new critical path.

2) Optimize project plan for resources – Overallocations and underallocations should be solved in order to optimize resources workloads. This has been discussed before in assigning resource section. The company must keep in mind that adjusting resources could result in change in project finish date.

3) Optimize project plan to meet budget – If the planned costs do not meet the budget, the company needs to optimize the plan to stay within budget. There are three ways to optimize the plan to meet budget, namely adjust resources to meet budget, adjust costs to meet budget, and reduce scope to meet budget. Which choice to choose depends on the situation, circumstances, and project manager's vision.

4.4.8 Distribute project plan

The last step for building a plan is to distribute a plan. There are two major options here that the company can choose or they can do both. One is to distribute a printed format and two is to distribute it online.

1) Distribute printed format – Many reporting views are available in Microsoft Project and all can be printed for reports. First user must choose which view do they want, then which information contained in a view that they want. Another method is to print a summarized project information. This is probably a better option for management and stakeholders because they do not have to go into details unless requested. For overview reports, there are options of printing project summary, top-level tasks, critical tasks, milestones, or working days. There are many predefined report formats to choose, but user can still create custom format if wanted. Project summary and critical tasks reports are shown in figure 4.11 and 4.12.

2) Distribute project information online – User can use Microsoft Project Server to distribute project information online or save the schedule as a web page. The user can choose to capture any active Microsoft Project view to be opened with any picture viewing programs. In any way, the company will be using e-mail as a method of distributing project information.

Microsoft Project : Master

Page Setup... | Print... | Close | Help

Dates			
Start:	Thu 01/01/04	Finish:	Sat 18/09/04
Baseline Start:	NA	Baseline Finish:	NA
Actual Start:	NA	Actual Finish:	NA
Start Variance:	0 days	Finish Variance:	0 days

Duration			
Scheduled:	225 days	Remaining:	225 days
Baseline:	0 days?	Actual:	0 days
Variance:	225 days	Percent Complete:	0%

Work			
Scheduled:	22,196.8 hrs	Remaining:	22,196.8 hrs
Baseline:	0 hrs	Actual:	0 hrs
Variance:	22,196.8 hrs	Percent Complete:	0%

Costs			
Scheduled:	036,549,380.00	Remaining:	036,549,380.00
Baseline:	00.00	Actual:	00.00
Variance:	036,549,380.00		

Task Status		Resource Status	
Tasks not yet started:	22	Work Resources:	28
Tasks in progress:	0	Overallocated Work Resources:	2
Tasks completed:	0	Material Resources:	0
Total Tasks:	22	Total Resources:	30

Page: 1 of 1

start

Figure 4.12 Project Summary Report

Microsoft Project - Master

Page Setup... | Print... | Close | Help

Critical Tasks as of Mon 08/03/04
Master

O	WBS	Task Name	Duration	Start
	1	Mechanical and electrical installation project	225 days	Thu 01/01/04
	1.3	Production	201 days	Thu 01/01/04
	1.3.4	Testing	165 days	Thu 01/01/04

ID	Successor Name	Type	Lag
18	Production ended	FS	0 days
20	Commissioning	FS	0 days

| | 1.4 | Turnover and startup | 60 days | Mon 12/07/04 |
| | 1.4.1 | Commissioning | | 60 days | Mon 12/07/04 |

ID	Successor Name	Type	Lag
21	Maintenance	SS	0 days

| | 1.4.2 | Maintenance | 60 days | Mon 12/07/04 |

ID	Successor Name	Type	Lag
22	Turnover and startup ended	FS	0 days

| | 1.4.3 | Turnover and startup ended | 0 days | Sat 18/09/04 |

Page: 1 of 2 Size: 1 row by 2 columns

start

Figure 4.13 Critical Tasks Report

4.5 Track and Manage a Project

When planning phase is over, the company is ready to track and manage the project as the progress moves along. Track and manage a project directly links to production phase in the company's project life cycle. While planning, scheduling, and allocating resources are already done in build a plan step, track and manage a project concentrates on managing the project according to those planned in the build a plan step. This step focuses on progress and costs of the project. The use of information system makes tracking easier and clearer for the company to manage. Better tracking and managing process will help the company keeps up with the schedule and control costs to remain within budget. There are 7 subcategories for track and manage project.

4.5.1 Track progress

Before tracking progress, there is a need for start up a project for tracking and record progress and updates.

1) Start up a project for tracking – Prior to start tracking, the company must decide which tracking method to use and what to track such as project start and finish date, work, or resource costs. To do that, the company saves the plan as a baseline to be compared with actual progress in the future. It must be remembered that when additional task or information is added to the project, the baseline must be updated as well. When baseline plan is saved and as the project progresses, an interim plan can be saved. An interim plan is project data after project begins but it only contains task start and finish date, therefore it is less detailed than baseline plan. The interim plan can be used to compare against baseline plan to assess project progress.

There are ways of getting project information. One of the ways is to collect data manually, this is what the company does. During the progress, the company updates task start and finish dates, completion percentage, and costs. For task start and finish dates and completion percentage, the information should be gathered from resources who are assigned to that task. For the costs, the company can get actual costs from accounting department. In addition, the company must

Figure 4.14 Tracking View of Project Plan

define a data collection plan in which it defines how often data is gathered and how often the project gets updated. Other methods of collecting data include using Microsoft Project Server where the project can be updated by anyone or using e-mail instead of manually collection. Tracking view of project plan is shown in figure 4.14.

2) Record progress and respond to updates – The basic idea of tracking progress is to collect information from teams and update the project plan with that information. There are ways of updating the plan, for example by percent complete, by actual duration, work start and finish dates, or actual work. If the company wants a more accurate tracking for costs, they can do that by enter cost manually and turn automatic cost update in the program off.

While tracking the project, the company might use earned value analysis to analyze project performance. Earned value analysis is a method for measuring

performance by comparing how much of the budget should have been spent in terms of the amount of work done and the baseline costs. The earned value analysis will tell the user whether they are in front or behind schedule and the budget has bee overspent or not. When the updates are done, the baseline plans or interim plans should also be updated and saved for the record. Figure 4.15 shows task sheet with schedule and baseline that will be used for earned value analysis.

Figure 4.15 Task Sheet in Variance View Before Earned Value Analysis

Figure 4.15 Variance After Analysis

In the above figure, information has been entered to create an example of how earned value analysis works. The earned value analysis will analyze the actual progress against the baseline and show the variance between them. If a task has a delay start or finish date, the tasks following it will also be adjusted according to those variances.

4.5.2 Manage a schedule

Along side with tracking actual progress on tasks as project begins, the schedule needs to be reviewed. The reason is to identify the problems or potential problems that could happen and manage those problems by adjusting the schedule.

1) Identify schedule problems – First the user must analyze the schedule. One method of analyzing schedule is to compare it with older version of project. Another is to compare current project finish date with a baseline. If there is a delay, the company must identify why it happens.

One of the clearest ways to see why there is a delay is to look at critical path. The critical path might be affected by adjustments that were made to the schedule result in delay in project finish date. Task dependencies that the company creates might be the reason of delay, so it is a good idea to review task dependencies again when the planning is done. Lastly, the delay could be caused by task constraints. Task constraints limit the flexibility of scheduling especially if the constraints were on critical tasks.
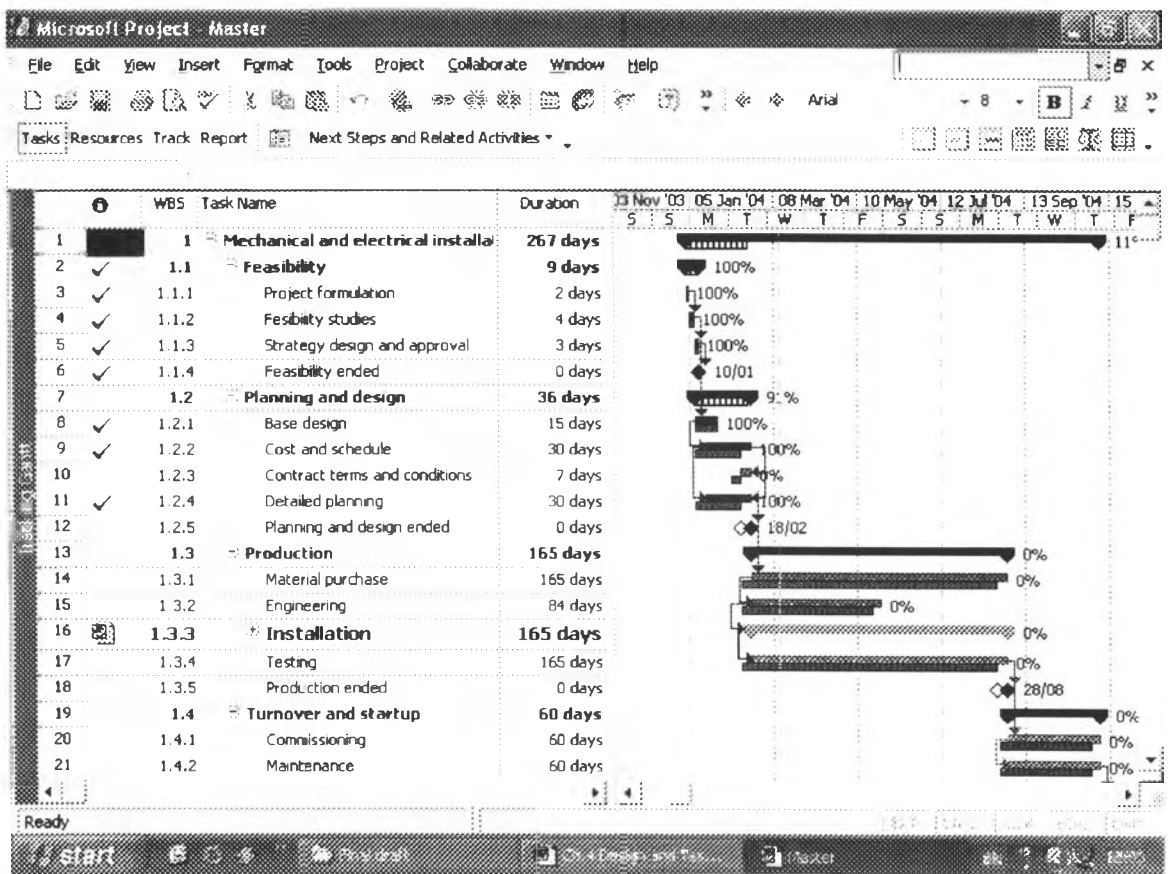
Figure 4.16 Tracking Gantt View

Figure 4.16 shows the actual progress against schedule and critical path. To go into detail, the company can see which tasks are delayed or incomplete by checking the variances between the baseline and actual start and finish dates in Tracking Gantt view. The user can use the Slipping Assignments filter to see resources that are assigned to tasks that are not yet complete and have been delay from baseline finish date. Tasks' progress can be viewed by progress line generated by Microsoft Project shown in figure 4.17. This progress line provides visual presentation of variance of actual progress and the baseline. The line pointing to the left means the task is behind schedule and vice versa.

Figure 4.17 Progress Line Showing Tasks' Progress

2) Getting back on schedule – Ways of getting tasks back on schedule include change task's duration which is easiest or modify task schedule such as dependencies, constraints, or resources. When all the changes have been made,

the schedule should be saved as an interim plan. This interim plan can be used to compare against the old version or with other projects to see where changes have been made.
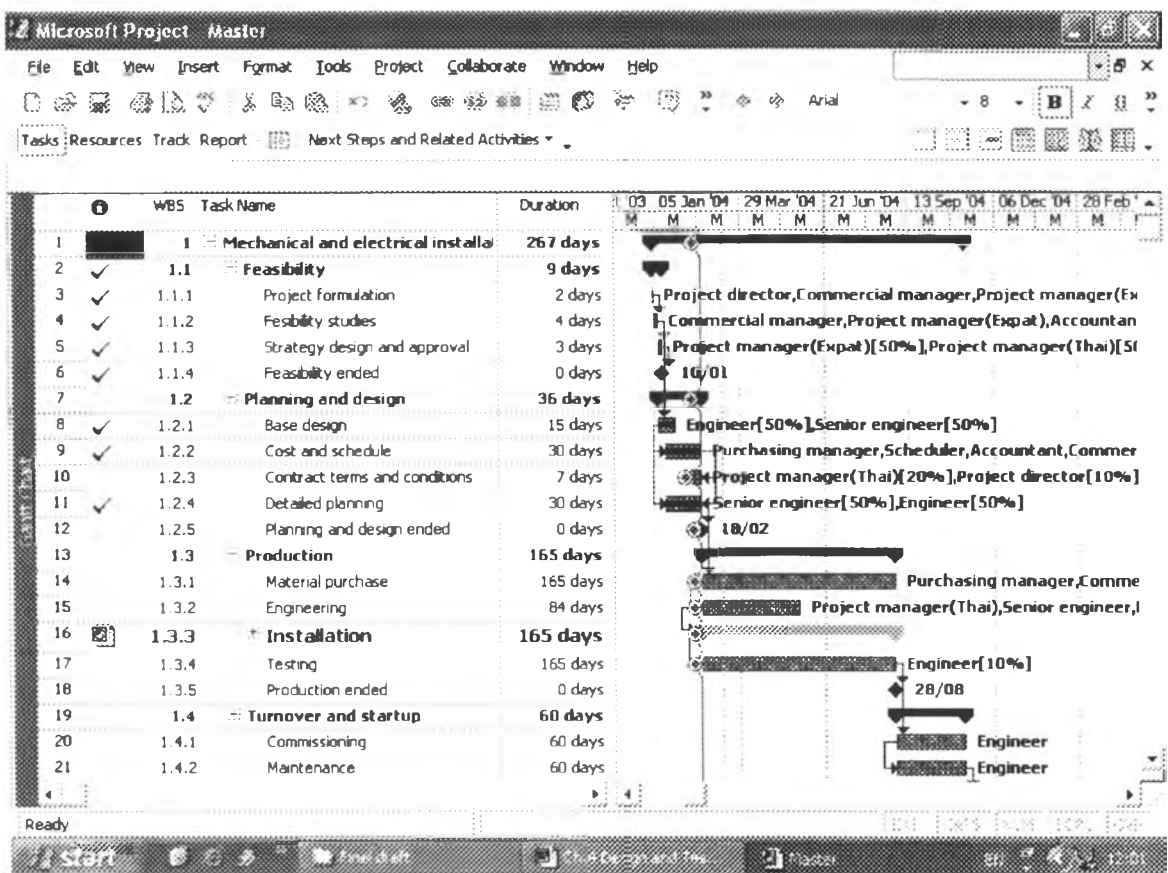
3) Distribute project information – The last step for managing a schedule is to distribute the changed project information. All personals must be notified of the changes via printed format, e-mail, or any other communication methods. This step is comparable to distribute project information while the company was in the building a plan phase.

4.5.3 Manage resources

Not only the schedule needs to be managed and reviewed, the resources also do too. The reason for managing resource is because if schedule changed, the resources originally assigned will be affected also. The resources might be assigned too much or too little work which will create resource allocation problems.

1) Track resource progress – The way to track resource progress is to balance resources workloads with track progress on tasks. The ways to track progress have been discussed earlier which include use Microsoft Project Server, e-mail, or manually tracking. The current practice of the company is to use manual tracking. The information gathered from resources then gets updated in the schedule.

2) Identify resource allocation problems – Resource allocation problems can be identified by reviewing assignments, availability, overallocations or underallocations, costs, and variances of planned against actual work. After review if resources were not optimally assigned to tasks, some measures might need to be taken to optimize resources.

3) Resolve resource allocation problems – Resource overallocation can be solved by leveling the resource while resource underallocation can be solved by controlling the resource use throughout the project. Once these problems have been solved, user might add note to the project about resource changes that have been made.

After the changes have been made, it is recommended to compare the changed schedule with the previous one. While comparing, pay attention to changes on critical path, project dates, and project costs.

4) Distribute project information – As for managing a schedule, the changed project information needs to be distribute to all personals.

4 5.4 Manage costs

After managing schedule and resources, costs are next on the list to be managed. One of the goals of the company while managing a project is to keep costs within budget and this can be done via costs management.

1) Identify cost problems – To identify cost problems, the company can review cost totals and cost variances periodically to see the changes and whether adjustments need to be made. The project costs can be viewed in the statistics or in project summary. After seeing the overall picture, cost variances for tasks, resources, and assignments need to be looked at to see when and where the costs differ from budgeted.

2) Staying within budget – The company will now know cost variances and ready to make adjustments. In order to make changes to the schedule, the company needs to make a decision of whether to change scope or quality to reduce costs. But either way, the company needs to consider the effect of the change on other tasks, resources, and project deliverables.

If change in scope and quality is not possible, the company must optimize the plan instead. To do that they have choices of reduce the cost of tasks by modifying how resources are assigned to them, reduce the total costs by lower the task or resource costs (per-use, rate-based, etc.), reduce the total costs by reducing the scope. Reducing scope is not possible because the scope is defined under the contract, therefore the company is left with only the first two options.

After the cost optimization have been made, be sure to review how they affect the project. The company must look at the critical path, project start and finish dates, and overallocated and underallocated resources. Then, notify the teams of the changed plan.

4.5.5 Manage scope

Because schedule, resources, and costs may change during the project, the effect of the changes can be seen in the scope. Therefore, the scope must be managed in order to cooperate those changes. In another instance, the change may have started from the scope if there is a need to reduce or increase. The change will inversely be affecting the schedule, resources, and costs.

1) Respond to changes in scope – Since this project was under a contract, the only way the scope is going to change is by the contractor. This has been the case for the company because during the project scope had been cut and increased in the form of Site Instructions. When there is a change in scope, the company must adjust the task list, resources, and costs. The adjustments will depend on how much the scope is changed. After the scope is changed, the effects on the project as a whole must be examined. Finally, the changes must be communicated to all the teams.

2) Distribute project information – The updated current information, not only distributed to team members, it must be distributed to the stakeholders as well. For the case company, the contractor must be notifies of what effects the changes in scope have on the project.

4.5.6 Manage risks

During the planning stage, risk management plan has been planned but as the project progresses, new risks might occur. These risks need to be assessed and resolved at various times during the project in order to maintain the schedule.

1) Identify new risks – Risks can be divided into high-risk tasks, budget risks, and resource risks. High-risk tasks include tasks with estimated duration, tasks with long duration, tasks on critical path, tasks with external dependencies and so on. These high-risk tasks must be identified and managed individually. Budget risks can be identified by overbudget tasks and variances from the plan. Resource risks include material with one supplier, resources with special skills, resources who are fully-allocated or overallocated and so on.

2) Respond to risks – The most common risks are those that threaten to delay task or project, increase the budget, overwhelm resources, or all of them. For each risk when it happens, the company should respond to them in the right fashion, for example respond to increase scope by referring to scope management.

3) Distribute project information – If the project is changed as a result of the risks, the updated project information must be distributed to teams and stakeholders.

4.5.7 Report project status

There are two options to reporting project status, first report in printed format and second report online. The reporting process has been discussed many times in this chapter. The company is currently using e-mail method of reporting to the contractor but inside the company is printed format.

4.6 Close a project

The purpose for this last step in the project is to review final project information. The activities that should be carries out in this step are gather and review project information and share it with stakeholders and collect lessons learn in the project to create best practices or save data as a template to be used in future projects.

The lessons learned from the project which includes project's success and failure can be used for a final team meeting, training for future projects, or recurring projects. The lessons learned also provide information for administrative closure and contract

closeout. Administrative closure includes verifying scope, documenting and maintaining project information, and producing summary information such as cost, work, and tasks. Contract closeout includes making sure that the final work is completed and delivered and all invoices are cleared. These documents and information can be obtained from the project report or project summary in Microsoft Project. Lastly, all information, manuals, and paper works must be handed over to the contractor.

4.7 Benefits From Implementing Project Management Process

After implementing project management process, the result shows many benefits for the company. Benefits are determined by things that improve the current project management process of the company. One of the improvements is that it provides solution to problems that the company had faced during the actual project. Second, the improved project management process is more efficient and more productive, hence saves the company on time and costs. The detail of some obvious benefits are listed below.

4.7.1 Scope management plan – The scope management plan gives the company ability to plan and deal with change in scope. During the project, the company faced many problems such as reduce in scope from the contractor and increase in scope in the form of site instruction and engineering change order. Because the company did not have scope management plan, the schedule was affected and resulted in delay of project end date and delivery. With scope management plan, the company will be able to know how scope change will affect the schedule and report that information to the contractor.

To give an example, in the middle of the project the contractor issues a site instruction (SI) which takes 3 days to complete. Even though the time it takes to complete the instruction is 3 days, the duration of the whole project may be extended by more than 3 days because the schedule could be affected. For example, site instruction might require resources that are fully allocated which means they must leave their scheduled task to work on site instruction tasks. As a result, the original scheduled work is delayed. These affects on schedule and additional costs, if applicable, must be reported to the contractor

because it is not the company's responsibility for the delay and higher costs of the project.

4.7.2 PERT analysis – Program Evaluation and Review Technique (PERT) analysis provides project manager the ability of viewing best-case, worst-case, and expected-case scenarios by using the method of estimating task durations. These scenarios can be translated to shortest, longest, and most likely project completion date. Prior to the implementation, project manager did not have any ideas of what is the shortest or longest time to complete the project. If the project manager and company have the ability to foresee the shortest completion time, it might set a goal for the company and try to achieve it.

PERT analysis also calculate weighted duration for each task. The weighted duration is calculated by given optimistic and pessimistic a weight of 1 and expected duration gets a weight of 4. The weight duration can be used in the project instead of expected duration to calculate a more reliable estimate of task durations A more reliable estimate of task durations means more time and costs for the project also become more reliable. The project manager can cut back on needless time and resources for each task.

4.7.3 Task splitting – Task splitting is something that the company has not used before. The ability of splitting tasks in Microsoft Project lets the company move and reschedule tasks that have been interrupted. During the actual project, many tasks were interrupted by many factors such as materials did not arrive in time or resources were assigned to additional and more urgent tasks. The whole schedule is automatically adjusted according to the change affected by task splitting.

To give example to when to use task splitting, it can be linked directly to the example given for scope management plan. It has been mentioned that sometime resources are required to stop working on their scheduled tasks and work on more urgent tasks instead. In this case, the scheduled task can be split until the resources finish with urgent tasks and become available to work again. The benefit of splitting task is that the company does not have to adjust the whole schedule when changes occur.

4.7.4 Resource management plan – Same with scope management plan, having a plan for resources presents the company with the ability to prepare and solve resource problems. Listing all resources in resource sheet in Microsoft Project is one of the actions on resource management plan. Resource sheet will solve the problem of wrong specifications for materials and equipments if submitted to the contractor for approval in advance. Not only the resources acquired are the right specifications, the plan will ensure the availability of resources as well. During the project, company had wasted a lot of money on ordering wrong specification materials and receiving late deliveries from lack of procurement planning.

For future projects and with resource management plan, the company should first list all resources, which are people, materials, and equipments, and send them to contractor for approval. This will solve the problem of purchasing wrong specification materials or equipments. Next, purchasing plan should be generated so they know what is needed and when. Having purchasing plan, the problem of materials not arriving on time will be diminished and therefore reduce the costs that the company has to pay for employees to stand around and do nothing.

4.7.5 Resource leveling technique – Resource leveling technique helps the company solve resource overallocation problem. Resources need to be checked for overallocation often throughout the project because changes are being made all the time. When changes occur, schedule, resources, and costs need to be checked whether the changes have effects on them or not. If the resources became overallocated, resource leveling must be used.

The benefit of resource leveling for the company is to spread out the work for resources so that they are not overworked. The work can also be distributed among resources to share the workloads. It is not only reducing overtime wages, it also improves moral in the company if resources are not overworked.

4.7.6 Project baseline and Earned Value Analysis – The project baseline contains information about task, resources, assignment, and costs in which the project manager can use to compare against actual progress. The first baseline should be saved after the

completing initial schedule process. If the scope of the project changes, another baseline can be saved and used to compare against the original baseline and actual progress.

Earned value analysis is a method of measuring project performance. It compares how much of the budget should have been spent against the amount of work done, and the baseline costs for the tasks, assignments, and resources. By using earned value analysis, it provides tracking and managing ability for the project manager. Project manager will be able to identify whether the cost of the project is ahead or behind schedule, under or over budget, and try to resolve that problem.

Project baseline and earned value analysis may not have direct effects on time or costs of the project. However, they are important tools in tracking and managing project to keep time and costs under control.

4.7.7 Risk management and contingency plan – Even though risk management is not really related to information system, it is considered to be an essential step in project management and a preventive measure. Risk management and contingency plan provide the company with ability to identify risks in advance and figure out how do they want to tackle them. The benefit of having risk management and contingency plan is to be prepared and ready for anything that will happen. Even though some risks may be unavoidable, but having a plan can help reducing the effects from those risks.

All of the above benefits are some of the clearer ones that can be seen when implementing information system for project management. The project management process itself also has many benefits if practiced correctly. The company should pay attention to implementing both project management process and information system in order to be fully beneficial. While the levels of time and costs saving depend on the effectiveness of the implementation, there is also an obvious saving that the company can see. If the company could keep up with the schedule and deliver project on time, they could avoid late fee of 2% for the project which is about 800,000 Baht. This is the most obvious cost saving for the company. Other savings could come from reducing time that employees wait around for materials or equipments, double ordering of materials, or overallocated resources which slow down other tasks. Consequently, it may take time for

the company to be able to fully apply and implement this system in the company. It may require additional fine-tuning and adjustments to optimize the implementation in which it is suggested in further studies in the next chapter.

4.8 Conclusion

In this chapter, the solution to problems including design a system and template for the company have been introduced. The chapter first discusses project life cycle and its different phases. Then it goes on to discuss about each phase of project management process. For each phase, there is also supporting information system which suggests what can be used in different phase. The focus of the next chapter will be on the implementation of the design and template for the case company. The chapter will contain what are the requirements, what are the things that company need, suggestions and so on.