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PROJECT MANAGEMENT FOR RELOCATION OF THE BEVERAGE PLANT

Miss Ratchaneewan Sookkee

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ในวิทยานิพนธ์นี้ศึกษาการบริหารโครงการการย้ายโรงงานเครื่องดื่ม เพื่อเสนอแผนงานโครงการและระบบการควบคุมโครงการ

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จากการศึกษาพบว่า ในโครงการนี้สมควรจัดตั้งองค์กรเฉพาะของโครงการขึ้น เพื่อให้ผู้จัดการโครงการได้มีอำนาจเต็ม ในการบริหารโครงการ และจะทำให้โครงการมีความสะดวกในการดำเนินงานสำหรับผู้ร่วมโครงการทุกคน

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โครงการนี้ใช้เวลา 57 วันในการทำงาน โดยใช้เทคนิคการวิเคราะห์ผังข่ายงาน และในด้านงบประมาณของโครงการคำนวณมาจาก อัตราค่าแรงงาน , ค่าวัตถุดิบ และการประมาณค่าใช้จ่ายผู้รับเหมา

การวางแผนและดำเนินโครงการนั้นสามารถทำได้โดย การรวบรวมข้อมูล วางแผนและวิเคราะห์โครงการโดยเทคนิคผังข่ายงานซึ่งผู้รับผิดชอบจะต้องใช้เวลานานในการวิเคราะห์ข้อมูล

เมื่อได้มีการนำไมโครซอพต์โปรเจคท์โปรแกรมคอมพิวเตอร์มาใช้ผู้รับผิดชอบจะสามารถใช้โปรแกรมนี้ช่วยช่วยลดเวลาในการวิเคราะห์ข้อมูลและการตัดสินใจ นอกจากนี้โปรแกรมยังมีส่วนช่วยในการควบคุมโครงการให้บรรลุตามเป้าหมายอีกด้วย

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KEY WORD: Project management /Beverage Plant
RATCHANEEWAN SOOKKEE : PROJECT MANAGEMENT FOR RELOCATION OF THE BEVERAGE PLANT.
THESIS ADVISOR: ASSIST.PROF.SUTHAS RATANAKUAKANGWAN, 162 pp.
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This thesis is a study on project management for relocation the beverage plant in order to proposed the project planning and control procedure system.

The structure of project management including project planning, project organization, scheduling, cost management, resource allocation, project expedition and project control.

Project planning involve 7 steps which are

1. Establish objectives
2. Define the required activities
3. Divide the activity into work groups
4. Construct the work breakdown structure
5. The action plan
6. Draw sub-diagrams
7. Develop the project planning (arrow) diagram

The pure project organization is suitable for this situation because project manager has full line authority over the project and pure organization generate the simple and flexible structure to all member of project team.

The methods in project operation are divide in three step which are : identify the activities of project, project scheduling and project budgeting.

The identification of each activity can be divided into workgroup which are:

1. Procurement. This department responsible for providing the convenience to other departments.
2. Engineering. This department responsible for take off and remove the production lines and water treatment system
3. Transportation. This department responsible for transport the production lines and water treatment system to another factory
4. Area preparation. This department responsible for the preparing the utility for the new production lines.
5. Installation. This department responsible for installation the production lines and water treatment system

The scheduling of this project take 57 working days to complete by using the activity network diagram analysis while project budgeting calculation from the labor cost, material price and estimated subcontract price.

Before using the Microsoft project, project manager take a long time to gathering, planning and analyzing the project plan with activity network diagram.

After using Microsoft project computer program project manager can analyze the data information especially the decision to expedite project and create problem solution when controlling the project with monitoring tool. The monitoring tool such as the progress line provide the overall project status and assist the project manager to compare each activity to entire project.

Microsoft project computer program reduces time consuming and providing the accurate analysis for project manager.

Department…The Regional Centre for Manufacturing Systems Engineering……..Student's signature……...
Field of study…Engineering Management……..Advisor's signature……...
Academic year……2000……Co-advisor's signature……..….

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Chapter 1

Introduction

1.1 Background of the research

Company X is the beverage producer in Thailand. It was established from the co-operation of Thai families and the US giant company. For almost 40 years, this company has rapidly grown while extended the production base spread over the parts of Thailand. Now this company has six plants which lie in the different area and condition. There are 3 plants (A, B, C) in Bangkok and suburban and 3 plants (D, E, F) in another province both in the North and Northeast part of Thailand. Individual plant has produce the different packages of product such as can, bottle and different flavors of each size of package. In each plant have individual layout and space usage, which vary along the plant director policy.

In recent year, Thailand faces the economic crisis and widely strike to the entrepreneurs. This company has significantly affected with this situation because the sale volumes of beverage product decrease very much. Top management team makes a consensus to change the marketing strategy by launching the new product in the new market called pure water. The new production line of this new product is defined to locate in plant A which is in the city area of Bangkok.

Plant A face the transportation problem for many years because of the transport system management of Land Transportation Department. The distribution trucks must come in and go out under the time limited because they are huge and have 18 wheels. However, the management team try to solve this problem by many methods such as avoiding immediately order of raw material and production planning schedule and co-operating between related department.

In this year, the legal constrains the operation more and more because of the transport logistics service station and the legal regulation for banning the large truck to come in the limited areas. In the second phase of this regulation some small warehouses in the city area must closed because it can not transport the product in and out the warehouse. Moreover, plant A has significantly affected to this regulation in phase 4 because it bans the large truck to enter and park all 24 hours.

At present, the price of water of plant A is higher than the other plant because plant A situate in the city area, the water that supplied in the plant is coming from the water works while the other plant lied in the suburb use the under world water. Relocation from plant A to plant C can reduce the cost of water supply.

Because plant A lied in city area, it is not good from the jam- packed traffic. The distribution system can not provide the highest effective transportation while it faces the problem of limited time to come to the plant. This reason makes the problem for transporting both raw materials such as empty bottle, sugar and finished goods.

The public image seems not good because around the plant bound with communities. The large truck that make traffic jam and sometimes obstruct the public road can annoy the people. Moreover, the sound of production line in the serene night is not good for this district.

The limited space make the staff difficult to manage the operation. For example, the raw material and finished product volumes need the accurate plan to manage rows and layers while the forklift trucks do not have more space to operate.

Line utilization of some production line is lower than the one in other plant. Now every plant plan to produce with 2 shifts, relocation the employee to be the 3rd shift will be the good way to this situation.

Changing the production base require a precise decision to control the budget and time management.

1.2 Statement of the problem

At present, Even the business is go well, plant A—one plant of company X is rather face the problem of transportation and working space because it lie in the city area which packed with community.

The Land Transportation department legislates the "Traffic Ban" in Bangkok. This rule composed of 4 phases which are:

1. Phase 1: Prohibit the truck which has 10 wheels up park on public road on the "Save area" 45 km^2 in 24 hours.
2. Phase 2: Prohibit the truck which has 10 wheels up park on public road in the "inner ring area" 113 km^2 24 hours.
   *The truck can not enter this area from 6.00 a.m.-10.00 a.m. and 3.00 p.m.- 10.00 p.m. every day except weekend.
3. Phase 3: Prohibit the truck which has 10 wheels enter the "inner ring area" 113 km^2 from 5.00 a.m. -10.00 p.m.
4. Phase 4: Prohibit the truck which has 10 wheels enter and park in the "outer ring area" 24 hours except the allowed truck can enter this area during 10.00 p.m.-5.00 a.m.

Plant A has most affected in Phase 4 because almost of the distribution trucks have 18 wheels and the plant location is in outer ring area. So the large truck can not use to distribute the product anymore including the supplier's large truck such as sugar truck can not come to supply plant A.

In order to solve this problem, the company has the policy to relocate the production base to the other plant which is not affected with the traffic ban. After the management team considers in various factors, plant C is the suitable place to relocate the production base. This relocation project should be done with the suitable planning because it is the major change of this company both employees and related production compositions. All of the activities should be considered when planning the project. The precise analysis can bring the accurate decision in long term planning for this company.

1.3 Purpose of research

The objective of this research is to determine relocation plan and control procedure for the beverage plant.

1.4 Scope of the research

In this research, the point of focus is on plant A of company X which will be closed in the near future.

1. Production line and equipment

    - Two production lines of pure water will be moved to plant C
    - Equipment : move to plant C

2. Manpower

    - 50 % move to plant C

1.5 Expected result

After complete this study, the relocation plan and control procedure for the beverage plant will be success in the form of report by using the Microsoft project computer program. Report will be composed of responsibility, activities, budget and time.

1.6 Project management procedure

1. Conceptual
    - Define the project scope
    - Review the objectives
    - Gathering the general information
2. Planning the project
    - Time management
    - Cost management
    - Resource management
    - Tool of management
        - Activity definition
        - Work Breakdown Structure
        - Work Element Costing
        - CPM/PERT
        - Gantt Charts
3. Planning the project control procedure
        - Milestones, checkpoints and budgets

4. Project termination
    - Final report on project planning and control procedure

1.7 Research procedure

1. Study relate literature
2. Collecting the information from two plants
3. Determine the activity, time, cost and resource allocation
4. Set up a project planning systems for this project by using the computer program of Microsoft Project
5. Control procedure
6. Conclusion and writing up

Chapter 2

Literature Review

2.1 Concerned theory

- **Project management**

Rattanavaraha, Chitarpar [1994] is study on project management for building up a factory manufacturing automobile brake system.

Her study on project feasibility to conclude that project are suitable for investment are composed of:

- Marketing
- Technical
- organization
- Financial

The structures of project management are comprised of:

- Project planning
- Time estimation
- Scheduling
- Cost
- Resource allocation
- Project control

In this project the computer program is use for project scheduling and budgeting.

Spinner, M. Pete, Project management [1997]

Spinner stated about project management as followings:

A **project** consists of a series of activities that have several distinguishing characteristics:

- The project has specific starting dates and ending dates.
- It has well-defined objectives.
- It achieves a specified product or result.
- It is a unique, nonrepetitive endeavor.
- Cost, time schedule, and resources(personnel/labor, equipment, material) are consumed.

Project management is defined as managing and directing time, material, personnel/labor, and cost to complete a project in an orderly, economical manner and to meet the established objectives of time, costs, and technical and/or service results.

A successful project using the project management approach will consist of three stages:

- **Planning**: understanding what work has to be done—including identifying individual activities and necessary resources—to complete the project; then developing a plan of action in a logical order that can be displayed graphically as a project planning diagram (or network).
- **Scheduling**: validating *when* the activities need to be done. This stage details the time allowed for the project and each activity—when they are to be started and completed.
- **Controlling**: monitoring (or tracking) progress of the project as it gets under way, analyzing performance, then resolving concerns. It also manages status reporting.

Reschke and Schelle, Dimensions of Project management [1992]

The authors state that the separate techniques of project management are well known, particularly the hard techniques of information based time, cost and quality control. The soft techniques, centering on management of people and their decisions are less well known. However, drawing all the techniques together are fundamentally approach to the project management.

Definition of project management

They define project management as a science of identifying the objectives for a task and organizing the activities of a group of people so that the objectives are achieved by completing the task.

The objectives normally compose a performance objective, which is the most important, and cost and time objectives.

Meeting the performance objective is always the most important because it is the beneficial change which the project is intended to achieve.

Project managers need a clear, homogeneous and connecting set of techniques which, when applied, will ensure that the objectives for every project are first properly identified and ultimately achieved.

Project management is not an exact science because its building blocks are the decision taken by ordinary imperfect people in uncertainty. However, project management science can dramatically increase the probability of getting projects finished on time, within budget and so that the finished thing does what it was supposed to do. It can make achievement of any two out of the three objectives of a project virtually certain.

The Basic Propositions

- The task which is the project is made up of separate activities.
- Each activity absorbs money and time and contributes to the ultimate performance of the completed project.
- The project manager must divide the task up into activities and allocate some of the available money and time to each.
- Activities are done by people using things. The people and the things are resources. Costs incurred by using resources, not by doing activities. In construction and engineering. For example, the people resources include designers, managers, skilled operators and unskilled operators. The other resources include materials, plant, equipment and fuel. Resources absorb costs according to how they are paid for. People have a cost per time period. Other resources usually have a cost per item or per unit of quantity.
- Project managers make the major decisions about how the objectives for the project are likely be achieved and supervise other people making all the other similar minor decisions.
- Several activities can be going on in parallel, all using the same time. Activities can not use the same money, it can be spent only once. A program showing when all activities are intended to be done must show the sequence in which they will have to be done, a budget cost forecast can just be a list of the activities with the forecast cost of each listed and total.

Project manager duties

- All decisions are directed towards achieving the project objectives.
- Only the remaining work in the project can be managed.
- Project should be finish on time and within budget
- Project managers must take space in the plan for the unexpected both money and time
- Project manager should keep changing the plan whenever a new one would be better.

Awani, Project management techniques [1983]

Network-based procedures of CPM (Critical Path Method) is well known and widely used to assist managers in planning and controlling both large and small projects of many types (Construction, research, development project, and many others).

Many managerial problems in the areas of project scheduling and control have been solved successfully with the aid of network models and network analysis techniques. Effective planning and scheduling are absolutely essential to the success of these types of activities.

Components of project management

Project management is concerned with planning, scheduling, and controlling non-routine activities within certain time and resource constraints. It may be broadly

described as making and enforcing the necessary decision as to what, how, who, when and where. Two roles are involved in these decisions. One of these is that of the project manager. In tracing the managerial chain of command up from the implementation level, the first position which has the authority to give an implementable answer to all the above questions is the project manager. He has the authority over and responsibility for the conduct of the project.

Although project management ideas are applied under a variety of different titles in different organizations, there are a number of outstanding factors which characterize most applicants:

1. The project manager operates independently of the organization's normal chain of command reflect an amalgamation of interfunctional resource directed toward a specific goal having time, cost, and technical performance parameters.
2. The project manager negotiates directly for support from functional elements; normal line and staff relationships give way to direct the beginning and completion of specific undertaking within the organization.
3. While the role of the project manager may very widely from one of a coordinating nature to general manager function, he is the single focal point of contract for bringing together organizational effort toward a single project objective.
4. A deliberate conflict exists between the project and the functional purposes of the organization.
5. Each project involves more than one subdivision of the organization; usually the project has company wide application.
6. An individual is needed to assume total responsibility and accountability for project success(or failure).

The second project management role is that of the project management systems engineer. This individual occupies an advisory position to the project manager and will be referred as the consultant.

A project management system should become operational with the selection of individuals to fill the two roles mentioned above. The project manager will then add members to the project organization as their talents become needed. These needs will develop as the project management system carries out its various functions, which are to:

1. Obtain detailed specifications of project objectives.
2. Obtain a specific statement of management objectives.
3. Determine what major alternative approaches to carrying out the project exist.
4. Estimate the results anticipated from each of the more promising alternatives.
5. Evaluate the results expected from the best alternative.
6. Decide whether or not further planning is required.
7. Produce and distribute the information necessary to convey the plan and schedule to the users.
8. Implement the plan and schedule selected by management
9. Periodically review the status of the project with respect to the management objectives.

Meredith , Jack R. and Mentel, Jr., Samuel J., Project management [2000]

- **Project planning**

The project manager is authorizes to give the project plan, approve really amount to a series of authorization, spend money(usually in limit), request resource and personnel, and start the project on its way. The process of developing the project plan always contain the following elements:

- **Overview**: This is a short summary of the objectives and scope of the project. A brief explanation of project team relation to the firm's objectives, a description of the managerial structure that will be used for the project.
- **Objectives**: This contains a more detailed statement of the general goal noted in the overview section
- **General Approach**: This section describes both the managerial and the technical approaches to the work.
- **Schedules**: This section describe the various schedule and lists all milestone events. The estimated time for each task should be obtained from those who will do the work.
- **Resources**: This section outline two primary aspects. First, the project budget contain the capital and expense requirement detailed by activity. Second, cost monitoring and control procedure must be designed to cover the special resource requirement such as special machines and materials.
- **Personnel**: This section lists the expected personnel requirements of the project. Special skills, types of training needed and any other special requirements.

- **Pure Project Organization**

The pure project organization is separated from the parent system. It becomes a self-contained unit with its own technical staff, its own administration, tied to the parent firm. Some parent organizations prescribe administrative, financial, personnel, and control procedures in detail. Other allow the project almost total freedom within the limits of financial. The following figure can be use to illustrate the pure project organization.

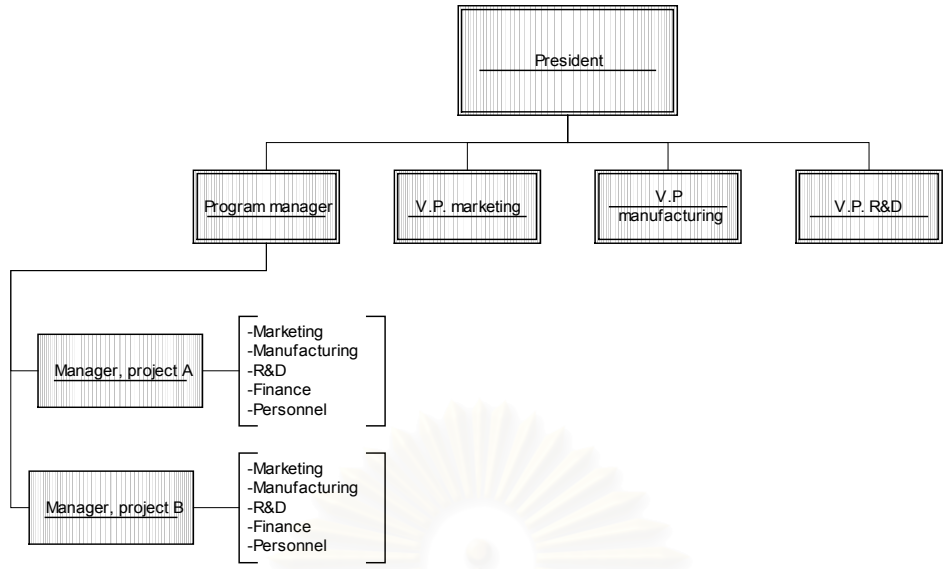


Figure 2-1 Pure project organization

Source : Meredith, Jack R. and Mantel Samuel J., Jr., Project management : A managerial approach, 4th edition, John Wiley and Sons, 2000: 145

- **The Work Breakdown Structure**

The Work Breakdown Structure(WBS) can delineate the subdivided into hierarchical units of task. Project manager can determine and use the WBS to control the accomplish task as the responsibility of each department. The following figure can be use to show an example of WBS.

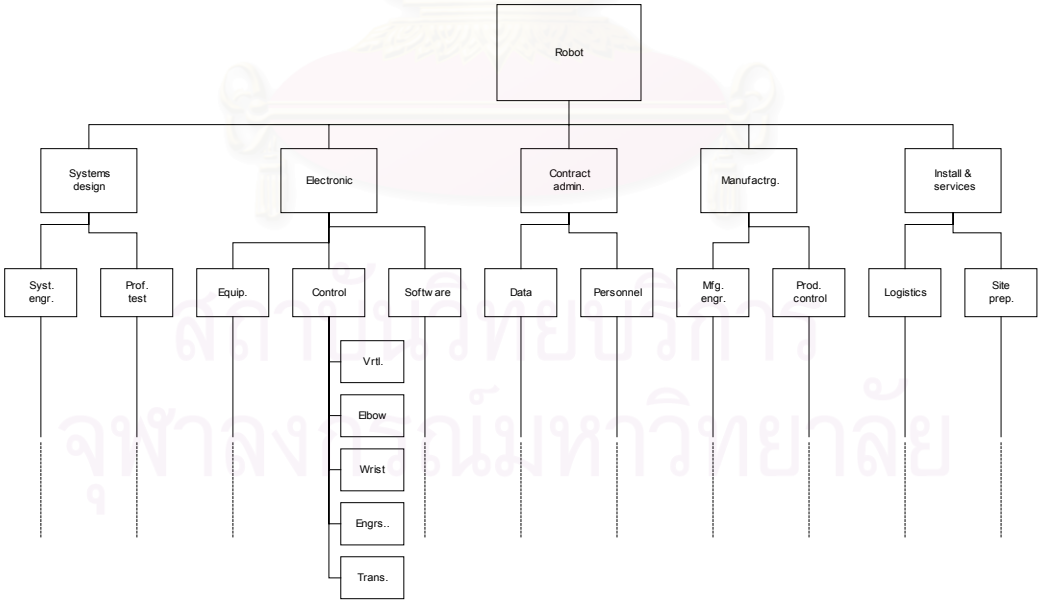


Figure2-2 An example of Work Breakdown Structure

Source : Meredith, Jack R. and Mantel Samuel J., Jr., Project management : A managerial approach, 4th edition, John Wiley and Sons, 2000: 204

Normally, the WBS is an vital document and can be used to illustrate how each piece of the project contributes to the whole in terms of performance, responsibility, budget, and schedule depending on the project manager' design.

- **Scheduling**

A schedule is the conversion of a project action plan into an operating timetable. Therefore, it act as a basic concept for monitoring and controlling project activity and, taken together with the plan and budget. In a project boundary, the scheduling function is more important than it would be in an ongoing operation because project lack the consequence of day-to-day operations and always show much more complicated problems of coordination.

- **Network techniques**

Second to Gantt charts, the network techniques such as PERT and CPM is the most common approach to the project scheduling.

PERT has basically been used for R&D projects, the type of projects for which it was developed, though its use is more common on the "development" side of R&D than it is on the "research" side.

CPM was designed for construction projects and has been normally bounded by the construction industry.

Terminology

There are five terms that should be mentioned in the network discussion.

Activity: A specific task that are required by the project, consume resource, and take time to accomplish.

Event: The result of completing one or more activities

Network: The combination of all activities and event. In general, delineates as nodes at the start and end of each nodes. Arrowheads placed on the node are use to identify the direction of flow. Before an event can be realized, all activities that precede must be completed. These are named its predecessors. Events have no time duration and use resource by themselves. They are only points on the network conditions of the system that can be recognized.

Path: The series of connected activities between any two events in a network.

Critical: Activities, events, or paths which can delay the completion of project if they delay. A project's critical path mean the consequence connection between critical activities from the start even to end event.

It is important for the authority of the project to know the all of activities in the project and transmute a project plan into a network. An activity can be in any of these condition.

Type 1. it may have a successor(s) but no predecessor
Type 2. it may have a predecessor(s) but no successor(s)
Type 3. It may have both predecessor(s) and successor(s)

The following figure can be use to illustrate the three types of activities.

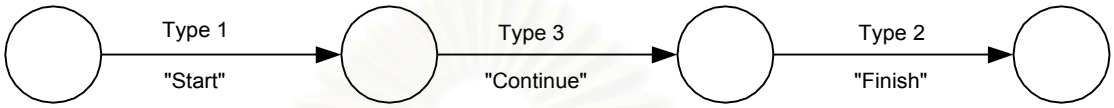


Figure 2-3 Three sequential activities, AOA format

Source : Meredith, Jack R. and Mantel Samuel J., Jr., Project management : A managerial approach, 4th edition, John Wiley and Sons, 2000: 309

The first of these is an activity that start the network. The second ends a network. The third is in the middle. Arrows are labeled with the appropriate type of numbers. More than one activities can start a network, end a network, or being in the middle. Any number of arrows can end at a node or depart from a node, as in the following figure.

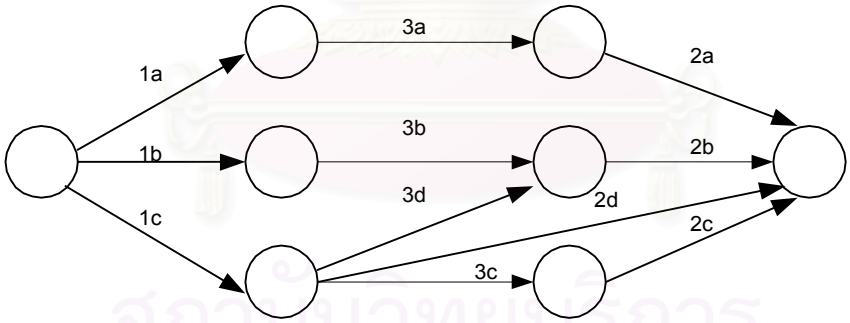


Figure2-4 Activity network, AOA format

Source : Meredith, Jack R. and Mantel Samuel J., Jr., Project management : A managerial approach, 4th edition, John Wiley and Sons, 2000: 309

In the above figure, arrows represent activities while nodes stand for events. This is an AOA(activity-on-arrow) network. The AOA network can identify events (milestones)clearly.

Constructing the Network

Before starting network construction, the action plan document should be developed because the action plan contains the needed information to meet the goal. It is a list of all activity that must be undertaken in order to complete a specified task, the time each activity is expected to take, any resource that will be used by the activity, and the predecessor activities for each activity. The following figure can be used to illustrate the example of action plan.

Activities	Predecessors	Time(days)	Cost	Responsibility
a	-	5	-	-
b	-	4	-	-
c	a	6	-	-
d	b	2	-	-
e	b	5	-	-
f	c, d	8	-	-

Figure 2-5 The example of action plan

The above figure show the action plan that can use as the information to start the network construction. First, start by assume the node numbered 1 denoted the event called “START”. Activities a and b have no predecessors, so assume their source is at “START”. Consider the predecessor and gradually develop the network by the relationship between the predecessor and successor. The following figure can be used to illustrate the network construction.

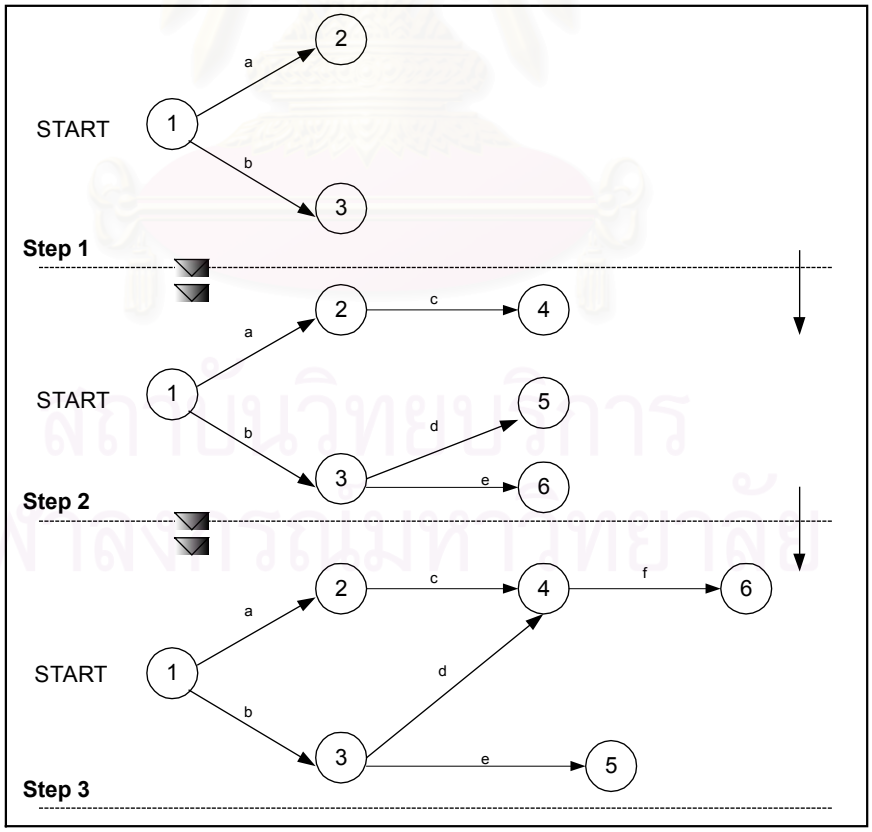


Figure 2-6 Sample of network construction
Source : Meredith, Jack R. and Mantel Samuel J., Jr., Project management : A managerial approach, 4th edition, John Wiley and Sons, 2000: 311

- **Resource Allocation**

  - **Critical path method**

Critical path method include a way of relating the project schedule to the level of physical resources allocated to the project. This allow the project manager to trade time for cost or other things.

  - **The resource allocation problem**

A shortcoming of the scheduling procedures is that they do not address the issues of resource utilization and availability. They focus on time rather than physical resources.

Sometime, some abundant resource may be traded for scarce one. It is possible to the project manager to trade for what is available.

The major points of the relationship between time use and resource use are these:

- **Time Limited**: The project must be finished by a certain time, using as few resources as possible. But it is time, not resource usage, that is critical.
- **Resource Limited**: The project must be finished as soon as possible, but without exceeding some specific level of resource usage or some general resource constraint.

  - **Resource Loading**

Resource loading describes the amounts of individual resources an existing schedule requires during specific time periods.

The PERT/CPM network technique is well suited for the job of generating time phased resource requirements. A Gantt chart could be adapted, but the PERT/CPM diagram, particularly if modified to illustrate slacks will be helpful in the analysis used for resource leveling.

  - **Resource Leveling**

Resource leveling aims to minimize the period by period variations in resource loading by shifting tasks within their slack allowances. The purposed is to create a smoother distribution of resource usage.

Cleland, Project management [1999]

Project planning

Project planing is an important part of the "deciding" aspect of the project team's job. More explicitly, project planning is the process of thinking through and making explicit the objectives, goals, and strategies necessary to bring the project through its life cycle to a successful termination.

Project planning involves the development of a strategy for the commitment of resources to support the project objectives and goals. The project plan reflects the strategic plan of the enterprise in providing guidance in the likely forthcoming strategic fit of the stream of project in the enterprise. The functional plans provide detailed guidance on how resources will be used to support the project purposes.

Project planning and control techniques are many and varied. For example, in one survey, project planning techniques included

1. Work breakdown structure
2. Network
   - Arrow scheme
   - Node Scheme
   - Precedence diagrams
3. Bar chart
   - With precedence
   - Without precedence
4. Critical path method(CPM)
5. Time/cost analysis
6. Resource leveling
7. Computer assistance

Project management procedures

- Establish the strategic fit of the project.
- Develop the project technical performance objective.
- Describe the project through the development of the project WBS.
- Identify and make provisions for the assignment of the functional work packages.
- Identify project work packages that will be subcontracted.
- Develop the master and work package schedules.
- Develop the logic networks and relationships of the project work packages.
- Identify the strategic issues that the project is likely to face.
- Estimate the project costs.
- Perform risk analysis
- Develop the project budgets, funding plans, and other resource plans.
- Ensure the development of organizational cost accounting system interfaces.
- Select the organizational design.
- Provide for the project management information system.

- Assess the organizational cultural ambience
- Develop project control concepts, processes, and techniques.
- Develop the project team.
- Plan for the nature and timing of the project audits.

Laoprajong, Piphop, Project management technique by CPM and PERT [1988]

The author state about project management by using CPM and PERT to plan and control the project to complete the target.

Complex projects that compose of many activities need the tool to analyze the relationship between these activities. Network analysis is suitable for complicated project because it combine the detail of each activity and math them with the step of project before calculate time to determine the schedule of project from the beginning to ending.

Project scheduling with CPM can be determined by forward computations and backward computations. The forward computation can estimate the earliest start and finish the individual activities. The backward computation can estimate the latest start and finish each activity. After calculate both backward and forward time estimation the planner will know the critical path and the float time of activity.

Float times latent in the activity that outside the critical path. Float times mean the time that can delay the start of that activity in the range of time and they do not effect the end of the project.

Float times help the planner to decide the activity of project. For example, it can reduce the resource by taking more time to complete activity and does not effect the other activity.

- **Project control**

Andersen et al, Goal directed project management [1995]

The monitoring and project control are not the same thing. Report is describing what has occurred and what the situation is. Control is doing something about what the report show.

Report is able to check whether the project is sticking to the plan. The purpose of reports is not to establish grounds for punishment or reward. The purpose is to establish whether there is a need for corrective measures—while there is still time to take those measures.

Control is management, not paperwork. Control involves analyzing the situation, deciding what to do and doing it.

If report reveal that there is a lapse in project progress, control involve in these decision:

- Move the milestone date;
- Lower the level of ambition;
- Bring in additional resources;
- Rearrange the workload.

Lientz and Rea, Project management for the 21st century [1995]

Tracking and Monitoring the project

Tracking and monitoring the project can let the project manager to know the where project is going and also be able to take advantage of potential improvements and to resolve problems and questions early so that they do not impact the project.

People are working on the project. As in many cases, there are varying levels of involvement depending on the specific team members.

The role of the project team member is to complete the assigned task. The member should also alert the manager about any problems or issues related to the project or to the specific tasks. The team member should take the initiative to approach the project manager with issues and opportunities.

Issues and Opportunities

The identification, tracking and resolution of issues and opportunities that could impact the project are fundamental activities in project management, they overlap administration and management. An issue is a potential problem, situation, or factor that can negatively impact the project. An opportunity is exactly that a chance to change something in the project and achieve benefit. Issued and opportunities typically relate to resources, structure of the project plan, methods, and tools. Modifications impact the schedule, risk, and cost. The source of the issue or opportunity may not be internal to the project, it can be external in terms of management, technology, another company organization, external competition or industry, government regulation, or another project.

Steps in addressing an issue or opportunity

1. Understand the issue or opportunity itself and distinguish it from symptoms or impacts or effects. This step requires thinking about the project itself as well as the specific issue or opportunity.
2. Understand the ramifications of taking potential actions or of inaction. This step defined the issue or opportunity and is attempting to understand how the project will be impacted by doing nothing or taking some action.
3. Decide on a plan of action and see if by changing the action in terms of scope, can resolve other issues.

Management activities

The following activities will be considered here:

- Determining the status of work on the project
- Analyzing the state of the project in terms of the schedule
- Assessing the quality of work
- Motivating and encouraging the team
- Getting issues and opportunities resolved
- Reporting to management

The project manager must keep on top of the project at all times. Even areas and activities that are either minor or seemed to be making progress last month or last week need to be checked

Project Control

Project control means the process and steps taken to control the project at the project level. Management control is the review and control of multiple projects at the managerial level, by way of contrast.

Project budget can fixed the human resources and overhead. In some project overtime is appropriate choice. However, it is always the expense that can raise the account.

In terms of control there are not only need a total amount for each budget category to acquisition, the rate of realistic expenditure should be estimated.

Kerzner, Project management [1998]

The author state that project manager measure his success by how well he can negotiate with both upper-level and functional management for the resources necessary to achieve the project objective.

Controlling

Controlling is a three-step process of measuring progress toward an objective, evaluating what remains to be done, and taking the necessary corrective action to achieve or exceed the objectives. These three steps—measuring, evaluating, and correcting—are defined as follows:

- *Measuring*: determining through formal and informal reports the degree to which progress toward objectives is being made.
- *Evaluating*: determining the possible ways to act on significant deviations from planned performance.
- *Correcting*: taking control action to correct an unfavorable trend or to tale advantage of an unusually favorable trend.

The project manager is responsible for ensuring the accomplishment of group and organizational goals and objectives. To effect this, he must have a thorough knowledge of standards and cost control policies and procedures so that a comparison is possible between operating results and pre-established standards. The project manager must then take the necessary corrective actions.

Directing

Directing is the implementing and carrying out (through others) of those approved plans that are necessary to achieve or exceed objectives. Directing involves such steps as:

- *Staffing*: seeing that qualified person is selected for each position.
- *Training*: teaching individuals and groups how to fulfill their duties and responsibilities.
- *Supervising*: giving others day-to-day instruction, guidance, and discipline as required so that they can fulfill their duties and responsibilities.
- *Delegating*: assigning work, responsibility, and authority so others can make maximum utilization of their abilities.
- *Motivating*: encouraging others to perform by fulfilling or appealing to their needs.
- *Counseling*: holding private discussions with another about how he might do better work, solve a personal problem, or realize his ambitions.
- *Coordinating*: seeing that activities are carried out in relation to their importance and with a minimum of conflict.

Reiss, Project Management Demystified [1992]

Progress monitoring and control

Project planning in the pre-project phase can either the success or failure. It depends on the project control system. To begin the progress monitoring process, project manager will normally evaluate what work has been done on the project since last monitor.

There are two ways of approaching progress monitoring for project manager:

1. DIY : Do it yourself. Project manger wander around the project measuring and counting to find out what work has gone on this week.
2. OPE : Other people's effort is the alternative. Project manager get others to measure progress and report their findings back to him.

It is normal to assess the actual progress achieved on a short list of activities—those activities which could be in progress. Progress can be measured as a remaining duration, an expected completion date, or a percentage completed.

Kezsbom et al, Dynamic Project Management [1989]

The element of project control—the process of controlling a project

The project controlling process is an *evaluative* process whereby deviations from planned events are reported and probable causes assessed, It is a *performance measurement* process by which corrective action is taken to alleviate the impact of these deviations and other unfavorable trends on project schedules, budgets, resources, or staffing levels. Project control is also a *quality assurance* process intended to maintain the technical performance standards of the product under development and to assure the quality of the product design.

Steps in establishing project control

1. *Establishing a measurement* system that can compare what has been planned to what actually will takes place; this requires the setting of hard milestones and the development of test plans
2. *Measure results* and assess deviations from the original project plan:
    - Schedule
    - Budget
    - Technical specifications
    - Resource requirements(staff, materials, equipment, etc.)
3. *Report results* to the appropriate project personnel and managers
4. *Forecast the results of any deviation*; evaluate potential hazards; review trends to analyze their impact on project progress; discuss trade-offs
5. *Take corrective action* to bring about the originally desired goal and accomplish the initial project objectives; if necessary, one should replan

Rosenau, Successful Project Management [1992]

Monitoring progress on a project

An approach to project manager to examine the work being done under the direct control of the project team and support teams.

Reports

Reports fall into three broad categories: the accomplishments along the performance, schedule progress, cost. Reports may be written as summaries to provide an overview or be detailed about a particular task activity or some other element of project work. Reports may be strictly for the use of the organization performing the project or be intended for people outside, such as the customer or contractors.

The project manager cannot depend entirely on reports. In the first place, they may be inaccurate, a common failing of reports, which are prone to arithmetical errors. If the work breakdown structure divides the project into many small activities, the manager can look at each of them individually and decide whether they are complete. Reports should always be as brief as possible. Pictures,

demonstrations, and models should also be encouraged. It is often hard for people not intimately concerned with the project to visualize the status, expected outcome, or even the concept. For them, tangible description, pictures, and such are by far the most appropriate means for providing reports.

Periodic Reviews

In general, every project should be reviewed once a month. Periodic reviews can catch deviations from plan before they become major disasters. An activity is in one of two conditions: complete or not complete. It is appropriate to ask which incomplete tasks are in progress and which are not yet been started. For those under way, find out whether there have already been any difficulties that would preclude their being completed on time within the cost plan.

Dingle, Project Management [1997]

Communication

Projects are run-created, designed, built, operated by and for people. People in an organization must communicate. An organization can hardly exist in the real world without people communicating in some way, but the criteria which characterize project work mean that they must communicate effectively and efficiently if the work is to be well directed and managed. One of the most frequent causes of project problems is communication failure.

Communications Methods

Spoken
This probably causes most problems. People are often unable to recall precisely what was said in a conversation or phone call. Messages which are important should be followed by at least a file note, or preferably a memo, recording of the discussion.

Written
There is always a conflict between the desire to limit the enormous quantity of correspondence which is a feature of large projects, and the requirement to ensure that essential communications are properly maintained. The need for clarity and simplicity in written communications needs constant emphasis. Training in the art of clear, simple and accurate expression in writing is an important part of project staff training.

Graphical
Design and construction drawings are an essential basis for the whole enterprise. On a large project there will be many thousands of drawings to be issued, approved, possibly amended, reissued and filed for future reference.

Charts and graphs are also used to convey information. This particularly applies to planning and progress data. It is important that these data are presented in a clear and accurate way, and where necessary, supported by adequate written explanations so that ambiguity is avoided.

Numerical
Tables of data will also be used to convey information. It is important that adequate explanatory notes are provided, so that readers get rapid and accurate understanding of the numerical information. Numerical data should be presented in a form which can be readily understood by management.

Electronic
Computers are in general use. They are very powerful and can deal with very large quantities of information. They must be used with intelligence and discretion. There is a natural tendency to believe implicitly in the output from computers. However, output should be regarded critically—it will have no more than the same degree of accuracy as the input.

Project Reports
Project reports are the main formal means, by which project progress is communicated and recorded. As records, they are vital parts of the project's audit trail, so they must be prepared with all possible care. Project reports should:

- State clearly the current status of the project:
- Compare actual achievements with the planned target achievements:
- Draw attention to critical issues:
- Identify problems and propose solutions:
- Promote effective management and control.

Effective management and control needs timely action, so projects must be produced regularly and promptly. It is usually better to have roughly accurate information quickly than to have precisely accurate information late.

Roman, Managing Projects [1986]

Project Control

Control has to be brought into perspective. It is an active management process to see that objectives are accomplished with a minimal expenditure of resources. To be more explicit, control involves the correlation of functional activities in an integrated reporting system that is accurate, objective, fast, and action directed. To be effective, control must give the project manager early warning of variances from plans. If these are detected quickly enough, corrective action can be taken before resources have been overextended to the point of impairing program objectives. Essentially, control includes the assessment and interrelation of three critical factors, examined in total perspective:

1. Actual performance, compared with planned,
2. The schedule of accomplishment,
3. Expenditures of resources in relation to accomplishment

Weiss and Wysocki, 5-Phase Project Management [1992]

Maintaining the project schedule

Regardless of the extent to which planning was complete and accurate, there will always be a number of events whose outcome could not have been predicted or even controlled. These will always seem to come up at exactly the worst times.

Purpose of controls

Controls are designed to focus on one or more of the three major components of a project—performance levels, costs, and time schedules. Three reasons for using controls are

1. To track progress
2. To detect variance from plan
3. To take corrective action

To track progress

The project manager will want to have in place a periodic (at least monthly) reporting system that identifies the status of every activity in the project. These reports should summarize progress for the current period as well as for the entire project.

To Detect Variance from plan

In larger projects, reports that say everything is on schedule and on budget. Exception reports, variance reports, and graphical reports provide information for management decision making—and provide it in a concise format.

To take Corrective Action

Once a significant variance from plan occurs, the next step is to determine whether corrective action is needed and then act appropriately. In complex projects this will require examining a number of problem solutions. When problems occur in the project, delays result and the project falls behind schedule. For the project to get back on schedule, resource will have to be reallocated. In larger projects the computer will be needed to examine a number of resource reallocation alternatives and pick the best.

Watson, Managing projects for personal success [1997]

Project Audits and Project Reviews

A project audit should assess compliance with the project processes and standards, whilst the purpose of a project review is to form a judgement as to whether the project plan will achieve the objectives on time and within budget. However, each has a distinct and important role to play in helping the project manager to achieve the overall project goal.

1. An **audit** is an official examination of accounts or, in project terms, an official examination of the project processes and the transactions that have taken place. It is an objective proceeding on the basis of standards and rules.
2. A **review** is a survey or assessment of the status of the status of the project and will include judgements made against the project objectives and the project plan. Reviews will include both objectives and subjective comment and may be wide-ranging, to incorporate an assessment of the project personnel and the project manager

Randolph and Posner, Effective project planning & Management [1988]

Draw a picture of the project schedule

It will not be simply to schedule but studies show that successful people make the effort required to organize their time and activities. Doing the behavior in line with goals will give the seven advantages:

1. Project team will have a *more realistic plan*—one that gives a more accurate picture of what will happen as the project progresses.
2. Project team will be better *able to anticipate* what needs to happen next.
3. Project team will know where to *concentrate the attention* to be sure the project stays on schedule and within the budget.
4. Project team will be able to *anticipate bottlenecks* and other coordination problems before they occur, so that project team can take action to correct a delay before it becomes severe.
5. Project team will have a valuable tool to *enhance coordination and communication* among the project team members.
6. Project team will have a tool that helps to *build commitment*—because it publicly identifies responsibilities and deadlines and creates an awareness of interdependencies.
7. Project team will have a tool that leads to completion of projects *on time*, *within budget*, and *according to quality standards*.

Lewis, The project manager's desk reference [2000]

Problem solving in projects

It can be said that project is a problem scheduled for solution. Expanding on that definition, a project is viewed as a job designed to solve a problem on large scale. Furthermore, the way a problem is defined affects how it is solved, so it is important that a proper definition be established before ant work is done. In addition, it is safe to say that many small problems exist to be solved in any large project, so it is impossible to separate problem solving from project management.

Another, related issue, is that many decisions must be made throughout the life of a project, and how these are handled can well determine whether a project is successful. For that reason, the skill in problem solving and decision making is the important skill for project manager to be successful in managing projects.

Decisions versus problems

Making a decision means trying to select the best alternative from a list that might be large or small.

A decision may be one step in solving a problem, or it may just be a choice that we must make. On the other hand, when the decision is part of solving a problem, it is one of several steps. The first step is to define the problem; he next is to generate alternative courses of action that might be taken to solve it Once this list is made, a choice from the alternatives can be made. This is the decision making step. In other words, problem solving always involves decision making, but not the other way around.

Solving problems with problem analysis

To solve problems, we use a general approach called problem analysis. The steps in analyzing problem are presented in the following figure.

Problem Analysis Steps

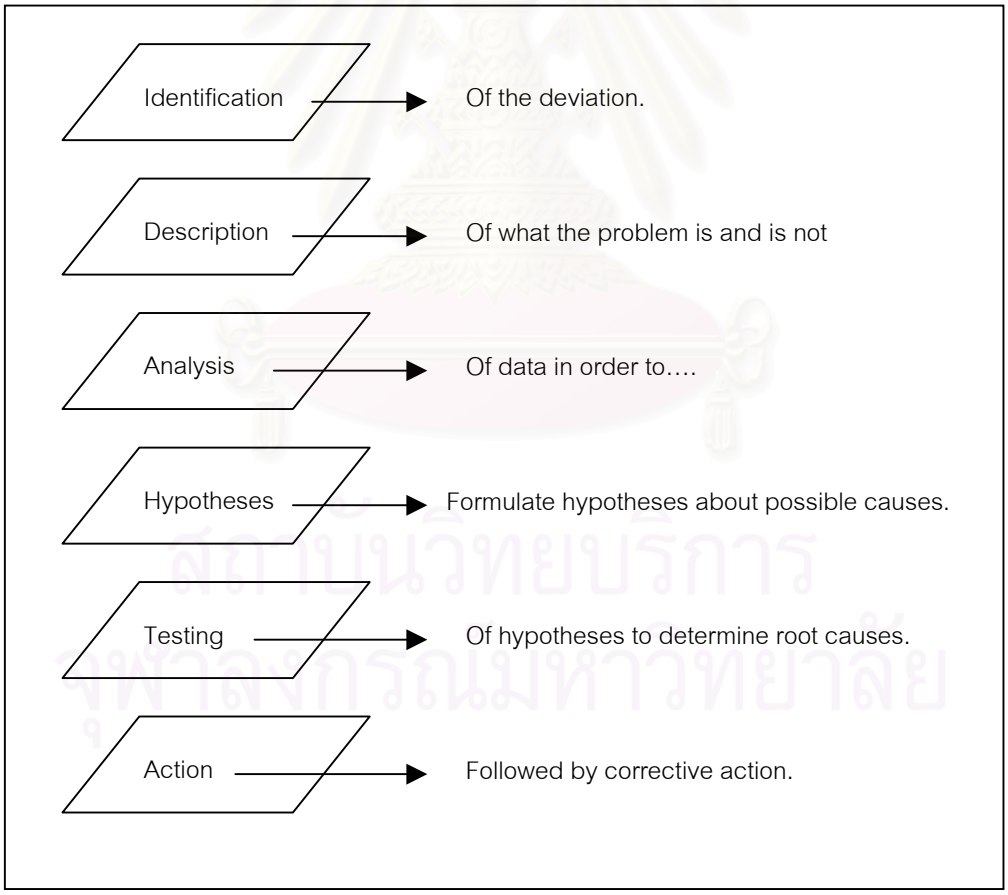


Figure2-7 Problem Analysis Steps
Source : Lewis, James P., The project manager's desk reference : A comprehensive guide to project planning, scheduling, evaluation, and systems, 2nd edition, McGraw-Hill, 2000 : 457

Identification

The first step in the problem analysis process is identification. A problem is a gap between a desired state and a present state—confronted by an obstacle that prevents easy closure of the gap. When a process is involved, as in monitoring progress on a project, that gap can be a deviation from standard performance.

Description Using Is/Is not Analysis and Stratification

Stratification and is/is not analysis are ways to localize a problem by exposing underlying patterns. Begin by brainstorming a list of the characteristics that could data collection forms that incorporate those factors, and collect the data. Next look for patterns related to time or sequence. Then check for systematic difference between days of the week, shifts, operators, and so on.

Analysis

Once stratified data have been collected, we need to analyze the differences to set the stage for formulating hypotheses about causes of the problem. The following questions are designed to help identify differences:

- What is different, distinctive, or unique between what the problem is and what it is not?
- What is different, distinctive, or unique between where the problem is and where is not?
- What is different, distinctive, or unique between when the problem is seen and when it is not?

These questions are structured to help us determine what has changed about the process. If nothing had changed, there would be no problem.

Formulation of Hypotheses

A hypothesis is a guess or conjecture about the cause of the problem. At this point all reasonable hypotheses should be listed.

Testing of Hypotheses

To test hypotheses, we first ask if the suspected cause can explain both sides of the problem description. That is, does the cause account for both the is and the is not effects? If it cannot explain both, it is unlikely to be a real cause.

The testing method follows:

- Test each possible cause through the description, especially the sharp contrast areas.
- Note all “only if” assumptions.

Action

At this point, there are three possible actions that might be taken. These are:

- Interim action. Buy time while the root cause of the problem is sought. This action seeks to cover symptoms.
- Adaptive action. Decide to live with the problem.
- Corrective action. Correct the actual cause. This is the only action that will truly solve the problem.

- **Project Termination**

Lock, Project Management [2000]

Formal project closure

Just as a formal document of authority has to be issued to open a project and allow expenditure to begin, so the end of a project should be marked by a formal announcement.

Project closure documentation

The formal closure notice need only be a very simple form, but it should contain the following information:

- Project title
- Project number
- The effective closure date
- Reason for closure (usually, but not always, because the project has been finished).
- Any special instructions.
- Closure authorization signature.
- Distribution, which should at least include all those who received the authorization notice when the project was opened.

Vanichchinchai, Assadej, Project-Based Production Planning and Control System [1997]

The author is study a project-based production planning and control system for a case study. The case is the operations of a distribution transformer manufacturer in Thailand. Transformers are made to order, usually in reasonable quantities. Therefore, an order could be treated as a project. The production of a project is broken-down into a number of batches to suit the nature of some operations. The system developed is based on the concept of Project Management Information System(PMIS) to facilitate computational procedure and to keep baseline databases. Its run on a personal computer. A part of planning system is developed with the Microsoft Project software. Other parts of the system, which include Material Requirement Schedule(MRS), Production Schedule(PS) and Project Monitoring and Control(PMC), are developed with Microsoft excel.

Rangsitsathien, Chaiwat, Project feasibility software package for manufacturing facility investment project [1998]

The author develop a Project feasibility software as an aid for investment decision-making in manufacturing facility. His study is concern about project feasibility in an investment in manufacturing facility is predominately concerned with marketing, manufacturing, finance, and management implications. A case study on project feasibility in an investment project in China will be used as an application of project feasibility software package.

Dennis Stratton, Industrial Management [2000]

Leadership with Attitude : Eight Winning Strategies

The author state about the leader's strategies to lead project through objectives;

1. Decide what to do

Instead of focusing on problems and faults, increase the effectiveness by focusing on the outcomes we want.

When project manager have clearly decided what he want to achieve, he will find it much easier to communicate that purpose to the people reporting to him, to set appropriate goals and objectives, and to hold himself and others team members.

2. Be honest.

To increase the personal and organizational effectiveness, tell it like it is. Be honest with people who work with him and for him about what's working and what isn't.

3. Express himself.

As he move up in responsibility, his relationships within the organization change. Being a respected leader doesn't mean being distant and unapproachable. Be himself. Be real. Like telling the truth, expressing himself will free up the people around him to be more expressive, and that will provide him with more of what he need to know to achieve results through people.

4. Take risks.

A consistent characteristic of great leaders is that they keep pushing the limits of what feels comfortable. If he almost always operate within the boundaries of what you think is reasonable, acceptable, and appropriate, one of the best ways to increase the effectiveness is to start pushing those boundaries.

5. Participate 100 percent

So much of effective leadership is how he show up in your day-to-day activities and responsibilities. Project manager spends most of his time in meeting with

project team, with subcontracts. How he conduct himself in these situations does more than anything to show what kind of commitment he has. He should fully engaged in the meeting process. Listen, learn, provide information, state his opinion, give the full value of his presence.

6. Take personal responsibility for his results.

Not everything is in his control. The supplier was late delivering the materials. The equipment broke down. When the results are not what he had planned and expected, it can be tempting to shift the blame. Our society reinforces this way of looking at things. When something goes wrong, we look for someone to sue.

7. Create partnerships.

The notion of partnership extends beyond the way in which he relate to the direct reports. To increase the effectiveness, he will need to collaborate with people in all departments and functions. He will get better results working with people, and usually he will get better solutions by involving other people at earlier stages of plans and projects.

8. Commit 100 percent

Once he has decided what he want, give it all you've got. His own highly visible commitment to the outcome will inspire the commitment of all the people he need to make that vision a reality.

Reginald Thomas Yu-Lee, Industrial Management [2000]

It's About Time

The author state about the term optimization that has been used for long time. The concept is to use mathematical techniques to arrive at the best solution, given what is being optimized (cost , profit, or time). To optimize a manufacturing system means that the effort to find best solutions focuses on finding the most effective use of resources over time.

Optimizing

Finding the optimal solution relates to a specific problem such as minimizing the cost associated with purchasing materials or maximizing throughput at an operation. So, the first step is to understand what the problem is—that is, what we want to optimize. We might try, for example, to minimize costs, maximize profit, minimize time, or maximize throughput.

When optimizing a manufacturing facility or manufacturing system, the objective should be profit per unit time. The amount of profit to be made will have some type of time constraint on it: there is not enough time to meet demand or there is too much time. In each case, decision emphasize making the greatest profit per unit time. This can make management to determine the minimum cost at which the demand can be met. The optimum solution is dictated by time.

Operational decisions in a manufacturing environment should all be considered in accordance with time—not cost.

Ebert, Project Management [1999]

The author state about technical controlling for software projects which is defined as a controlling activity concerned with identifying, measuring, accumulating, analyzing and interpreting project information for strategy formulation, planning and tracking activities, decision-making, and cost accounting. Objectives are derived from these activities:

- Decision-making: What should we do?
- Attention-directing: What should we look at?
- Performance evaluation: How well are we doing?
- Planning: What can we reasonably achieve in a given period?
- Target-setting: How much can we improve in a given period?

Applications of technical controlling

The basic activities within software project management can be clustered as

- Tendering and requirements management
- Estimation and costing
- Resource management
- Planning and scheduling
- Monitoring and reviews
- Product control.

Most benefits that we have recorded since establishing a comprehensive technical controlling program are indeed related to project management:

- Improved tracking and control of each development project based on uniform mechanisms
- Earlier identification of deviations from the given targets and plans
- Accumulation of history data from all different types of projects that are reused for improving estimations and planning of further projects
- Tracking process improvements and deviations from process.

The targets of technical controlling are as follows:

- Setting process and product goals
- Quantitative tracking of project performance during software development
- Analyzing measurement data to discover any existing or anticipated problems
- Determining risk
- Early available release criteria for all work products

- Creation of an experience database for improved project management
- Motivation and trigger for actual improvements
- Success control during reengineering and improvement projects

Sangtrakulchareon, Puangkaew and Nitsushad, Jeeraboon, Project management by Microsoft project98 [1998]

At present, Computer plays a vital role in way of life both in the office and home use. So, user need to understand the detail of individual program.

Due to the widespread of computer, we need computer to assist the project management especially the complex project.

Microsoft project 98

Normally, project management requires the carefully planning or scheduling. Time calculation and cost estimation are the difficult for complex project.

Microsoft project is the computer program that can response these requirements to decrease the information management because the user put the data into program and this program can compute time, resource and cost.

Program properties

In Microsoft project, there are many charts that can use to illustrate the tasks. For example, Gantt chart, PERT chart, Calendar. There are many characteristics of software that should be mentioned:

1. **Friendliness**. This software has clear and logical manuals, help screens, tutorials, a menu driven structure, easy editing, and so on.
2. **Schedules**. Gantt chart mandatory, as well as automatic recalculation with updates of times, costs, and resources. Plots of earliest start, scheduled start, slack/float, latest finish, planned finish, and actual finish times are desirable. The software should also be able to display PERT/CPM networks. The time units for schedule display (and resource usage) should vary from minutes to years.
3. **Calendars**. Either a job shop and/or calendar dates are necessary, plus the ability to indicate working days, non working days, and holidays for each resource used.
4. **Budgets**. The ability to include a budget for planning, monitoring, and control.
5. **Reports**. The ability to interface the reports with a word processing package and generate many formats of reports.
6. **Graphics**. The ability to see the schedule and inter actions is especially important. For Gantt charts, this software is able to show the technical dependencies between work units or tasks.
7. **Charts**. Charts for responsibility and histograms for resource were deemed particularly useful.

8. **Migration**. The ability to transfer data to and from spreadsheets, word processors, database programs, graphics programs, and desired add-on programs.
9. **Consolidation**. The ability to aggregate multiple projects into a single database for determination of total resource usage and detection of resource conflicts. This software must have the ability to recalculate all schedules and resource records when updated information is added.

It can be conclude that Microsoft project can help those who require effective project management because;

1. Microsoft project computer program can assist the project manager to manage and admin project in practical system.
2. Project manger can use the Microsoft project computer program to check the deficiency of activity.
3. Project manger can use the Microsoft project computer program to analyze the problem and find out the solution.
4. Microsoft project computer program is suitable for those who require the efficient project management.

Chapter 3

Data Analysis

3.1 Introduction

Company X is the beverage producer in Thailand. It was established from the co-operation of Thai families and the US giant company. For almost 40 years, this company has rapidly grown while extended the production base spread over the parts of Thailand. Now this company has six plants which lie in the different area and condition. There are 3 plants (A, B, C) in Bangkok and suburban and 3 plants (D, E, F) in another province both in the North and Northeast part of Thailand. Individual plant has produce the different packages of product such as can, bottle and different flavors of each size of package. In each plant have individual layout and space usage, which vary along the plant director policy.

There are two interesting plants named A plant(A) and C plant(C). A should be mentioned first because it faced the problem and must be closed in the near future.

3.2 Production lines

A has four old production lines and two new production lines. However, the old production lines will not mention because they are not involve in this research. The two new production lines are the line of pure water product which have the similar detail for the line composition. In the other hand, one differ from the other only the size of filling and changing the size of bottle can be done easily by one machine operator to level the filler tank and change the starwheel & center guide. The following section will be discuss about the composition of pure water production line.

The following figure can be used to describe the process of pure water production.

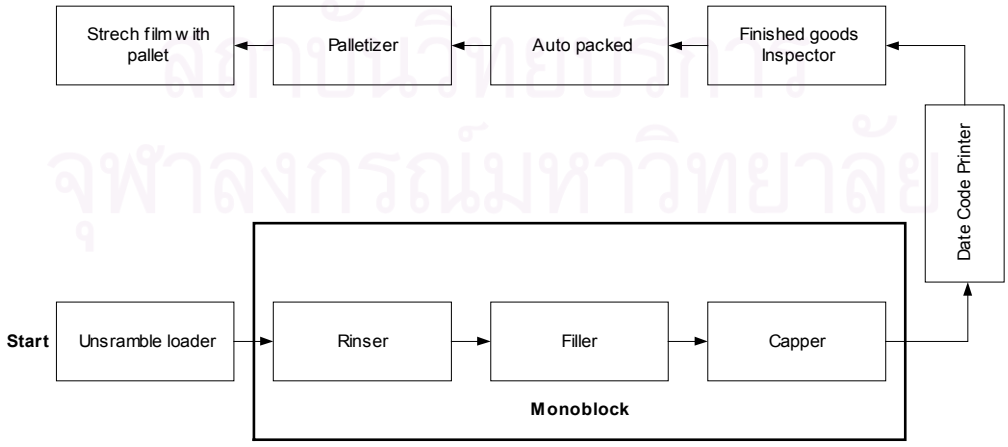


Figure 3-1 The process of pure water production

In general, pure water production line compose of major three machines which are:

- Unscramble loader
- Monoblock
- Auto packed

The other block in figure 3-1, we can call other equipment because they require manual by machine operators rather than automatically program. More over, they do not fix to the production line by the conveyor. They are free to move to the other part or direction of production line.

1. **Unscramble loader** is the machine that use to sort and arrange empty bottle to the in feed conveyor.
2. **Monoblock** : The empty bottles will be fed to the rinser in monoblock machine. After the machine rise the empty bottle, the bottle will be fed to the filler to fill the pure water depending on the volume of the bottle to fill in. Capper that lie in the monoblock will press the cap to filling bottle and send them to print the date code. The inspector will check the condition of finished goods such as water level, capping, clearing and date code printing before let them fed to the auto packed.
3. **Auto packed** : The inspected finished goods will be sent to auto packed to set them into packing size and wrap the goods by shrink wrap film and warm air. After that the machine operators will lift the packed of finished goods to the pallet. When the pallet is full of finished product, the fork lift driver will lift pallet to wrap by the stretch film in order to protect the product.

The following figure illustrate the unscramble loader, monoblock and auto packed respectively.

The unscramble loader figures show the picture of this machine and the dimension both side view and top view. These pictures can assist the responsibility to estimate machine centre marking.

The monoblock figure show the composition of this machine and the dimension both production lines. The difference between two lines is at the detail of filler in monoblock base.

The auto packed figure show the composition and dimension of this machine.

After the individual machine figure were shown, the figure 3-7 and 3-8 will illustrate the two production lines.

The figure 3-9 will illustrate the location of two production lines in the production building.

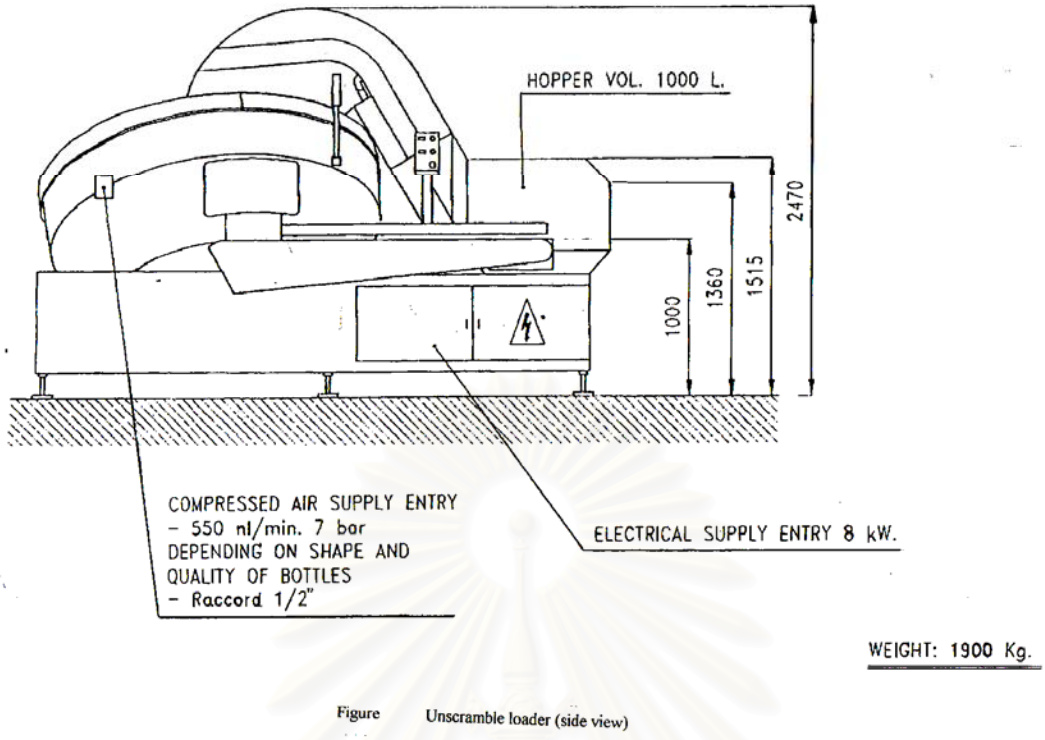


Figure 3-2 Unscramble loader(side view)
Source : Maintenance Department of A plant

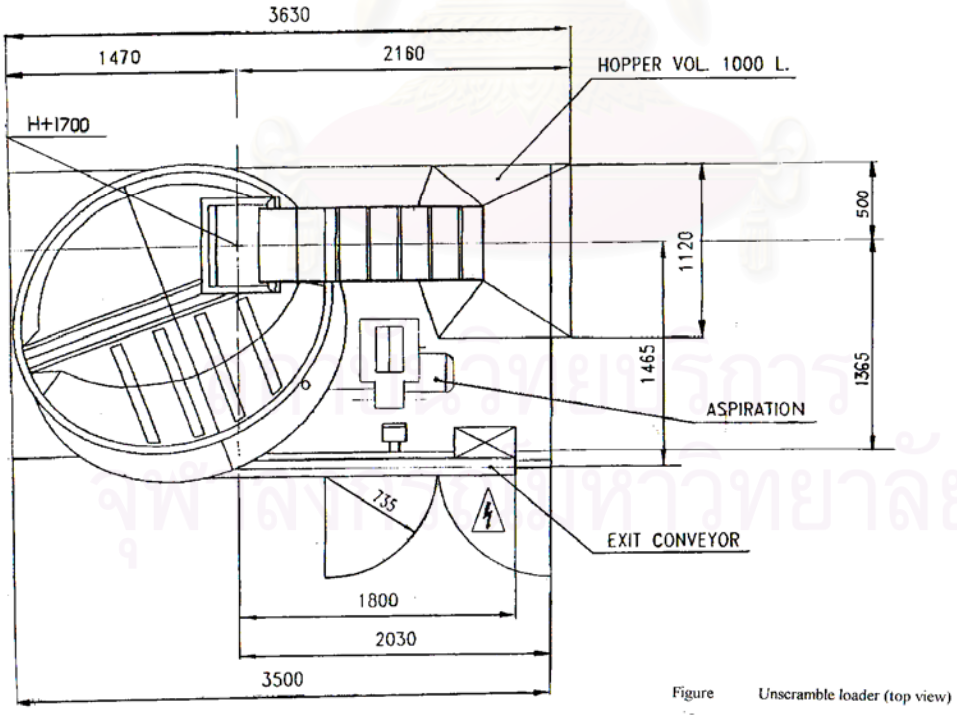


Figure 3-3 Unscramble loader (top view)
Source : Maintenance Department of A plant

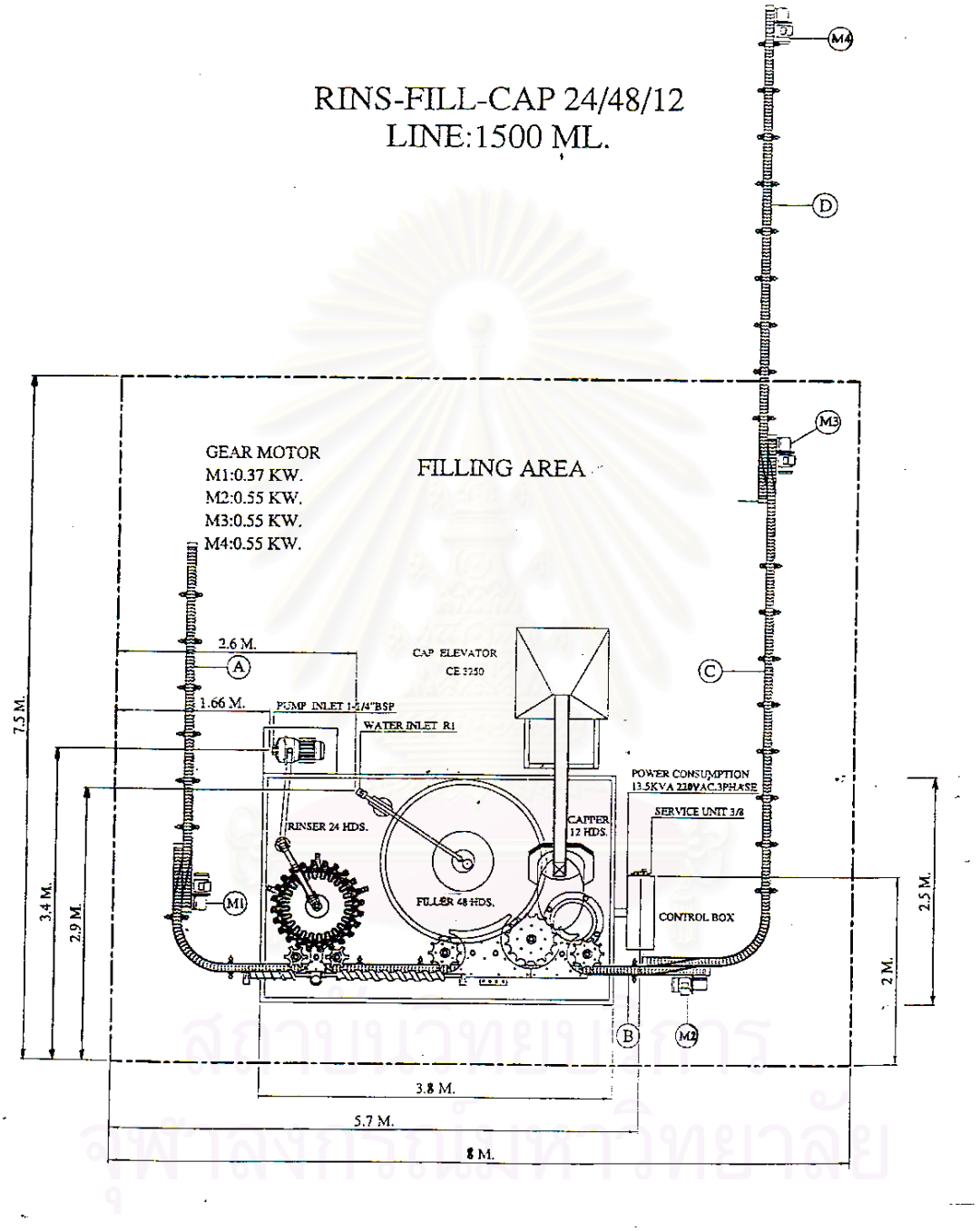


Figure Monoblock machine of 1500 ML

Figure 3-4 Monoblock machine of 1500 ML
Source : Maintenance Department of A plant

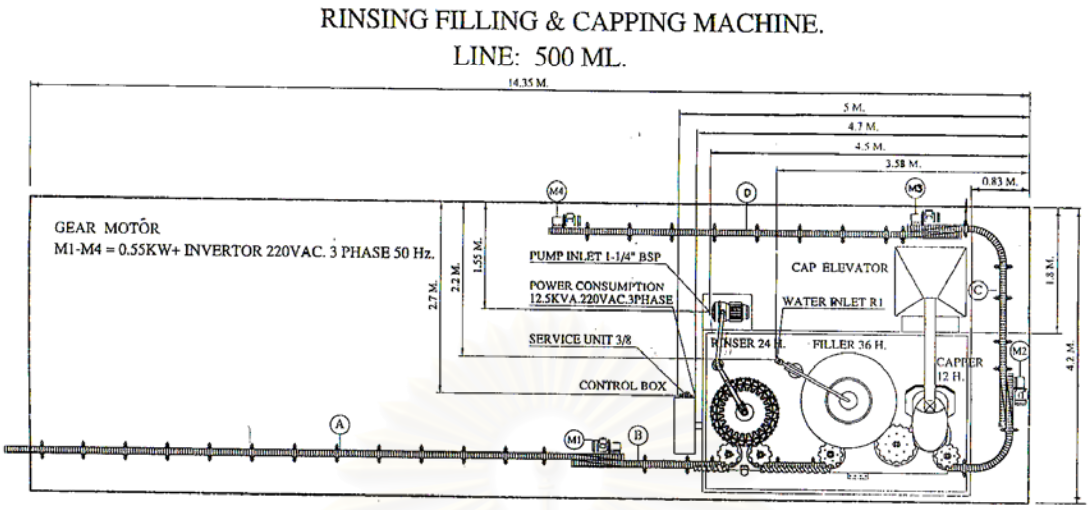


Figure Monoblock machine of 500 ML

Figure 3-5 Monoblock machine of 500 ML
Source : Maintenance Department of A plant

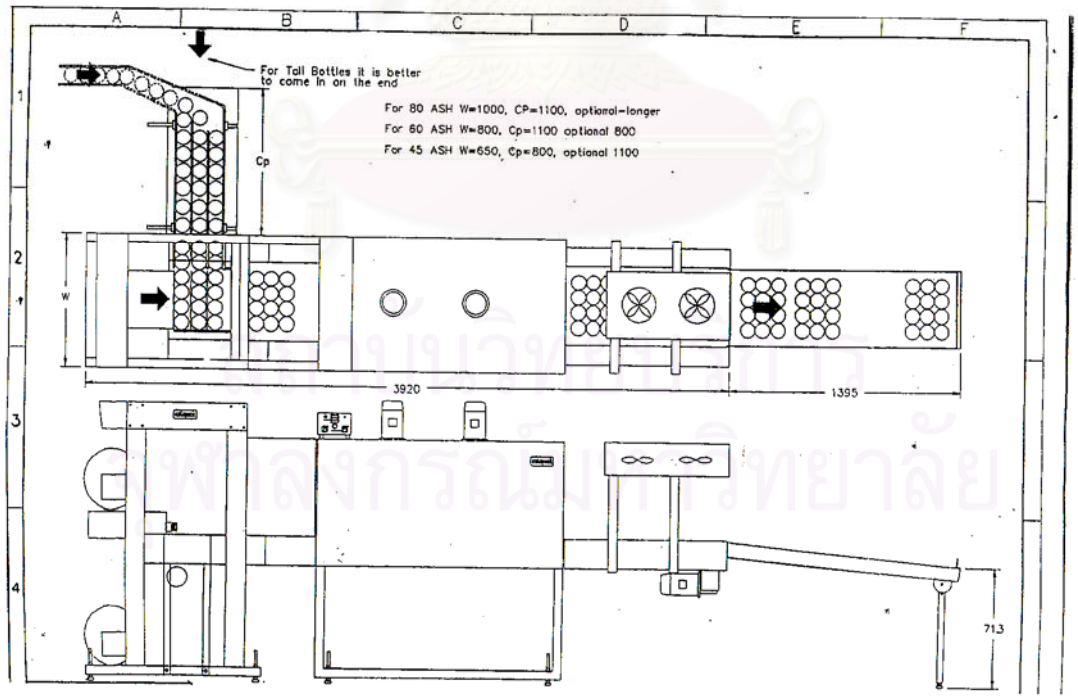


Figure Auto packed machine

Figure 3-6 Auto packed machine
Source : Maintenance Department of A plant

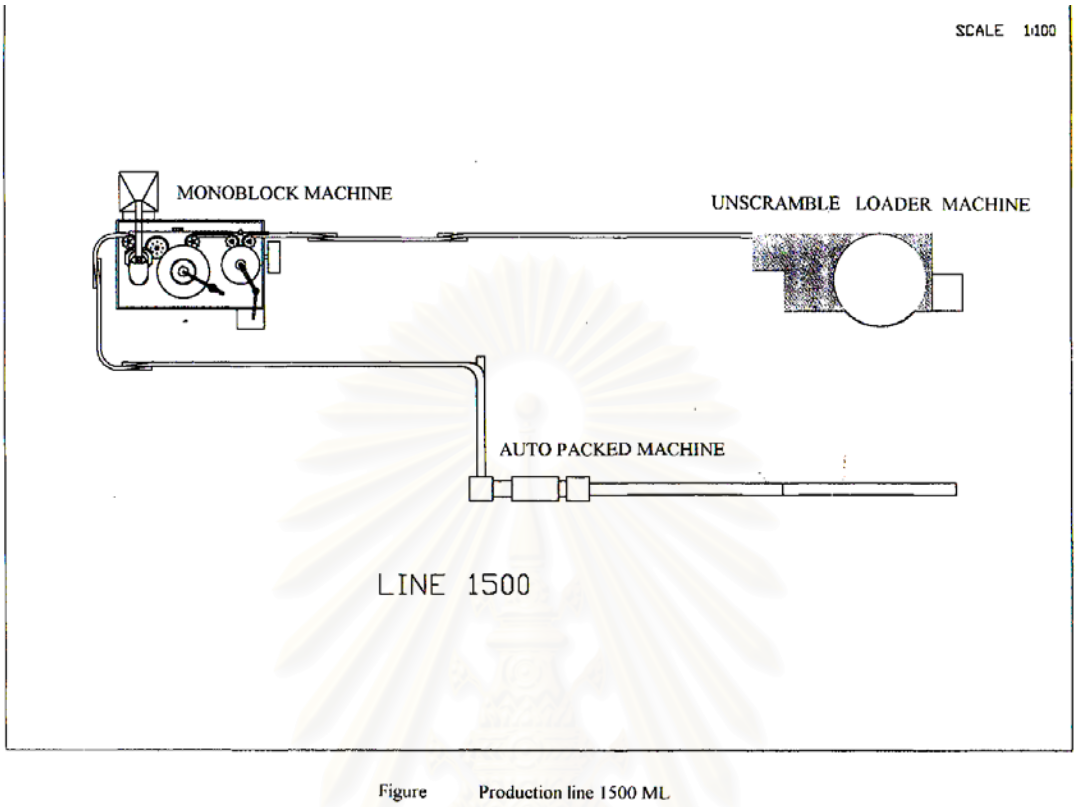


Figure Production line 1500 ML

Figure 3-7 Production line 1500 ML
Source : Maintenance Department of A plant

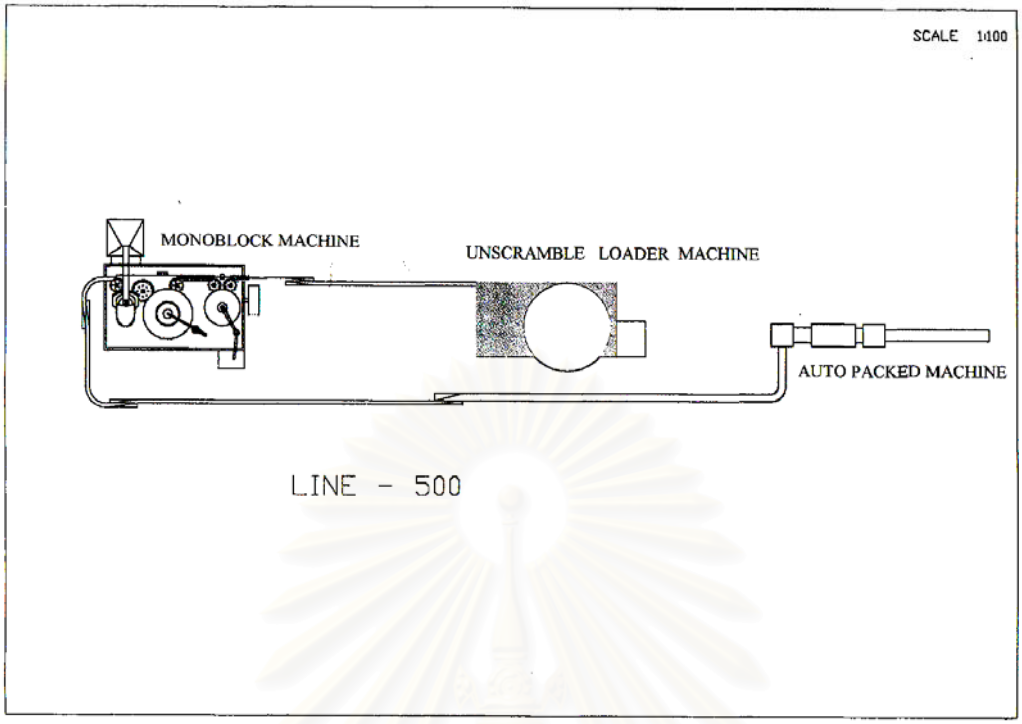


Figure Production line 500 ML

Figure 3-8 Production line 500 ML
Source : Maintenance Department of A plant

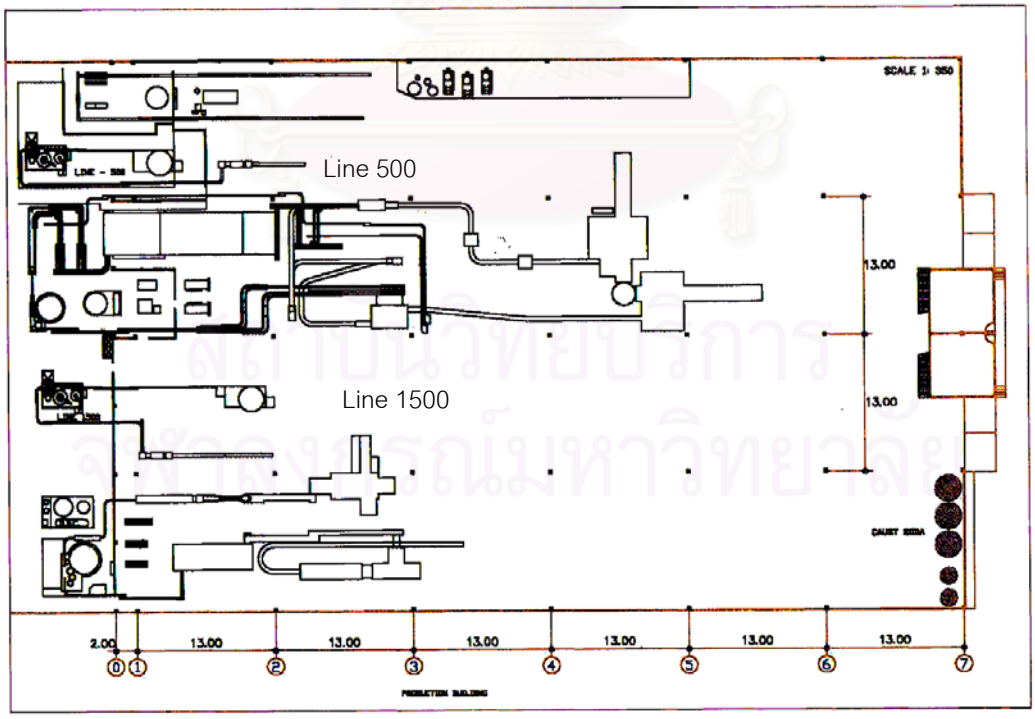


Figure 3-9 Production Building
Source : Maintenance Department of A plant

3.3 Water treatment system

Water treatment system begin with the water in storage tank is sent to pre ozone tank and then to activated filter tank and softener tank. Water is passed the filter bag before sent to uv sterilization and then sent to post ozone before sent to storage tank. When start the production line the water in this storage tank will be sent to pressure tank and cartridge filter and finally to the filler tank of the production line.

The following table illustrates the water treatment plant diagram and the symbol in the diagram is delineated also.

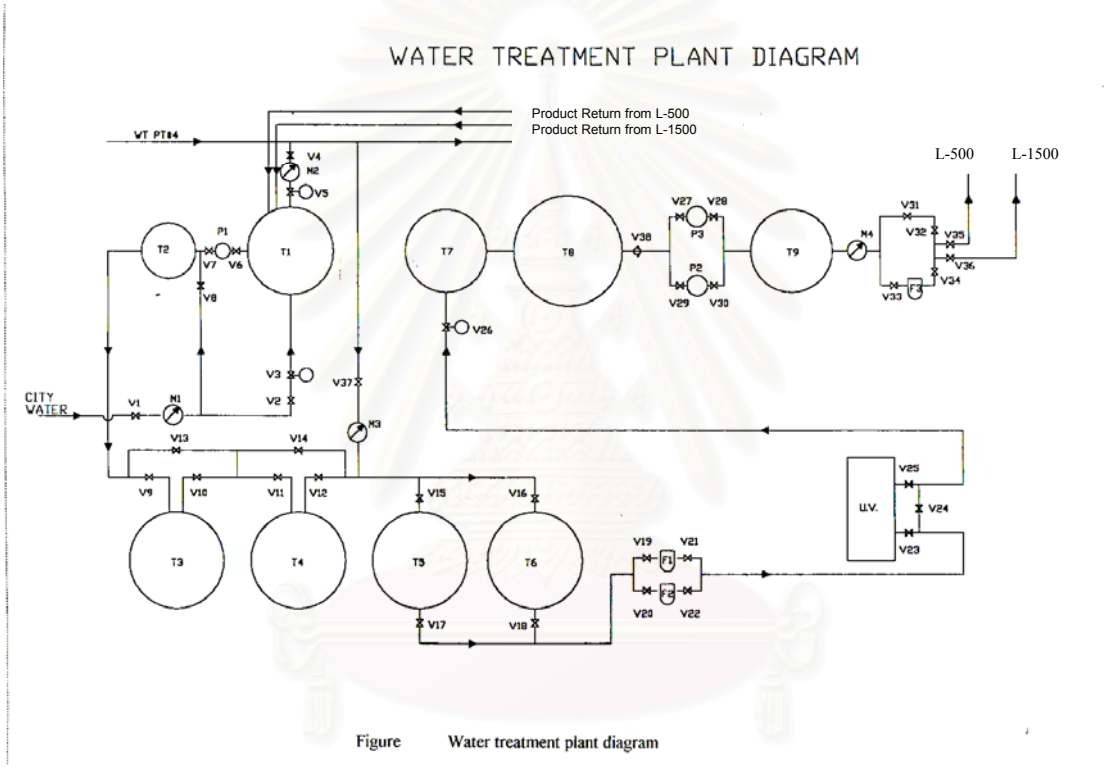


Figure 3-10 Water treatment plant diagram
Source : Maintenance Department of A plant

ITEM	SIGHT	NAME	ITEM	SIGHT	NAME
1	T1	Raw water tank	31	V16	Butterfly valve
2	T2	Pre-Ozone	32	V17	Butterfly valve
3	T3	Activated filter tank	33	V18	Butterfly valve
4	T4	Activated filter tank	34	V19	Butterfly valve
5	T5	Softener tank	35	V20	Butterfly valve
6	T6	Softener tank	36	V21	Butterfly valve
7	T7	Post-Ozone	37	V22	Butterfly valve
8	T8	Storage tank	38	V23	Butterfly valve
9	T9	Pressure tank	39	V24	Butterfly valve
10	F1	Filter bag	40	V25	Butterfly valve
11	F2	Filter bag	41	V26	Motor valve
12	F3	Cartridge filter	42	V27	Butterfly valve
13	P1	Raw water pump	43	V28	Butterfly valve
14	P2	Booster pump	44	V29	Butterfly valve
15	P3	Booster pump	45	V30	Butterfly valve
16	V1	Butterfly valve	46	V31	Butterfly valve
17	V2	Butterfly valve	47	V32	Butterfly valve
18	V3	Motor valve	48	V33	Butterfly valve
19	V4	Butterfly valve	49	V34	Butterfly valve
20	V5	Motor valve	50	V35	Butterfly valve
21	V6	Butterfly valve	51	V36	Butterfly valve
22	V7	Check valve	52	V37	Butterfly valve
23	V8	Butterfly valve	53	V38	Check valve
24	V9	Butterfly valve	54	UV	Ultraviolet sterilize
25	V10	Butterfly valve	55	M1	Water flow meter
26	V11	Butterfly valve	56	M2	Water flow meter
27	V12	Butterfly valve	57	M3	Water flow meter
28	V13	Butterfly valve	58	M4	Water flow meter
29	V14	Butterfly valve			
30	V15	Butterfly valve			

Table 3-1 Water treatment plant diagram : symbol and name
Source : Maintenance Department of A plant

Figure 3-11 illustrate the plan lay out of A plant to overview the direction of transportation the production line.

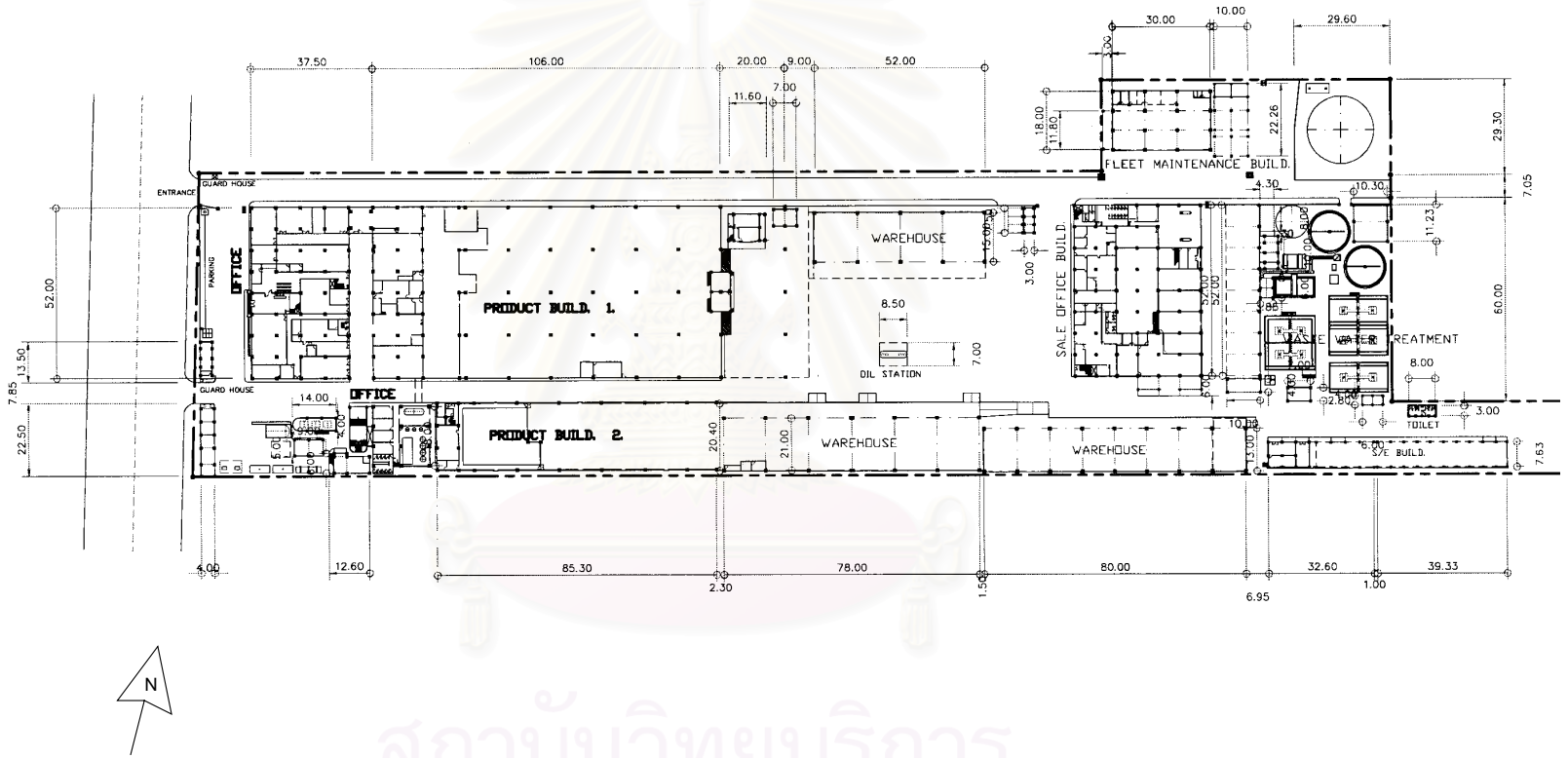


Figure 3-11 Plan Lay-Out A Plant

Source : MaintenanceDepartment of A Pla

3.4 The way of transportation

Plant A

Plant A is the first plant of this company. This plant started to produce in the year of 1969 and distribute the goods for Bangkok area and Eastern area of Thailand. This plant situated in city area. It is called Ram Kham Haeng District which is bounded with community. This plant is not far from the main junction named Lam Salee Junction. This junction is connect three main roads which are Lad Phrao road, Ram Kham Haeng road, Sri Nakharin road.

From the survey, the following figure can be used to illustrate the way to transport production lines from A plant to C plant.

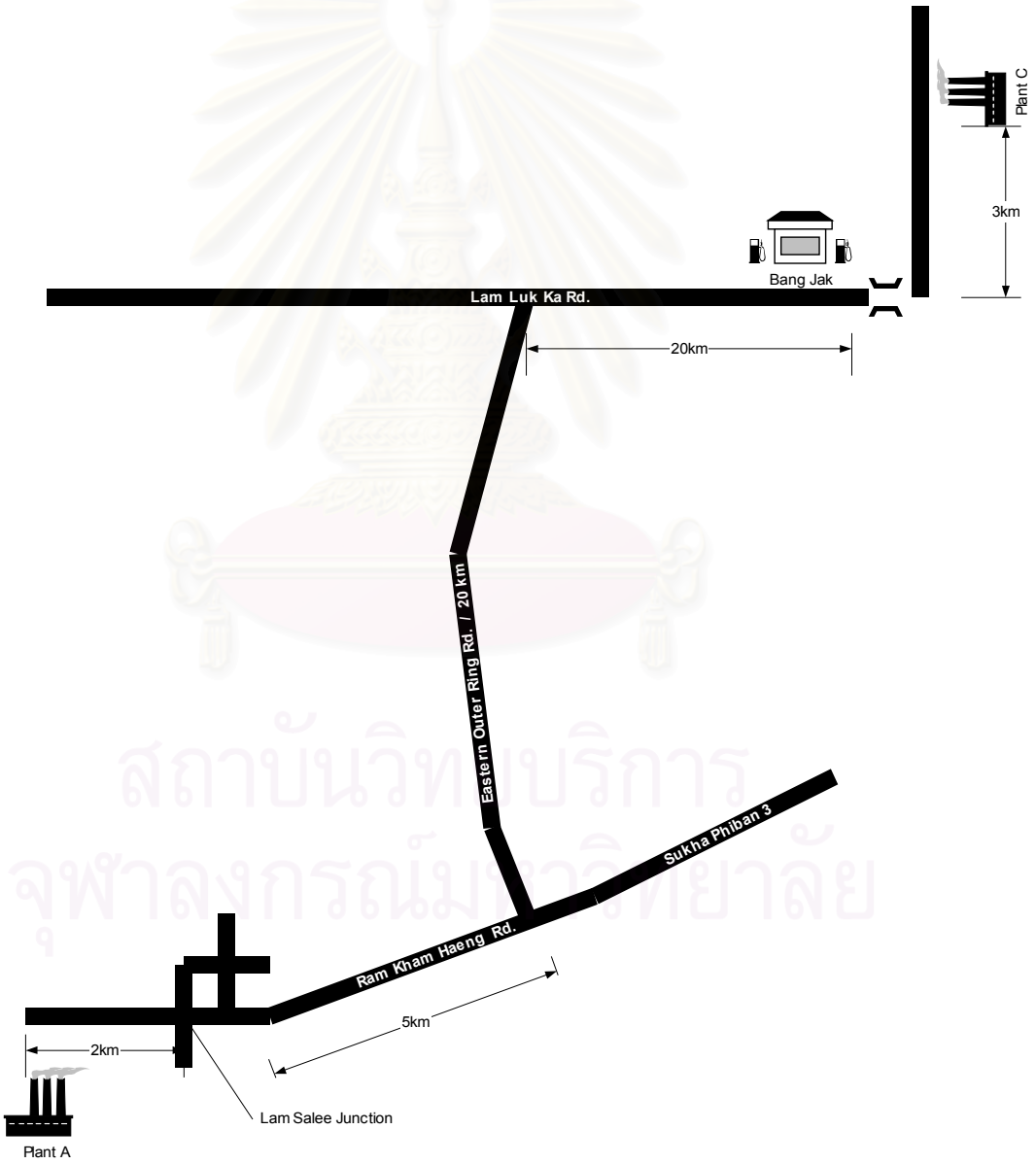


Figure 3-12 The way to transport from A plant to C plant

First, from A plant go straight pass Lam Salee Junction along the Ram Kham Haeng Road around 5 kms. Turn left to the Eastern outer ring road for 20 kms and down to Lam Luk Ka Road. Direct to Nakornnayoke province for 20 kms and see Bang Jak gas station as a sign then turn left for 3 kms, the driver will see C plant on his right hand side.

3.5 Location to place the production lines

Plant C

Plant C is the third plant in Central area but it is the fifth plant of this company. This plant started to produce in the year of 1996 and distribute the goods for Eastern area and some part of North area of Thailand. Plant C is the most largest and high technology factory of this company which cover the 200 plantations. This plant is situated in rural area of Pathumthanee province. It lied on the Leab Klong road which is straight along the channel, Tambon Pearch Udom, Lam Luk Ka district. It far from the A plant around 50 kilometers. Even it lies in rural area, it is very convenient to transport the goods because of the good road and free from traffic ban regulation.

The following figure can be used to illustrate plan lay out of C plant to understand the direction to transport the production lines from the main street.

Figure 3-13 illustrate the location of two production lines that will be placed.

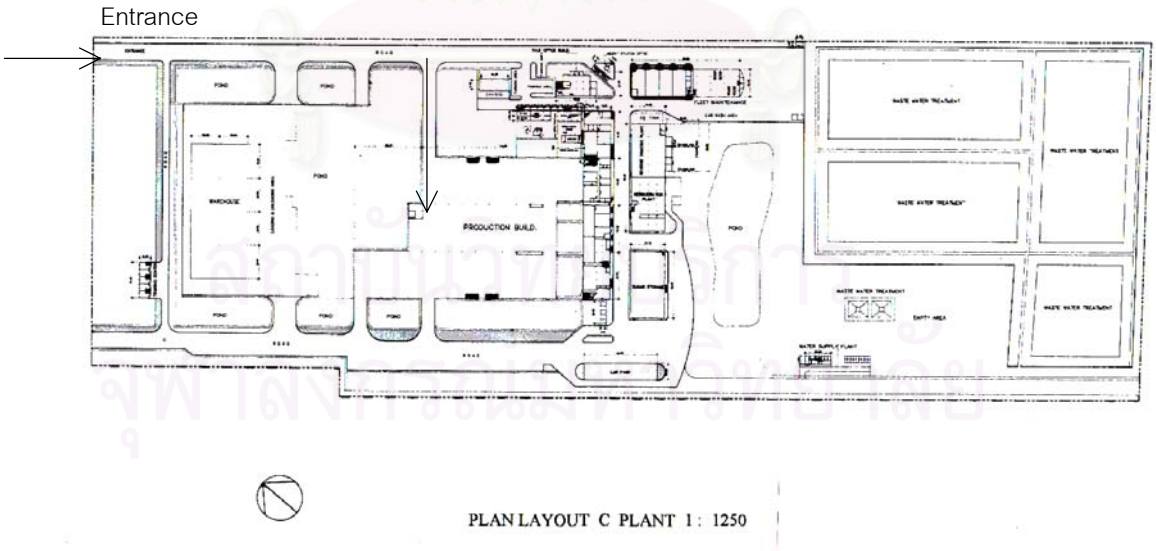


Figure 3-13 Plan Lay-out C Plant
Source : Head Office of company X

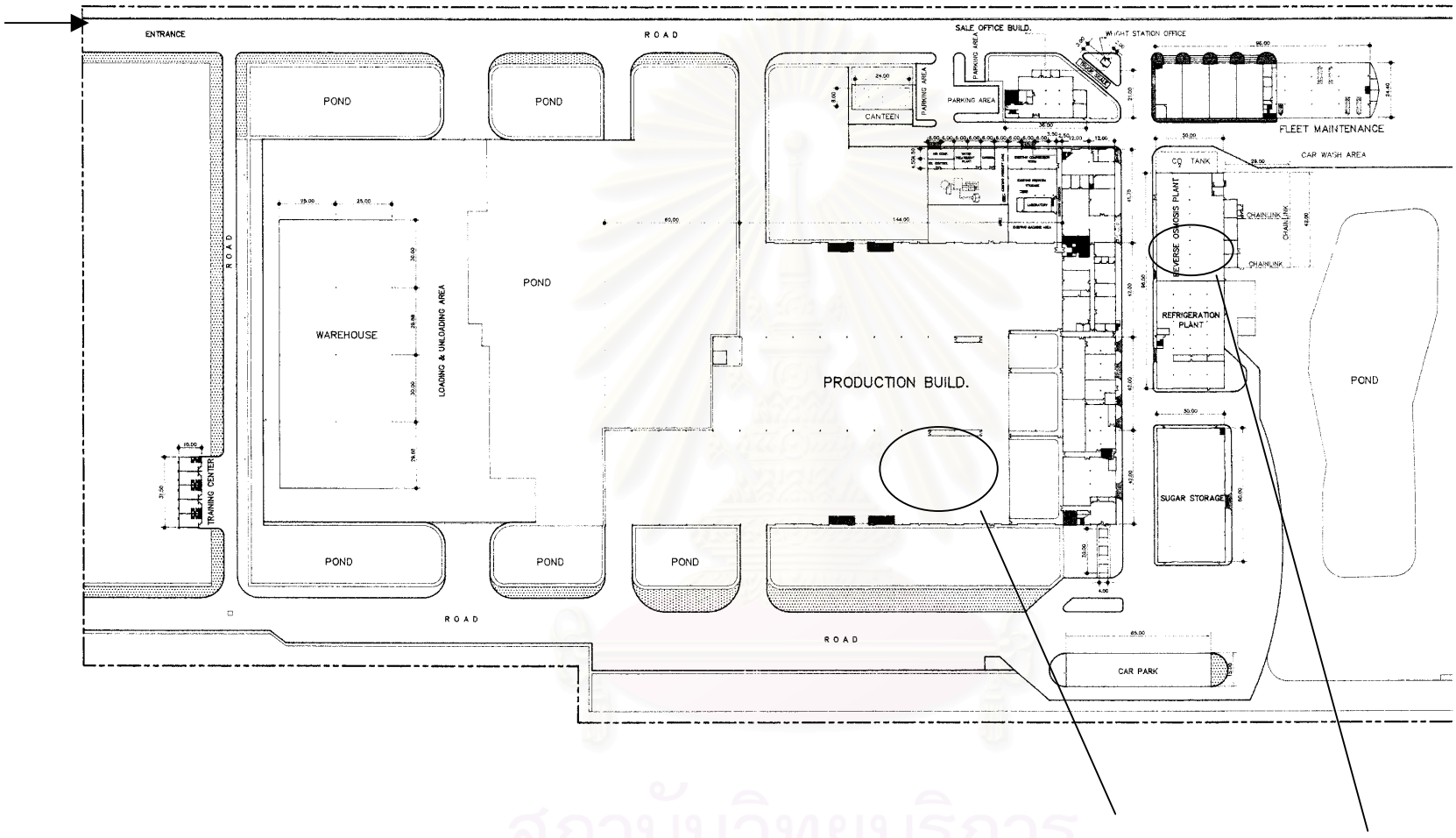


Figure 3-14 Plan Lay-Out C plant

Source : Head Office of company X

3.6 Manpower

Due to surveying in two plant there are some interesting information from these two plants. The following figure can be used to illustrate the organization chart of A plant and C plant.

ORGANIZATION CHART OF A PLANT

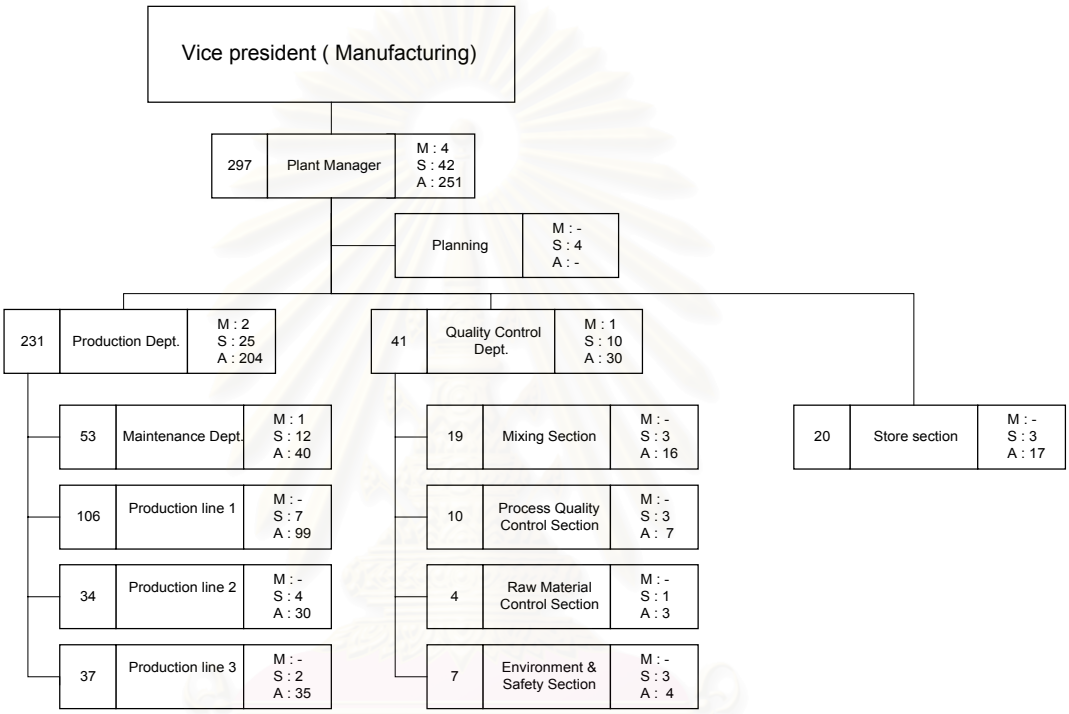


Figure 3-15 The organization chart of A plant
Source : Plant Division, A plant

ORGANIZATION CHART OF C PLANT

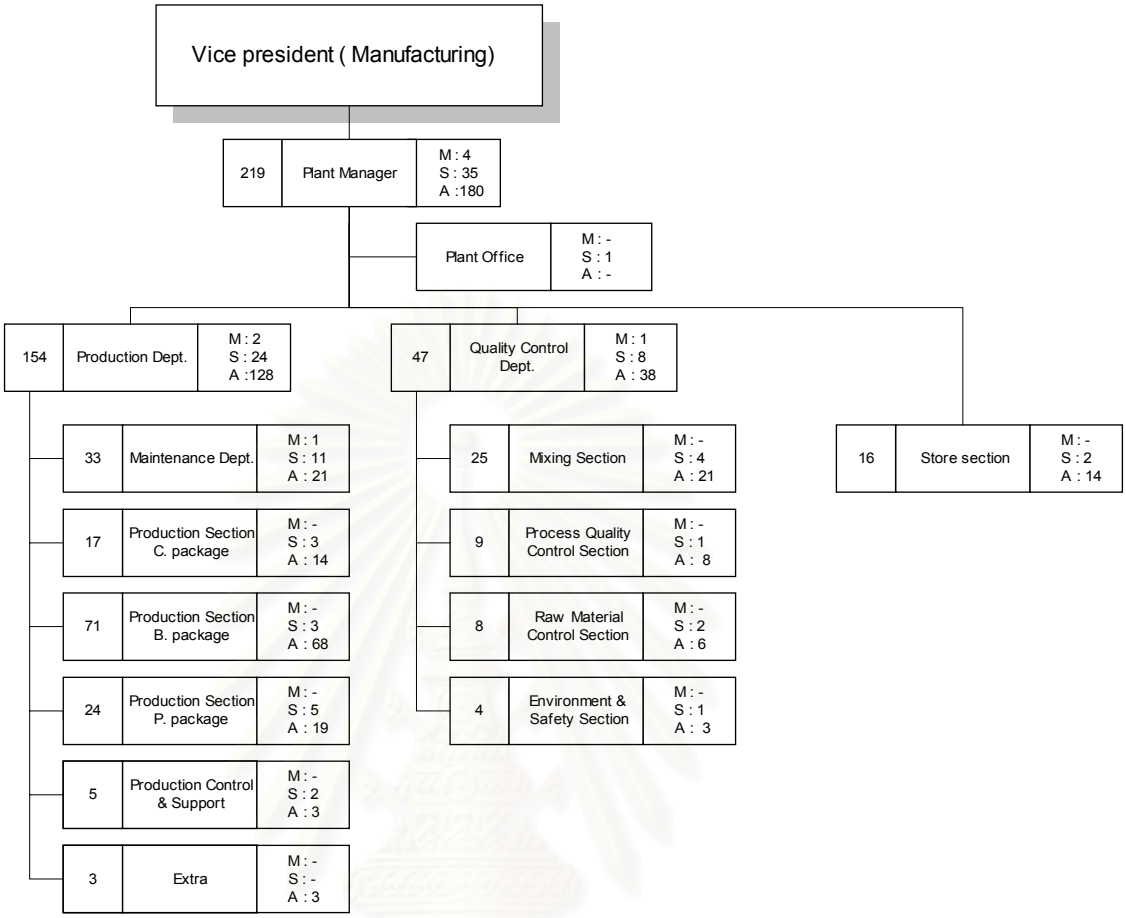


Figure 3-16 The organization chart of C plant
Source : Plant Division, C plant

The above figures illustrate the organization chart of both plants. The major structure of the organization of A plant is same as the organization of C plant.

Vice president (manufacturing) responsible for two plants, while plant manager responsible for individual plant. Under the plant manager, there are two departments and two sections. Two departments are production department and quality control. Two sections are plant office or planning and store section. Under production department there is maintenance department with maintenance manager directly report to production manager. Under department, there are many sections depending on the responsibility.

There are alternatives for the employee of plant A after closing which are.

- **Move to C plant** especially the employee in production line 2 because it responsible for producing pure water. When the production lines are moved, the employees in this section probably move too. The other section is maintenance department will be move to C plant because this department responsible for supporting the other department in factory and at present , the employees in

maintenance department in C plant is rather work hard. The other sections that will probably move to C plant are the mixing and process quality control section and raw material control section because if we move the production lines these sections will work harder than present. The store section will be move to support the procurement for other department. Other section may be in other alternative.

- **Move to other plant** because C plant is quite far from A plant. The distance between two plants is 50 kilometers so, some employees cannot go for work and they will seek the position in other plant.

- **Move to the head quarter**. Some employees such as the department manager, environmental section, raw material control section and store section probably move to the quality assurance in head quarter.

- **Resign.** This is the last alternative for employees that cannot choose the mentioned choice. They will receive the compensation calculated by the working duration.

Conclusion

It can be conclude that the employees from A plant can move to C plant. The detail are as followings:

Section in A plant	Number of employees	Section in C plant
Production line 2	34	*New* production section
Maintenance Dept.	53	Maintenance Dept.
Mixing Section	19	Mixing Section
Process Quality Control Section	10	Process Quality Control Section
Raw Material Control Section	4	Raw Material Control Section
Store Section	20	Store Section

Table 3-2 The number of employee that will move from A plant to C plant

The summaries of number of employees that move from A plant to C plant equal 140 persons. The total employees of A plant equal 297 persons. The percent of moved employees equal 47.13 percent. If we round the number of percent we can get 50 percent of employees from A plant move to C plant.

3.7 The existing working system

In this section, the existing system of this company will be discussed. After management team make a consensus to launch a project, the project manager will be appointed to respond the project. Project manager will make Gantt chart for initiate project. This Gantt chart show the overall planning steps of the project. The following figure can be used to illustrate the Gantt chart of project.

Project : RELOCATE THE DBC Unit

Activity	In charge		Times(Days)											
			1	2	3	4	5	6	7	8	9	10	11	12
1.Remove Rinser,Filler-Seamer: Piping and Control	Mechanic Supervisor	Plan												
	Mr. A	Actual												
2.Construct the NH3 Comp. Concrete found and	Mechanic Supervisor	Plan												
Control cabinet	Mr. A	Actual												
3. Remove and installation of DBC Unit: NH3 Comp.	Electric Supervisor	Plan												
	Mr. B	Actual												
4. Refrigeration Unit testing	Electric Supervisor	Plan												
	Mr. B	Actual												
5. Repair floor tile, wall tile and drain line	Mechanic Supervisor	Plan												
	Mr. A	Actual												
6. Remove production line	Mechanic Supervisor	Plan												
	Mr. A	Actual												
7.Piping Works: electrical installation	Electric Supervisor	Plan												
	Mr. B	Actual												
8. Empty bottle and full good Conveyor	Mechanic Supervisor	Plan												
	Mr. A	Actual												
9.Test run the production line	Mech&Elect Supervisor	Plan												
	Mr. A &Mr. B	Actual												
10. Room construction	Mechanic Supervisor	Plan												
	Mr. A	Actual												
11. Install an Air Treatment System for filling room	Electric Supervisor	Plan												
and Exhaust fan unit for Unscrambling room	Mr. B	Actual												

Figure 3-17 The example of Gantt chart in the existing working system
Source : Maintenance Department of A plant

The simple planning technique is suitable for the small project such as internal department project. However, the complicated project required more information such as the share resource and relationship between activities.

3.8 Project organization

In the existing system project manager does not plan the organization of the project. He only identify the head responsibility of the task for individual project. From the above figure, The in charge persons must have their own plan to select all of resource such as the special tool, manpower and have their own check sheet or keep in mind that the task is completed follow the plan or delay. If some task is delayed it will make the whole project delay from the plan. However the in charge persons do not know that which task is the critical task and if the critical is delay how can they manage it. There are two ways to manage by the project manager. First, the project manager can revise plan by add the resource or over time working. Second, he can accept the delay and follow the old plan. Anyway, this existing working system used the paper and manual calculation and decision by only the project manager. The paper system is suitable for the simple project. By that way, the complex project that deal with many departments should consider the computer program that can assist the project manager in making decision.

As mention above, the in charge person is response to find the resource such as manpower and special tool. Due to the limited manpower especially the special

skill labor such as the mechanic and electrician, the Mechanic supervisor and Electric supervisor do not know that in each day the expected labor will be occupied by the other person or not. If the expected labor is occupied how can the supervisor manage in this situation which are resource sharing or select the new resource.

3.9 Discussion

The existing working system for individual project in this company is depend on only the project manager's decision and lack of co-ordination between the department. Moreover, there are no pure organization for the project, it can confuse the responsibility to do the routine work or special project.

Moreover, it is more difficult for the project manager to control the project that usually late from the plan without the reasonable cause because he do not keep the previous record.

Role of the researcher

In a role of researcher, the author has follow this step :

1. Gathering the data from two plants
    - Background of this research
    - Production lines
    - Water treatment system
    - The way to transport
    - Location to place the production lines
    - Man Power
    - The existing working system
2. Classify these information to analyze
3. Analyze the involved theory and apply to this project
4. Propose the project planning and control system—See in the next chapter

Chapter 4

The Proposed Project Planning and Control System

4.1 Introduction

Company X is the beverage producer in Thailand. It was established from the co-operation of Thai families and the US giant company. For almost 40 years, this company has rapidly grown while extended the production base spread over the parts of Thailand. Now this company has six plants which lie in the different area and condition. There are 3 plants (A, B, C) in Bangkok and suburban and 3 plants (D, E, F) in another province both in the North and Northeast part of Thailand. Individual plant has produce the different packages of product such as can, bottle and different flavors of each size of package. In each plant have individual layout and space usage, which vary along the plant director policy.

In recent year, Thailand faces the economic crisis and widely strike to the entrepreneurs. This company has significantly affected with this situation because the sale volumes of beverage product decrease very much. Top management team makes a consensus to change the marketing strategy by launching the new product in the new market called pure water. The new production line of this new product is defined to locate in plant A which is in the city area of Bangkok.

Plant A face the transportation problem for many years because of the transport system management of Land Transportation Department. The distribution trucks must come in and go out under the time limited because they are huge and have 18 wheels. However, the management team try to solve this problem by many methods such as avoiding immediately order of raw material and production planning schedule and co-operating between related department.

In this year, the legal constrains the operation more and more because of the transport logistics service station and the legal regulation for banning the large truck to come in the limited areas. In the second phase of this regulation some small warehouses in the city area must closed because it can not transport the product in and out the warehouse. Moreover, plant A has significantly affected to this regulation in phase 4 because it bans the large truck to enter and park all 24 hours.

At present, the price of water of plant A is higher than the other plant because plant A situate in the city area, the water that supplied in the plant is coming from the water works while the other plant lied in the suburb use the under world water. Relocation from plant A to plant C can reduce the cost of water supply.

Because plant A lied in city area, it is not good from the jam- packed traffic. The distribution system can not provide the highest effective transportation while it faces the problem of limited time to come to the plant. This reason makes the problem for transporting both raw materials such as empty bottle, sugar and finished goods.

The public image seems not good because around the plant bound with communities. The large truck that make traffic jam and sometimes obstruct the public road can annoy the people. Moreover, the sound of production line in the serene night is not good for this district.

The limited space make the staff difficult to manage the operation. For example, the raw material and finished product volumes need the accurate plan to manage rows and layers while the forklift trucks do not have more space to operate.

Line utilization of some production line is lower than the one in other plant. Now every plant plan to produce with 2 shifts, relocation the employee to be the 3rd shift will be the good way to this situation.

Changing the production base require a precise decision to control the budget and time management.

Traffic ban regulation

At present, Even the business is go well, plant A—one plant of company X is rather face the problem of transportation and working space because it lie in the city area which packed with community.

The Land Transportation department legislates the "Traffic Ban" in Bangkok. This rule composed of 4 phases which are:

1. Phase 1: Prohibit the truck which has 10 wheels up park on public road on the "Save area" 45 km^2 in 24 hours.
2. Phase 2: Prohibit the truck which has 10 wheels up park on public road in the "inner ring area" 113 km^2 24 hours.
   *The truck can not enter this area from 6.00 a.m.-10.00 a.m. and 3.00 p.m.-10.00 p.m. every day except weekend.
3. Phase 3: Prohibit the truck which has 10 wheels enter the "inner ring area" 113 km^2 from 5.00 a.m. -10.00 p.m.
4. Phase 4: Prohibit the truck which has 10 wheels enter and park in the "outer ring area" 24 hours except the allowed truck can enter this area during 10.00 p.m.-5.00 a.m.

Plant A has most affected in Phase 4 because almost of the distribution trucks have 18 wheels and the plant location is in outer ring area. So the large truck can not use to distribute the product anymore including the supplier's large truck such as sugar truck can not come to supply plant A.

In order to solve this problem, the company has the policy to relocate the production base to the other plant which is not affected with the traffic ban. After the management team considers in various factors, plant C is the suitable place to relocate the production base. This relocation project should be done with the suitable planning because it is the major change of this company both employees and related

production compositions. All of the activities should be considered when planning the project. The precise analysis can bring the accurate decision in long term planning for this company.

4.2 Objective of research

The objective of this research is to determine relocation plan and control procedure for the beverage plant.

4.3 Project manager

The first thing after the top management making a consensus is to find the project manager responsible for the project. In the other hand, he is the key man to the project that can make vital decision instead of the top management.

After the project manager is appointed, he will take the responsibility for planning, implementing, and completing the project, starting with the job of getting things begun.

The project manager can be chosen and installed as soon as the project is at the earlier point that seems requirement to top management. If the project is appointed prior to project selection or if the project manager originated the project, the normal tasks are simplified.

The project manager has the three responsibilities, which are:

- Responsibility to the parent organization
- Responsibility to the project
- Responsibility to the member of project team

The project team can be set after the project planning is successful.

4.4 Project planning (Spinner, 1997)

The project manager is authorized to direct the project plan, approvals really amount to a series of authorizations.

Planning project can be known as the most time consuming phase of the total project. However, it worth it to spent the time in this phase, it reduce the unexpected problem in the future if there is the good planning. Those who have succeeded the planning phase can be ensure that they have a complete of what the project entails.

Planning a project will follow these steps:

Step 1 : Establish objectives.

The objective of this project is to determine relocation plan and control procedure for the plant A.

Step 2 : Define the required activities.

This step is to identify the activities needed to complete the project. Identifying the activities is done by those persons who have most knowledge and experience of work to be done. This step is quite an effort to complete because it is a checklist of the work to be done and can be time consuming.

The work description for each activity to allow the understanding of this project is shown in the following figure.

TAKE OFF PRODUCTION LINES in A PLANT

ID	ACTIVITY	DESCRIPTION
1	A	Meeting to assign the responsibility
2	B	Drawing survey and prepare the purchase order for equipment
3	C	Procurement for equipment
4	D	Preparation step before unlock the machines
5	E	Remove or Unlock the machine compositions and classify in each set
6	F	Clear the moving way inside factory
7	G	Wall openning
8	H	Move machines from floor to trucks
9	I	Transportation machine from plant A to plant C

TAKE OFF WATER TREATMENT SYSTEM in A PLANT

ID	ACTIVITY	DESCRIPTION
10	J	Take out utility system and unlock the water treatment equipment
11	K	Move water treatment equipment from floor to trucks
12	L	Transportation water treatment system from plant A to plant C

AREA PREPARING in C PLANT

ID	ACTIVITY	DESCRIPTION
13	M	Drawing and Utility survey in C plant
14	N	Design utility and prepare the purchase order for equipment
15	O	Area clearing
16	P	Wire way from MDB and rack making
17	Q	Electric control cabinet making
18	R	Filling room construction
19	S	Floor surface making(Stone-hard)
20	T	Piping making from water treatment and air compressor to production line

PRODUCTION LINE and WATER TREATMENT SYSTEM SETTING in C PLANT

ID	ACTIVITY	DESCRIPTION
21	U	Marking centre for major machines and tanks
22	V	Machines placing and alignment
23	W	Transmission system placing and alignment
24	X	Connect electric system and piping system to the production line
		WATER TREATMENT SYSTEM
25	Y	Tank placing and connect the other equipment
26	Z	Electric system and piping connection
		TEST RUN and PRODUCTION
27	AA	Test Run
28	AB	Production

Table 4-1 Activities for the Relocation the beverage plant project

From the above figure, there are 4 major steps in this project which are;

1. Take off production lines in plant A
2. Take off the water treatment system in plant A
3. Area preparing in plant C
4. Production line and Water treatment system setting in plant C

Step 3 : Divide activities into work groups.

To assist in determining relationships between activities, it is desirable to first group the closely related functions under major categories or departments. For the relocate plant project it involve in engineering, procurement, transportation, area preparation and installation. Setting these functions up in logical grouping simplifies the activity of determining how the activities relate to each other. The following figure can be use to illustrate this step.

Major Departments of Work

Engineering

- A - Meeting to assign the responsibility
- B - Drawing survey and prepare the purchase order for equipment
- D - Preparation step before unlock the machines
- E - Remove or Unlock the machine compositions and classify in each set
- G - Wall openning
- J - Take out utility system and unlock the water treatment equipment

Procurement

- C - Procurement for equipment
- F - Clear the moving way inside factory

Transportation

- H - Move machines from floor to trucks
- I - Transportation machine from plant A to plant C
- K - Move water treatment equipment from floor to trucks
- L - Transportation water treatment from plant A to plant C

Area Preparation

- M - Drawing and Utility survey in C plant
- N - Design utility and prepare the purchase order for equipment
- O - Area clearing
- P - Wire way from MDB and rack making
- Q - Electric control cabinet making
- R - Filling room construction
- S - Floor surface making(Stone-hard)
- T - Piping making from water treatment and air compressor to production line

Installation

- U - Marking centre for major machines and tanks
- V - Machines placing and alignment
- W - Transmission system placing and alignment
- X - Connect electric system and piping system to the production line
- Y - Tank placing and connect the other equipment
- Z - Electric system and piping connection
- AA - Test Run
- AB - Production

Step 4: Construct the Work breakdown Structure.

The Work breakdown Structure amplifies step 3 by graphically setting up the groupings in the form of an organization chart. Listed under each group are the activities needed to be complete this specific group. The following figure is used to show the work breakdown structure of this project.

Work Break down Structure

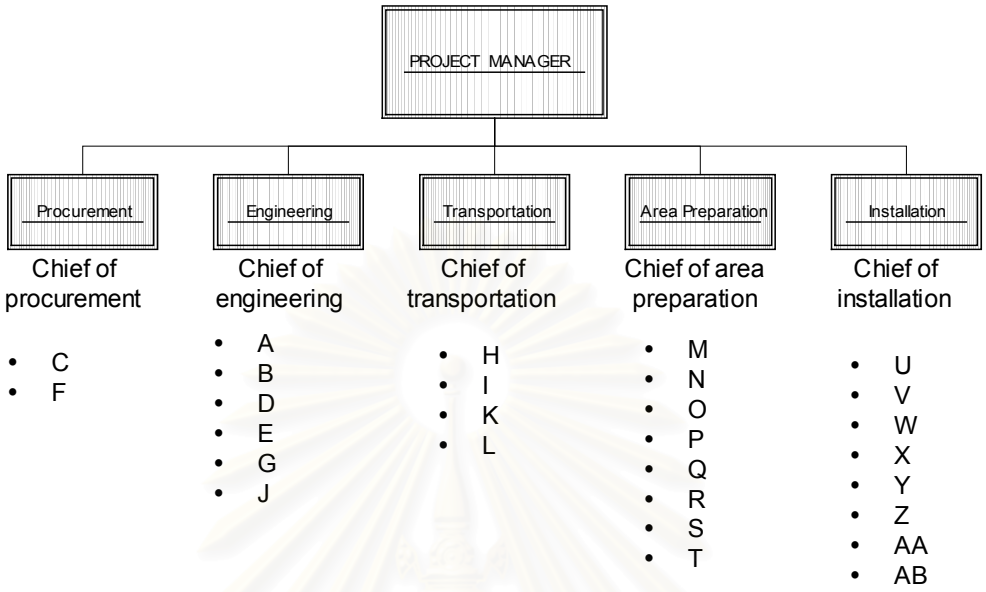


Figure4-1 Work breakdown structure(WBS) for this project

However, the planner should specify the resource in each activity to overview the entire project. Persons responsible for each assignment can be shown on the WBS chart. The following figure can be used to illustrate the WBS with resource.

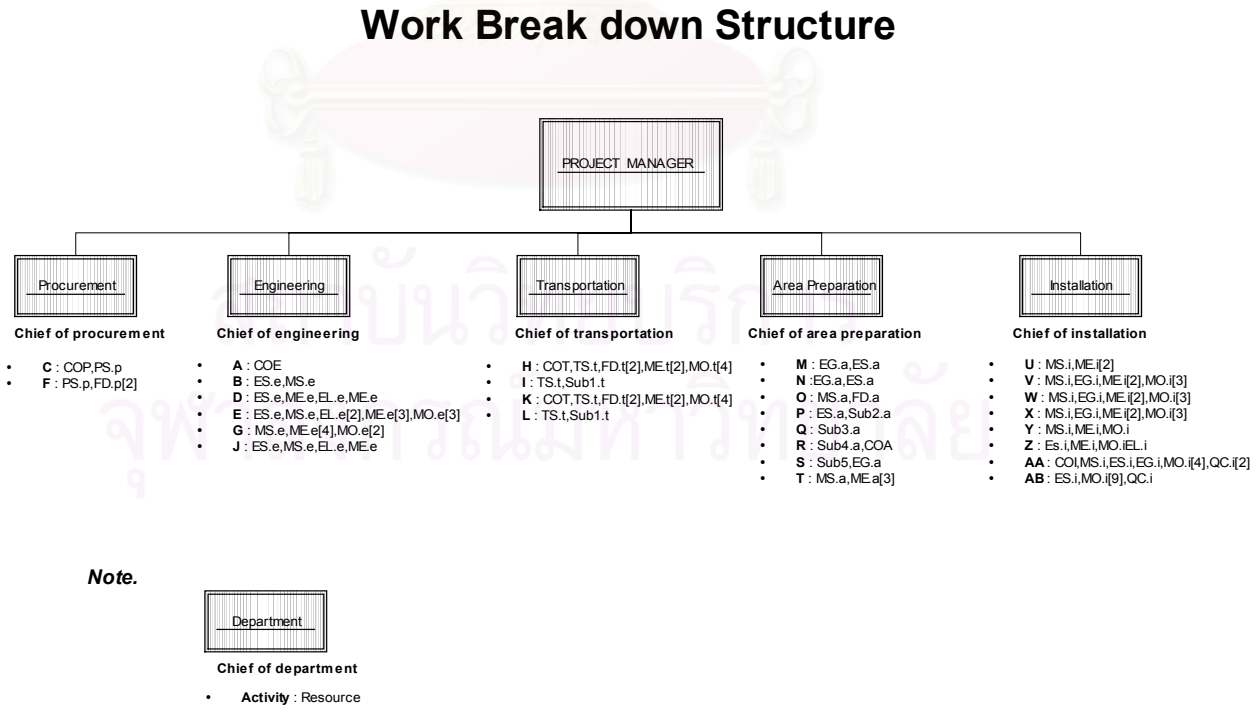


Figure4-2 Work breakdown structure with resource for this project

From the above figure, WBS is the major step in planning process because it is structured in accordance with the way the activities will be performed and reflects the way in which project resource will be summarized.

The following table illustrate the resource name in the work breakdown structure:

Initial	Resource Name	Group
COE	Chief of Engineering	Engineering
ES.e	Electric Supervisor in Engineering	Engineering
MS.e	Mechanic Supervisor in Engineering	Engineering
COP	Chief of Procurement	Procurement
PS.p	Procurement Staff	Procurement
EL.e	Electrician	Engineering
ME.e	Mechanic	Engineering
MO.e	Machine Operator	Engineering
FD.p	Fork lift Driver	Procurement
COT	Chief of Transportation	Transportation
TS.t	Transportation Supervisor	Transportation
FD.t	Fork lift Driver	Transportation
ME.t	Mechanic	Transportation
MO.t	Machine Operator	Transportation
Sub1.t	Subcontract1	Transportation
COA	Chief of Area Preparation	Area Preparation
EG.a	Engineer	Area Preparation
ES.a	Electric Supervisor in Area Preparation	Area Preparation
MS.a	Mechanic Supervisor in Area Preparation	Area Preparation
ME.a	Mechanic	Area Preparation
EL.a	Electrician	Area Preparation
FD.a	Fork lift Driver	Area Preparation
Sub2.a	Subcontract2	Area Preparation
Sub3.a	Subcontract3	Area Preparation
Sub4.a	Subcontract4	Area Preparation
Sub5.a	Subcontract5	Area Preparation
COI	Chief of Installation	Installation
MS.I	Mechanic Supervisor in Installation	Installation
ES.I	Electric Supervisor in Installation	Installation
EG.I	Engineer	Installation
ME.I	Mechanic	Installation
MO.I	Machine Operator	Installation
EL.I	Electrician	Installation
QC.I	Quality control	Installation

Table 4-2 The resource name of this project

Work Breakdown Structure Description

- **Procurement**

The procurement department responsible for the arrange the purchase order, request order from other department such as purchase the special equipment. Moreover, this department supply the requisition for goods and provide the fork-lift and driver to clear the moving way inside plant A. In the other hand, procurement department is set up for convenient the other department in terms of procure and provide tooling, stuff and fork-lift to the other department.

- **Engineering**

The engineering department starts the project by assigning the responsibility to all departments. The major duty of this department is preparation before take off the production line and the water treatment equipment and removing the machine composition and pack these compositions in each set in order to facilitate the installation department. However, before moving machine composition, this department must open the wall for the transportation department.

- **Transportation**

The transportation department responsible for moving machine compositions and water treatment equipment from floor to truck and transport from plant A to plant C.

- **Area preparation**

The area preparation department has the major duties in plant C which are area clearing and utility preparation. Area clearing must be done in order to move the machine composition without obstacles. This department prepares the utility for the new installation which are wire way from main board distribution to the production line and rack making to place the wire because of the weight of wire and good image of wire way. Area preparation responsible for electric control cabinet making, filling room construction, floor surface making and piping making as well. In the other hand, the area preparation department responsible for preparing the area and utility supply to the new production line.

- **Installation**

The installation department responsible for installs the production line and water treatment equipment and connects the utility supply to these compositions. After install the production line, this department must test run until the production run result is acceptable which reach to the final step, the production.

Step 5: The Action plan.

The action plan is a tool to gather the information of the project, which are composed of activity, description, predecessor, time and responsibility and type.

The composition of the action plan can be mainly divided into four parts which are:
1. take off the production line and separate pack in each set in plant A
2. take off the water treatment system in plant A
3. transport the production line from plant A to plant C
4. compose the production line, test run and production in plant C

The following figure shown the activities that occur in plant A

TAKE OFF PRODUCTION LINES in A PLANT

ACTIVITY	DESCRIPTION	PREDECESSOR	TIME(Day)	RESPONSIBILITY	TYPE
A	Meeting to assign the responsibility	-	1	Engineering	F
B	Drawing survey and prepare the purchase order for equipment	A	2	Engineering	F
C	Procurement for equipment	B	7	Procurement	F
D	Preparation step before unlock the machines	C	3	Engineering	D
E	Remove or Unlock the machine compositions and classify in each set	D	6	Engineering	D
F	Clear the moving way inside factory	A	1	Procurement	F
G	Wall openning	E	2	Engineering	F
H	Move machines from floor to trucks	E,F,G	1	Transportation	F
I	Transportation from plant A to plant C	H	2	Transportation	D

TAKE OFF WATER TREATMENT SYSTEM in A PLANT

ACTIVITY	DESCRIPTION	PREDECESSOR	TIME(Day)	RESPONSIBILITY	TYPE
J	Take out utility system and unlock the water treatment equipment	C	1	Engineering	F
K	Move water treatment equipment from floor to trucks	J	1	Transportation	F
L	Transportation from plant A to plant C	K	2	Transportation	D

Table 4-3 The activity in plant A

The activities in the above figure will occur in plant A. There are the meaning in each column.

1. The ACTIVITY column means the symbol of activity that relative to the project.
2. The DESCRIPTION column means the activity definition.
3. The PREDECESSOR column means the activity that must finished before this activity.
5. The TIME column means the duration that can complete the activity.
6. The RESPONSIBILITY column means the department that responsible for the individual activity.
7. The TYPE column means the type of activity. There are 2 types of activity which are Fixed duration and Resource driven.

   Fixed duration mean that no matter what resource are added the time is still consistency.

   Resource driven mean that if we add the resource we can reduce the duration.

The following figure can be used to illustrate the activity in plant C

AREA PREPARING in C PLANT

ACTIVITY	DESCRIPTION	PREDECESSOR	TIME(Day)	RESPONSIBILITY	TYPE
M	Drawing and Utility survey	A	1	Area Preparation	F
N	Design utility and prepare the purchase order for equipment	M	2	Area Preparation	F
O	Area clearing	A	1	Area Preparation	F
P	Wire way from MDB and rack making	N,C	2	Area Preparation	F
Q	Electric control cabinet making	N,C	14	Area Preparation	F
R	Filling room construction	N,C,O	18	Area Preparation	F
S	Floor surface making(Stone-hard)	R	10	Area Preparation	F
T	Piping making from water treatment and air compressor to production line	N,C	5	Area Preparation	D

PRODUCTION LINE and WATER TREATMENT SYSTEM SETTING in C PLANT

ACTIVITY	DESCRIPTION	PREDECESSOR	TIME(Day)	RESPONSIBILITY	TYPE
U	Marking centre for major machines and tanks	C,R,S	1	Installation	F
V	Machines placing and alignment	U,I	2	Installation	F
W	Transmission system placing and alignment	V	8	Installation	D
X	Connect electric system and piping system to the production line	W,T,Q,P	4	Installation	D
	WATER TREATMENT SYSTEM				
Y	Tank placing and connect the other equipment	U,L	2	Installation	F
Z	Electric system and piping connection	Y,T	2	Installation	D
	TEST RUN and PRODUCTION				
AA	Test Run	X,Z	3	Installation	F
AB	Production	AA	1	Installation	F

Table 4-4 The activity in plant C

Step 6: Draw subdiagrams.

To further assist in the development of the project planning diagram, the subdiagramming style sets up sequentially preliminary diagrams to show relationships of major departments as well as individual activities. The first steps of the subdiagrams (Figure4-6) are done by the individual departments or areas of responsibility to show the delineation of their work activities within their own department.

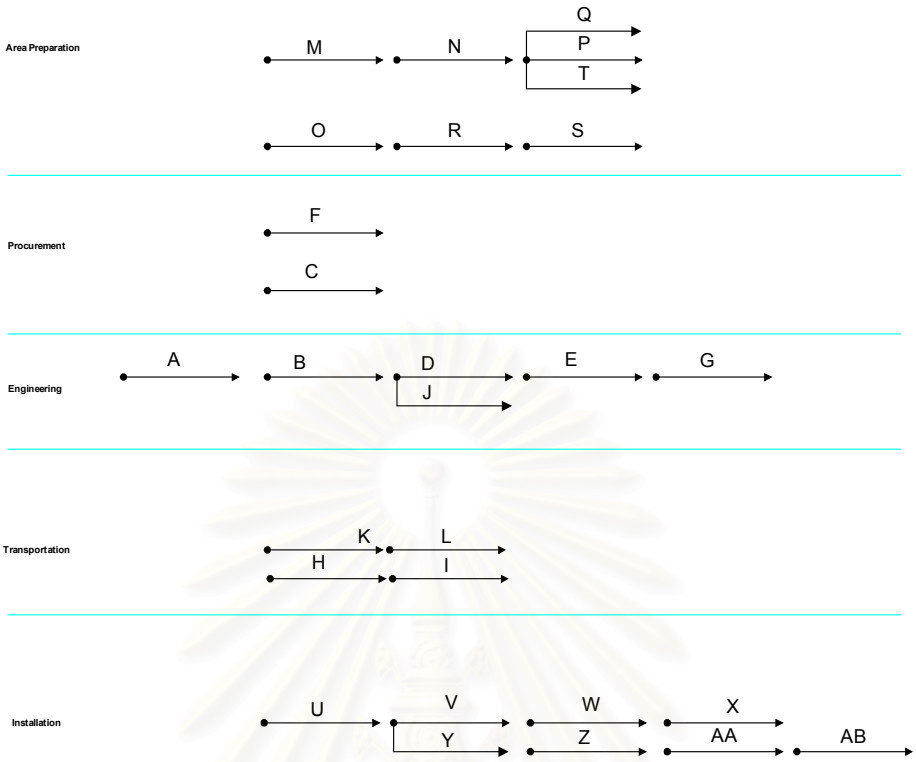


Figure 4-3 The Arrow diagram of the relocation project

The final step of the subdiagrams (Figure4-7) shows the interrelationships of the work among areas of responsibility.

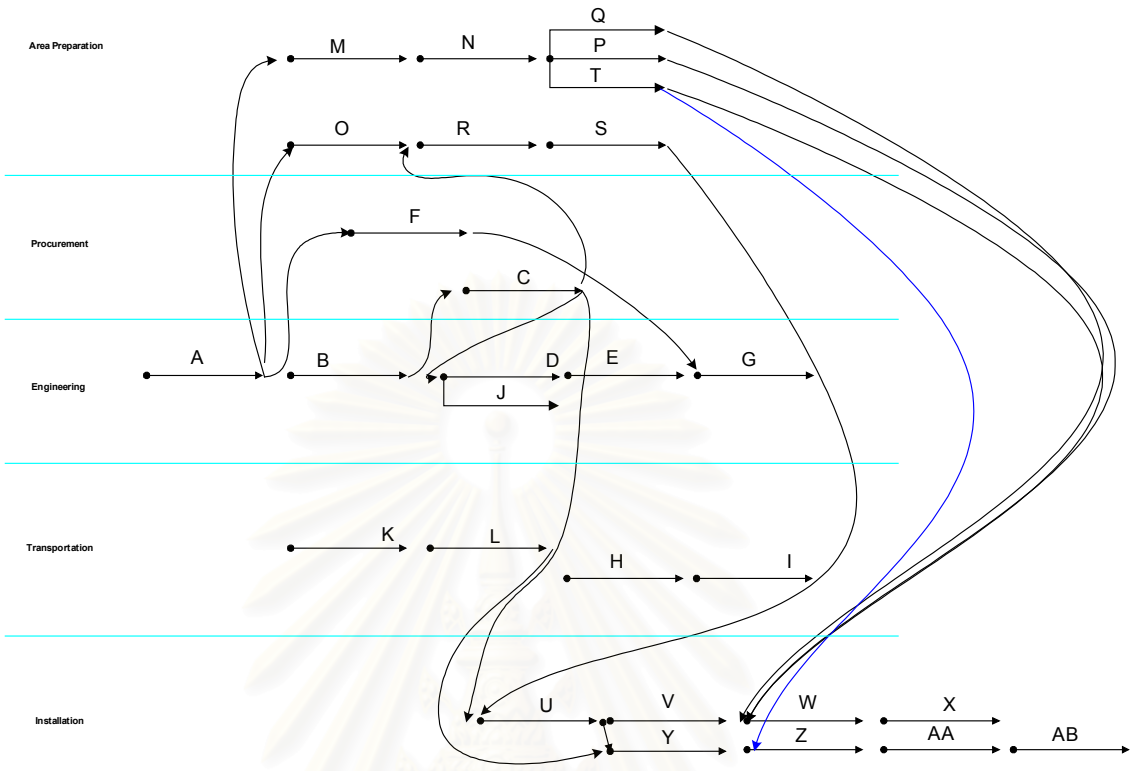


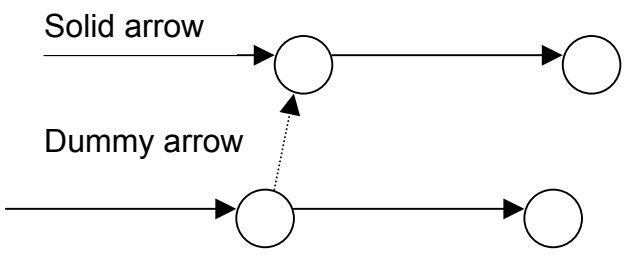
Figure 4-4 Arrow diagram (inter relation) of the relocation project

Arrow Diagramming Rules.

In an arrow diagram, an arrow is used to represent an activity.

The work is assumed to flow in the direction in which the arrow points. It begins at the left end of the arrow and finishes at the right end or head of the arrow.

Two types of arrows are used in diagramming:



1. **Solid** arrows represent activities.
    - The solid arrow represents a job or activity that consumes time (has a duration) and resources.
    - Work is assumed to flow in the direction in which the arrow points.
    - The length can vary (time or duration is not symbolized by the length)
2. **Dummy** arrows show special interrelationships.
    - Dummy arrows are drawn as dashed lines.
    - Dummy arrows do not represent an activity; they have no duration and do not consume any resources.
    - When drawing the diagram, dummy arrows are used as an expedient to separate and identify the major divisions of the project.
    - Dummy arrows are used at times when there may be confusion in identifying activities.

The beginning and ending of each arrow is called a node. A node has the same credential as an event. Nodes are noted as circles on the diagram and are numbered for identification, but are not necessarily numbered in sequence.

Step 7. Develop the project planning (arrow) diagram.

Finally, the project planning diagram is developed showing the relationships of all of the activities(Figure 4-4). IF the intermediate steps are followed, this step is essentially a refinement of the final step of the subdiagrams. By adding the node symbols and the numbering identification, the basic project planning diagram for scheduling purpose is essentially complete.

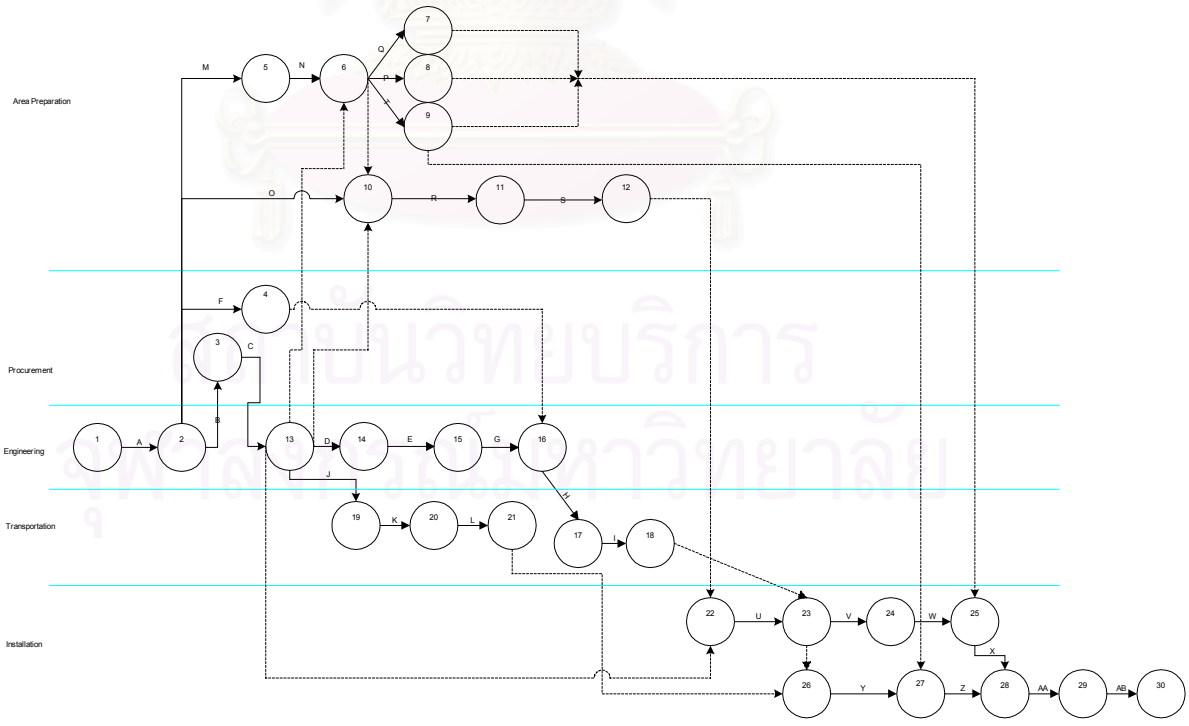


Figure 4-5 The project planning diagram of this project

4.5 Human Resource (Meredith and Mentel Jr., 2000)

When project is initiated, two issues immediately arise. First, a decision has to be made about how to tie the project to the parent firm. Second, a decision has to be made about how to organize the project itself.

Pure Project Organization

The pure project organization is separated from the parent system. It becomes a self-contained unit with its own technical staff, its own administration, tied to the parent firm. Some parent organizations prescribe administrative, financial, personnel, and control procedures in detail. Other allow the project almost total freedom within the limits of financial.

In this project, the human resource can be planned from the detail in figure 4-3 and figure4-6. After analyze the information, the project organization are form as the following figure.

Advantage of pure project organization

1. The project manager has full line authority over the project. Though the project manager report to a senior executive in the parent organization, there is a complete work force devoted to the project. The project manager is like the CEO of a firm that is dedicated tocarrying out the project.
2. All members of the project work force are directly responsible to the PM. There are no functional division heads whose permission must be sought or whose advice must be cared before making technological decisions. The PM is truly the project director.
3. When the project is removed from the functional division, the lines of communication are shortened. The entire functional structure is bypassed, and the PM communicates directly with senior corporate management. The shortened communication lines result in faster communications with fewer failures.
4. The project team that has a strong and separate identity of its own tends to develop a high level of commitment from its member. Motivation is high and acts to foster the task orientation.
5. Pure project organizations are structurally simple and flexible, which makes them relatively easy to understand and to implement.

Project Organization

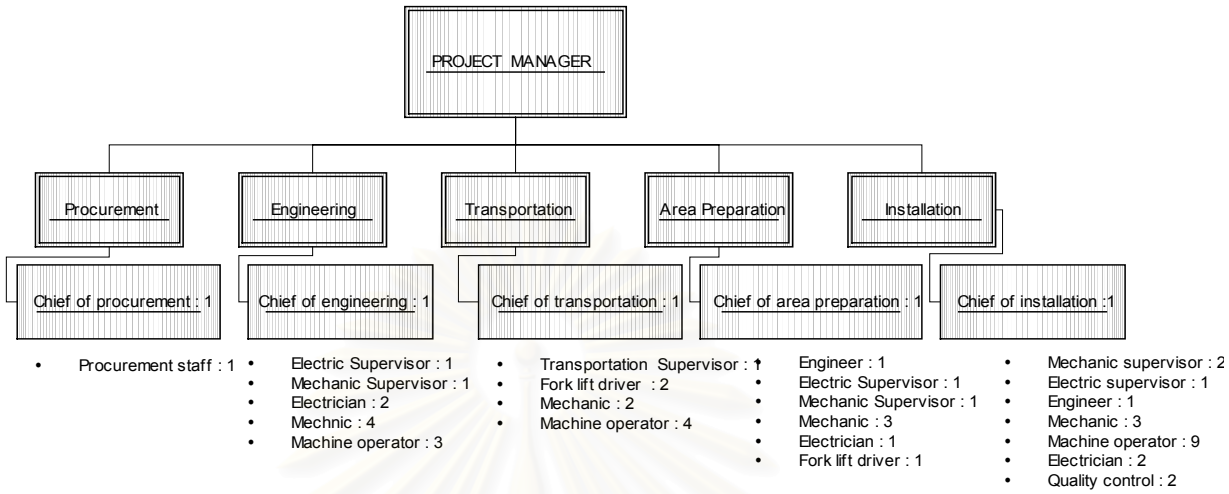


Figure 4-6 The Project organization

4.6 Cost base management

The cost of project gathered from the expense that happened in each activity. In the other hand the cost of resource in each activity is calculation by the computer program. However, the expense from any resource are base on these information.

The number in these information is rounded number to estimate the cost.

Resource	Salary (Baht)
Project manager	45,000
Department manager	36,000
Mechanic/Electric Supervisor, Staff	12,000
Engineer	15,000
Mechanic	8,000
Electrician	8,000
Machine operator/ Quality control	7,000
Fork lift driver	6,000

Table 4-5 The Salary of the internal resource
Source : Average number from Maintenance Department of two plants

The following figure can be used to illustrate the cost/use of the subcontract

Resource	Cost/Use (Baht)
Subcontract 1	15,000
Subcontract 2	460,000
Subcontract 3	180,000
Subcontract 4	4,800,000
Subcontract 5	1,920,000

Table 4-6 The estimated cost of Subcontract based on the time of use
Source : Calculation from the estimation of material price

Subcontract 1 is the hired crane company. It is estimate by interviewing the experience person in the company and the price is insurance included.

The price/ 1 crane /1 time = 5,000 Baht

For the transportation of production line and equipment, it is estimated to use 3 times to complete. Another activity, the transportation of water treatment system is estimated to use 3 time to complete also.

So the cost of Subcontract 1/ usage = 5,000 x 3 = **15,000** Baht

Subcontract 2 is the one who is hired to make the wire way from main distribution board(MDB) and wire rack.

The cost of this subcontract is calculation from the material's price.

The way to know the price of electric material is to calculation the power load from the production line.

There are three main major machine in this production line, which are;

Machine	**Power consumption(Kw)**
Unscramble loader	10
Filler	7.5
Auto packed	15

Calculation the electric current:

$$I = \frac{10KW}{380x0.8x\sqrt{3}} = 19A$$

$$I = \frac{7.5KW}{380x0.8x\sqrt{3}} = 15A$$

$$I = \frac{15KW}{380x0.8x\sqrt{3}} = 30A$$

In the industry the power is 3 phases 330 volts, when we know the electric current we can open the table to select the type of wire that relative to these load.

Assume from the current, use the THW wire type as followings:

Wire Type

THW : L 240 Sq. mm. Length 200M x 3 = 600 M

THW : N 120 Sq. mm. Length 200M x 1 = 200 M

THW : G 70 Sq. mm. Length 200M x 1 = 200 M

Rack Type

In order to the image and easily to maintenance the Wire way should be put on the rack.

Assume the rack is the same type as the old on in plant C which is the standard steel. The following figure can be used to delineate the type of rack.

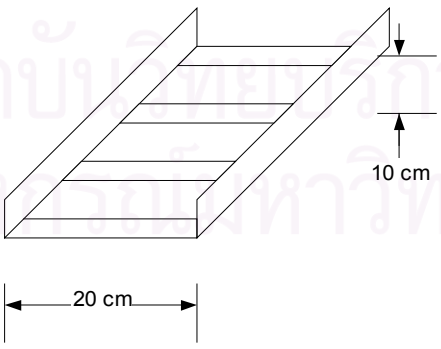


Figure 4-7 Wire Rack picture

The following table is illustrate the price list of wire and rack.

Type	Price (Baht)
Wire : THW 240 Sq. mm.	537 Baht/M
Wire : THW 120 Sq. mm.	242 Baht/M
Wire : THW 70 Sq. mm.	147 Baht/M
Rack : Opened type	300 Baht/M

Table 4-7 Price list of Wire and rack
Source : Maintenance Department of C plant

So the calculations of wire way from MDB and rack making are described as follows:

Wire's price and Rack's price = length(M) x Price(Baht/M)

1. THW : L 240 Sq. mm. Length 200M x 3 = 600 (M) x 537 (B/M) =322,200 Baht
2. THW : N 120 Sq. mm. Length 200M x 1 = 200 (M) x 242 (B/M) =48,400 Baht
3. THW : G 70 Sq. mm. Length 200M x 1 = 200 (M) x 147 (B/M) =29,400 Baht
4. Rack : Steel opened type, Length 200 M = 200 (M) x 300 (B/M) =60,000 Baht

So, the material price of the Subcontract2 equals;

322,200+48,400+30,000+29,400 = **460,000** Baht

Subcontract 3 is the one who is hired to make the electric control cabinet which is use to control the power supply in the production line. It is compose of the Breaker switch for individual machine.

The cost of this subcontract is calculation from the material's price.

From the above information, there are three major machines for each line. So, there are six breaker switches for two production line and one main breaker in the control cabinet.

From the above calculation of the electric current for major machine,

Current for Unscramble loader, filler and auto packed = 19A,15A and 30A

The following figure illustrates the diagram of the control cabinet.

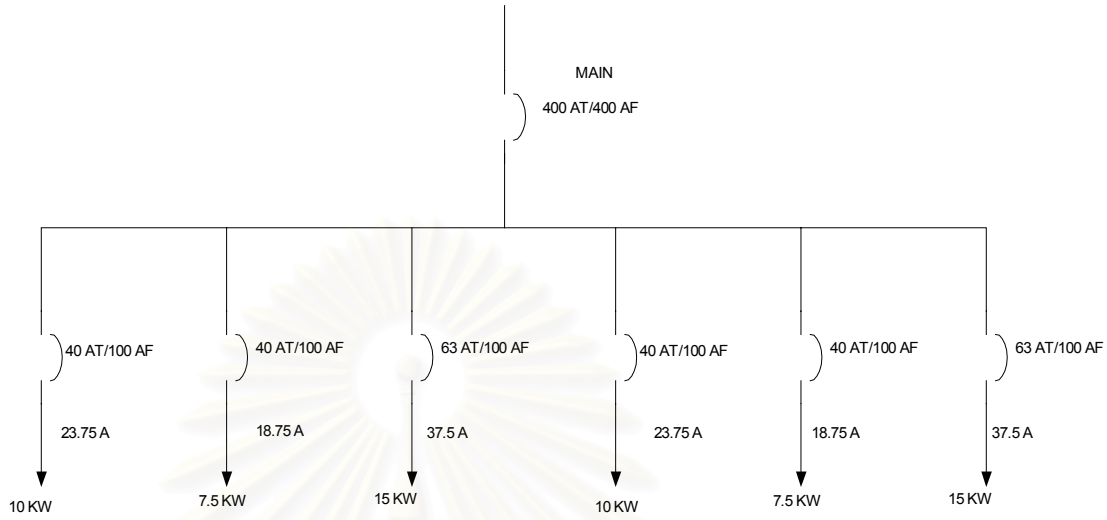


Figure 4-8 The diagram of the breaker switches in the control cabinet

The following figure shows the control cabinet that meet the specific requirement.

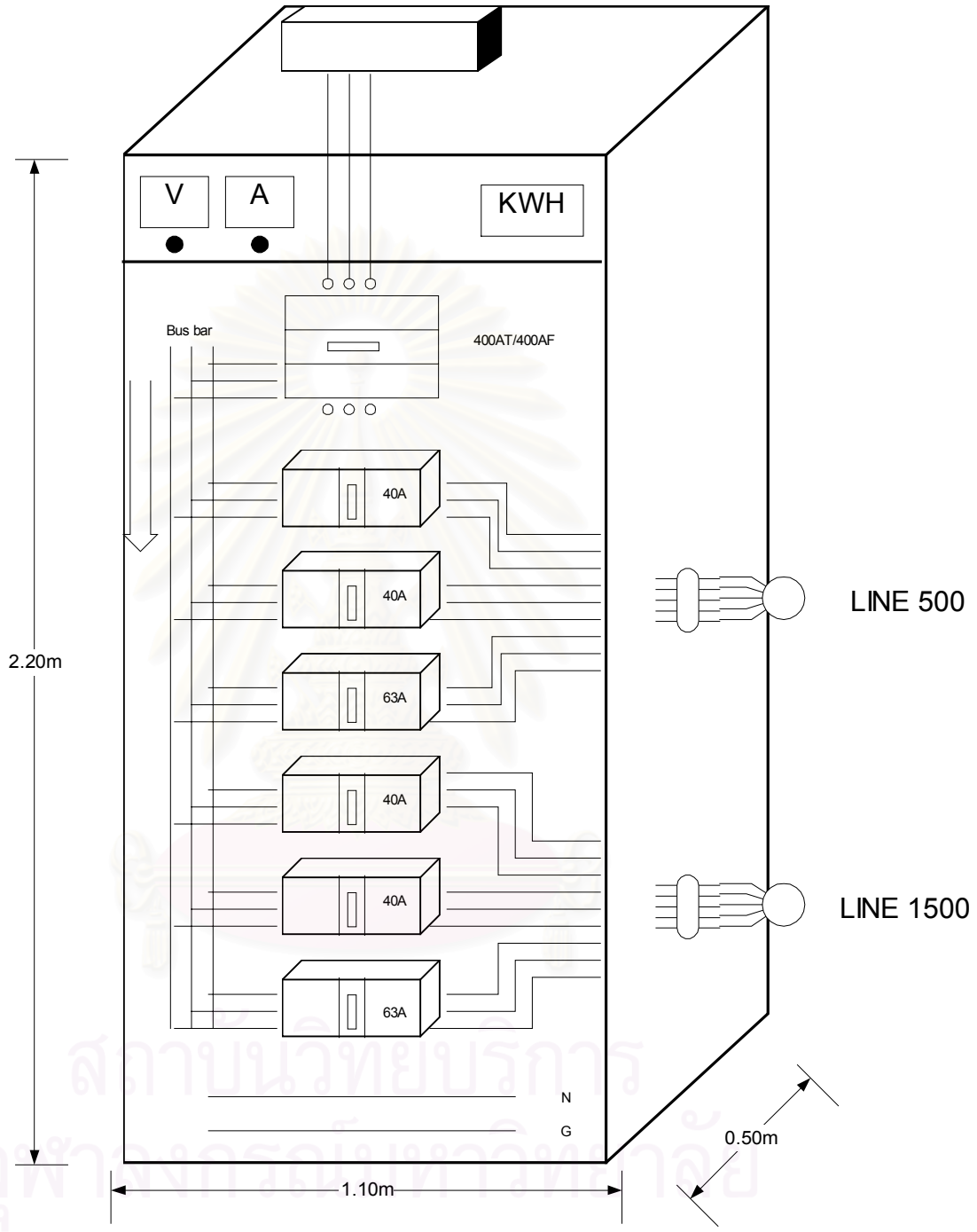


Figure 4-9 The Control cabinet design

From the control cabinet design, the calculation of material's price can be describe as follows:

Items	Unit use	Price(Baht)/Unit
1. Stainless steel cabinet 2.20m x 1.10m x 0.50m	1	50,000
2. Main switch 400AT/400AF	1	30,000
3. Control Breaker 40AT/100AF	4	13,000
4. Control Breaker 63 AT/100 AF	2	17,000
5. Bus bar	20 M	150
6. Wire :THW 240 Sq. mm	11 M	537
7. Volt meter	1	380
8. Amp. meter	1	320
9. Kilowatt meter	1	4,000

Table 4-8 Price list of the control cabinet composition for the two production line
Source : Maintenance Department of C plant

The calculations for the control cabinet composition are shown as follow;

1. Control cabinet = 50,000x1 = 50,000 Baht
2. Main switch = 30,000x1 = 30,000 Baht
3. Control Breaker 40 AT/100AF = 13,000x4 = 52,000 Baht
4. Control Breaker 63 AT/100AF = 17,000x2 = 34,000 Baht
5. Bus bar = 150x 20 = 3,000Baht
6. Wire : THW 240 Sq. mm. = 537x 11 = 5,907 Baht
7. Volt meter = 380x1 = 380 Baht
8. Amp. Meter = 320x1 = 320 Baht
9. Kilowatt meter = 4,000x1 = 4,000 Baht

Therefor, the price of control cabinet composition equals **179,607** Baht

In order to estimate the cost, the number is rounded to **180,000** Baht

Other resource that should be mentioned is the Subcontract 4 .

Subcontract 4 is the one who hired to construct the filling room of production line to protect the contamination when filling product.

From the interview of the previous project manager of filling room construction in plant F, the similar filling room construction, the estimated cost of filling room construction can be described as follows:

Estimated cost of filling room construction is about 10,000 Baht per square metre. In this case the construction area equals 20mx24m

So, the estimated cost of filling room construction equals

10,000 x 20 x 24 = **4,800,000** Baht

Subcontract 5 is the one who hired to make the floor surface of filling room.

From the interview of the previous project manager of floor surface making in plant F, the similar filling room construction, the estimated cost of filling room construction can be described as follows:

Estimated cost of floor surface making is about 4,000 Baht per square metre.

In this case the floor surface area equals 20mx24m

So, the estimated cost of floor surface making equals

4,000 x 20 x 24 = **1,920,000** Baht

Activity T : Piping making from water treatment and air compressor to production line

Due to this activity use the special resource that is the stainless steel pipe, the price of stainless steel pipe should be mentioned. The production process of pure water need the stainless steel 304 to conduct the ozone water because Stainless 304 does not oxidizing with the ozone. There for in plant C the area preparation whose responsible for activity T need to make the new pipe both water pipe and air pipe. The water treatment building is separated from the production building, so the calculation must be divided into two section as following;

Section 1

From water treatment building to the main piping set

Stainless steel pipe length 6 M/ pipe

Estimated unit of pipe 5” around 4 pipes

The price of stainless steel 304: 5” = 8,000 Baht/ pipe

Therefore, the price of pipes 5” is 8,000x 4 = 32,000 Baht

Estimated unit of pipe 3” around 29 pipes

The price of stainless steel 304: 3” = 4,000 Baht/ pipe

Therefore, the price of pipes is 4,000x 29 = 116,000 Baht

Other equipment is estimated around 30 % of the price of pipe, so it equals (116,000+32,000)x0.3 = 44,400 Baht

Therefore, the total price in this section equals

32,000+116,000+44,400 = **192,400** Baht

Section 2

From the main piping set to production line

Water Piping

Estimated unit of pipe around 6 pipes

The price of stainless steel 304: 2” = 3,000 Baht/ pipe

Therefore, the price of pipes is 3,000x 6 = 18,000 Baht

Other equipment is estimated around 60 % of the price of pipe, so it equals 18,000x0.6 = 10,800 Baht

Stainless steel stand cost 2,000 Baht/piece, use 6 pieces, so it equal 12,000 Baht

Therefore, the total price of water pipe equals 18,000+10,800 +12,000= **40,800** Baht

Air piping

The air piping also use **stainless steel 304**. The following table describe the detail of air piping.

Item	Estimated Unit(Pipe)	Unit price(Baht)	Cost(Baht)
1”	2	1,200	2,400
¾”	4	1,000	4,000
½”	1	600	600

Table 4-9 Cost of stainless steel pipe
Source : Maintenance Department of C plant

From the Table 4-9 the cost of stainless steel pipe equal 7,000 Baht

Other equipment is estimated around 60 % of the price of pipe, so it equals 8,800x0.6 = 4,200 Baht

Stainless steel stand cost 2,000 Baht/piece, use 6 pieces, so it equal 12,000 Baht

Therefore, the total price of air piping equals 7,000+4,200 +12,000 = **23,200** Baht

Therefore, the total cost in this section equal 40,800+23,200 = **64,000** Baht

The Total cost of piping material equal 192,400+64,000 **= 256,400** Baht

The price of material is gathering from maintenance department of C plant and round number to estimate the cost.

4.7 Activity Network of the relocation project

From the figure 4-5 and Table 4-3 the activity network of the relocation project are shown as follows:

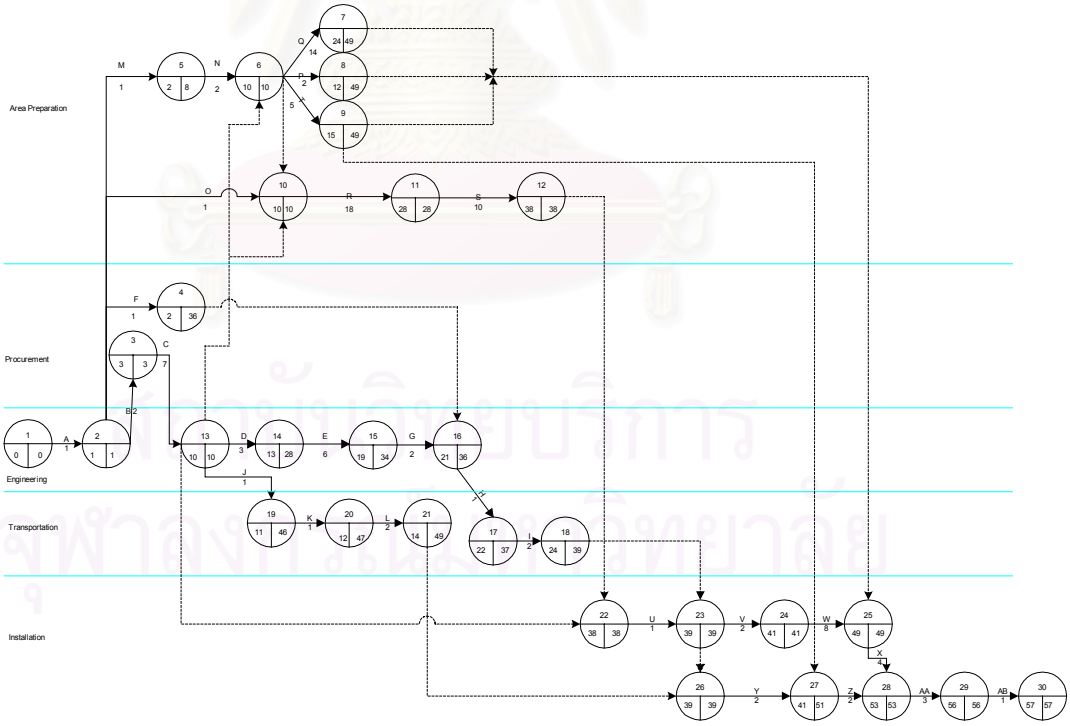


Figure 4-10 The activity network for the relocation project

4.8 Total Float

From the figure 4-19, there are many slack time in individual activity. The following figure illustrate the total float in each activity.

Node	Activity	LF	Duration	ES	TF
1-2	A	1	1	0	0
2-3	B	3	2	1	0
3-13	C	10	7	3	0
13-14	D	28	3	10	15
14-15	E	34	6	13	15
15-16	G	36	2	19	15
16-17	H	37	1	21	15
17-18	I	39	2	22	15
18-23	-	39	0	24	15
23-26	-	49	0	39	10
26-27	Y	51	2	39	10
27-28	Z	53	2	41	10
28-29	AA	56	3	53	0
29-30	AB	57	1	56	0
2-4	F	36	1	1	34
4-16	-	36	0	2	34
2-10	O	10	1	1	8
10-11	R	28	18	10	0
11-12	S	38	10	28	0
12-22	-	38	0	38	0
22-23	U	39	1	38	0
23-24	V	41	2	39	0
24-25	W	49	8	41	0
25-28	X	53	4	49	0
13-22	-	38	0	10	28
13-10	-	10	0	10	0

Table 4-10 The total float in individual activity

4.9 Critical path method

From figure 4-10, the number 0 present that there are no slack time in that path so we can mark the activity which has TF = 0 in the figure 4-10 with the red line. This can be called critical path of the project. The following figure illustrates the critical path of the project.

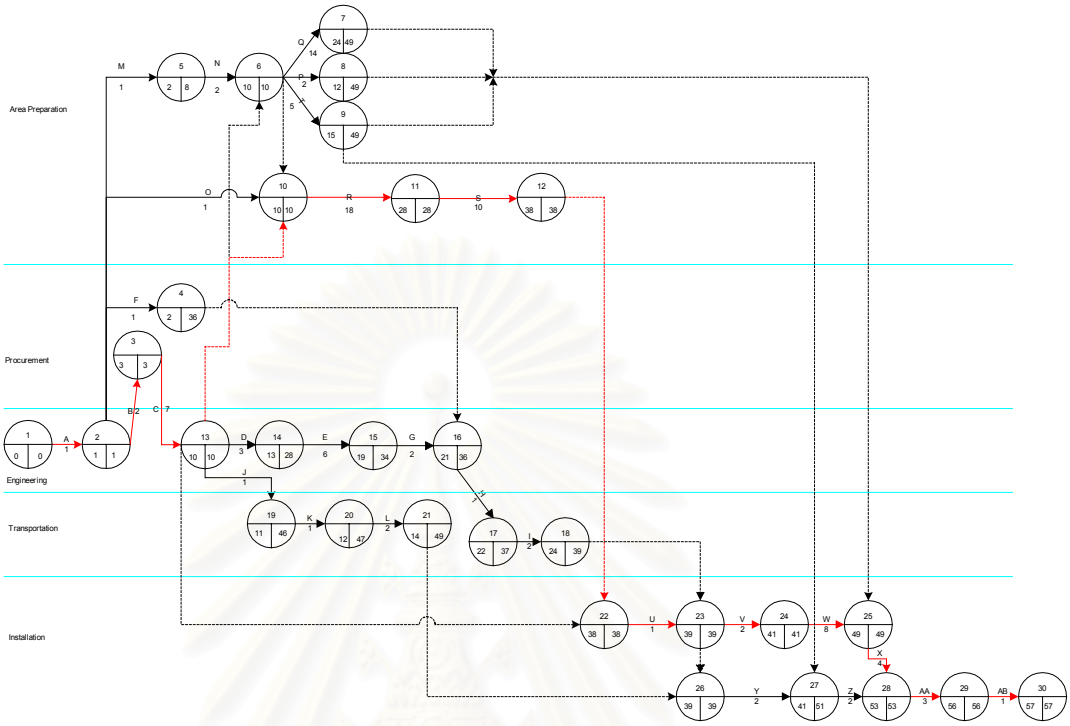


Figure 4-11 The Critical Path of the project

4.10 Gantt chart of the project before leveling

The following figure illustrate the scheduling and human resource of the project by Microsoft project computer program.

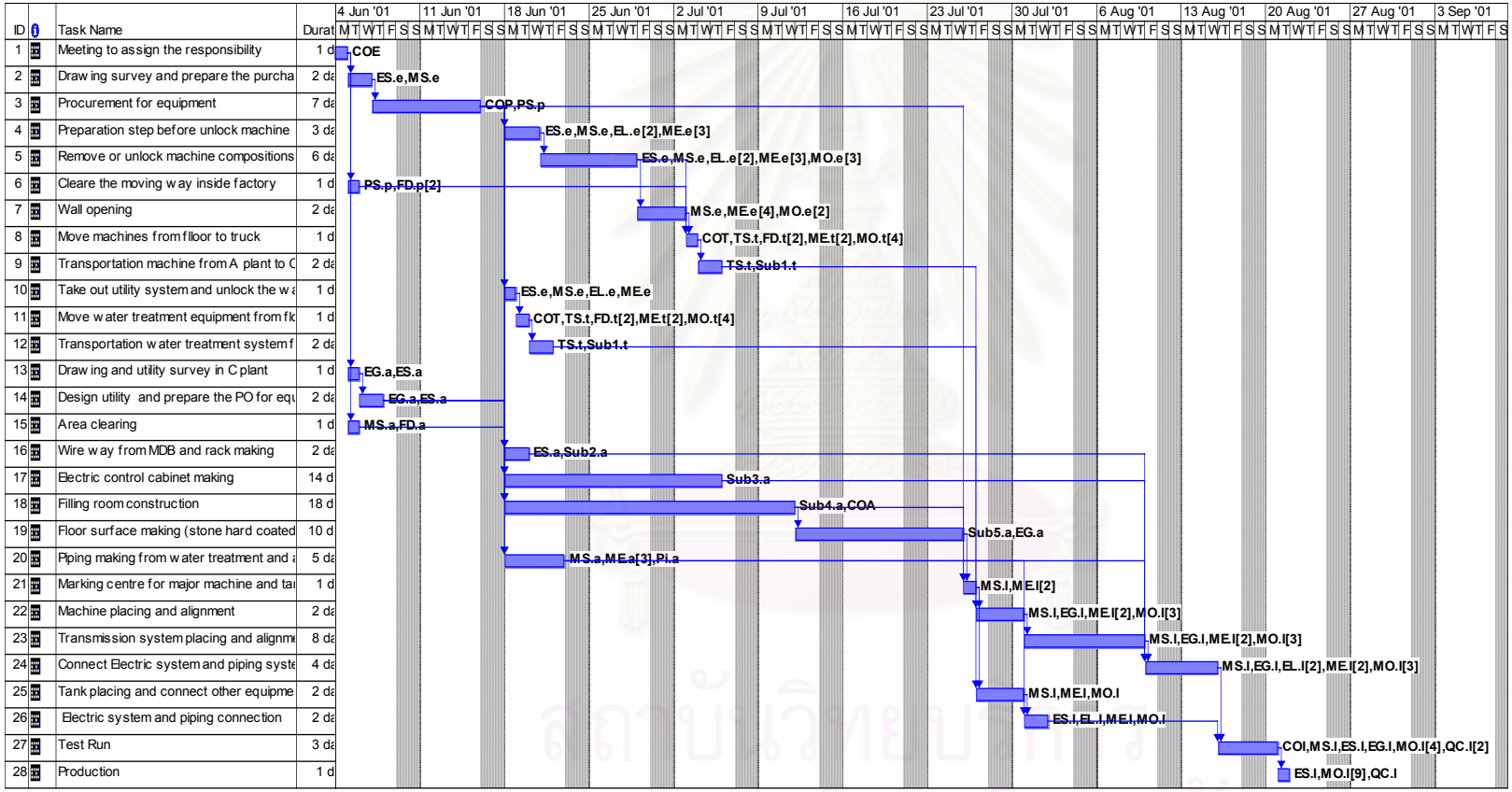


Figure 4-12 The schedule of this project

Human resource

ID	Resource Name	Initials	Group	Max. Units	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Bas
1	COE	Chief of Engineering	Engineering	1	ß1,636.00/day	ß2,455.00/day	ß0.00	Prorated	Star
2	ES.e	Elecctric Supervisor in Engineering	Engineering	2	ß545.00/day	ß818.00/day	ß0.00	Prorated	Star
3	MS.e	Mechanic Supervisor in Engineering	Engineering	2	ß545.00/day	ß818.00/day	ß0.00	Prorated	Star
4	COP	Chief of Procurement	Procurement	1	ß1,636.00/day	ß2,455.00/day	ß0.00	Prorated	Star
5	PS.p	Procurement Staff	Procurement	1	ß545.00/day	ß818.00/day	ß0.00	Prorated	Star
6	EL.e	Electrician	Engineering	3	ß364.00/day	ß545.00/day	ß0.00	Prorated	Star
7	ME.e	Mechanic	Engineering	4	ß364.00/day	ß545.00/day	ß0.00	Prorated	Star
8	MO.e	Machine Operator	Engineering	3	ß318.00/day	ß477.00/day	ß0.00	Prorated	Star
9	FD.p	Fork lift Driver	Procurement	2	ß273.00/day	ß409.00/day	ß0.00	Prorated	Star
10	COT	Chief of Transportation	Transportation	1	ß1,636.00/day	ß2,455.00/day	ß0.00	Prorated	Star
11	TS.t	Transportation Supervisor	Transportation	1	ß545.00/day	ß818.00/day	ß0.00	Prorated	Star
12	FD.t	Fork lift Driver	Transportation	2	ß273.00/day	ß409.00/day	ß0.00	Prorated	Star
13	ME.t	Mechanic	Transportation	2	ß364.00/day	ß545.00/day	ß0.00	Prorated	Star
14	MO.t	Machine Operator	Transportation	4	ß318.00/day	ß477.00/day	ß0.00	Prorated	Star
15	Sub1.t	Subcontract1	Transportation	1	ß0.00/hr	ß0.00/hr	ß15,000.00	End	Star
16	COA	Chief of Area Preparation	Area Preparation	1	ß1,636.00/day	ß2,455.00/day	ß0.00	Prorated	Star
17	EG.a	Engineer	Area Preparation	1	ß682.00/day	ß1,023.00/day	ß0.00	Prorated	Star
18	ES.a	Elecctric Supervisor in Area Preparation	Area Preparation	1	ß545.00/day	ß818.00/day	ß0.00	Prorated	Star
19	MS.a	Mechanic Supervisor in Area Preparation	Area Preparation	1	ß545.00/day	ß818.00/day	ß0.00	Prorated	Star
20	ME.a	Mechanic	Area Preparation	3	ß364.00/day	ß545.00/day	ß0.00	Prorated	Star
21	EL.a	Electrician	Area Preparation	1	ß364.00/day	ß545.00/day	ß0.00	Prorated	Star
22	FD.a	Fork lift Driver	Area Preparation	1	ß273.00/day	ß409.00/day	ß0.00	Prorated	Star
23	Sub2.a	Subcontract2	Area Preparation	1	ß0.00/hr	ß0.00/hr	ß460,000.00	End	Star
24	Sub3.a	Subcontract3	Area Preparation	1	ß0.00/hr	ß0.00/hr	ß180,000.00	End	Star
25	Sub4.a	Subcontract4	Area Preparation	1	ß0.00/hr	ß0.00/hr	ß4,800,000.00	End	Star
26	Sub5.a	Subcontract5	Area Preparation	1	ß0.00/hr	ß0.00/hr	ß1,920,000.00	End	Star
27	Pi.a	Pipe	Area Preparation	1	ß0.00/hr	ß0.00/hr	ß256,400.00	End	Star
28	COI	Chief of Installation	Installation	1	ß1,636.00/day	ß2,455.00/day	ß0.00	Prorated	Star
29	MS.I	Mechanic Supervisor in Installation	Installation	2	ß545.00/day	ß818.00/day	ß0.00	Prorated	Star
30	ES.I	Elecctric Supervisor in Installation	Installation	1	ß545.00/day	ß818.00/day	ß0.00	Prorated	Star
31	EG.I	Engineer	Installation	1	ß682.00/day	ß1,023.00/day	ß0.00	Prorated	Star
32	ME.I	Mechanic	Installation	3	ß364.00/day	ß545.00/day	ß0.00	Prorated	Star
33	MO.I	Machine Operator	Installation	9	ß318.00/day	ß477.00/day	ß0.00	Prorated	Star
34	EL.I	Electrician	Installation	2	ß364.00/day	ß545.00/day	ß0.00	Prorated	Star
35	QC.I	Quality control	Installation	2	ß318.00/day	ß477.00/day	ß0.00	Prorated	Star

Figure 4-13 Human resource of this project

Assignment of human resources in each activity

1. Meeting to assign the responsibility

This activity requires only one person to direct the first meeting of this project. The chief of engineering responsible for this activity because he is one of the most important persons in this project. In general, chief of engineering knows about all steps to process the project and he will distribute the responsibility to involved departments. However, the chief of engineering requires many hours to plan for meeting because it begin with project concept, project organization setting, assign the responsibility. So, we assume this activity require 8 hours or 1 day to complete.

2. Drawing survey and prepare the purchase order for equipment

This activity requires two persons to survey drawing of plant layout and production lines layout if they are not complete, these persons should prepare new drawings for this project. This activity requires the person who knows about the electric system in A plant, so the electric supervisor is suitable for this activity. Another person is the one who know about the mechanic of both production lines and the water treatment system in water treatment room, so the mechanic supervisor is suitable. Each person requires about 16 hours or 2 days to complete this activity. This time include the estimation of tools and equipment for the engineering department and prepare the purchase order for equipment to the procurement department.

3. Procurement for equipment

This activity requires two persons to arrange the purchase order for the other departments. The procurement staff responsible for processing the documentation of each purchase order and communication between the department and outside suppliers or subcontracts. The chief of procurement responsible for dealing the price of the subcontracts that meets the specification in purchase order of each department. This activity requires 56 hours or 7 days after receiving purchase order from other department until receiving equipment from suppliers. Otherwise, the subcontract's name will be set up.

4. Preparation step before unlock machine

This activity can be described in terms of take out electric system and take out water and air system. It requires the person who know about the electric system, so two electricians are required to help each other when one of them work the complicated tasks such as peel off the wire and switch on-off the main breaker of electric system. Because this activity is dangerous so, the electric supervisors is required to control the electricians. Another task is take off the water and air system required three mechanics to help each other because water and air system in the production lines are labor needed and required the mechanic skill so, the mechanic supervisor is needed to control the mechanics. This activity requires 24 hours or 3 days to complete for two production lines.

5. Remove or Unlock the machine compositions and classify in each set

This activity requires many persons to complete because it needs both technical skill and labor to handle the heavy parts. This activity requires the person who knows about the electric circuit, so two electricians are required to help each other when one of them work the complicated tasks. Because this activity is dangerous so, the electric supervisors is required to control the electricians. This main task is unlock machine's compositions so, it requires three mechanics to help each other such as remove nut and bolts at joint of machine's parts before classify in each set. Moreover, it requires three machine operators to help each other handle with the heavy and large size parts of machine. So, the mechanic supervisor is needed to control the mechanics and machine operators. This activity requires 48 hours or 6 days to complete for two production lines.

6. Clear the moving way inside factory

Due to the way to move machine to the truck is use to place finished goods, two fork lift drivers are needed to clear that way. Procurement staff required to control the fork lift driver to work correctly on time schedule. This activity requires 8 hours or 1 day to complete.

7. Wall openning

In order to move machine to trucks, project team need to open the filling room's wall. This activity involve in mechanic skill, so it need four mechanics and two machine operators to handle the canvas and demolish the marked wall. This activity require 16 hours or 2 days to complete.

8. Move machine from floor to trucks

This activity involve in mechanic skill, so, it require two mechanics, four machine operators and two fork lift drivers to lift the classified parts of machine. The transportation supervisor is required to control the mechanics and machine operators and coordinate between the project team member. The chief of transportation is required for responsibility of moving machine and coordinate between project team and subcontract 1. This activity require 8 hours or 1 day to complete.

9. Transportation machine from plant A to plant C

This activity requires transportation supervisor to responsible for transport machine from A plant to C plant while hire the subcontract to transport the machine. This activity requires 16 hours or 2 days to complete.

10. Take out utility system and unlock the water treatment equipment

This activity require one electrician to take of the electric system in water treatment room and it require electric supervisor to control the electrician. This activity requires one mechanic to take off the air system and unlock the water treatment equipment to

ready to move. It require mechanic supervisor to control the mechanic. This activity requires 8 hours or 1 day to complete.

11. Move water treatment equipment from floor to trucks

This activity involve in mechanic skill, so, it require two mechanics, four machine operators and two fork lift drivers to lift the water treatment equipment. The transportation supervisor is required to control the mechanics and machine operators and coordinate between the project team member. The chief of transportation is required for responsibility of water treatment equipment and coordinate between project team and subcontract 1. This activity requires 8 hours or 1 day to complete.

12. Transportation water treatment system from plant A to plant C

This activity requires transportation supervisor to responsible for transport water treatment system from A plant to C plant while hire the subcontract to transport the water treatment system. This activity requires 16 hours or 2 days to complete.

13. Drawing and Utility survey in C plant

This activity require two persons who know about the utility of C plant which are electric system and mechanic include that they should design the required utility for the new production line in C plant. So, engineer and electric supervisor to complete within 8 hours or1 day.

14. Design utility and prepare the purchase order for equipment

This activity is consecutively from Activity number 13, engineer and electric supervisor are required to complete this activity within 16 hours or 2 days.

15. Area clearing

This activity require fork lift driver to clear the area of production line position because this place is use to place the finished goods. The mechanic supervisor is required to control the forklift driver to clear the way to transport machine from the entrance of factory to the production line position. This activity require 8 hours or 1 day to complete.

16. Wire way from MDB and rack making

Due to the electric job is dangerous, we decide to hire the subcontract 2 to make wire way and rack. This activity require electric supervisor to coordinate with subcontract and require 16 hours or 2 days to complete.

17. Electric control cabinet making

As mention previously, the electric job is dangerous, we decide to hire subcontract 3 to make the electric control cabinet by giving it the specification. This cabinet require 112 hours or 14 day to complete.

18. Filling room construction

We decide to hire subcontract 4 to construct the filling room. However, the chief of area preparation is required for coordinating and making decision if there are some problems. This activity require 144 hours or 18 days to complete.

19. Floor surface making (Stone-hard)

We decide to hire the subcontract 5 to coat the floor surface with stone-hard. Stone hard has the specific properties which are easy to maintenance, acid and alkali resistance, hard and non-slip. This activity require 80 hours or ten days to complete and it require engineer to coordinate between project team and subcontract.

20. Piping making from water treatment and air compressor to production line

This activity need the person who have mechanic skill. So, three mechanics is requires to help each other when they do the labor work such as lift or cut pipes. The mechanic supervisor is required to control and suggest these mechanics to complete this activity within 40 hours or 5 days.

21. Marking centre for major machines and tanks

This activity require mechanic skill which is the knowledge about the drawing of production lines and the water treatment equipment. This activity require two mechanics to complete and the mechanic supervisor is required to control these mechanics. This activity require 8 hours to complete.

22. Machines placing and alignment

This activity require the person who have mechanical skill because this activity is one of the most important steps in this project. Therefor, two mechanics and three machine operator are required to place and align machine. Engineer and mechanic supervisor are require to suggest and control this activity to complete within 8 hours or 2 days.

23. Transmission system placing and alignment

This activity is consecutively from the activity number 22. So, the persons in this activity is the same as the above activity. This activity require 64 hours or 8 days to complete.

24. Connect electric system and piping system to the production line

This activity is consecutively from the activity number 23. So, the persons in this activity is the same as the above activity and plus two electrician to connect the electric system. This activity require 32 hours or 4 days to complete.

25. Tank placing and connect the other equipment

This activity requires one mechanic and one machine operator to complete. The mechanic supervisor is required to control and suggest the mechanic and machine operator. This activity require 16 hours or 2 days to complete.

26. Electric system and piping connection

This activity is consecutively from the activity number 25 but this activity require the electric skill. So, it require one electrician, one mechanic and one machine operator. The electric supervisor is required to control this activity. This activity require 16 hours or 2 days to complete.

27. Test Run

This activity is one of the most important steps in this project, there are four machine operators and 2 quality control to test run the production line. The chief of installation, mechanic supervisor, electric supervisor and engineer are needed to observe and control this activity. If there are some problem, they are required to making the decision. This activity require 24 hours or 3 days to complete.

28. Production

This last activity requires nine machine operators and one quality control. The electric supervisor is required to control the production and if there are some problem, he will coordinate with the other persons immediately. This activity require 8 hours or 1 day to complete.

Assumption for cost estimation

When we assign resource in each activity, the cost estimation cal be calculate by the salary of the human resource and cost based management. The following lines will present the example of method to calculate the cost of activity.

Activity 1 Meeting to assign the responsibility

This activity has only one person which is the chief of engineering. From cost base management, the salary of department manager equals 36,000 Baht.

So, the salary of chief of engineering equals 36,000 Baht.

Assume that working day per month equals 22 days.

The cost per day of this resource equals 36,000 / 22 = 1,636.36 Baht/day

This activity require 1 day to complete

If we round the number then 1,636.36 will be **1,636** Baht.

Activity 2 Drawing survey and prepare the purchase order for equipment

This activity require 2 persons which are electric supervisor and mechanic supervisor. From cost base management, the salary of mechanic and electric supervisors are the same which equal 12,000 Baht. The following line will present for each person :

The mechanic supervisor's salary equal 12,000 Baht

Assume working day per month equal 22 Days

The cost per day of this resource equals 12,000 / 22 = 545.45 Baht/day

If we round the number then 545.45 will be 545 Baht.

This activity require 2 day to complete

So, the cost of mechanic supervisor in this activity equal 545 x 2 = 1,090 Baht

However, the method to calculate for electric supervisor is as same as mechanic supervisor.

It can be concluded that the cost of this activity equal 1,090 x 2 = **2,180** Baht

The following table will illustrate the cost of each activity for this project, which compute from the cost base management topic.

Cash Flow of project before leveling (Baht)

	4/6/01	11/6/01	18/6/01	25/6/01	2/7/01	9/7/01	16/7/01	23/7/01	30/7/01	6/8/01	13/8/01	20/8/01	Total
Meeting to assign the responsibility	1,636.00												1,636.00
Drawing survey and prepare the purchase order for equipment	2,180.00												2,180.00
Procurement for equipment	4,362.00	10,905.00											15,267.00
Preparation step before unlock the machines			5,454.00										5,454.00
Remove or Unlock the machine compositions and classify in each set			7,728.00	15,456.00									23,184.00
Clear the moving way inside factory	1,091.00												1,091.00
Wall openning				2,637.00	2,637.00								5,274.00
Move machines from floor to trucks					4,727.00								4,727.00
Transportation machine from plant A to plant C					16,090.00								16,090.00
Take out the utility system and unlock the water treatment equipment			1,818.00										1,818.00
Move water treatment equipment from floor to trucks			4,727.00										4,727.00
Transportation water treatment system from plant A to plant C			16,090.00										16,090.00
Drawing and Utility survey in C plant	1,227.00												1,227.00
Design utility and prepare the purchase order for equipment	2,454.00												2,454.00
Area clearing	818.00												818.00
Wire way from MDB and rack making			461,090.00										461,090.00
Electric control cabinet making					180,000.00								180,000.00
Filling room construction			8,180.00	8,180.00	8,180.00	4,804,908.00							4,829,448.00
Floor surface making(Stone-hard)						1,364.00	3,410.00	1,922,046.00					1,926,820.00
Piping making from water treatment and air compressor to production line			264,585.00										264,585.00
Marking centre for major machines and tanks								1,273.00					1,273.00
Machines placing and alignment								2,909.00	2,909.00				5,818.00
Transmission system placing and alignment									11,636.00	11,636.00			23,272.00
Connect electric system and piping system to the production line										3,637.00	10,911.00		14,548.00
Tank placing and connect the other equipment								1,227.00	1,227.00				2,454.00
Electric system and piping connection									3,182.00				3,182.00
Test Run											10,632.00	5,316.00	15,948.00
Production												3,725.00	3,725.00
Total	13,768.00	10,905.00	769,672.00	26,273.00	211,634.00	4,806,272.00	3,410.00	1,927,455.00	18,954.00	15,273.00	21,543.00	9,041.00	7,834,200.00

Table 4-11 Cash flow of this project before leveling

Conclusion of the plan before leveling

The first plan before resource leveling can be described as follows:

1. There are 28 activities in the plan.

2. Critical path are illustrated by the following figure :

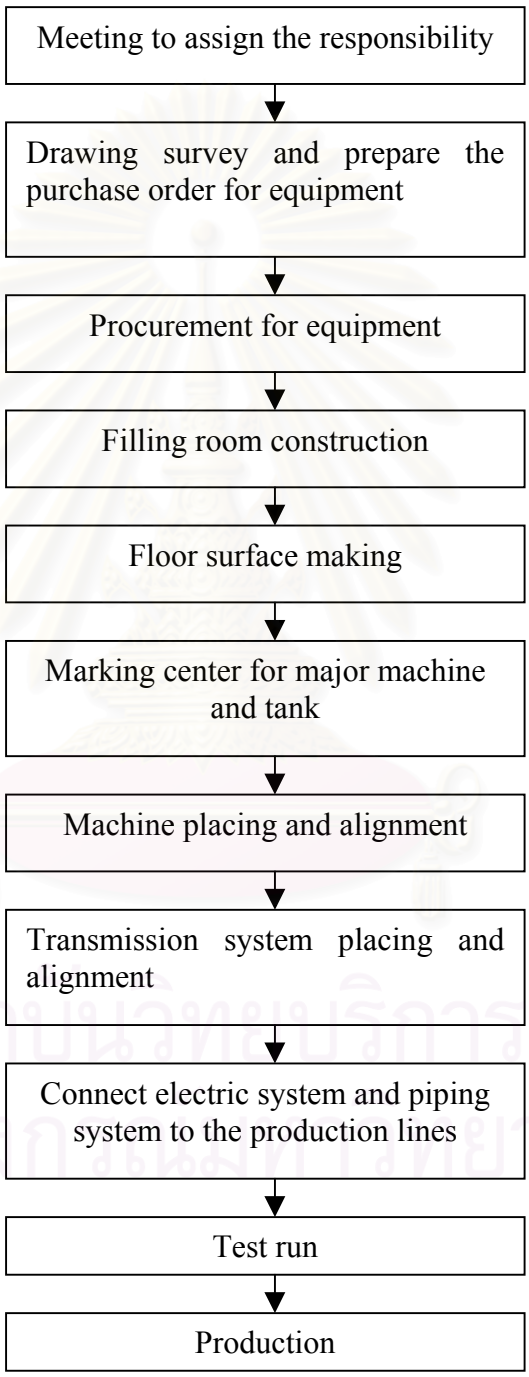


Figure 4- 14 Critical path of the project before leveling

3. This project take 57 day to complete.
4. There are 65 persons involve in this project which are:
    - Engineering = 15 persons
    - Procurement = 4 persons
    - Transportation = 11 persons
    - Area preparation = 14 persons
    - Installation = 21 persons

5. This project consumes 7,834,200 Baht to complete. Cost can be divided into 12 weeks as followings:

Week	Baht
1	13,768
2	10,905
3	769,672
4	26,273
5	211,634
6	4,806,272
7	3,410
8	1,927,455
9	18,954
10	15,273
11	21,543
12	9,041

Table 4-12 Cost allocation into 12 weeks for relocation project before leveling

4.11 Leveling

Microsoft project computer program can assist the planner to level the abundant resource by calculating the float time and total man power.

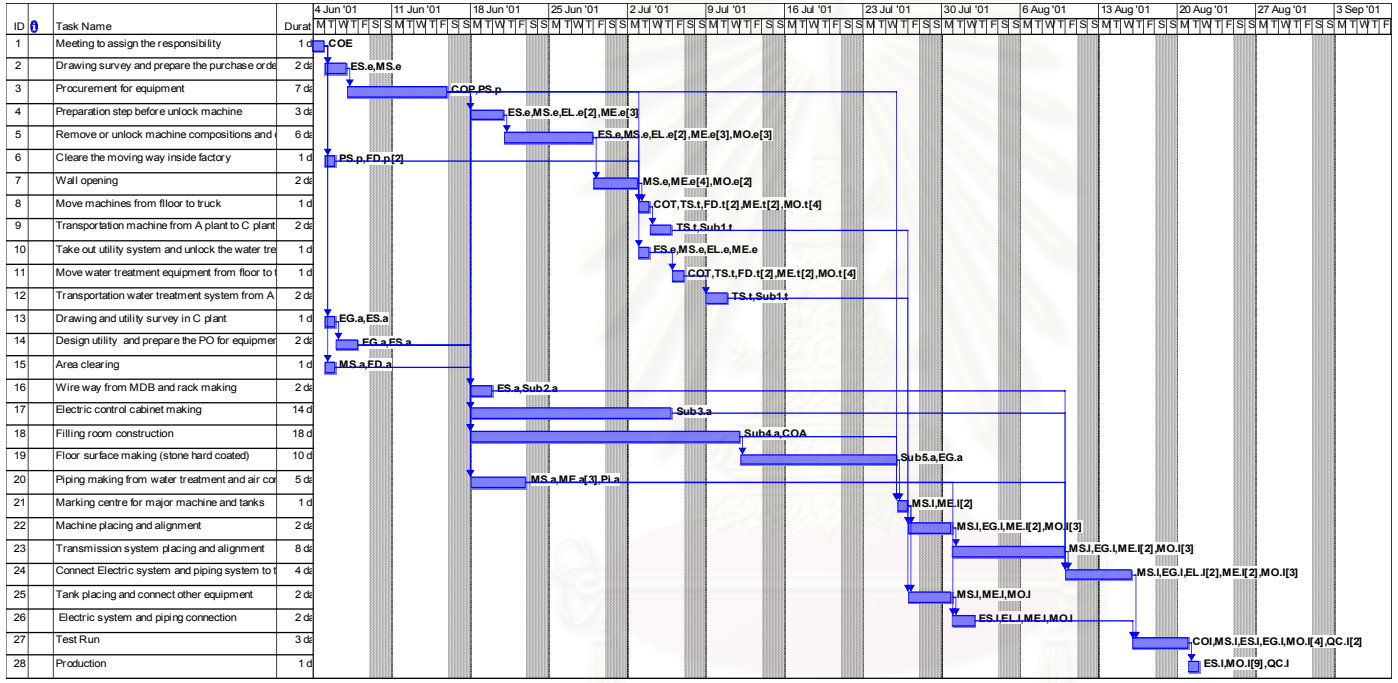


Figure 4-15 Gantt chart of project after resource leveling

Human Resource

The following figure show the human resource that can reduce three person which are ES.e, MS.e and EL.e.

ID	Resource Name	Initials	Group	Max. Units	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Base Calendar	Code
1	COE	Chief of Engineering	Engineering	1	฿1,636.00/day	฿2,455.00/day	฿0.00	Prorated	Standard	
2	ES.e	Elecctric Supervisor in	Engineering	1	฿545.00/day	฿818.00/day	฿0.00	Prorated	Standard	
3	MS.e	Mechanic Supervisor i	Engineering	1	฿545.00/day	฿818.00/day	฿0.00	Prorated	Standard	
4	COP	Chief of Procurement	Procurement	1	฿1,636.00/day	฿2,455.00/day	฿0.00	Prorated	Standard	
5	PS.p	Procurement Staff	Procurement	1	฿545.00/day	฿818.00/day	฿0.00	Prorated	Standard	
6	EL.e	Electrician	Engineering	2	฿364.00/day	฿545.00/day	฿0.00	Prorated	Standard	
7	ME.e	Mechanic	Engineering	4	฿364.00/day	฿545.00/day	฿0.00	Prorated	Standard	
8	MO.e	Machine Operator	Engineering	3	฿318.00/day	฿477.00/day	฿0.00	Prorated	Standard	
9	FD.p	Fork lift Driver	Procurement	2	฿273.00/day	฿409.00/day	฿0.00	Prorated	Standard	
10	COT	Chief of Transportation	Transportation	1	฿1,636.00/day	฿2,455.00/day	฿0.00	Prorated	Standard	
11	TS.t	Transportation Supervi	Transportation	1	฿545.00/day	฿818.00/day	฿0.00	Prorated	Standard	
12	FD.t	Fork lift Driver	Transportation	2	฿273.00/day	฿409.00/day	฿0.00	Prorated	Standard	
13	ME.t	Mechanic	Transportation	2	฿364.00/day	฿545.00/day	฿0.00	Prorated	Standard	
14	MO.t	Machine Operator	Transportation	4	฿318.00/day	฿477.00/day	฿0.00	Prorated	Standard	
15	Sub1.t	Subcontract1	Transportation	1	฿0.00/hr	฿0.00/hr	฿15,000.00	End	Standard	
16	COA	Chief of Area Preparati	Area Preparatio	1	฿1,636.00/day	฿2,455.00/day	฿0.00	Prorated	Standard	
17	EG.a	Engineer	Area Preparatio	1	฿682.00/day	฿1,023.00/day	฿0.00	Prorated	Standard	
18	ES.a	Elecctric Supervisor in	Area Preparatio	1	฿545.00/day	฿818.00/day	฿0.00	Prorated	Standard	
19	MS.a	Mechanic Supervisor i	Area Preparatio	1	฿545.00/day	฿818.00/day	฿0.00	Prorated	Standard	
20	ME.a	Mechanic	Area Preparatio	3	฿364.00/day	฿545.00/day	฿0.00	Prorated	Standard	
21	EL.a	Electrician	Area Preparatio	1	฿364.00/day	฿545.00/day	฿0.00	Prorated	Standard	
22	FD.a	Fork lift Driver	Area Preparatio	1	฿273.00/day	฿409.00/day	฿0.00	Prorated	Standard	
23	Sub2.a	Subcontract2	Area Preparatio	1	฿0.00/hr	฿0.00/hr	฿460,000.00	End	Standard	
24	Sub3.a	Subcontract3	Area Preparatio	1	฿0.00/hr	฿0.00/hr	฿180,000.00	End	Standard	
25	Sub4.a	Subcontract4	Area Preparatio	1	฿0.00/hr	฿0.00/hr	฿4,800,000.00	End	Standard	
26	Sub5.a	Subcontract5	Area Preparatio	1	฿0.00/hr	฿0.00/hr	฿1,920,000.00	End	Standard	
27	Pi.a	Pipe	Area Preparatio	1	฿0.00/hr	฿0.00/hr	฿256,400.00	End	Standard	
28	COI	Chief of Installation	Installation	1	฿1,636.00/day	฿2,455.00/day	฿0.00	Prorated	Standard	
29	MS.I	Mechanic Supervisor i	Installation	2	฿545.00/day	฿818.00/day	฿0.00	Prorated	Standard	
30	ES.I	Elecctric Supervisor in	Installation	1	฿545.00/day	฿818.00/day	฿0.00	Prorated	Standard	
31	EG.I	Engineer	Installation	1	฿682.00/day	฿1,023.00/day	฿0.00	Prorated	Standard	
32	ME.I	Mechanic	Installation	3	฿364.00/day	฿545.00/day	฿0.00	Prorated	Standard	
33	MO.I	Machine Operator	Installation	9	฿318.00/day	฿477.00/day	฿0.00	Prorated	Standard	
34	EL.I	Electrician	Installation	2	฿364.00/day	฿545.00/day	฿0.00	Prorated	Standard	
35	QC.I	Quality control	Installation	2	฿318.00/day	฿477.00/day	฿0.00	Prorated	Standard	

Figure 4-16 Human Resource of the project after resource leveling

Cash Flow of project after leveling (Baht)

	4/6/01	11/6/01	18/6/01	25/6/01	2/7/01	9/7/01	16/7/01	23/7/01	30/7/01	6/8/01	13/8/01	20/8/01	Total
Meeting to assign the responsibility	1,636.00												1,636.00
Drawing survey and prepare the purchase order for equipment	2,180.00												2,180.00
Procurement for equipment	4,362.00	10,905.00											15,267.00
Preparation step before unlock the machines			5,454.00										5,454.00
Remove or Unlock the machine compositions and classify in each set			7,728.00	15,456.00									23,184.00
Clear the moving way inside factory	1,091.00												1,091.00
Wall openning				2,637.00	2,637.00								5,274.00
Move machines from floor to trucks					4,727.00								4,727.00
Transportation machine from plant A to plant C					16,090.00								16,090.00
Take out the utility system and unlock the water treatment equipment					1,818.00								1,818.00
Move water treatment equipment from floor to trucks					4,727.00								4,727.00
Transportation water treatment system from plant A to plant C						16,090.00							16,090.00
Drawing and Utility survey in C plant	1,227.00												1,227.00
Design utility and prepare the purchase order for equipment	2,454.00												2,454.00
Area clearing	818.00												818.00
Wire way from MDB and rack making			461,090.00										461,090.00
Electric control cabinet making					180,000.00								180,000.00
Filling room construction			8,180.00	8,180.00	8,180.00	4,804,908.00							4,829,448.00
Floor surface making(Stone-hard)						1,364.00	3,410.00	1,922,046.00					1,926,820.00
Piping making from water treatment and air compressor to production line			264,585.00										264,585.00
Marking centre for major machines and tanks								1,273.00					1,273.00
Machines placing and alignment								2,909.00	2,909.00				5,818.00
Transmission system placing and alignment									11,636.00	11,636.00			23,272.00
Connect electric system and piping system to the production line										3,637.00	10,911.00		14,548.00
Tank placing and connect the other equipment								1,227.00	1,227.00				2,454.00
Electric system and piping connection									3,182.00				3,182.00
Test Run											10,632.00	5,316.00	15,948.00
Production												3,725.00	3,725.00
Total	13,768.00	10,905.00	747,037.00	26,273.00	218,179.00	4,822,362.00	3,410.00	1,927,455.00	18,954.00	15,273.00	21,543.00	9,041.00	7,834,200.00

Table 4-13 Cash flow of this project after leveling

Conclusion of the plan after leveling

The plan after resource leveling can be described as follows:

1. There are 28 activities in the plan.

2. Critical path is same as before leveling. However, critical path are illustrated by the following figure :

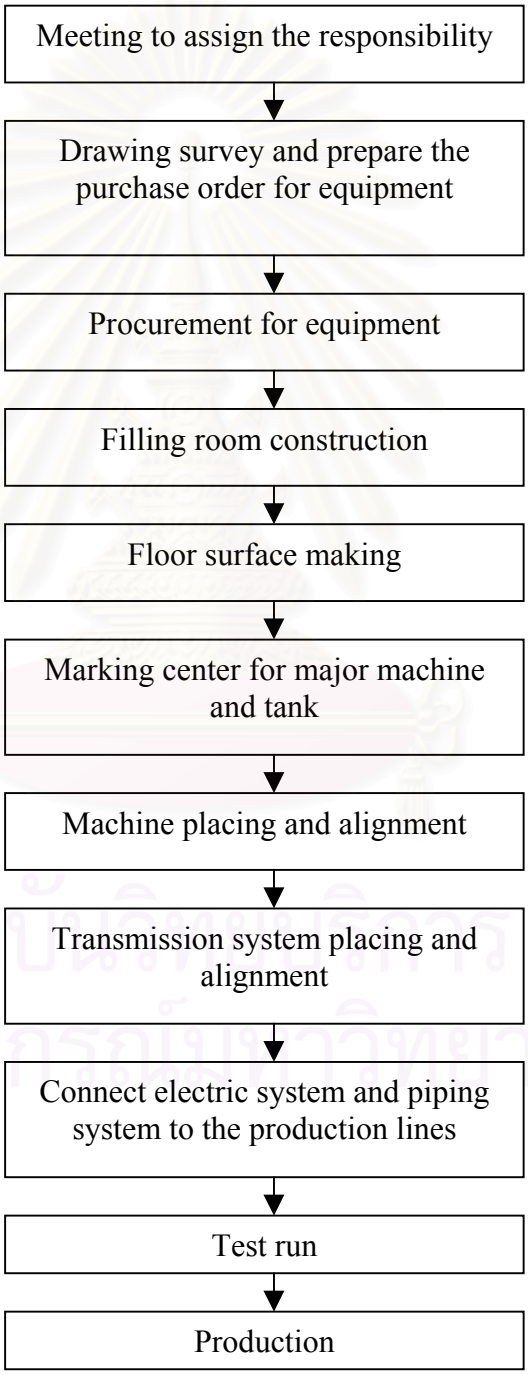


Figure 4-17 Critical path of the project after leveling

3. This project take 57 day to complete.

4. There are 62 persons involve in this project which are:
   - Engineering = 12 persons
   - Procurement = 4 persons
   - Transportation = 11 persons
   - Area preparation = 14 persons
   - Installation = 21 persons

5. This project consumes 7,834,200 Baht to complete. Cost can be divided into 12 weeks as followings:

Week	Baht
1	13,768
2	10,905
3	**747,037**
4	26,273
5	**218,179**
6	**4,822,362**
7	3,410
8	1,927,455
9	18,954
10	15,273
11	21,543
12	9,041

Table 4- 14 Cost allocation into 12 weeks for relocation project after leveling

Conclusion when using Microsoft Project computer program for resource leveling

Resource allocation

In the project management, planner can predict the demand of resources by estimating each type of person. However, the amount of resource is not the minimum number because planner will estimate to fulfill the one way scheduling. Therefore, this will cause a series of sudden high demands followed by ver low demands. Resource demands that are not smooth mean that project will need a large number of resources many of whom will be sitting around one day but working really hard the next.

Planner can decide to allocate resources to activities. It is not too hard to predict the demand for resources on a activity by activity basis, but it hard to predict the demand for resources over a whole project without computer even planner can do.

In this project, the amount of resource in the first step which estimate from each activity can be describes as the following line.

There are 65 persons involve in this project distribute in each department which are:

- Engineering = 15 persons
- Procurement = 4 persons
- Transportation = 11 persons
- Area preparation = 14 persons
- Installation = 21 persons

Resource leveling

Resource leveling is a process by which the software ensures that the project never demands more resources than planner said are available. After leveling, resource demand never exceeds resource availability. When planner ask the software to level the resources, it will use the resource availability levels or profiles as a target to aim for and try to find a way of achieving the project on time without exceeding the resource profiles. Activities are delayed automatically so as to wait for resource to become available.

In this project, the amount of resource after resource leveling can be describes as the following line.

There are 62 persons involve in this project distribute in each department which are:

- Engineering = 12 persons
- Procurement = 4 persons
- Transportation = 11 persons
- Area preparation = 14 persons
- Installation = 21 persons

Microsoft project computer program can convenient the planner to level the resource with accurately and it can reduce the resource without project postpone.
When using Microsoft project computer program for resource leveling is the optimum alternative because it can level both work and money. It can help planner to reduce human resource 3 persons. The human resource reduce from 65 persons to 63 persons which can make the number of project member lower than before leveling—earliest start option. Moreover, it can smooth the money to vary along time schedule.

4.12 Expedite the project

In case of some critical activity delay, this program can help project manager to expedite the project such as add more human resource or adding overt time working to reduce critical time and complete project on time performance. However, the critical time, cost and manpower will be change in proportion and depending on the decision of project manger.

There are many ways to decrease the critical time in order to reduce the delay project as followings:

- Increase working time per day. For example, assume standard working time is 8 hrs per day, we can adding working time from 8 hrs per day to 12 hrs per day.
- Adding more resource to reduce the critical time.
- Adding new resource to reduce the critical time.

When the project manager check the progress of project and find that there are probably delay activities from the critical one, project manager should reduce the critical time before it postpone project.

The following example illustrates one way to reduce critical time by adding the over time working.

Figure 4-18 noted the activity number 23, it is chosen as the critical activity that is resource driven activity and probably delay.

Figure 4-19 adding over time working might reduce the critical time.

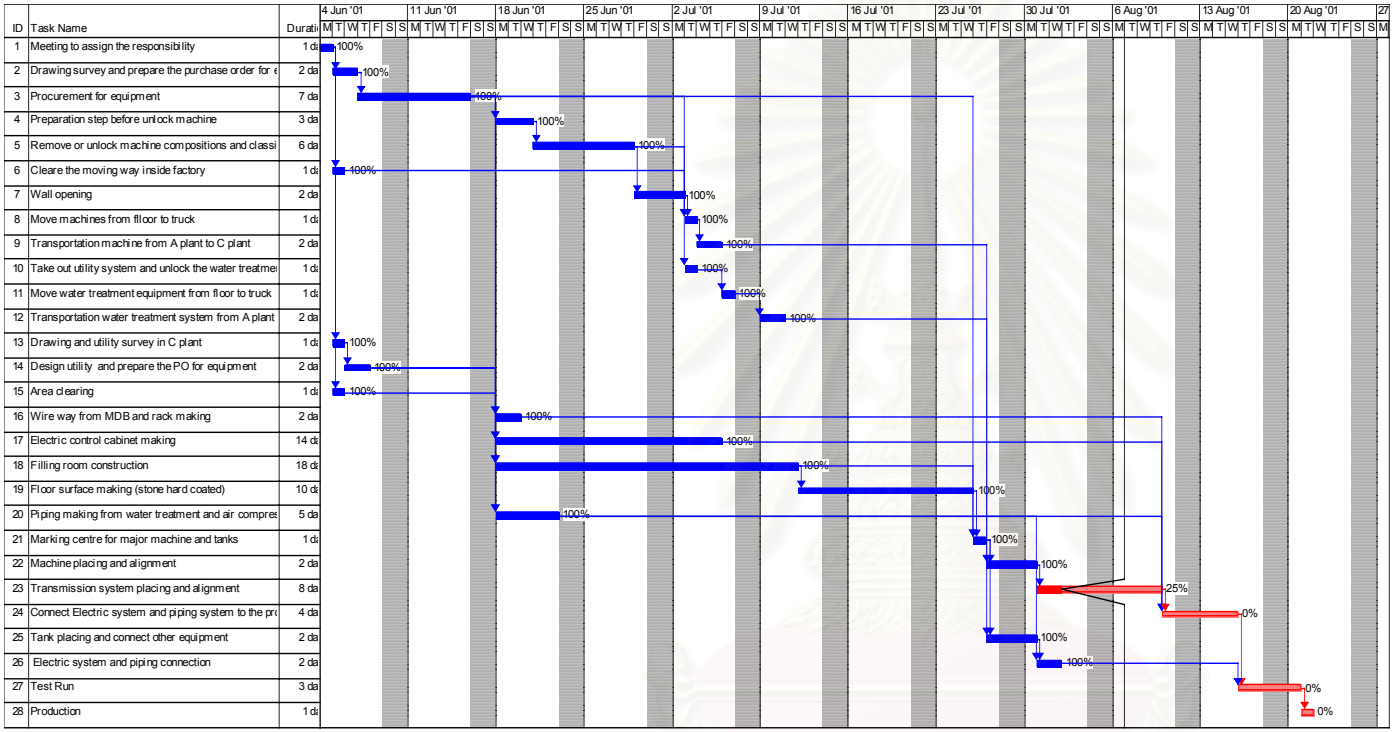


Figure 4-18 An example of critical activity that probably delay: activity number 23

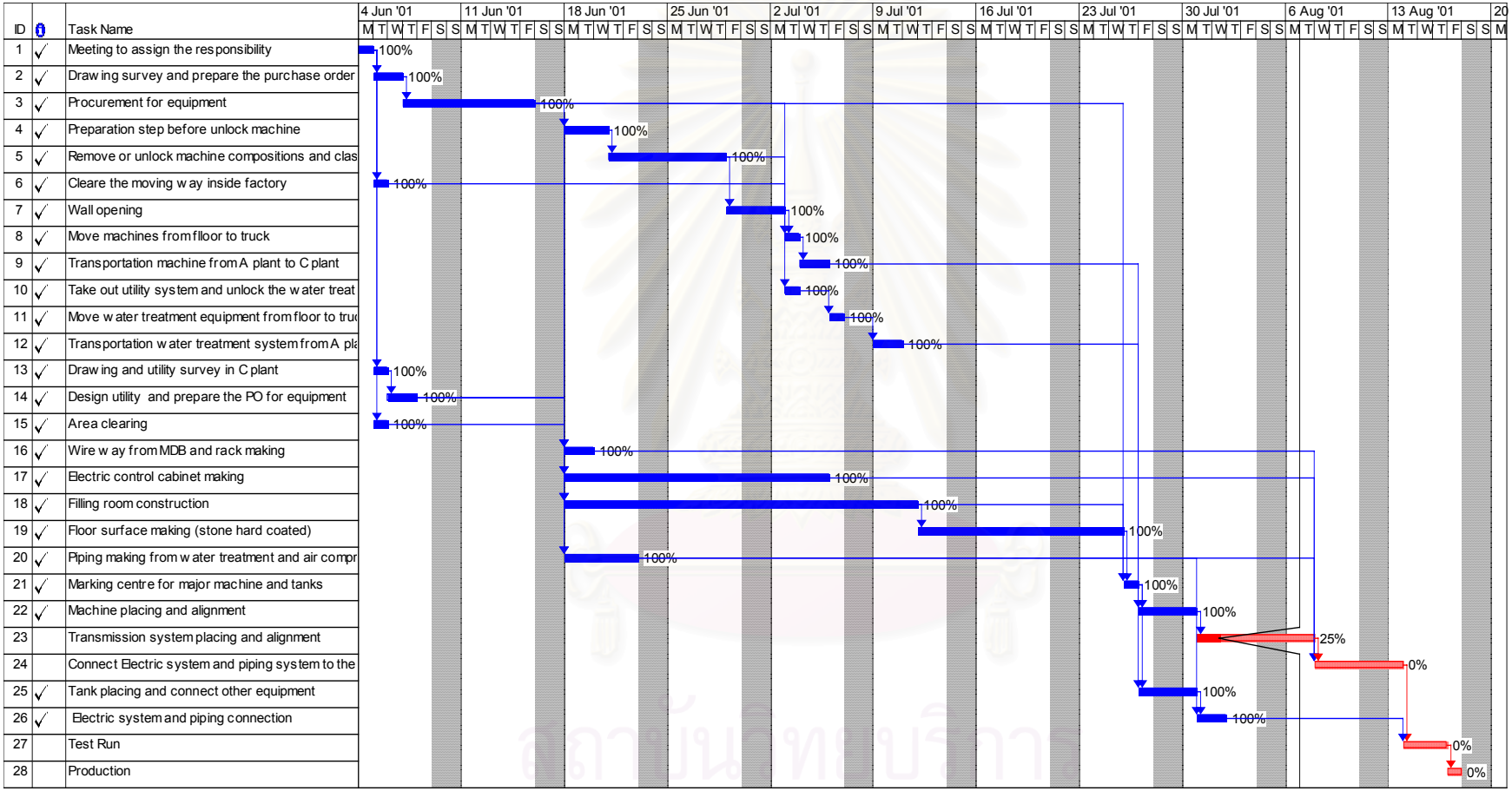


Figure 4-19 Critical time after adding over time working

Cash Flow when expedite project (Baht)

	4/6/01	11/6/01	18/6/01	25/6/01	2/7/01	9/7/01	16/7/01	23/7/01	30/7/01	6/8/01	13/8/01	Total
Meeting to assign the responsibility	1,636.00											1,636.00
Drawing survey and prepare the purchase order for equipment	2,180.00											2,180.00
Procurement for equipment	4,362.00	10,905.00										15,267.00
Preparation step before unlock the machines			5,454.00									5,454.00
Remove or Unlock the machine compositions and classify in each set			7,728.00	15,456.00								23,184.00
Clear the moving way inside factory	1,091.00											1,091.00
Wall openning				2,637.00	2,637.00							5,274.00
Move machines from floor to trucks					4,727.00							4,727.00
Transportation machine from plant A to plant C					16,090.00							16,090.00
Take out the utility system and unlock the water treatment equipment					1,818.00							1,818.00
Move water treatment equipment from floor to trucks					4,727.00							4,727.00
Transportation water treatment system from plant A to plant C						16,090.00						16,090.00
Drawing and Utility survey in C plant	1,227.00											1,227.00
Design utility and prepare the purchase order for equipment	2,454.00											2,454.00
Area clearing	818.00											818.00
Wire way from MDB and rack making			461,090.00									461,090.00
Electric control cabinet making					180,000.00							180,000.00
Filling room construction			8,180.00	8,180.00	8,180.00	4,804,908.00						4,829,448.00
Floor surface making(Stone-hard)						1,364.00	3,410.00	1,922,046.00				1,926,820.00
Piping making from water treatment and air compressor to production line			264,585.00									264,585.00
Marking centre for major machines and tanks								1,273.00				1,273.00
Machines placing and alignment								2,909.00	2,909.00			5,818.00
Transmission system placing and alignment									24,153.56	4,842.21		28,995.77
Connect electric system and piping system to the production line										10,911.00	3,637.00	14,548.00
Tank placing and connect the other equipment								1,227.00	1,227.00			2,454.00
Electric system and piping connection									3,182.00			3,182.00
Test Run											15,948.00	15,948.00
Production											3,725.00	3,725.00
Total	13,768.00	10,905.00	747,037.00	26,273.00	218,179.00	4,822,362.00	3,410.00	1,927,455.00	31,471.56	15,753.21	23,310.00	7,839,923.77

Table 4-15 Cash flow of this project when expedite project

Conclusion of the plan when expedite project

The plan when expedite project can be described as follows:

1. There are 28 activities in the plan.

2. Critical path is same as after resource leveling. However, critical path are illustrated by the following figure :

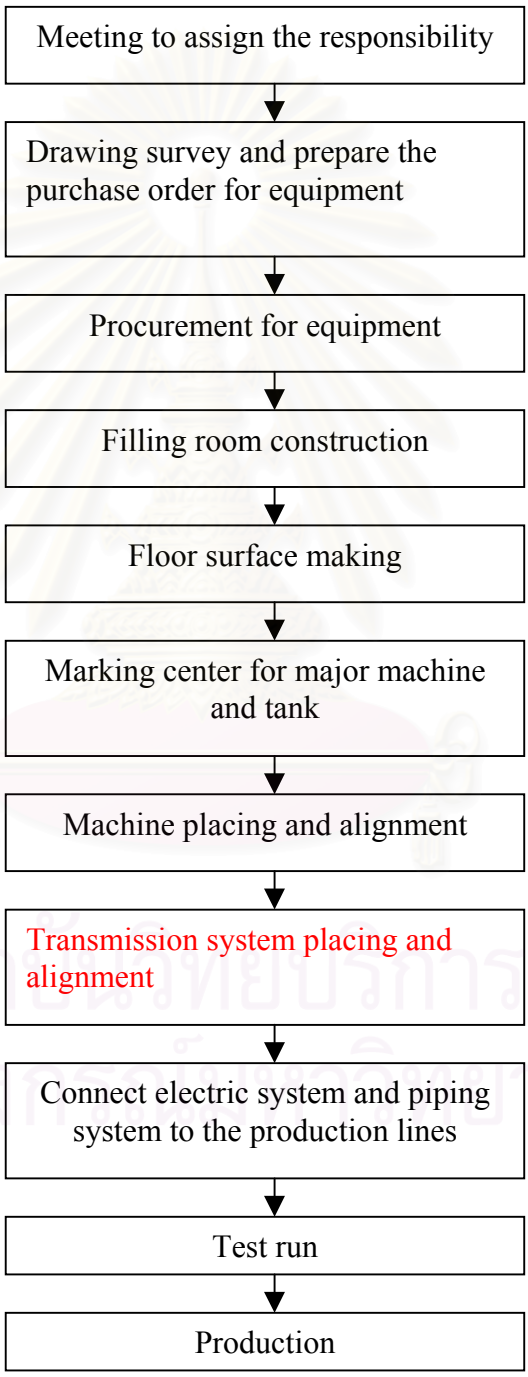


Figure 4- 20 Critical path of the project when expedite project

3. This project take 55 day to complete.

4. There are 62 persons involve in this project which are:
   - Engineering = 12 persons
   - Procurement = 4 persons
   - Transportation = 11 persons
   - Area preparation = 14 persons
   - Installation = 21 persons

5. There are overtime working of the resource to expedite the project. Project manager can adjust overtime working per day to suit the remaining time. In this case, project manage add 48 hours to expedite project and can reduce the duration from 8 days to 6 days. The following figure illustrate the expedite project by adding overtime working to activity number 23.

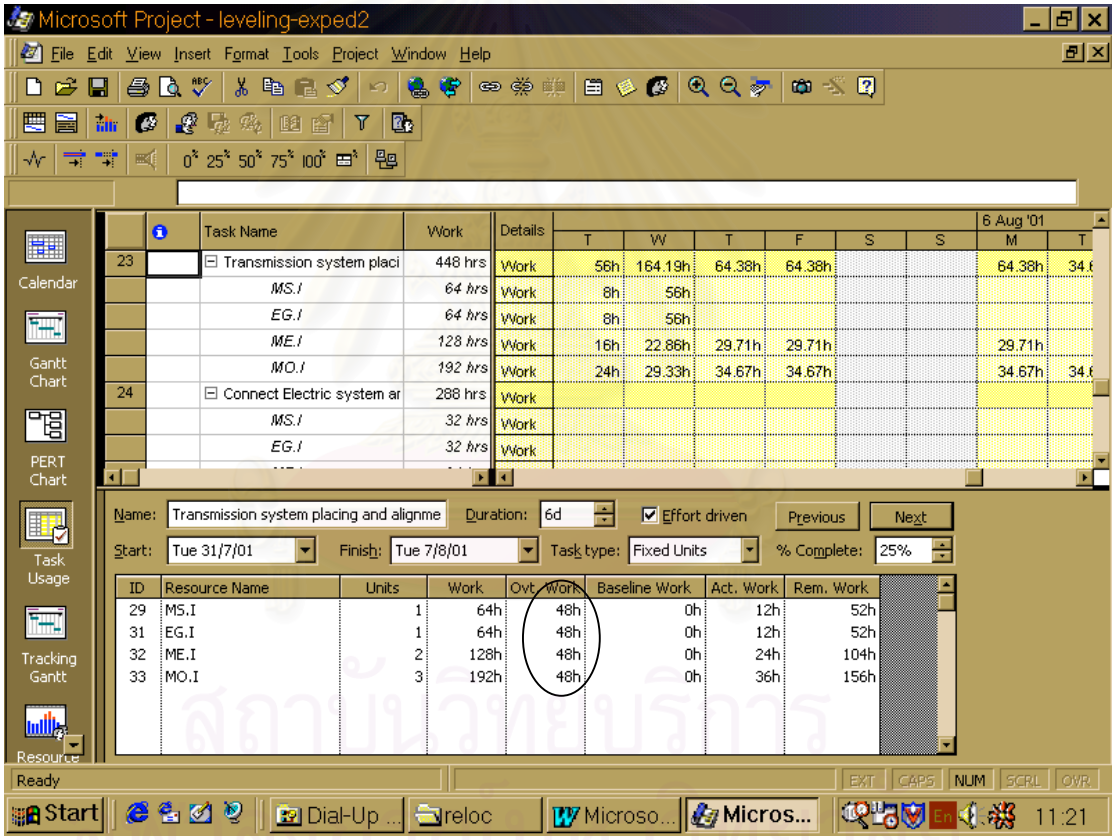


Figure 4-21 An example for adding overtime to expedite project

6. However, the overtime working rate is higher than standard rate. So, the cost will be change. This project consumes 7,839,923.77 Baht to complete. Cost can be divided into 12 weeks as followings:

Week	Baht
1	13,768
2	10,905
3	747,037
4	26,273
5	218,179
6	4,822,362
7	3,410
8	1,927,455
9	**31,471.56**
10	**15,753.21**
11	**23,310**
12	-

Table 4- 16 Cost allocation into 12 weeks for relocation project when expedite project

There are changing cost in week number 9, 10 and 11 while can reduce working time of project from 57 days to 55 days. Project complete in eleven week.

Conclusion when using Microsoft Project computer program to expedite the project

In general, planner try to smooth the demand of each resource. Without the computer program, planner can do but it is very hard to estimate the resource of entire project. Microsoft Project computer program can assist planner not only to level resource but to expedite the project as well. Without computer program, everything will depend on project manager's decision but with computer program, project manager can look at the record and trial the decision by adding the information into the program. However, the result of project in terms of cost and duration after expedite project will be differ from the normal situation. The following line illustrate these results.

Normal situation

- It take 57 days to complete with 62 persons in standard scheduling involve in the project
- It consume 7,834,200 Baht to complete project

Expedite project

- It take 55 days to complete with 62 persons with overtime working along the duration of the activity that probably delay.
- It consume 7,839,923.77 Baht to complete the project

Microsoft Project computer program can assist the project manager in the urgent situation. It facilitates the manager to analyze the entire project. Project manage can raise the hypothesis and trial by adding the information to find the best decision. In some case there are the many selections for the manager to making decision. In that computer program allow the manager to simulation before reaching the decisions. Without the computer program, project manager can make the decision but it takes time to deliberate and calculate the advantage and disadvantage in terms of number. In this case the project duration reduce around 2 days because this nature of each activity constrain with the fixed duration.

4.13 Project Control

Controlling a project is the name of maintaining and measuring project's performance involves four stages: (1) periodically reviewing the performance of each project activity on the schedule, (2) measuring and evaluating its performance against the planned project objectives, (3) taking the necessary action on critical activities that are affecting project performance and (4) Communicating overall progress to management and project team through meetings, memos and written reports.

Measuring project performance

Project control is an early warning system to resolve problems in the earlier stages of the project and thus avoid panic situations when the project nears completion. It compares the early start/early finish schedule, based on the original plan, with the actual performance of the project.

The four distinct stages characterized as follows:

- Monitor: periodic checking of the plan and schedule
- Assess : identifying the critical items and problems
- Resolve : finding solutions to the problems
- Communicate : advising management, project team members, suppliers, vendors, and contractors of project status

Monitoring the Project

Monitoring project activities is a continuous checking of their performance. This effort is essential to keeping the project under control. At least once a week, the project manager will formally check the total project. If there are disturbing signs that the project may be heading for difficulties, formal monitoring and reporting will be more frequent. The present status of each project activity is noted and recorded during the monitoring stage.

For example, the relocation plant project, at the end of week 3 we meet with those involved to review the schedule. The review finds the timing of several activities has deviated from the planned schedule.

Activity	Description	Duration (Days)	
		Original	Revised
B	Drawing survey and prepare order for equipment	2	3
C	Procurement for equipment	7	9
R	Filling room construction	18	21

Node	Activity	LF	Duration	Revised	ES	TF
1-2	A	1	1		0	0
2-3	B	3	2	3	1	0
3-13	C	10	7	9	3	0
13-14	D	28	3		10	15
14-15	E	34	6		13	15
15-16	G	36	2		19	15
16-17	H	37	1		21	15
17-18	I	39	2		22	15
18-23	-	39	0		24	15
23-26	-	49	0		39	10
26-27	Y	51	2		39	10
27-28	Z	53	2		41	10
28-29	AA	56	3		53	0
29-30	AB	57	1		56	0
2-4	F	36	1		1	34
4-16	-	36	0		2	34
2-10	O	10	1		1	8
10-11	R	28	18	21	10	0
11-12	S	38	10		28	0
12-22	-	38	0		38	0
22-23	U	39	1		38	0
23-24	V	41	2		39	0
24-25	W	49	8		41	0
25-28	X	53	4		49	0
13-22	-	38	0		10	28
13-10	-	10	0		10	0

Figure 4-22 Duration changes to the project schedule for the Relocation plant project

The next steps will determine whether any of these activities will significantly affect the schedule (see Figure 4-22). Those are the only markings as all of the other project activities have progressed, are progressing, or are planned to progress according to the original schedule. The project team members responsibility for their respective activities review and confirm changes on the planning diagram. Memos, status meetings, or any other means of communication may serve the same purpose.

Assessing the Project

The next stage, assessing the project, determines what effect the changes have on the project schedule, particularly on the project completion date. The duration changes replace the original times. With the revised duration in place, new calculation are made for the earliest start times and latest finish times of all of the project activities. The earliest start time of node 30, the last node of the project has change from 57 days to 63 days. This indicates that, because of the changes, the project has been extended 6 days beyond the original schedule.

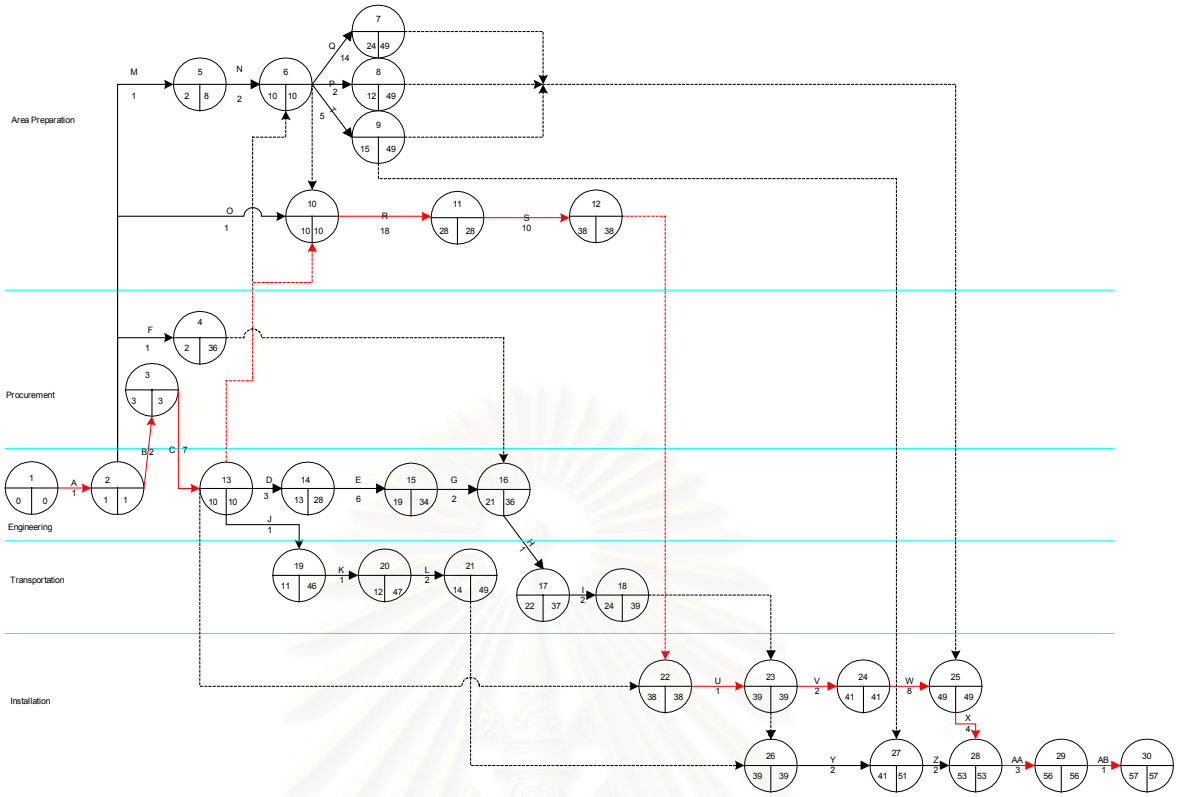


Figure 4-23 The original activity network for the relocation project

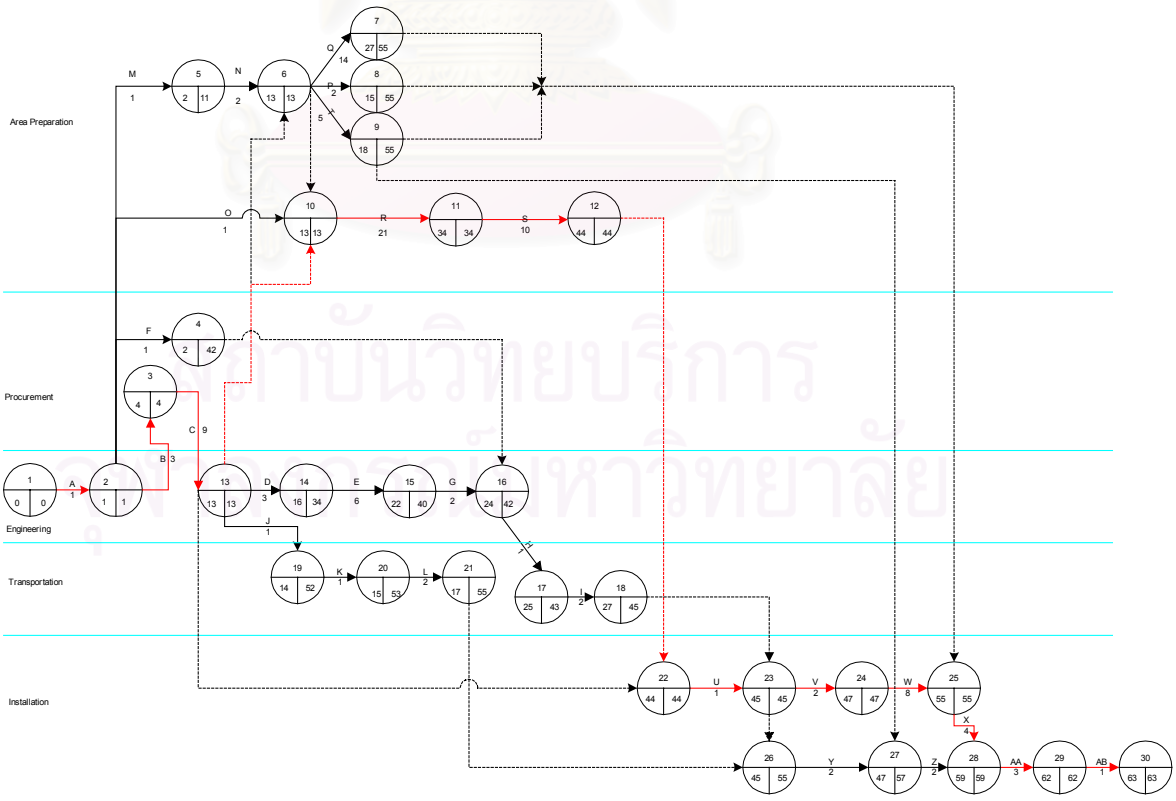


Figure4-24 Revised estimates, earliest start times, and latest finish times of the relocation project

To observe the total effect, a completely new schedule is to be prepared, requiring recalculation of the total float for each activity. The new schedule will be helpful to recognize all activities with 0 float and also those with relatively small float. The schedule gives more attention to these activities

1. To prevent further potential delays and
2. To reduce their duration as possible way to restore the project to its original completion date.

The revised schedule is quite complete, showing early and latest start times, early and latest finish times, duration and float. It is very helpful in reviewing the entire project to help resolve the scheduling problems.

Resolving Problems

Certain questions must be answered to help solve the planning and scheduling concerns and/or problems of the project:

1. Which specific activities are behind schedule? How much will hey delay the project date if not corrected?
2. What are the reasons for delays that have cause the project to fall behind schedule?
3. What steps have been or are being taken(or should be taken) to get back on schedule, and what results have been achieved or expected?
4. Will any other specific recommendations for further action restore the schedule and prevent further concerns?

Project manger should note the activities with 0 float, especially those that contributed to schedule problems, are first to be examined. While some of these activities were not necessarily affected any change, they nevertheless should be analyzed, as all of them are on the critical path that has extended the date of this project's completion.

Critical Activity	Description	Duration (Days)	Float
B	Drawing survey and prepare order for equipment	3	0
C	Procurement for equipment	9	0
R	Filling room construction	21	0

Of the critical activities indicated, two activities—Drawing survey and prepare order for equipment and Procurement for equipment and Filling room construction—took longer than schedule to complete. It is too late to address these delays, so any resolutions to correct the behind-schedule situation will need to involve other critical activities.

To eliminate the excess duration of the activities, these steps should be taken:

- Add over time to the activity T—Piping making and activity W—Transmission system placing and alignment.
- Contract the subcontract5 to negotiate the possible work acceleration in some critical areas.

If these two steps are difficult to achieve, there is time to review other options. The advantage of the project control approach, using the early warning system, is that it allows time to resolve the problems—action to resolve is being taken at week 3 of the project and the duration is 8 weeks away at week11.

Communicating

It is important to communicate the project status to management, suppliers, vendors, contractors, and project team members. While a written report is possibly one of the most valuable communication devices, other effective means include phone calls, memos, personal contact, and meeting formally as well as continuously throughout the project.

Meeting

A majority of project meeting is concern with day to day problems met on all projects.
A suggestion for the project meeting shown as follows:

- Use meeting for making group decisions or getting input for important problems.
- Have preset starting and stopping times as well as a written agenda. Stick to with both and above all.
- Be prepared prior to the meeting
- If a serious problem or crisis arises, call a meeting for the purpose of dealing with that issue only.

For example, the meeting report of the relocation project is shown as followings:

Relocation Project
June 25,2001

1. Procurement
- There are some problem with subcontract quotation, so this affect to the activity C—Procurement for equipment extend from 7 days to 9 days.
- Other activity is on schedule duration.

2. Engineering

- There are some problem with the utility survey because of the electric trip, so this affect to the activity B—drawing survey and prepare the purchase order for equipment extend from 2 days to 3 days.
- Other activity are on schedule duration.

3. Transportation
- Waiting for beginning with ready resource.

4. Area preparation
- There is some problem with the subcontract4's internal problem, so the progress of work is possible delay. The subcontract4' responsibility tell that it will extend from 18 days to 21 days.

5. Installation

- Waiting for beginning with ready resource.

Discussion

There are several suggestion from the chief of department and project manager decide to accelerate the possible work to complete the project on time schedule.

Figure 4-25 The example of project meeting

Microsoft Project computer program can illustrate the status report of project in terms of graphic which composed of milestones, percent complete of activities and progress line to project manager. A status report present a view of what is happening in the project, offering readers an opportunity to suggest improvements early enough to make an impact on the project's progress.

The status report is based on the progress schedule, which is a graphic presentation of the project schedule revised to show actual progress.

Using the Computer

Microsoft Project computer program assist the project manager to control the project by viewing the milestones, activities complete percentage and progress lines. Preparing a computerized milestone report is a more desirable approach than the time- consuming manual method.

Milestones

Another means to communicate the status of a project, especially to management, is the uses of milestones. Milestone are selected events that are crucial to achieving objectives. They are key events, such as the completion date of a major phase of a project. These events may or may not be on the critical path. To enter milestone to program, the duration of that activity must be zero.

Milestone is the point that determines the progress of activities. Milestone is not the activities in the project because it has zero duration to complete, but it is the activity that we put to show the progress of activity. For example, if checking in activity number 6 is complete, the activity number 1 and 2 should be 100 percent complete while activity number three should be 50 percent complete. Otherwise, the project will probably delay from the plan. See figure4-26. Milestone is useful for the project manager to aware of the progress of the project and if there are some problem, project manager can find out the solution.

Complete Percentage

Microsoft Project computer program allow project manager to partially complete individual activity. The complete percentage are view as the status of each activity separately. It can help project manager to solve if there are activities that might difficulty the project.

Progress determination by activity is the activity update by the user not the computer program. Normally, project manager is the one who know about the activity progress and sometimes project manager want to change the progress of each activity to the real situation. Microsoft project allow user to do that by putting percent complete of each activity to the project plan. Project manager can click mouse and drag to the right way in each activity to update the progress and after leaving mouse there are number of percent complete showing on the screen. These progress determinations are easily to add, change and understand for the user. It is helpful for the project manager to analyze the project in each activity and if there are some problem, project manager can find out the solution on time. See fig. 4-27.

Progress line

Complete percentage can assist project manager to know the status of each activity. However, there are the mean to know the status of each activity compare to the overall project which called the progress line. Progress line can help project

manager to further analyze the project and early find the solution of possibly problem.

In general, project compose of many activities. The way to know the status of each activity compare to the overall plan, project manager can consider percent complete of each activity. However, in doing so, it take a long time to analyze. In order to solve this problem, Microsoft project has the progress line to help project manager to analyze the progress or delay of each activity compare to overall project.

When project manager click the progress line button in the menu bar and click mouse at the date, there are the progress line show the progress of each activity compare to the chosen date. If progress line go to the right way, it means that this activity is progress than the plan. If that activity is on time performance, the progress line will pass with straight line. Progress line can illustrate the status of activity compare to the overall project. See figure 4-28.

Many Progress lines

In some case, only one progress line cannot use to analyze the overall project. Many progress lines are more suitable than one line. In this case, project manager can determine the progress line in required period such as daily, weekly, monthly. This will help project manager to see the problem before it occur and reschedule on time.

When using computer program, project manager can use the following items to control the project.

Milestone adding and progress control

In order to remind the project manager to track the progress of project. Milestone probably determined in Microsoft project program by adding zero work day for the activity. It require no time and no resource to complete. The following figure can be used to illustrate the milestone.

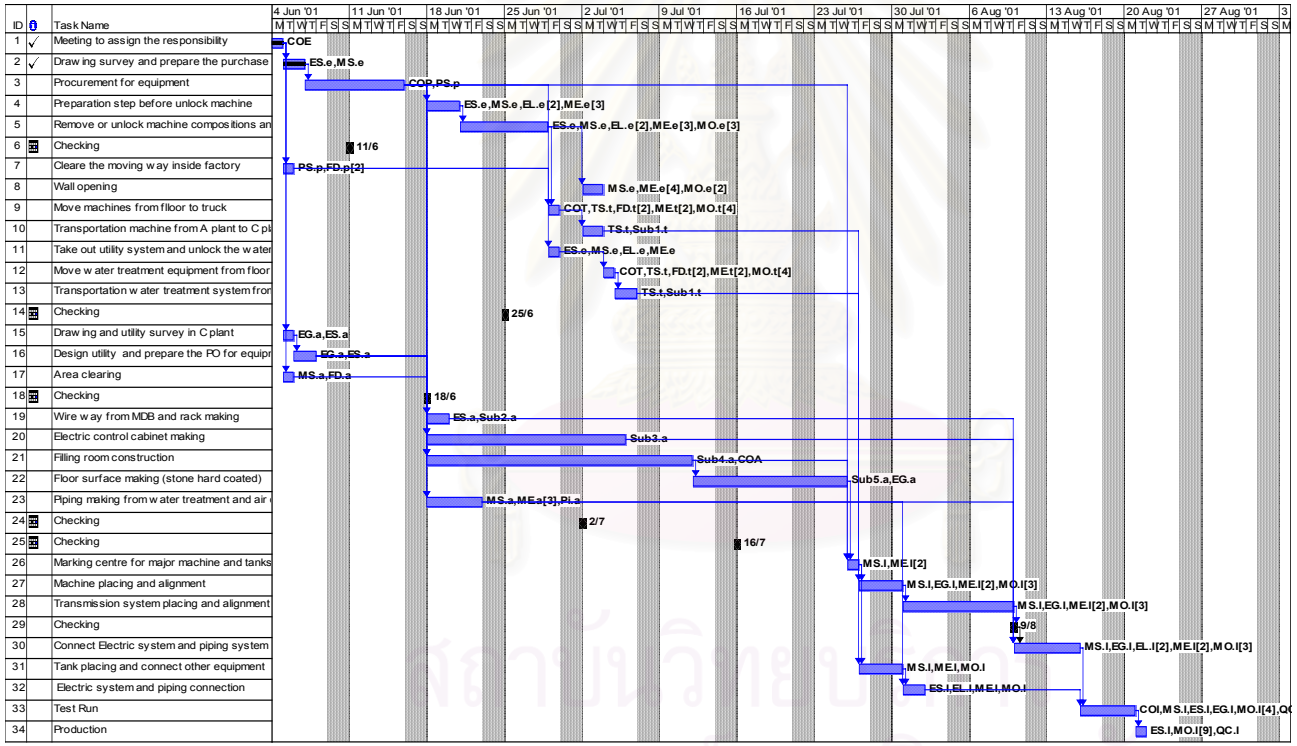


Figure4-26 Milestone for project control

Moreover, this program allow the project manager to update the actual percent complete in each activity. The following figure can be used to illustrate the update percent complete of activity.

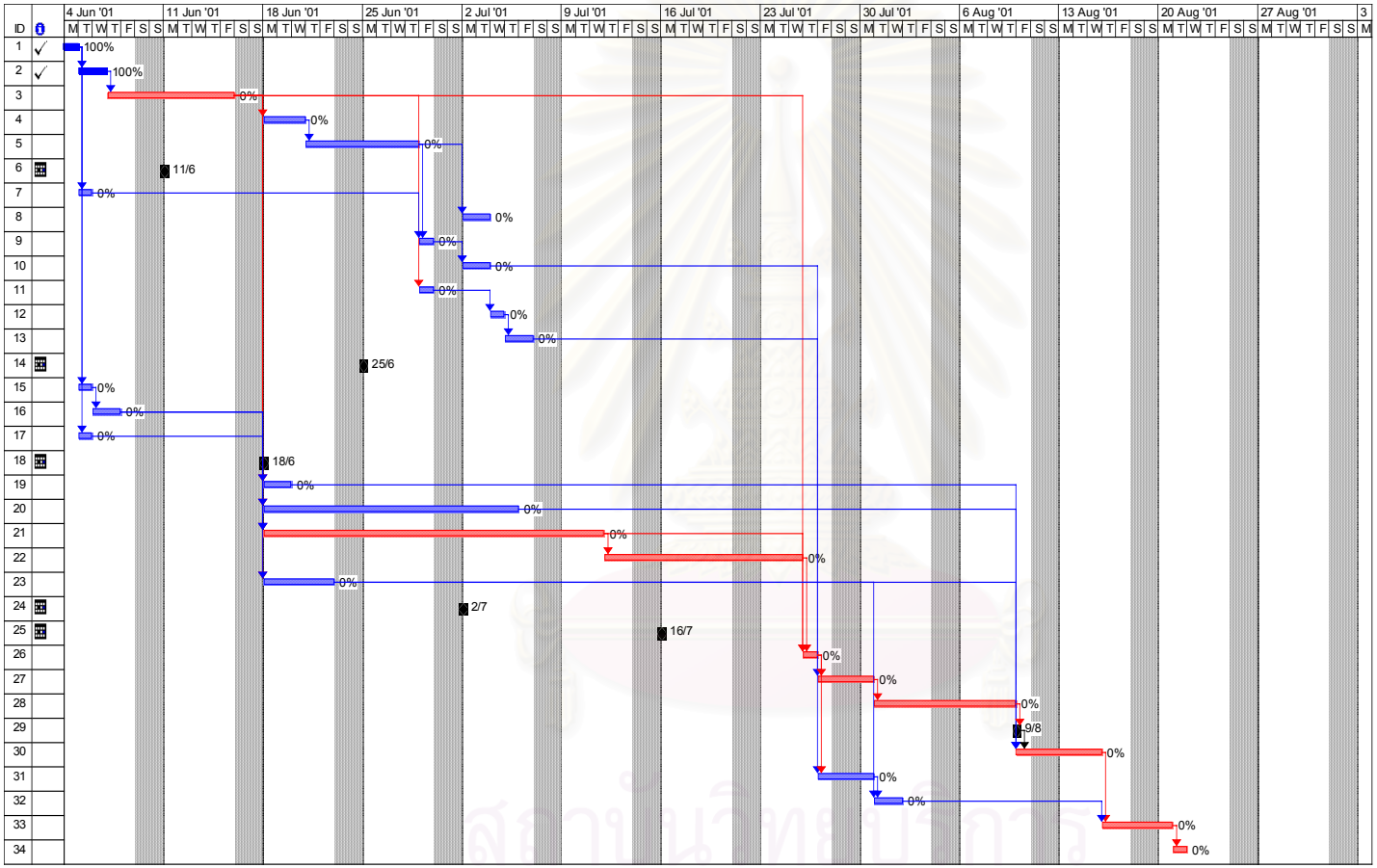


Figure 4-27 Progress control by the percent complete of the task

Progress Line

Normally, project is composed of many activities. In order to know the status of every activity, project manager can use the progress line to analyze the project situation and reschedule before some problem occur if there are some delay activity.

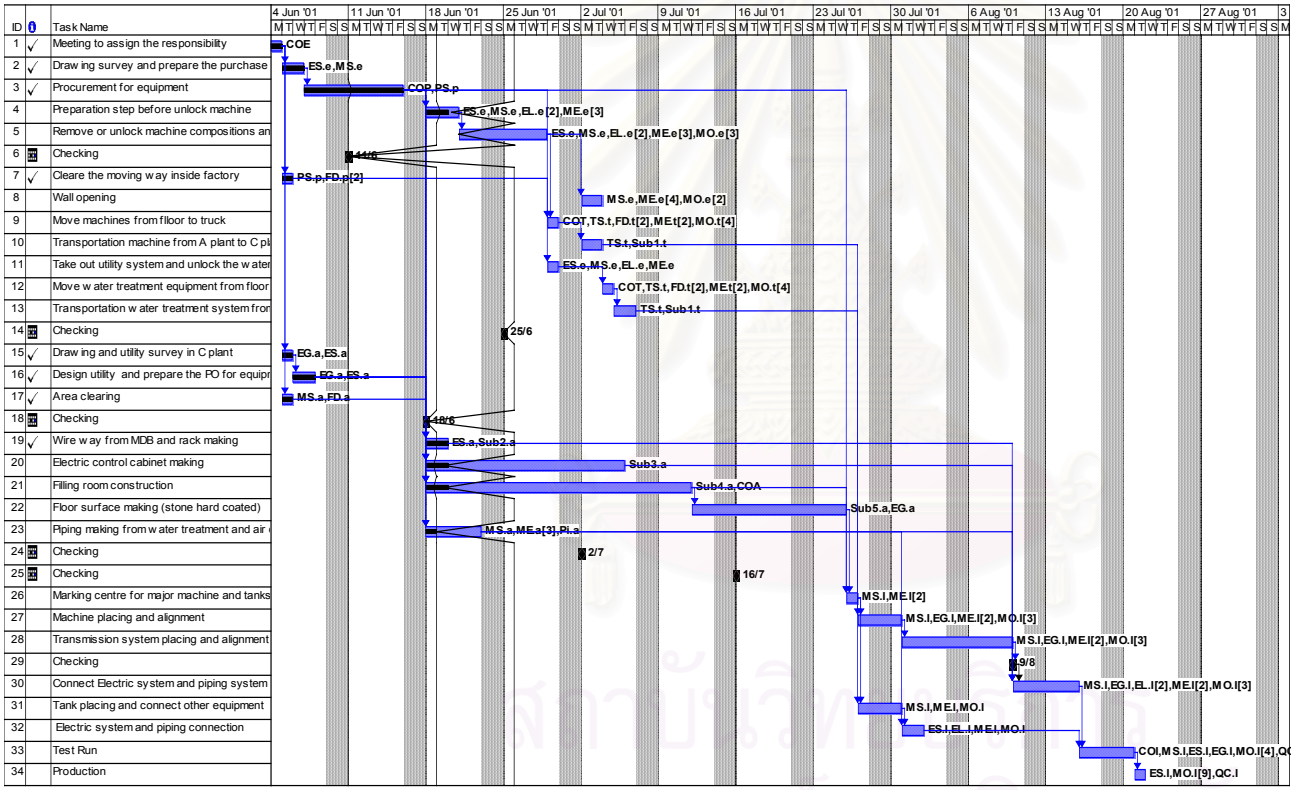


Figure4-28 The progress line

4.14 Project termination

The Final report

Good project management systems have a memory. Th embodiment of this memory is the Project Final Report. The final report is not another evaluation; rather, it is the history of the project. It present what went right or wrong, of who served the project in what capacity, of what was done to create the substance of the project, of how it was managed. There are some subjects should be addressed.

1. *Project Performance*. A key element of the report is a comparison of what the project achieved. This comparison may be quite extensive and should include explanations of all significant deviations of actual from plan.

For example, The different between plan and actual need the reason to illustrate the cause and problem as shown in the example of project meeting.

2. *Administrative Performance*. The administration of project can not solve technical problems, but it can enable good technology to be implemented (or prevent it). Administrative practices should be reviewed, and those that worked particularly well or poorly should be highlighted. It is important, when report the reasons why some specific practice was effective and ineffective.

For example, the administration of project should be evaluated in terms of the appropriate responsibility for each department or comment for the next project.

3. *Organizational Structure*. The final report should comments on the ways the structure aided or obstructed the progress of the project.

For example, the comment of pure project organization should be evaluated in terms of the fluent or difficulty of cooperate work between departments and external project organization.

4. *Techniques of Project Management*. The outcome of the project is so dependent on the skill with which the forecasting, planning, budgeting, scheduling, resource allocation, and control are handled that attention must be given to checking on the way these tasks were accomplished. If the forecasts, budgets, and schedules were not reasonable accurate, recommendations for improved methods should be made.

For example, In this case we use the Microsoft project computer program to assist the project manager to plan , control and keep the record of data information. If the plan is not reasonable accurate, the project team’s comments should be review and suggest other methods for improvement.

Chapter 5

Conclusion and Recommendation

5.1 Conclusion

This thesis aims to propose the project planning and control procedure of the project management for relocation of the beverage plant.

There are two major sections in this thesis. First section mentioned about the production lines that will be moved to C plant. This section includes of the pure water process production and the composition of these production lines. After mention about the production line, the plan layout and distance between two plants are discussed later.

The organization of two plants illustrate the major structure. It slightly differs from one in the detail of section under department. However, the numbers of employee that possibly move to C plant was discussed and the alternatives for the employees were also addressed.

In existing project system in this company, the project manager only use the Gantt chart to direct the project. There are lack of co-ordination between the department and authorization. In the other hand, the existing working system for individual project in this company is depend on only the project manager's decision and lack of co-ordination between the department. Moreover, there are no pure organization for the project, it can confuse the responsibility to do the routine work or special project.

Moreover, it is more difficult for the project manager to control the project that usually late from the plan without the proper cause because he do not keep the previous record.

The second section concern about the proposed project planning and control system. The project planning, a key step of the project management is mentioned in the first section because it is the vital step to direct the project.

Project planning are discussed step by step which are:

1. Establish objectives
2. Define the required activities
3. Divide the activity into work groups
4. Construct the work breakdown structure
5. The action plan
6. Draw sundiagrams
7. Develop the project planning (arrow) diagram

In this case the pure project organization is suitable because it is convenient to plan and control form the complex activity network.

Cost base management is used to describe the calculation base that might put in the computer program and allow the computer program to calculate the actual cost.

The activity network and float time in each activity are used to illustrated the critical path of the project. After putting the important data, the computer program will generate the project schedule and project budget.

Moreover, the computer program can assist the planner in resource leveling by calculation the available slack. There for the program will level both resource and cost.

Propose project planning

There are 7 steps to plan the project which are:

1. Establish objectives

This project aim to determine the relocation plan and control procedure.

2. Defined the required activities

There are four major steps in this project which are;

1. Take off the production lines in plant A
2. Take off the water treatment system in plant A
3. Area preparing in plant C
4. Production line and Water treatment system setting in plant C

After define the major steps in this project, we will derive the activity that will occur in each step

3. Divide activities into work group

To assist in determining responsibility of each activities, there are five departments involve in this project which are;

1. Engineering responsible for removing machine composition and take off the utility system

2. Procurement responsible for procurement for every equipment and clear the moving way inside factory

3. Transportation responsible for moving and transportation machine from plant A to plant C

4. Area preparation responsible for area and utility preparation in plant C to support the relocation of production lines.

5. Installation responsible for managing the composition of machines and install them to produce the goods.

4. Construct the Work breakdown structure

Work breakdown structure is constructed in order to set the over all plan. It compose of the organization of this project and the responsibility of each department.

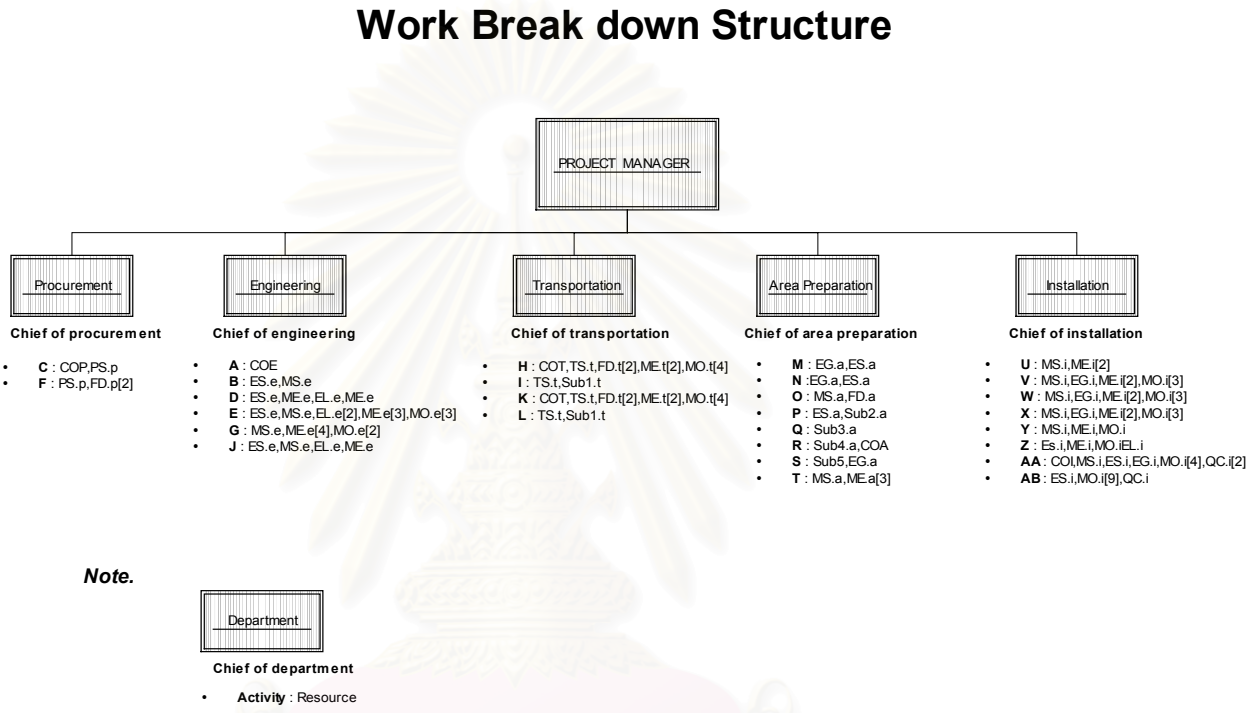


Figure 5-1 The Work Breakdown Structure of this project

5. The action plan

The action plan is a tool to gather the information of the project, which are compose of activities, description, predecessor, time and responsibility and type of the activity.

The action plan of this project are illustrated as follows:

TAKE OFF PRODUCTION LINES in A PLANT

ACTIVITY	DESCRIPTION	PREDECESSOR	TIME(Day)	RESPONSIBILITY	TYPE
A	Meeting to assign the responsibility	-	1	Engineering	F
B	Drawing survey and prepare the purchase order for equipment	A	2	Engineering	F
C	Procurement for equipment	B	7	Procurement	F
D	Preparation step before unlock the machines	C	3	Engineering	D
E	Remove or Unlock the machine compositions and classify in each set	D	6	Engineering	D
F	Clear the moving way inside factory	A	1	Procurement	F
G	Wall openning	E	2	Engineering	F
H	Move machines from floor to trucks	E,F,G	1	Transportation	F
I	Transportation from plant A to plant C	H	2	Transportation	D

TAKE OFF WATER TREATMENT SYSTEM in A PLANT

ACTIVITY	DESCRIPTION	PREDECESSOR	TIME(Day)	RESPONSIBILITY	TYPE
J	Take out the utility and unlock the water treatment equipment	C	1	Engineering	F
K	Move water treatment equipment from floor to trucks	J	1	Transportation	F
L	Transportation from plant A to plant C	K	2	Transportation	D

AREA PREPARING in C PLANT

ACTIVITY	DESCRIPTION	PREDECESSOR	TIME(Day)	RESPONSIBILITY	TYPE
M	Drawing and Utility survey	A	1	Area Preparation	F
N	Design utility and prepare the purchase order for equipment	M	2	Area Preparation	F
O	Area clearing	A	1	Area Preparation	F
P	Wire way from MDB and rack making	N,C	2	Area Preparation	F
Q	Electric control cabinet making	N,C	14	Area Preparation	F
R	Filling room construction	N,C,O	18	Area Preparation	F
S	Floor surface making(Stone-hard)	R	10	Area Preparation	F
T	Piping making from water treatment and air compressor to production line	N,C	5	Area Preparation	D

PRODUCTION LINE and WATER TREATMENT SYSTEM SETTING in C PLANT

ACTIVITY	DESCRIPTION	PREDECESSOR	TIME(Day)	RESPONSIBILITY	TYPE
U	Marking centre for major machines and tanks	C,R,S	1	Installation	F
V	Machines placing and alignment	U,I	2	Installation	F
W	Transmission system placing and alignment	V	8	Installation	D
X	Connect electric system and piping system to the production line	W,T,Q,P	4	Installation	D
	WATER TREATMENT SYSTEM				
Y	Tank placing and connect the other equipment	U,L	2	Installation	F
Z	Electric system and piping connection	Y,T	2	Installation	D
	TEST RUN and PRODUCTION				
AA	Test Run	X,Z	3	Installation	F
AB	Production	AA	1	Installation	F

Figure 5-2 The Action plan of this project

6. Draw the subdiagram

Subdiagram use to show the relationship of each activity in their own department

7. Project planning diagram

Project planning diagram use to show the relationship of all activities.

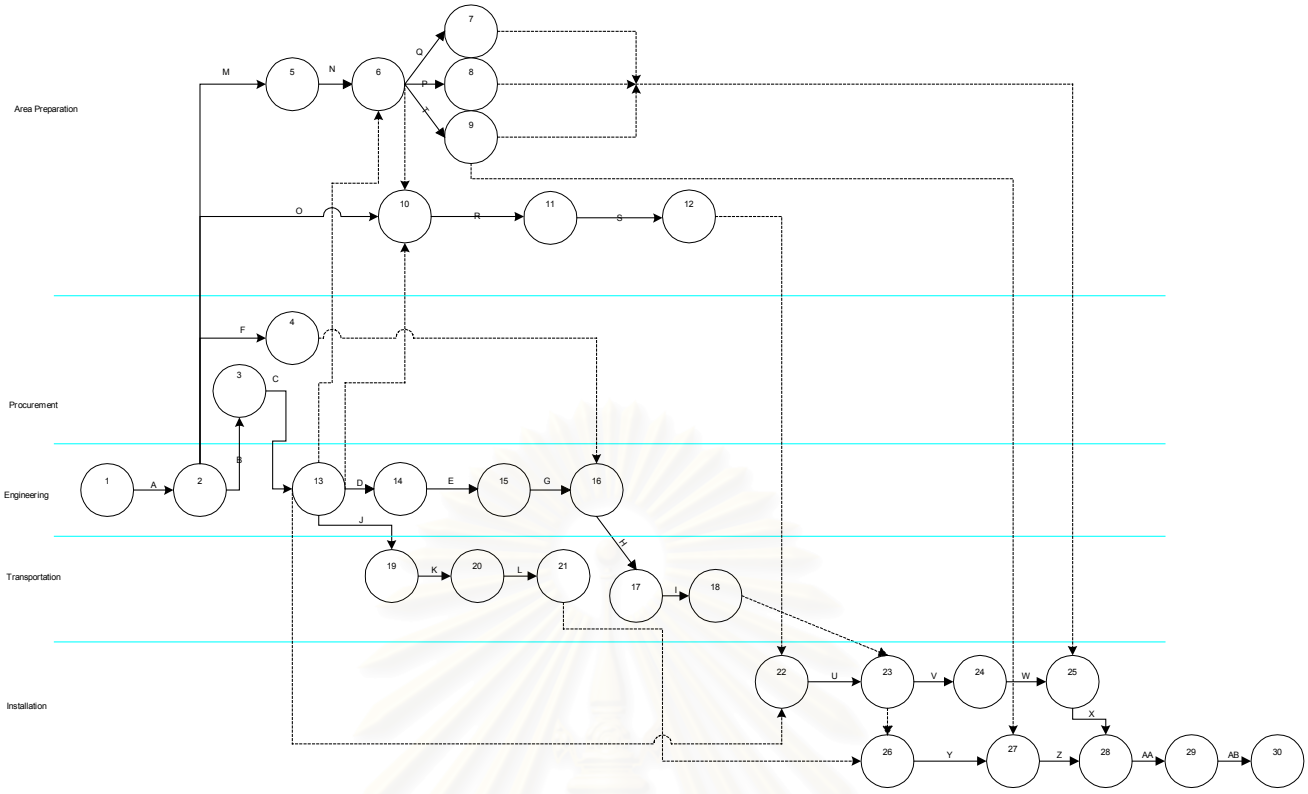


Figure 5-3 The Project Planning diagram

Without the computer program the critical path of this project are illustrate as following:

The following figure illustrate the Critical Path of this project

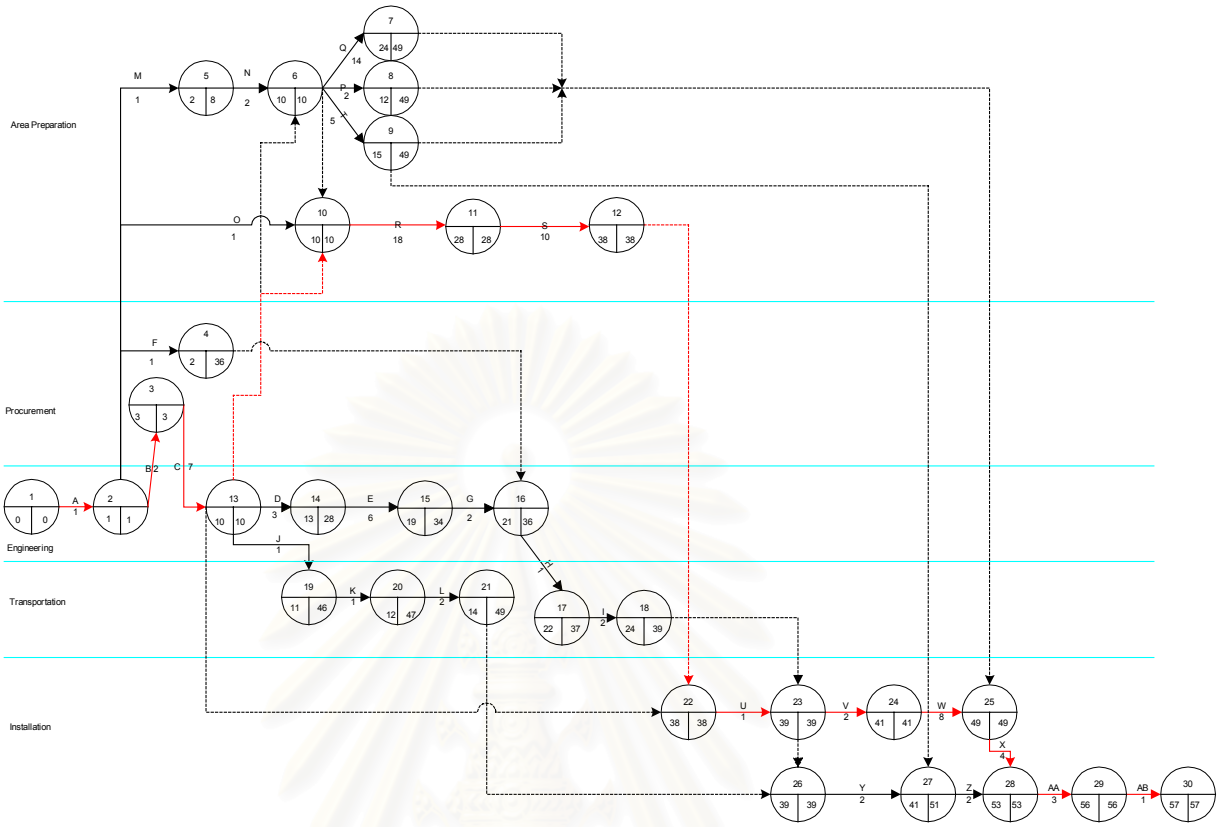


Figure 5-4 The Critical Path of project

After putting the required information into Microsoft project planning computer program, this program will generate the schedule and resource leveling for the project.

It can be concluded that the plan of project after resource leveling is;

1. There are 28 activities in the plan.

2. Critical path are illustrated by the following figure :

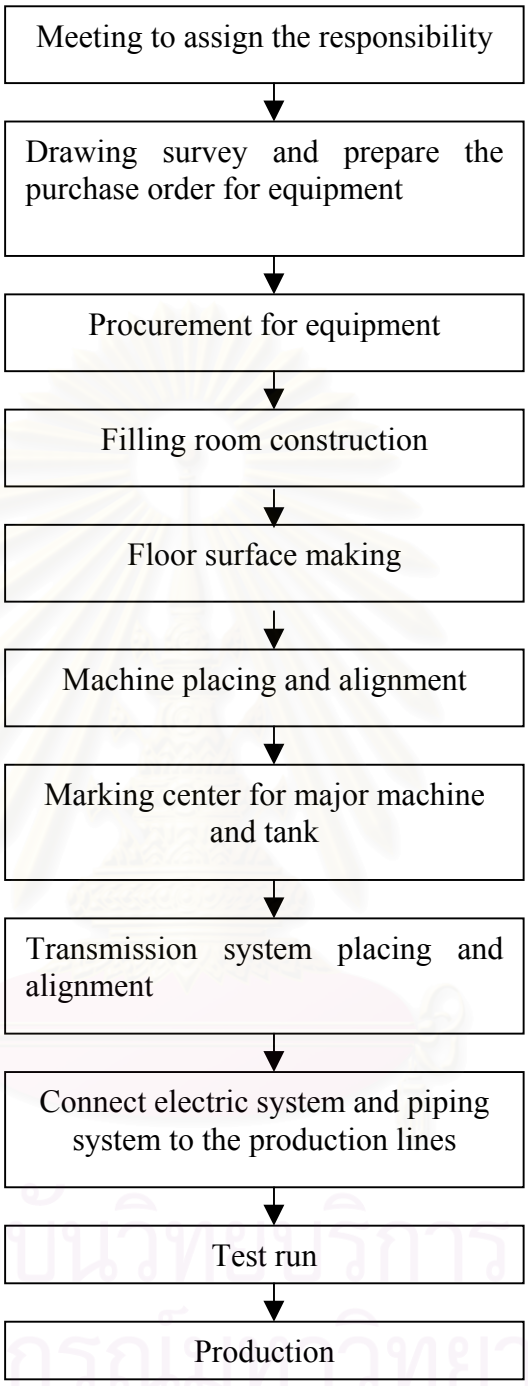


Figure 5- 5 Critical path of the project after leveling

3. This project take 57 day to complete.

4. There are 62 persons involve in this project which are:

- Engineering = 12 persons
- Procurement = 4 persons
- Transportation = 11 persons
- Area preparation = 14 persons
- Installation = 21 persons

5. This project consumes 7,834,200 Baht to complete. Cost can be divided into 12 weeks as followings:

Week	Baht
1	13,768
2	10,905
3	747,037
4	26,273
5	218,179
6	4,822,362
7	3,410
8	1,927,455
9	18,954
10	15,273
11	21,543
12	9,041

Figure 5- 6 Cost allocation into 12 weeks for relocation project after leveling

In some case, there are some activities that probably delay and might delay all of project. The program allow the planner to expedite the project by many alternative such as adding more resource, adding the over time working or changing the resource to finished the project on time. It depend on the project manager decision.

Project Control

Project control is an early warning system to resolve problems in the earlier stages of the project and thus avoid panic situations when the project nears completion. It compares the early start/early finish schedule, based on the original plan, with the actual performance of the project.

The four distinct stages characterized as follows:

- Monitor: periodic checking of the plan and schedule
- Assess : identifying the critical items and problems
- Resolve : finding solutions to the problems
- Communicate : advising management, project team members, suppliers, vendors, and contractors of project status

This program has the function to control the project which are milestone to remind the project manager to track the progress of project. The percent complete is used to update in each activity. The progress line is used for analyze the project situation and find the correction before the project delay.

5.2 Comment

Project planning and control procedure can be effectively done by the given recommendations as follows:

1. The chosen project manager should really know about the direction of the project because he is the key man to direct the project through the aim.

2. The project planning and control system should be analyze before the beginning of the project because it can generate the alternative for those who have authority to approve.

3. This project planning and control procedure is one of the alternatives that we propose to the authority to consider by using the Microsoft project computer program to assist the information collecting.

5.3 Recommendation for further study

From an academic point of view, this research proposes the project planning and control system to those who authorize in the company by depending on the numerical analysis-time, cost, human resource estimation.

In reality, project requires non numerical analysis such as the problem solving in that place of project. The recommendation for further study of this research can be described as follows:

1. It aims to submit project manager to implement the plan. If there are some obstructions, project manager can keep the record and find out the solution or reschedule depending on the project manager's decision. However, project manager, who know about the direction of project, should making the decision with the reasons from the collected information and deliberate the best alternative for his decision.

2. Project manager should understand the proper of project direction. What can and can not do in project management and carry the team member to reach the goal of project within time and budget. Problems are being solved with brain rather than additional money.

3. Project planning and control system should be analyze and develop this plan to the other involved project by project manager because he is the key man to direct project with his properties in terms of planning, problem solving, time management, decision making, data analysis and leadership skill.

4. Time measurement in each activity should be collected to benefit the other project when estimates time, resource and cost. An average expected time for an activity come from assuming that work will be nearly identical to work formally done and that person being assigned to the task will have a certain skill level. A less skilled person can be expected to take longer at that activity.

5. The Microsoft Project computer program can be applied to the other fields of work such as production planning and scheduling in terms of economic batch quantity and lot size product. The other field such as machine installation or building construction can be applied, too.

6. In this research, Microsoft Project 98, program computer was used to assist in gathering and analyzing information. However, this program is developed from Microsoft Project98 to Microsoft Project 2000. The new version has been launched into the market already.

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Appendices

Appendix A
(Before leveling)

Critical Tasks
relocate1

ID	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1	Meeting to assign the responsibility	1 day	Mon 4/6/01	Mon 4/6/01		COE
	ID — Successor Name — Type — Lag					
	2 — Drawing survey and prepare the purchase order for equipment — FS — 0 days					
	6 — Cleare the moving way inside factory — FS — 0 days					
	13 — Drawing and utility survey in C plant — FS — 0 days					
	15 — Area clearing — FS — 0 days					
2	Drawing survey and prepare the purchase order for equipment	2 days	Tue 5/6/01	Wed 6/6/01	1	ES.e,MS.e
	ID — Successor Name — Type — Lag					
	3 — Procurement for equipment — FS — 0 days					
3	Procurement for equipment	7 days	Thu 7/6/01	Fri 15/6/01	2	COP,PS.p
	ID — Successor Name — Type — Lag					
	4 — Preparation step before unlock machine — FS — 0 days					
	10 — Take out utility system and unlock the water treatment equipment — FS — 0 days					
	16 — Wire way from MDB and rack making — FS — 0 days					
	17 — Electric control cabinet making — FS — 0 days					
	18 — Filling room construction — FS — 0 days					
	20 — Piping making from water treatment and air compressor to production — FS — 0 days					
	21 — Marking centre for major machine and tanks — FS — 0 days					
18	Filling room construction	18 days	Mon 18/6/01	Wed 11/7/01	14,15,3	Sub4.a,COA
	ID — Successor Name — Type — Lag					
	19 — Floor surface making (stone hard coated) — FS — 0 days					
	21 — Marking centre for major machine and tanks — FS — 0 days					
19	Floor surface making (stone hard coated)	10 days	Thu 12/7/01	Wed 25/7/01	18	Sub5.a,EG.a
	ID — Successor Name — Type — Lag					
	21 — Marking centre for major machine and tanks — FS — 0 days					
21	Marking centre for major machine and tanks	1 day	Thu 26/7/01	Thu 26/7/01	18,19,3	MS.I,ME.I[2]
	ID — Successor Name — Type — Lag					
	22 — Machine placing and alignment — FS — 0 days					
	25 — Tank placing and connect other equipment — FS — 0 days					
22	Machine placing and alignment	2 days	Fri 27/7/01	Mon 30/7/01	21,9	MS.I,EG.I,ME.I[2],MO.I[3]
	ID — Successor Name — Type — Lag					
	23 — Transmission system placing and alignment — FS — 0 days					
23	Transmission system placing and alignment	6 days	Tue 31/7/01	Thu 9/8/01	22	MS.I,EG.I,ME.I[2],MO.I[3]
	ID — Successor Name — Type — Lag					
	24 — Connect Electric system and piping system to the production line — FS — 0 days					
24	Connect Electric system and piping system to the production line	4 days	Fri 10/8/01	Wed 15/8/01	16,17,20,23	MS.I,EG.I,EL.I[2],ME.I[2],MC
	ID — Successor Name — Type — Lag					
	27 — Test Run — FS — 0 days					
27	Test Run	3 days	Thu 16/8/01	Mon 20/8/01	24,26	CO!,MS.I,ES.I,EG.I,MO.I[4],(
	ID — Successor Name — Type — Lag					
	28 — Production — FS — 0 days					
28	Production	1 day	Tue 21/8/01	Tue 21/8/01	27	ES.I,MO.I[9],QC.I

Base Calendar
relocate1

BASE CALENDAR: Standard	
Day	Hours
Monday	8:00 - 12:00, 13:00 - 17:00
Tuesday	8:00 - 12:00, 13:00 - 17:00
Wednesday	8:00 - 12:00, 13:00 - 17:00
Thursday	8:00 - 12:00, 13:00 - 17:00
Friday	8:00 - 12:00, 13:00 - 17:00
Saturday	Nonworking
Sunday	Nonworking
Exceptions:	None

ID		Resource Name	Work
1		COE	8 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
1	Meeting to assign the responsibility	1	8 hrs	0 days	Mon 4/6/01	Mon 4/6/01

2		ES.e	96 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
2	Drawing survey and prepare the purchase order for equipment	1	16 hrs	0 days	Tue 5/6/01	Wed 6/6/01
4	Preparation step before unlock machine	1	24 hrs	0 days	Mon 18/6/01	Wed 20/6/01
5	Remove or unlock machine compositions and classify in each set	1	48 hrs	0 days	Thu 21/6/01	Thu 28/6/01
10	Take out utility system and unlock the water treatment equipment	1	8 hrs	0 days	Mon 18/6/01	Mon 18/6/01

3		MS.e	112 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
2	Drawing survey and prepare the purchase order for equipment	1	16 hrs	0 days	Tue 5/6/01	Wed 6/6/01
4	Preparation step before unlock machine	1	24 hrs	0 days	Mon 18/6/01	Wed 20/6/01
5	Remove or unlock machine compositions and classify in each set	1	48 hrs	0 days	Thu 21/6/01	Thu 28/6/01
7	Wall opening	1	16 hrs	0 days	Fri 29/6/01	Mon 2/7/01
10	Take out utility system and unlock the water treatment equipment	1	8 hrs	0 days	Mon 18/6/01	Mon 18/6/01

4		COP	56 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
3	Procurement for equipment	1	56 hrs	0 days	Thu 7/6/01	Fri 15/6/01

5		PS.p	64 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
3	Procurement for equipment	1	56 hrs	0 days	Thu 7/6/01	Fri 15/6/01
6	Cleare the moving way inside factory	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01

6		EL.e	128 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
4	Preparation step before unlock machine	2	24 hrs	0 days	Mon 18/6/01	Tue 19/6/01
5	Remove or unlock machine compositions and classify in each set	2	96 hrs	0 days	Thu 21/6/01	Thu 28/6/01
10	Take out utility system and unlock the water treatment equipment	1	8 hrs	0 days	Mon 18/6/01	Mon 18/6/01

7		ME.e	240 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
4	Preparation step before unlock machine	3	24 hrs	0 days	Mon 18/6/01	Mon 18/6/01
5	Remove or unlock machine compositions and classify in each set	3	144 hrs	0 days	Thu 21/6/01	Thu 28/6/01
7	Wall opening	4	64 hrs	0 days	Fri 29/6/01	Mon 2/7/01
10	Take out utility system and unlock the water treatment equipment	1	8 hrs	0 days	Mon 18/6/01	Mon 18/6/01

8		MO.e	176 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
5	Remove or unlock machine compositions and classify in each set	3	144 hrs	0 days	Thu 21/6/01	Thu 28/6/01
7	Wall opening	2	32 hrs	0 days	Fri 29/6/01	Mon 2/7/01

ID		Resource Name	Work
9		FD.p	16 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
6	Cleare the moving way inside factory	2	16 hrs	0 days	Tue 5/6/01	Tue 5/6/01

10		COT	16 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01
11	Move water treatment equipment from floor to truck	1	8 hrs	0 days	Tue 19/6/01	Tue 19/6/01

11		TS.t	48 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01
9	Transportation machine from A plant to C plant	1	16 hrs	0 days	Wed 4/7/01	Thu 5/7/01
11	Move water treatment equipment from floor to truck	1	8 hrs	0 days	Tue 19/6/01	Tue 19/6/01
12	Transportation water treatment system from A plant to C plant	1	16 hrs	0 days	Wed 20/6/01	Thu 21/6/01

12		FD.t	32 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	2	16 hrs	0 days	Tue 3/7/01	Tue 3/7/01
11	Move water treatment equipment from floor to truck	2	16 hrs	0 days	Tue 19/6/01	Tue 19/6/01

13		ME.t	32 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	2	16 hrs	0 days	Tue 3/7/01	Tue 3/7/01
11	Move water treatment equipment from floor to truck	2	16 hrs	0 days	Tue 19/6/01	Tue 19/6/01

14		MO.t	64 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	4	32 hrs	0 days	Tue 3/7/01	Tue 3/7/01
11	Move water treatment equipment from floor to truck	4	32 hrs	0 days	Tue 19/6/01	Tue 19/6/01

15		Sub1.t	32 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
9	Transportation machine from A plant to C plant	1	16 hrs	0 days	Wed 4/7/01	Thu 5/7/01
12	Transportation water treatment system from A plant to C plant	1	16 hrs	0 days	Wed 20/6/01	Thu 21/6/01

16		COA	144 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
18	Filling room construction	1	144 hrs	0 days	Mon 18/6/01	Wed 11/7/01

17		EG.a	104 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
13	Drawing and utility survey in C plant	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01
14	Design utility and prepare the PO for equipment	1	16 hrs	0 days	Wed 6/6/01	Thu 7/6/01
19	Floor surface making (stone hard coated)	1	80 hrs	0 days	Thu 12/7/01	Wed 25/7/01

ID	Resource Name	Work
18	ES.a	40 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
13	Drawing and utility survey in C plant	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01
14	Design utility and prepare the PO for equipment	1	16 hrs	0 days	Wed 6/6/01	Thu 7/6/01
16	Wire way from MDB and rack making	1	16 hrs	0 days	Mon 18/6/01	Tue 19/6/01

19	MS.a	48 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
15	Area clearing	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01
20	Piping making from water treatment and air compressor to production	1	40 hrs	0 days	Mon 18/6/01	Fri 22/6/01

20	ME.a	120 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
20	Piping making from water treatment and air compressor to production	3	120 hrs	0 days	Mon 18/6/01	Fri 22/6/01

21	EL.a	0 hrs
22	FD.a	8 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
15	Area clearing	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01

23	Sub2.a	16 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
16	Wire way from MDB and rack making	1	16 hrs	0 days	Mon 18/6/01	Tue 19/6/01

24	Sub3.a	112 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
17	Electric control cabinet making	1	112 hrs	0 days	Mon 18/6/01	Thu 5/7/01

25	Sub4.a	144 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
18	Filling room construction	1	144 hrs	0 days	Mon 18/6/01	Wed 11/7/01

26	Sub5.a	80 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
19	Floor surface making (stone hard coated)	1	80 hrs	0 days	Thu 12/7/01	Wed 25/7/01

27	PI.a	40 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
20	Piping making from water treatment and air compressor to production	1	40 hrs	0 days	Mon 18/6/01	Fri 22/6/01

28	COI	24 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
27	Test Run	1	24 hrs	0 days	Thu 16/8/01	Mon 20/8/01

29	MS.I	160 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
21	Marking centre for major machine and tanks	1	8 hrs	0 days	Thu 26/7/01	Thu 26/7/01
22	Machine placing and alignment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01

ID		Resource Name	Work

"MS.I" continued

ID	Task Name	Units	Work	Delay	Start	Finish
23	Transmission system placing and alignment	1	64 hrs	0 days	Tue 31/7/01	Thu 9/8/01
24	Connect Electric system and piping system to the production line	1	32 hrs	0 days	Fri 10/8/01	Wed 15/8/01
25	Tank placing and connect other equipment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01
27	Test Run	1	24 hrs	0 days	Thu 16/8/01	Mon 20/8/01

30 ES.I 48 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
26	Electric system and piping connection	1	16 hrs	0 days	Tue 31/7/01	Wed 1/8/01
27	Test Run	1	24 hrs	0 days	Thu 16/8/01	Mon 20/8/01
28	Production	1	8 hrs	0 days	Tue 21/8/01	Tue 21/8/01

31 EG.I 136 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
22	Machine placing and alignment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01
23	Transmission system placing and alignment	1	64 hrs	0 days	Tue 31/7/01	Thu 9/8/01
24	Connect Electric system and piping system to the production line	1	32 hrs	0 days	Fri 10/8/01	Wed 15/8/01
27	Test Run	1	24 hrs	0 days	Thu 16/8/01	Mon 20/8/01

32 ME.I 272 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
21	Marking centre for major machine and tanks	2	16 hrs	0 days	Thu 26/7/01	Thu 26/7/01
22	Machine placing and alignment	2	32 hrs	0 days	Fri 27/7/01	Mon 30/7/01
23	Transmission system placing and alignment	2	128 hrs	0 days	Tue 31/7/01	Thu 9/8/01
24	Connect Electric system and piping system to the production line	2	64 hrs	0 days	Fri 10/8/01	Wed 15/8/01
25	Tank placing and connect other equipment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01
26	Electric system and piping connection	1	16 hrs	0 days	Tue 31/7/01	Wed 1/8/01

33 MO.I 536 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
22	Machine placing and alignment	3	48 hrs	0 days	Fri 27/7/01	Mon 30/7/01
23	Transmission system placing and alignment	3	192 hrs	0 days	Tue 31/7/01	Thu 9/8/01
24	Connect Electric system and piping system to the production line	3	96 hrs	0 days	Fri 10/8/01	Wed 15/8/01
25	Tank placing and connect other equipment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01
26	Electric system and piping connection	1	16 hrs	0 days	Tue 31/7/01	Wed 1/8/01
27	Test Run	4	96 hrs	0 days	Thu 16/8/01	Mon 20/8/01
28	Production	9	72 hrs	0 days	Tue 21/8/01	Tue 21/8/01

34 EL.I 80 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
24	Connect Electric system and piping system to the production line	2	64 hrs	0 days	Fri 10/8/01	Wed 15/8/01
26	Electric system and piping connection	1	16 hrs	0 days	Tue 31/7/01	Wed 1/8/01

35 QC.I 56 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
27	Test Run	2	48 hrs	0 days	Thu 16/8/01	Mon 20/8/01
28	Production	1	8 hrs	0 days	Tue 21/8/01	Tue 21/8/01

Budget Report
relocate1

ID	Task Name	Fixed Cost	Fixed Cost Accrual	Total Cost	Baseline	Variance	Actual	Remaining
18	Filling room construction	฿0.00	Prorated	฿4,829,448.00	฿0.00	฿4,829,448.00	฿0.00	฿4,829,448.00
19	Floor surface making (stone hard coate	฿0.00	Prorated	฿1,926,820.00	฿0.00	฿1,926,820.00	฿0.00	฿1,926,820.00
16	Wire way from MDB and rack making	฿0.00	Prorated	฿461,090.00	฿0.00	฿461,090.00	฿0.00	฿461,090.00
20	Piping making from water treatment an	฿0.00	Prorated	฿264,585.00	฿0.00	฿264,585.00	฿0.00	฿264,585.00
17	Electric control cabinet making	฿0.00	Prorated	฿180,000.00	฿0.00	฿180,000.00	฿0.00	฿180,000.00
23	Transmission system placing and align	฿0.00	Prorated	฿23,272.00	฿0.00	฿23,272.00	฿0.00	฿23,272.00
5	Remove or unlock machine compositio	฿0.00	Prorated	฿23,184.00	฿0.00	฿23,184.00	฿0.00	฿23,184.00
9	Transportation machine from A plant to	฿0.00	Prorated	฿16,090.00	฿0.00	฿16,090.00	฿0.00	฿16,090.00
12	Transportation water treatment system	฿0.00	Prorated	฿16,090.00	฿0.00	฿16,090.00	฿0.00	฿16,090.00
27	Test Run	฿0.00	Prorated	฿15,948.00	฿0.00	฿15,948.00	฿0.00	฿15,948.00
3	Procurement for equipment	฿0.00	Prorated	฿15,267.00	฿0.00	฿15,267.00	฿0.00	฿15,267.00
24	Connect Electric system and piping sys	฿0.00	Prorated	฿14,548.00	฿0.00	฿14,548.00	฿0.00	฿14,548.00
22	Machine placing and alignment	฿0.00	Prorated	฿5,818.00	฿0.00	฿5,818.00	฿0.00	฿5,818.00
4	Preparation step before unlock machin	฿0.00	Prorated	฿5,454.00	฿0.00	฿5,454.00	฿0.00	฿5,454.00
7	Wall opening	฿0.00	Prorated	฿5,274.00	฿0.00	฿5,274.00	฿0.00	฿5,274.00
8	Move machines from floor to truck	฿0.00	Prorated	฿4,727.00	฿0.00	฿4,727.00	฿0.00	฿4,727.00
11	Move water treatment equipment from	฿0.00	Prorated	฿4,727.00	฿0.00	฿4,727.00	฿0.00	฿4,727.00
28	Production	฿0.00	Prorated	฿3,725.00	฿0.00	฿3,725.00	฿0.00	฿3,725.00
26	Electric system and piping connection	฿0.00	Prorated	฿3,182.00	฿0.00	฿3,182.00	฿0.00	฿3,182.00
14	Design utility and prepare the PO for e	฿0.00	Prorated	฿2,454.00	฿0.00	฿2,454.00	฿0.00	฿2,454.00
25	Tank placing and connect other equipn	฿0.00	Prorated	฿2,454.00	฿0.00	฿2,454.00	฿0.00	฿2,454.00
2	Drawing survey and prepare the purch	฿0.00	Prorated	฿2,180.00	฿0.00	฿2,180.00	฿0.00	฿2,180.00
10	Take out utility system and unlock the v	฿0.00	Prorated	฿1,818.00	฿0.00	฿1,818.00	฿0.00	฿1,818.00
1	Meeting to assign the responsibility	฿0.00	Prorated	฿1,636.00	฿0.00	฿1,636.00	฿0.00	฿1,636.00
21	Marking centre for major machine and	฿0.00	Prorated	฿1,273.00	฿0.00	฿1,273.00	฿0.00	฿1,273.00
13	Drawing and utility survey in C plant	฿0.00	Prorated	฿1,227.00	฿0.00	฿1,227.00	฿0.00	฿1,227.00
6	Cleare the moving way inside factory	฿0.00	Prorated	฿1,091.00	฿0.00	฿1,091.00	฿0.00	฿1,091.00
15	Area clearing	฿0.00	Prorated	฿818.00	฿0.00	฿818.00	฿0.00	฿818.00
		฿0.00		**฿7,834,200.00**	**฿0.00**	**฿7,834,200.00**	**฿0.00**	**฿7,834,200.00**

June 2001

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
				1	2	3
4	5	6	7	8	9	10
Meeting to assign the responsibility, 1	Drawing survey and prepare the purchase order for equipment, 2 days			Procurement for equipment, 7 days		
	Cleare the moving way inside factory,	Design utility and prepare the PO for equipment, 2 days				
	Drawing and utility survey in C plant, 1					
	Area clearing, 1 day					
11	12	13	14	15	16	17
	Procurement for equipment, 7 days					
18	19	20	21	22	23	24
	Preparation step before unlock machine, 3 days			Remove or unlock machine compositions and classify in each set , 6 days		
Take out utility system and unlock the	Move water treatment equipment from	Transportation water treatment system from A plant to C plant, 2 days				
	Wire way from MDB and rack making, 2 days					
			Electric control cabinet making, 14 days			
			Filling room construction, 18 days			
			Piping making from water treatment and air compressor to production, 5 days			
25	26	27	28	29	30	
	Remove or unlock machine compositions and classify in each set , 6 days				Wall opening, 2 days	
			Electric control cabinet making, 14 days			
			Filling room construction, 18 days			

July 2001

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
						1
				Wall opening, 2 days		
Electric control cabinet making, 14 days						
Filling room construction, 18 days						
2	3	4	5	6	7	8
Wall opening, 2 days	Move machines from floor to truck, 1	Transportation machine from A plant to C plant, 2 days				
Electric control cabinet making, 14 days						
Filling room construction, 18 days						
9	10	11	12	13	14	15
Filling room construction, 18 days						
			Floor surface making (stone hard coated), 10 days			
16	17	18	19	20	21	22
Floor surface making (stone hard coated), 10 days						
23	24	25	26	27	28	29
			Marking centre for major machine and	Machine placing and alignment, 2 days		
				Tank placing and connect other equipment, 2 days		
Floor surface making (stone hard coated), 10 days						
30	31					
Machine placing and alignment, 2 day	Transmission system placing and alignment, 8 days					
Tank placing and connect other equip	Electric system and piping connection, 2 days					

August 2001

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
		1	2	3	4	5
	Transmission system placing and alignment, 6 days					
	Electric system and piping connection, 2 days					
6	7	8	9	10	11	12
Transmission system placing and alignment, 8 days				Connect Electric system and piping system to the production line, 4 days		
13	14	15	16	17	18	19
Connect Electric system and piping system to the production line, 4 days			Test Run, 3 days			
20	21	22	23	24	25	26
Test Run, 3 days	Production, 1 day					
27	28	29	30	31		

Appendix B
(After leveling)

ID	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1	Meeting to assign the responsibility	1 day	Mon 4/6/01	Mon 4/6/01		COE

ID	Successor Name	Type	Lag
2	Drawing survey and prepare the purchase order for equipment	FS	0 days
6	Cleare the moving way inside factory	FS	0 days
13	Drawing and utility survey in C plant	FS	0 days
15	Area clearing	FS	0 days

2	Drawing survey and prepare the purchase order for equipment	2 days	Tue 5/6/01	Wed 6/6/01	1	ES.e,MS.e

ID	Successor Name	Type	Lag
3	Procurement for equipment	FS	0 days

3	Procurement for equipment	7 days	Thu 7/6/01	Fri 15/6/01	2	COP,PS.p

ID	Successor Name	Type	Lag
4	Preparation step before unlock machine	FS	0 days
10	Take out utility system and unlock the water treatment equipment	FS	0 days
16	Wire way from MDB and rack making	FS	0 days
17	Electric control cabinet making	FS	0 days
18	Filling room construction	FS	0 days
20	Piping making from water treatment and air compressor to production	FS	0 days
21	Marking centre for major machine and tanks	FS	0 days

18	Filling room construction	18 days	Mon 18/6/01	Wed 11/7/01	14,15,3	Sub4.a,COA

ID	Successor Name	Type	Lag
19	Floor surface making (stone hard coated)	FS	0 days
21	Marking centre for major machine and tanks	FS	0 days

19	Floor surface making (stone hard coated)	10 days	Thu 12/7/01	Wed 25/7/01	18	Sub5.a,EG.a

ID	Successor Name	Type	Lag
21	Marking centre for major machine and tanks	FS	0 days

21	Marking centre for major machine and tanks	1 day	Thu 26/7/01	Thu 26/7/01	18,19,3	MS.I,ME.I[2]

ID	Successor Name	Type	Lag
22	Machine placing and alignment	FS	0 days
25	Tank placing and connect other equipment	FS	0 days

22	Machine placing and alignment	2 days	Fri 27/7/01	Mon 30/7/01	21,9	MS.I,EG.I,ME.I[2],MO.I[3]

ID	Successor Name	Type	Lag
23	Transmission system placing and alignment	FS	0 days

23	Transmission system placing and alignment	8 days	Tue 31/7/01	Thu 9/8/01	22	MS.I,EG.I,ME.I[2],MO.I[3]

ID	Successor Name	Type	Lag
24	Connect Electric system and piping system to the production line	FS	0 days

24	Connect Electric system and piping system to the production line	4 days	Fri 10/8/01	Wed 15/8/01	16,17,20,23	MS.I,EG.I,EL.I[2],ME.I[2],MO

ID	Successor Name	Type	Lag
27	Test Run	FS	0 days

27	Test Run	3 days	Thu 16/8/01	Mon 20/8/01	24,26	COI,MS.I,ES.I,EG.I,MO.I[4],(

ID	Successor Name	Type	Lag
28	Production	FS	0 days

28	Production	1 day	Tue 21/8/01	Tue 21/8/01	27	ES.I,MO.I[9],QC.I

Base Calendar
relocate-m

BASE CALENDAR: Day	Standard Hours
Monday	8:00 - 12:00, 13:00 - 17:00
Tuesday	8:00 - 12:00, 13:00 - 17:00
Wednesday	8:00 - 12:00, 13:00 - 17:00
Thursday	8:00 - 12:00, 13:00 - 17:00
Friday	8:00 - 12:00, 13:00 - 17:00
Saturday	Nonworking
Sunday	Nonworking
Exceptions:	None

Budget Report
relocate-m

ID	Task Name	Fixed Cost	Fixed Cost Accrual	Total Cost	Baseline	Variance	Actual	Remaining
18	Filling room construction	฿0.00	Prorated	฿4,829,448.00	฿0.00	฿4,829,448.00	฿0.00	฿4,829,448.00
19	Floor surface making (stone hard coat	฿0.00	Prorated	฿1,926,820.00	฿0.00	฿1,926,820.00	฿0.00	฿1,926,820.00
16	Wire way from MDB and rack making	฿0.00	Prorated	฿461,090.00	฿0.00	฿461,090.00	฿0.00	฿461,090.00
20	Piping making from water treatment an	฿0.00	Prorated	฿264,585.00	฿0.00	฿264,585.00	฿0.00	฿264,585.00
17	Electric control cabinet making	฿0.00	Prorated	฿180,000.00	฿0.00	฿180,000.00	฿0.00	฿180,000.00
23	Transmission system placing and align	฿0.00	Prorated	฿23,272.00	฿0.00	฿23,272.00	฿0.00	฿23,272.00
5	Remove or unlock machine compositio	฿0.00	Prorated	฿23,184.00	฿0.00	฿23,184.00	฿0.00	฿23,184.00
9	Transportation machine from A plant to	฿0.00	Prorated	฿16,090.00	฿0.00	฿16,090.00	฿0.00	฿16,090.00
12	Transportation water treatment system	฿0.00	Prorated	฿16,090.00	฿0.00	฿16,090.00	฿0.00	฿16,090.00
27	Test Run	฿0.00	Prorated	฿15,948.00	฿0.00	฿15,948.00	฿0.00	฿15,948.00
3	Procurement for equipment	฿0.00	Prorated	฿15,267.00	฿0.00	฿15,267.00	฿0.00	฿15,267.00
24	Connect Electric system and piping sy	฿0.00	Prorated	฿14,548.00	฿0.00	฿14,548.00	฿0.00	฿14,548.00
22	Machine placing and alignment	฿0.00	Prorated	฿5,818.00	฿0.00	฿5,818.00	฿0.00	฿5,818.00
4	Preparation step before unlock machin	฿0.00	Prorated	฿5,454.00	฿0.00	฿5,454.00	฿0.00	฿5,454.00
7	Wall opening	฿0.00	Prorated	฿5,274.00	฿0.00	฿5,274.00	฿0.00	฿5,274.00
8	Move machines from floor to truck	฿0.00	Prorated	฿4,727.00	฿0.00	฿4,727.00	฿0.00	฿4,727.00
11	Move water treatment equipment from	฿0.00	Prorated	฿4,727.00	฿0.00	฿4,727.00	฿0.00	฿4,727.00
28	Production	฿0.00	Prorated	฿3,725.00	฿0.00	฿3,725.00	฿0.00	฿3,725.00
26	Electric system and piping connection	฿0.00	Prorated	฿3,182.00	฿0.00	฿3,182.00	฿0.00	฿3,182.00
14	Design utility and prepare the PO for e	฿0.00	Prorated	฿2,454.00	฿0.00	฿2,454.00	฿0.00	฿2,454.00
25	Tank placing and connect other equipr	฿0.00	Prorated	฿2,454.00	฿0.00	฿2,454.00	฿0.00	฿2,454.00
2	Drawing survey and prepare the purch	฿0.00	Prorated	฿2,180.00	฿0.00	฿2,180.00	฿0.00	฿2,180.00
10	Take out utility system and unlock the	฿0.00	Prorated	฿1,818.00	฿0.00	฿1,818.00	฿0.00	฿1,818.00
1	Meeting to assign the responsibility	฿0.00	Prorated	฿1,636.00	฿0.00	฿1,636.00	฿0.00	฿1,636.00
21	Marking centre for major machine and	฿0.00	Prorated	฿1,273.00	฿0.00	฿1,273.00	฿0.00	฿1,273.00
13	Drawing and utility survey in C plant	฿0.00	Prorated	฿1,227.00	฿0.00	฿1,227.00	฿0.00	฿1,227.00
6	Cleare the moving way inside factory	฿0.00	Prorated	฿1,091.00	฿0.00	฿1,091.00	฿0.00	฿1,091.00
15	Area clearing	฿0.00	Prorated	฿818.00	฿0.00	฿818.00	฿0.00	฿818.00
		฿0.00		**฿7,834,200.00**	**฿0.00**	**฿7,834,200.00**	**฿0.00**	**฿7,834,200.00**

ID	Resource Name	Work
1	COE	8 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
1	Meeting to assign the responsibility	1	8 hrs	0 days	Mon 4/6/01	Mon 4/6/01

2	ES.e	96 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
2	Drawing survey and prepare the purchase order for equipment	1	16 hrs	0 days	Tue 5/6/01	Wed 6/6/01
4	Preparation step before unlock machine	1	24 hrs	0 days	Mon 18/6/01	Wed 20/6/01
5	Remove or unlock machine compositions and classify in each set	1	48 hrs	0 days	Thu 21/6/01	Thu 28/6/01
10	Take out utility system and unlock the water treatment equipment	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01

3	MS.e	112 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
2	Drawing survey and prepare the purchase order for equipment	1	16 hrs	0 days	Tue 5/6/01	Wed 6/6/01
4	Preparation step before unlock machine	1	24 hrs	0 days	Mon 18/6/01	Wed 20/6/01
5	Remove or unlock machine compositions and classify in each set	1	48 hrs	0 days	Thu 21/6/01	Thu 28/6/01
7	Wall opening	1	16 hrs	0 days	Fri 29/6/01	Mon 2/7/01
10	Take out utility system and unlock the water treatment equipment	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01

4	COP	56 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
3	Procurement for equipment	1	56 hrs	0 days	Thu 7/6/01	Fri 15/6/01

5	PS.p	64 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
3	Procurement for equipment	1	56 hrs	0 days	Thu 7/6/01	Fri 15/6/01
6	Cleare the moving way inside factory	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01

6	EL.e	128 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
4	Preparation step before unlock machine	2	24 hrs	0 days	Mon 18/6/01	Tue 19/6/01
5	Remove or unlock machine compositions and classify in each set	2	96 hrs	0 days	Thu 21/6/01	Thu 28/6/01
10	Take out utility system and unlock the water treatment equipment	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01

7	ME.e	240 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
4	Preparation step before unlock machine	3	24 hrs	0 days	Mon 18/6/01	Mon 18/6/01
5	Remove or unlock machine compositions and classify in each set	3	144 hrs	0 days	Thu 21/6/01	Thu 28/6/01
7	Wall opening	4	64 hrs	0 days	Fri 29/6/01	Mon 2/7/01
10	Take out utility system and unlock the water treatment equipment	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01

8	MO.e	176 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
5	Remove or unlock machine compositions and classify in each set	3	144 hrs	0 days	Thu 21/6/01	Thu 28/6/01
7	Wall opening	2	32 hrs	0 days	Fri 29/6/01	Mon 2/7/01

ID	Resource Name	Work
9	FD.p	16 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
6	Cleare the moving way inside factory	2	16 hrs	0 days	Tue 5/6/01	Tue 5/6/01

10	COT	16 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01
11	Move water treatment equipment from floor to truck	1	8 hrs	0 days	Fri 6/7/01	Fri 6/7/01

11	TS.t	48 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01
9	Transportation machine from A plant to C plant	1	16 hrs	0 days	Wed 4/7/01	Thu 5/7/01
11	Move water treatment equipment from floor to truck	1	8 hrs	0 days	Fri 6/7/01	Fri 6/7/01
12	Transportation water treatment system from A plant to C plant	1	16 hrs	0 days	Mon 9/7/01	Tue 10/7/01

12	FD.t	32 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	2	16 hrs	0 days	Tue 3/7/01	Tue 3/7/01
11	Move water treatment equipment from floor to truck	2	16 hrs	0 days	Fri 6/7/01	Fri 6/7/01

13	ME.t	32 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	2	16 hrs	0 days	Tue 3/7/01	Tue 3/7/01
11	Move water treatment equipment from floor to truck	2	16 hrs	0 days	Fri 6/7/01	Fri 6/7/01

14	MO.t	64 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	4	32 hrs	0 days	Tue 3/7/01	Tue 3/7/01
11	Move water treatment equipment from floor to truck	4	32 hrs	0 days	Fri 6/7/01	Fri 6/7/01

15	Sub1.t	32 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
9	Transportation machine from A plant to C plant	1	16 hrs	0 days	Wed 4/7/01	Thu 5/7/01
12	Transportation water treatment system from A plant to C plant	1	16 hrs	0 days	Mon 9/7/01	Tue 10/7/01

16	COA	144 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
18	Filling room construction	1	144 hrs	0 days	Mon 18/6/01	Wed 11/7/01

17	EG.a	104 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
13	Drawing and utility survey in C plant	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01
14	Design utility and prepare the PO for equipment	1	16 hrs	0 days	Wed 6/6/01	Thu 7/6/01
19	Floor surface making (stone hard coated)	1	80 hrs	0 days	Thu 12/7/01	Wed 25/7/01

ID	Resource Name	Work
18	ES.a	40 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
13	Drawing and utility survey in C plant	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01
14	Design utility and prepare the PO for equipment	1	16 hrs	0 days	Wed 6/6/01	Thu 7/6/01
16	Wire way from MDB and rack making	1	16 hrs	0 days	Mon 18/6/01	Tue 19/6/01

19	MS.a	48 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
15	Area clearing	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01
20	Piping making from water treatment and air compressor to production	1	40 hrs	0 days	Mon 18/6/01	Fri 22/6/01

20	ME.a	120 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
20	Piping making from water treatment and air compressor to production	3	120 hrs	0 days	Mon 18/6/01	Fri 22/6/01

21	EL.a	0 hrs
22	FD.a	8 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
15	Area clearing	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01

23	Sub2.a	16 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
16	Wire way from MDB and rack making	1	16 hrs	0 days	Mon 18/6/01	Tue 19/6/01

24	Sub3.a	112 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
17	Electric control cabinet making	1	112 hrs	0 days	Mon 18/6/01	Thu 5/7/01

25	Sub4.a	144 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
18	Filling room construction	1	144 hrs	0 days	Mon 18/6/01	Wed 11/7/01

26	Sub5.a	80 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
19	Floor surface making (stone hard coated)	1	80 hrs	0 days	Thu 12/7/01	Wed 25/7/01

27	Pi.a	40 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
20	Piping making from water treatment and air compressor to production	1	40 hrs	0 days	Mon 18/6/01	Fri 22/6/01

28	COI	24 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
27	Test Run	1	24 hrs	0 days	Thu 16/8/01	Mon 20/8/01

29	MS.I	160 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
21	Marking centre for major machine and tanks	1	8 hrs	0 days	Thu 26/7/01	Thu 26/7/01
22	Machine placing and alignment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01

ID		Resource Name	Work

"MS.I" continued

ID	Task Name	Units	Work	Delay	Start	Finish
23	Transmission system placing and alignment	1	64 hrs	0 days	Tue 31/7/01	Thu 9/8/01
24	Connect Electric system and piping system to the production line	1	32 hrs	0 days	Fri 10/8/01	Wed 15/8/01
25	Tank placing and connect other equipment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01
27	Test Run	1	24 hrs	0 days	Thu 16/8/01	Mon 20/8/01

30 ES.I 48 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
26	Electric system and piping connection	1	16 hrs	0 days	Tue 31/7/01	Wed 1/8/01
27	Test Run	1	24 hrs	0 days	Thu 16/8/01	Mon 20/8/01
28	Production	1	8 hrs	0 days	Tue 21/8/01	Tue 21/8/01

31 EG.I 136 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
22	Machine placing and alignment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01
23	Transmission system placing and alignment	1	64 hrs	0 days	Tue 31/7/01	Thu 9/8/01
24	Connect Electric system and piping system to the production line	1	32 hrs	0 days	Fri 10/8/01	Wed 15/8/01
27	Test Run	1	24 hrs	0 days	Thu 16/8/01	Mon 20/8/01

32 ME.I 272 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
21	Marking centre for major machine and tanks	2	16 hrs	0 days	Thu 26/7/01	Thu 26/7/01
22	Machine placing and alignment	2	32 hrs	0 days	Fri 27/7/01	Mon 30/7/01
23	Transmission system placing and alignment	2	128 hrs	0 days	Tue 31/7/01	Thu 9/8/01
24	Connect Electric system and piping system to the production line	2	64 hrs	0 days	Fri 10/8/01	Wed 15/8/01
25	Tank placing and connect other equipment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01
26	Electric system and piping connection	1	16 hrs	0 days	Tue 31/7/01	Wed 1/8/01

33 MO.I 536 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
22	Machine placing and alignment	3	48 hrs	0 days	Fri 27/7/01	Mon 30/7/01
23	Transmission system placing and alignment	3	192 hrs	0 days	Tue 31/7/01	Thu 9/8/01
24	Connect Electric system and piping system to the production line	3	96 hrs	0 days	Fri 10/8/01	Wed 15/8/01
25	Tank placing and connect other equipment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01
26	Electric system and piping connection	1	16 hrs	0 days	Tue 31/7/01	Wed 1/8/01
27	Test Run	4	96 hrs	0 days	Thu 16/8/01	Mon 20/8/01
28	Production	9	72 hrs	0 days	Tue 21/8/01	Tue 21/8/01

34 EL.I 80 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
24	Connect Electric system and piping system to the production line	2	64 hrs	0 days	Fri 10/8/01	Wed 15/8/01
26	Electric system and piping connection	1	16 hrs	0 days	Tue 31/7/01	Wed 1/8/01

35 QC.I 56 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
27	Test Run	2	48 hrs	0 days	Thu 16/8/01	Mon 20/8/01
28	Production	1	8 hrs	0 days	Tue 21/8/01	Tue 21/8/01

June 2001

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
				1	2	3
4	5	6	7	8	9	10
Meeting to assign the responsibility, 1	Drawing survey and prepare the purchase order for equipment, 2 days		Procurement for equipment, 7 days			
	Cleare the moving way inside factory,	Design utility and prepare the PO for equipment, 2 days				
	Drawing and utility survey in C plant,					
	Area clearing, 1 day					
11	12	13	14	15	16	17
Procurement for equipment, 7 days						
18	19	20	21	22	23	24
Preparation step before unlock machine, 3 days			Remove or unlock machine compositions and classify in each set , 6 days			
Wire way from MDB and rack making, 2 days						
Electric control cabinet making, 14 days						
Filling room construction, 18 days						
Piping making from water treatment and air compressor to production, 5 days						
25	26	27	28	29	30	
Remove or unlock machine compositions and classify in each set , 6 days				Wall opening, 2 days		
Electric control cabinet making, 14 days						
Filling room construction, 18 days						

July 2001

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
					1	
				Wall opening, 2 days		
Electric control cabinet making, 14 days						
Filling room construction, 18 days						
2	3	4	5	6	7	8
Wall opening, 2 days	Move machines from floor to truck, 1	Transportation machine from A plant to C plant, 2 days				
	Take out utility system and unlock the			Move water treatment equipment fron		
Electric control cabinet making, 14 days						
Filling room construction, 18 days						
9	10	11	12	13	14	15
Transportation water treatment system from A plant to C plant, 2 days						
Filling room construction, 18 days						
			Floor surface making (stone hard coated), 10 days			
16	17	18	19	20	21	22
Floor surface making (stone hard coated), 10 days						
23	24	25	26	27	28	29
			Marking centre for major machine and	Machine placing and alignment, 2 days		
				Tank placing and connect other equipment, 2 days		
Floor surface making (stone hard coated), 10 days						
30	31					
Machine placing and alignment, 2 day	Transmission system placing and alignment, 8 days					
Tank placing and connect other equip	Electric system and piping connection, 2 days					

August 2001

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
		1	2	3	4	5
	Transmission system placing and alignment, 8 days					
	Electric system and piping connection, 2 days					
6	7	8	9	10	11	12
Transmission system placing and alignment, 8 days				Connect Electric system and piping system to the production line, 4 days		
13	14	15	16	17	18	19
Connect Electric system and piping system to the production line, 4 days			Test Run, 3 days			
20	21	22	23	24	25	26
Test Run, 3 days	Production, 1 day					
27	28	29	30	31		

Appendix C
(Expedite project)

ID	Task Name	Duration	Start	Finish	Predecessors	Resource Names
23	Transmission system placing and alignment	6 days	Tue 31/7/01	Tue 7/8/01	22	MS.I,EG.I,ME.I[2],MO.I[3]
	ID: 24 — Successor Name: Connect Electric system and piping system to the production line — Type: FS — Lag: 0 days					
24	Connect Electric system and piping system to the production line	4 days	Wed 8/8/01	Mon 13/8/01	16,17,20,23	MS.I,EG.I,EL.I[2],ME.I[2],MO.
	ID: 27 — Successor Name: Test Run — Type: FS — Lag: 0 days					
27	Test Run	3 days	Tue 14/8/01	Thu 16/8/01	24,26	COI,MS.I,ES.I,EG.I,MO.I[4],C
	ID: 28 — Successor Name: Production — Type: FS — Lag: 0 days					
28	Production	1 day	Fri 17/8/01	Fri 17/8/01	27	ES.I,MO.I[9],QC.I

Base Calendar
leveling-exped2

BASE CALENDAR: Standard	
Day	Hours
Monday	8:00 - 12:00, 13:00 - 17:00
Tuesday	8:00 - 12:00, 13:00 - 17:00
Wednesday	8:00 - 12:00, 13:00 - 17:00
Thursday	8:00 - 12:00, 13:00 - 17:00
Friday	8:00 - 12:00, 13:00 - 17:00
Saturday	Nonworking
Sunday	Nonworking
Exceptions:	None

Budget Report
leveling-exped2

ID	Task Name	Fixed Cost	Fixed Cost Accrual	Total Cost	Baseline	Variance	Actual	Remaining
18	Filling room construction	฿0.00	Prorated	฿4,829,448.00	฿0.00	฿4,829,448.00	฿4,829,448.00	฿0.00
19	Floor surface making (stone hard coate	฿0.00	Prorated	฿1,926,820.00	฿0.00	฿1,926,820.00	฿1,926,820.00	฿0.00
16	Wire way from MDB and rack making	฿0.00	Prorated	฿461,090.00	฿0.00	฿461,090.00	฿461,090.00	฿0.00
20	Piping making from water treatment an	฿0.00	Prorated	฿264,585.00	฿0.00	฿264,585.00	฿264,585.00	฿0.00
17	Electric control cabinet making	฿0.00	Prorated	฿180,000.00	฿0.00	฿180,000.00	฿180,000.00	฿0.00
23	Transmission system placing and align	฿0.00	Prorated	฿28,996.00	฿0.00	฿28,996.00	฿4,363.50	฿24,632.50
5	Remove or unlock machine compositio	฿0.00	Prorated	฿23,184.00	฿0.00	฿23,184.00	฿23,184.00	฿0.00
9	Transportation machine from A plant to	฿0.00	Prorated	฿16,090.00	฿0.00	฿16,090.00	฿16,090.00	฿0.00
12	Transportation water treatment system	฿0.00	Prorated	฿16,090.00	฿0.00	฿16,090.00	฿16,090.00	฿0.00
27	Test Run	฿0.00	Prorated	฿15,948.00	฿0.00	฿15,948.00	฿0.00	฿15,948.00
3	Procurement for equipment	฿0.00	Prorated	฿15,267.00	฿0.00	฿15,267.00	฿15,267.00	฿0.00
24	Connect Electric system and piping sys	฿0.00	Prorated	฿14,548.00	฿0.00	฿14,548.00	฿0.00	฿14,548.00
22	Machine placing and alignment	฿0.00	Prorated	฿5,818.00	฿0.00	฿5,818.00	฿5,818.00	฿0.00
4	Preparation step before unlock machin	฿0.00	Prorated	฿5,454.00	฿0.00	฿5,454.00	฿5,454.00	฿0.00
7	Wall opening	฿0.00	Prorated	฿5,274.00	฿0.00	฿5,274.00	฿5,274.00	฿0.00
8	Move machines from floor to truck	฿0.00	Prorated	฿4,727.00	฿0.00	฿4,727.00	฿4,727.00	฿0.00
11	Move water treatment equipment from	฿0.00	Prorated	฿4,727.00	฿0.00	฿4,727.00	฿4,727.00	฿0.00
28	Production	฿0.00	Prorated	฿3,725.00	฿0.00	฿3,725.00	฿0.00	฿3,725.00
26	Electric system and piping connection	฿0.00	Prorated	฿3,182.00	฿0.00	฿3,182.00	฿3,182.00	฿0.00
14	Design utility and prepare the PO for e	฿0.00	Prorated	฿2,454.00	฿0.00	฿2,454.00	฿2,454.00	฿0.00
25	Tank placing and connect other equipn	฿0.00	Prorated	฿2,454.00	฿0.00	฿2,454.00	฿2,454.00	฿0.00
2	Drawing survey and prepare the purch	฿0.00	Prorated	฿2,180.00	฿0.00	฿2,180.00	฿2,180.00	฿0.00
10	Take out utility system and unlock the v	฿0.00	Prorated	฿1,818.00	฿0.00	฿1,818.00	฿1,818.00	฿0.00
1	Meeting to assign the responsibility	฿0.00	Prorated	฿1,636.00	฿0.00	฿1,636.00	฿1,636.00	฿0.00
21	Marking centre for major machine and	฿0.00	Prorated	฿1,273.00	฿0.00	฿1,273.00	฿1,273.00	฿0.00
13	Drawing and utility survey in C plant	฿0.00	Prorated	฿1,227.00	฿0.00	฿1,227.00	฿1,227.00	฿0.00
6	Cleare the moving way inside factory	฿0.00	Prorated	฿1,091.00	฿0.00	฿1,091.00	฿1,091.00	฿0.00
15	Area clearing	฿0.00	Prorated	฿818.00	฿0.00	฿818.00	฿818.00	฿0.00
		฿0.00		฿7,839,924.00	฿0.00	฿7,839,924.00	฿7,781,070.50	฿58,853.50

ID	Resource Name	Work
1	COE	8 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
1	Meeting to assign the responsibility	1	8 hrs	0 days	Mon 4/6/01	Mon 4/6/01

2	ES.e	96 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
2	Drawing survey and prepare the purchase order for equipment	1	16 hrs	0 days	Tue 5/6/01	Wed 6/6/01
4	Preparation step before unlock machine	1	24 hrs	0 days	Mon 18/6/01	Wed 20/6/01
5	Remove or unlock machine compositions and classify in each set	1	48 hrs	0 days	Thu 21/6/01	Thu 28/6/01
10	Take out utility system and unlock the water treatment equipment	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01

3	MS.e	112 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
2	Drawing survey and prepare the purchase order for equipment	1	16 hrs	0 days	Tue 5/6/01	Wed 6/6/01
4	Preparation step before unlock machine	1	24 hrs	0 days	Mon 18/6/01	Wed 20/6/01
5	Remove or unlock machine compositions and classify in each set	1	48 hrs	0 days	Thu 21/6/01	Thu 28/6/01
7	Wall opening	1	16 hrs	0 days	Fri 29/6/01	Mon 2/7/01
10	Take out utility system and unlock the water treatment equipment	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01

4	COP	56 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
3	Procurement for equipment	1	56 hrs	0 days	Thu 7/6/01	Fri 15/6/01

5	PS.p	64 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
3	Procurement for equipment	1	56 hrs	0 days	Thu 7/6/01	Fri 15/6/01
6	Cleare the moving way inside factory	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01

6	EL.e	128 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
4	Preparation step before unlock machine	2	24 hrs	0 days	Mon 18/6/01	Tue 19/6/01
5	Remove or unlock machine compositions and classify in each set	2	96 hrs	0 days	Thu 21/6/01	Thu 28/6/01
10	Take out utility system and unlock the water treatment equipment	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01

7	ME.e	240 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
4	Preparation step before unlock machine	3	24 hrs	0 days	Mon 18/6/01	Mon 18/6/01
5	Remove or unlock machine compositions and classify in each set	3	144 hrs	0 days	Thu 21/6/01	Thu 28/6/01
7	Wall opening	4	64 hrs	0 days	Fri 29/6/01	Mon 2/7/01
10	Take out utility system and unlock the water treatment equipment	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01

8	MO.e	176 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
5	Remove or unlock machine compositions and classify in each set	3	144 hrs	0 days	Thu 21/6/01	Thu 28/6/01
7	Wall opening	2	32 hrs	0 days	Fri 29/6/01	Mon 2/7/01

ID		Resource Name	Work
9		FD.p	16 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
6	Cleare the moving way inside factory	2	16 hrs	0 days	Tue 5/6/01	Tue 5/6/01

10		COT	16 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01
11	Move water treatment equipment from floor to truck	1	8 hrs	0 days	Fri 6/7/01	Fri 6/7/01

11		TS.t	48 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	1	8 hrs	0 days	Tue 3/7/01	Tue 3/7/01
9	Transportation machine from A plant to C plant	1	16 hrs	0 days	Wed 4/7/01	Thu 5/7/01
11	Move water treatment equipment from floor to truck	1	8 hrs	0 days	Fri 6/7/01	Fri 6/7/01
12	Transportation water treatment system from A plant to C plant	1	16 hrs	0 days	Mon 9/7/01	Tue 10/7/01

12		FD.t	32 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	2	16 hrs	0 days	Tue 3/7/01	Tue 3/7/01
11	Move water treatment equipment from floor to truck	2	16 hrs	0 days	Fri 6/7/01	Fri 6/7/01

13		ME.t	32 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	2	16 hrs	0 days	Tue 3/7/01	Tue 3/7/01
11	Move water treatment equipment from floor to truck	2	16 hrs	0 days	Fri 6/7/01	Fri 6/7/01

14		MO.t	64 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
8	Move machines from floor to truck	4	32 hrs	0 days	Tue 3/7/01	Tue 3/7/01
11	Move water treatment equipment from floor to truck	4	32 hrs	0 days	Fri 6/7/01	Fri 6/7/01

15		Sub1.t	32 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
9	Transportation machine from A plant to C plant	1	16 hrs	0 days	Wed 4/7/01	Thu 5/7/01
12	Transportation water treatment system from A plant to C plant	1	16 hrs	0 days	Mon 9/7/01	Tue 10/7/01

16		COA	144 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
18	Filling room construction	1	144 hrs	0 days	Mon 18/6/01	Wed 11/7/01

17		EG.a	104 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
13	Drawing and utility survey in C plant	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01
14	Design utility and prepare the PO for equipment	1	16 hrs	0 days	Wed 6/6/01	Thu 7/6/01
19	Floor surface making (stone hard coated)	1	80 hrs	0 days	Thu 12/7/01	Wed 25/7/01

ID	Resource Name	Work
18	ES.a	40 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
13	Drawing and utility survey in C plant	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01
14	Design utility and prepare the PO for equipment	1	16 hrs	0 days	Wed 6/6/01	Thu 7/6/01
16	Wire way from MDB and rack making	1	16 hrs	0 days	Mon 18/6/01	Tue 19/6/01

19	MS.a	48 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
15	Area clearing	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01
20	Piping making from water treatment and air compressor to production	1	40 hrs	0 days	Mon 18/6/01	Fri 22/6/01

20	ME.a	120 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
20	Piping making from water treatment and air compressor to production	3	120 hrs	0 days	Mon 18/6/01	Fri 22/6/01

21	EL.a	0 hrs
22	FD.a	8 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
15	Area clearing	1	8 hrs	0 days	Tue 5/6/01	Tue 5/6/01

23	Sub2.a	16 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
16	Wire way from MDB and rack making	1	16 hrs	0 days	Mon 18/6/01	Tue 19/6/01

24	Sub3.a	112 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
17	Electric control cabinet making	1	112 hrs	0 days	Mon 18/6/01	Thu 5/7/01

25	Sub4.a	144 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
18	Filling room construction	1	144 hrs	0 days	Mon 18/6/01	Wed 11/7/01

26	Sub5.a	80 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
19	Floor surface making (stone hard coated)	1	80 hrs	0 days	Thu 12/7/01	Wed 25/7/01

27	PI.a	40 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
20	Piping making from water treatment and air compressor to production	1	40 hrs	0 days	Mon 18/6/01	Fri 22/6/01

28	COI	24 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
27	Test Run	1	24 hrs	0 days	Tue 14/8/01	Thu 16/8/01

29	MS.I	160 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
21	Marking centre for major machine and tanks	1	8 hrs	0 days	Thu 26/7/01	Thu 26/7/01
22	Machine placing and alignment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01

ID		Resource Name	Work

"MS.I" continued

ID	Task Name	Units	Work	Delay	Start	Finish
23	Transmission system placing and alignment	1	64 hrs	0 days	Tue 31/7/01	Wed 1/8/01
24	Connect Electric system and piping system to the production line	1	32 hrs	0 days	Wed 8/8/01	Mon 13/8/01
25	Tank placing and connect other equipment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01
27	Test Run	1	24 hrs	0 days	Tue 14/8/01	Thu 16/8/01

30 ES.I 48 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
26	Electric system and piping connection	1	16 hrs	0 days	Tue 31/7/01	Wed 1/8/01
27	Test Run	1	24 hrs	0 days	Tue 14/8/01	Thu 16/8/01
28	Production	1	8 hrs	0 days	Fri 17/8/01	Fri 17/8/01

31 EG.I 136 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
22	Machine placing and alignment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01
23	Transmission system placing and alignment	1	64 hrs	0 days	Tue 31/7/01	Wed 1/8/01
24	Connect Electric system and piping system to the production line	1	32 hrs	0 days	Wed 8/8/01	Mon 13/8/01
27	Test Run	1	24 hrs	0 days	Tue 14/8/01	Thu 16/8/01

32 ME.I 272 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
21	Marking centre for major machine and tanks	2	16 hrs	0 days	Thu 26/7/01	Thu 26/7/01
22	Machine placing and alignment	2	32 hrs	0 days	Fri 27/7/01	Mon 30/7/01
23	Transmission system placing and alignment	2	128 hrs	0 days	Tue 31/7/01	Mon 6/8/01
24	Connect Electric system and piping system to the production line	2	64 hrs	0 days	Wed 8/8/01	Mon 13/8/01
25	Tank placing and connect other equipment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01
26	Electric system and piping connection	1	16 hrs	0 days	Tue 31/7/01	Wed 1/8/01

33 MO.I 536 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
22	Machine placing and alignment	3	48 hrs	0 days	Fri 27/7/01	Mon 30/7/01
23	Transmission system placing and alignment	3	192 hrs	0 days	Tue 31/7/01	Tue 7/8/01
24	Connect Electric system and piping system to the production line	3	96 hrs	0 days	Wed 8/8/01	Mon 13/8/01
25	Tank placing and connect other equipment	1	16 hrs	0 days	Fri 27/7/01	Mon 30/7/01
26	Electric system and piping connection	1	16 hrs	0 days	Tue 31/7/01	Wed 1/8/01
27	Test Run	4	96 hrs	0 days	Tue 14/8/01	Thu 16/8/01
28	Production	9	72 hrs	0 days	Fri 17/8/01	Fri 17/8/01

34 EL.I 80 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
24	Connect Electric system and piping system to the production line	2	64 hrs	0 days	Wed 8/8/01	Mon 13/8/01
26	Electric system and piping connection	1	16 hrs	0 days	Tue 31/7/01	Wed 1/8/01

35 QC.I 56 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
27	Test Run	2	48 hrs	0 days	Tue 14/8/01	Thu 16/8/01
28	Production	1	8 hrs	0 days	Fri 17/8/01	Fri 17/8/01

June 2001

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
				1	2	3
4	5	6	7	8	9	10
Meeting to assign the responsibility, 1	Drawing survey and prepare the purchase order for equipment, 2 days		Procurement for equipment, 7 days			
	Cleare the moving way inside factory,	Design utility and prepare the PO for equipment, 2 days				
	Drawing and utility survey in C plant,					
	Area clearing, 1 day					
11	12	13	14	15	16	17
Procurement for equipment, 7 days						
18	19	20	21	22	23	24
Preparation step before unlock machine, 3 days			Remove or unlock machine compositions and classify in each set , 6 days			
Wire way from MDB and rack making, 2 days						
Electric control cabinet making, 14 days						
Filling room construction, 18 days						
Piping making from water treatment and air compressor to production, 5 days						
25	26	27	28	29	30	
Remove or unlock machine compositions and classify in each set , 6 days				Wall opening, 2 days		
Electric control cabinet making, 14 days						
Filling room construction, 18 days						

July 2001

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
						1
				Wall opening, 2 days		
Electric control cabinet making, 14 days						
Filling room construction, 18 days						
2	3	4	5	6	7	8
Wall opening, 2 days	Move machines from filoor to truck, 1	Transportation machine from A plant to C plant, 2 days				
	Take out utility system and unlock the			Move water treatment equipment fron		
Electric control cabinet making, 14 days						
Filling room construction, 18 days						
9	10	11	12	13	14	15
Transportation water treatment system from A plant to C plant, 2 days						
Filling room construction, 18 days						
			Floor surface making (stone hard coated), 10 days			
16	17	18	19	20	21	22
Floor surface making (stone hard coated), 10 days						
23	24	25	26	27	28	29
			Marking centre for major machine and	Machine placing and alignment, 2 days		
				Tank placing and connect other equipment, 2 days		
Floor surface making (stone hard coated), 10 days						
30	31					
Machine placing and alignment, 2 day	Transmission system placing and alignment, 6 days					
Tank placing and connect other equip	Electric system and piping connection, 2 days					

August 2001

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
		1	2	3	4	5
	Transmission system placing and alignment, 6 days					
	Electric system and piping connection, 2 days					
6	7	8	9	10	11	12
Transmission system placing and alignment, 6 days		Connect Electric system and piping system to the production line, 4 days				
13	14	15	16	17	18	19
Connect Electric system and piping sy	Test Run, 3 days			Production, 1 day		
20	21	22	23	24	25	26
27	28	29	30	31		

Biography

Ratchaneewan Sookkee was born on June 4th, 1972 in Singburi, Thailand. She graduated from Kasetsart University in 1994 with a Bachelor degree in Agricultural Engineering. After graduated, she started her work in the giant soft drink company in Thailand at the position of production planning engineer. In 1999, she studied for the Master degree in Engineering Management at the Regional Centre for Manufacturing Systems Engineering, Faculty of Engineering, Chulalongkorn University and University of Warwick.