CHAPTER IX

PROJECT PLANNING

According to Spinner (16), a project is defined as, "a series of activities that have several distinguishing characteristics of specific starting dates and ending dates; has a well-defined objectives; achieves a specific result/product; is a unique, non repetitive endeavor; and last but not least, cost, time schedule, and resources are consumes". Thus, from Spinner's point of view, 'project management' is about the management of time, material, personnel/labor, and cost orderly and economically in order to achieve the established objectives in term of time, costs, and technical outcomes.

Additionally, the key part of 'project management' is project planning. Project planning is a foundation or a pillar of project management. It is about; knowing what to do, when to do, and to whom the task is assigned to do in order to accomplish the specified goals or objectives. For the project to be successful (within the provided budget, specification and time), it therefore must be appropriately planned. Without good planning, the risk of failures would be high.

From the result concluded in the previous chapter, the recommended biodiesel production capacity for Thailand at the present time is to be operated at the rate of 10,000 litres per day. Therefore, from the concluded result, the feasibility study used to support this project planning for setting up a biodiesel factory with the production capacity of 10,000 litres per day would be from The Krabi Oil Palm Farmer Co-operatives' feasibility study (45).

9.1 Objectives of project planning

The objectives of this project planning would be to develop a project guideline and procedure for the construction of 10,000 litres per day biodiesel factory with the cost constraint of 18.5 million baht and the time constraint of 8 months accordingly.

9.2 Project organization

When the objectives of a project have been laid down, the following step that must be executed in order to accomplish a project is to identify a project structure. For this project, setting up of a biodiesel factory with the production capacity of 10,000 litres per day, since it is the set-up of a small biodiesel production plant the project organizational structure required is relatively simple. The proposed project organizational structure for this project is a functional structure; as shown in Figure 9.1.

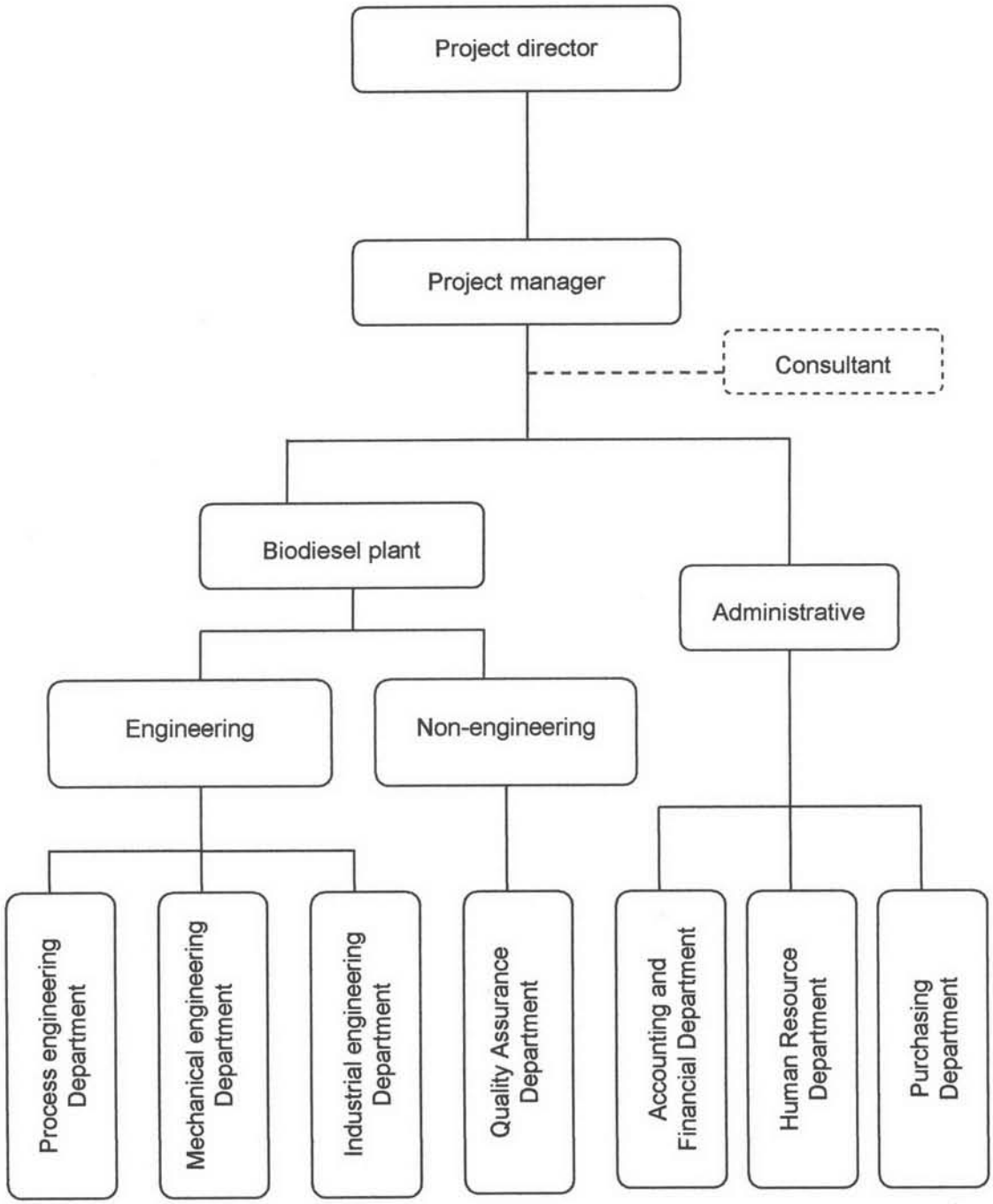

Figure 9.1: Proposed project structure for setting up a small biodiesel factory

9.3 Activity analysis

For the project planning to go as schedule, the project manager should start by developing a list of activities to be done in order to complete the project. According to Spinner (16), he suggested that in planning a project the first step is to develop the diagram, which sometimes this refers to as 'activity analysis'. This diagram is created by listing out all the jobs required to complete the project.

Consequently, for this study of planning for setting up a biodiesel factory with the production capacity of 10,000 litres per day, the listing out all of the job required or 'activity analysis' is shown below in Table 9.1:

Table 9.1: Activity analysis of a biodiesel set-up project

Activity	Description
A	Establishment of the project team
B	Consultant selection
C	Production specification
D	Equipments and machineries specification
E	Plant structure specification
F	Plant utilities specification
G	Raw material sources identification
H	Bid opening and contract making of the plant construction
I	Bid opening and contract making of the plant utilities installation

Table 9.1: Activity analysis of a biodiesel set-up project (continued)

Activity	Description
J	Equipments and machineries providers identification and acquiring
K	Land preparation
L	Plant construction
M	Issue of raw material purchasing order
N	Training program preparation
O	Training for biodiesel operation
P	Plant utilities installation
Q	Hand-over of the plant construction
R	Equipments and machineries testing
S	Receipt of raw material for trial production
T	Trial production and quality inspection
U	Receipt of raw material for actual production
V	Commencement of the actual biodiesel production

Description of each task is explained as followed:

Task A: Setting up of the project team – the recruitment of human resources to form a project team; where most of these recruited people would be stayed

on and continued to work even when the actual production starts. This process of setting up a project team would take about 3 days.

Task B: Consultant selection – the hiring of suitable consultant is one of the key determinants on the success of a project. Hence, at this stage, several biodiesel specialists/consultants would be reviewed for their biodiesel-related backgrounds, and later be contacted to ascertain their interests to cooperation with the company in constructing a biodiesel factory. This process of consultant selection would take about 5 days.

Task C: Specifying the production capacity for biodiesel operation – this task is to predetermine the production capacity schedule for a time period; in this case, the production capacity predetermination might be for the first year of the operation. This process of predetermination of production capacity would take about 4 days.

Task D: Equipments and machineries specification – this task would include the identification of type and number of the equipments and machineries required. This process would take about 7 days.

Task E: Plant structure specification – this task includes the designing of the plant architecture, and also the detail planning and positioning of the specified equipments and machineries (plant layout). This process takes 7 days to accomplish.

Task F: Utilities specification – this task involves the identification of the required utilities to be integrated into the biodiesel production plant, and as well as, the administrative workplace. The process would take 3 days to be completed.

Task G: Raw material sources/providers identification – this involves securing of the raw material by finding out as many raw material suppliers as possible.

These suppliers would be issued with the quality specification of the raw material and the required amount of each month of the raw material for the first year. The few chosen suppliers would then be contacted for contract-making. All of these require about 30 days to be completed.

Task H: Bid opening and contract making of the plant construction – this task is to invite the experienced construction companies to take part in the bidding for the construction of a biodiesel plant by issuing them the scope of work to be done. The successful bidder would sign the contract with the company to begin the project. The process would take 14 days to be completed.

Task I: Bid opening and contract making of the plant utilities installation – this task is to invite the experienced utilities installing companies to take part in the bidding by issuing them the scope of work to be done. The successful bidder would sign the contract with the company to begin the project. The process would take 7 days to be completed.

Task J: Equipments and machineries providers identification and acquiring – this task includes the gathering of information on the selected type of equipments and machineries to determine the purchasing model from different companies. Few models of the required equipments and machineries from selected companies would be compared and negotiated in term of price, performance, ease of maintenance, and production flexibility. The chosen model of each type of required equipments and machineries would then be issued out with the purchasing order. Then, each of the ordered equipments and machineries would be tracked individually upon its arrival. This whole process would require about 75 days to be completed.

Task K: Land preparation – this task involves the clearing of the undergrowths growing on the piece on land and the filling of the earth in order to level

the land for further construction. The process would take 7 days to be finished.

Task L: Plant construction – this task involves in the set-up of the factory structure. This would include roofing, walling, flooring, and the setting up of all the structural works involving steel, iron, and etc. It would be responsible by the selected construction company. The whole process would take about 45 days.

Task M: Issue of raw material purchasing order – this task involves with the ordering of raw material for both the trial production and for the actual operation. After the potential raw material providers or suppliers have been identified, the raw material from few providers would be issued with the purchasing order; one lot for the trial production, and another lot for the actual production. This process would require about 5 days to be completed.

Task N: Training program preparation – this task involves the formulation of the assorted training programs: the delivery of different types of training suited to different departments. This task also includes the identification of training schedule and the preparation of training documents. The process time consumption is 14 days.

Task O: Training for biodiesel operation – this involves the training of the employees about the factory's rules and regulations, and together with the briefing of their assigned duties. Moreover, all employees from different departments would also be sent for the tailored-designed training program to prepare for their different assigned duties. The whole process would take about 30 days.

Task P: Plant utilities installation – this task involves the installation of all the identified utilities, such as electricity, plumbing, telephone lines, lighting, and etc. This process would take 14 days.

Task Q: Hand-over of the plant construction – this task involves the inspection in term of the completion of all the works required in setting up a biodiesel plant structure as specified in a contract. Any imperfects would be modified or repaired to be completed as stated on the contract. The whole process would take about 7 days.

Task R: Equipments and machineries testing – the task is about inspecting the ordered equipments and machineries. Equipments and machineries inspection would be in term of the correctness of the stated dimension and capacity, as well as their functional performances. If the received products pass the inspection, they would then be installed to the designated places for further process trial. The process would take about 21 days.

Task S: Receipt of the ordered raw material for trial production – the task is about inspecting the incoming raw material that has been ordered for trial production. The inspection would be concerning several criteria of timeliness (whether the raw material arrives on time or later than the stated schedule), correct amount, and as specified quality. If the received goods pass the inspection, the raw material would then be transferred to the designated storage place for further usage. The process would take 3 days to be accomplished.

Task T: Trial production and quality inspection – this task involves the testing of the whole biodiesel production process; from the input of the raw material to the final finished product (biodiesel), in order to assess its production capability and finished product quality. If the process fails, it must be fixed or repaired. The time taken for the trial production and quality inspection process is 14 days.

Task U: Receipt of the ordered raw material for actual production – the task is about inspecting the incoming raw material that has been ordered for actual production. If the received goods pass the inspection, the raw material would then be transferred to the designated storage place for further usage. The process would take 3 days to be accomplished.

Task V: Commencement of the actual production – it is the start off of the biodiesel operation. The process time consumption is considering 1 day.

9.4 Work Breakdown Structure (WBS)

As suggested by Spinner (16), after the activity analysis has been conducted, the next step is to construct the work breakdown structure (WBS). With reference to Young (20), he added that work breakdown structure is one of the convenient tools to employ for displaying all the works required of the whole project.

For this project of constructing a biodiesel factory with a production capacity of 10,000 litres per day, the work breakdown structure would be constructed in a hierarchical structure; with the high level of the structure representing the four key elements of this project; which are the plant structure and utilities, equipments and machineries, raw material and human resources, and their details of the four identified key elements would be described in the lower level of the structure to show all the elements composing of this project as shown in Figure 9.2.

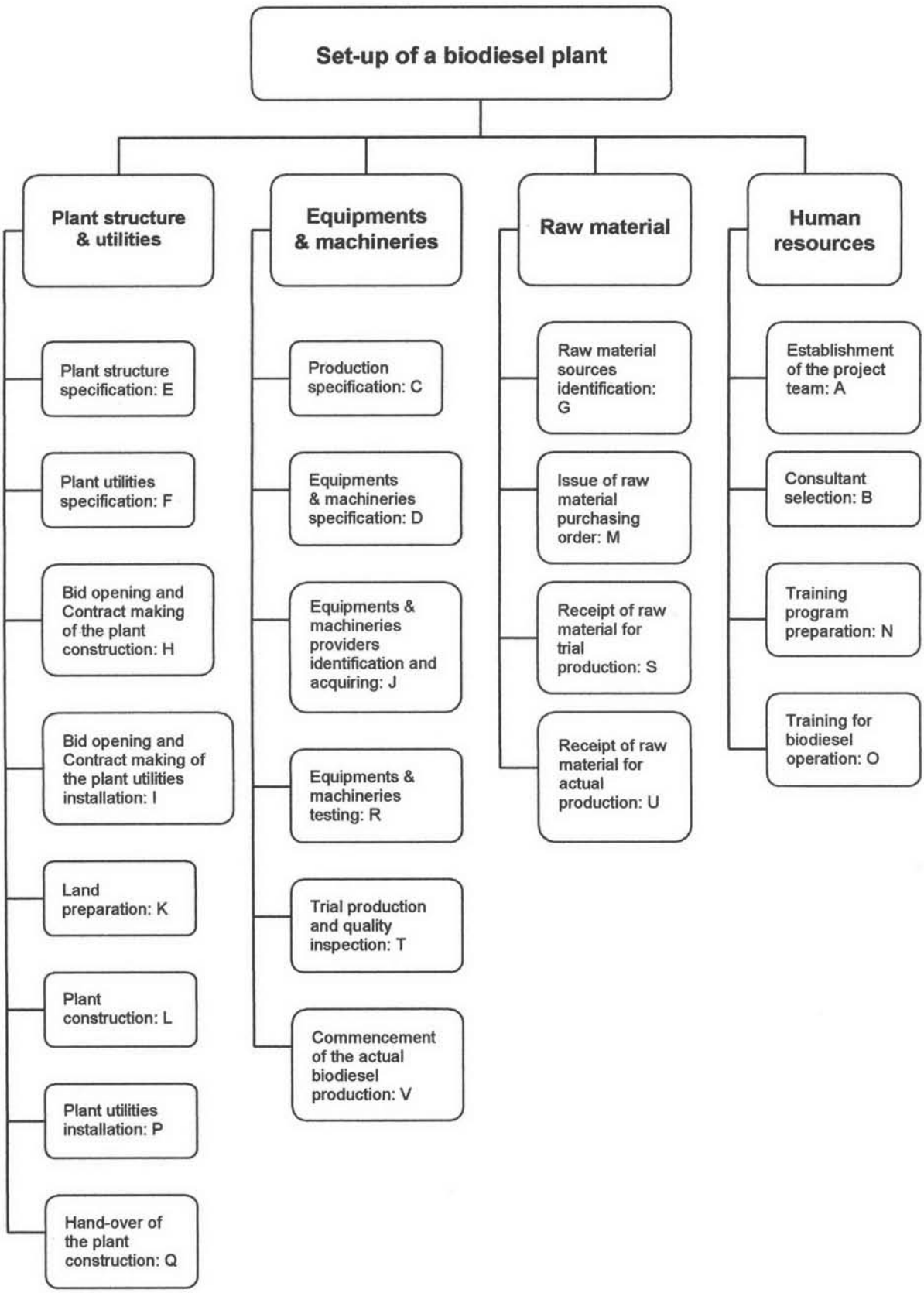

Figure 9.2: The work breakdown structure (WBS) of setting up a biodiesel factory

9.4.1 Plant structure and utilities

For the plant structure and utilities work package, it starts from the designing of the plant architectural work – involving with the detail planning and positioning of the required equipments and machineries (plant structure specification). Then, the next step is to specify what kind of utilities needed to be installed into the factory (plant utilities specification). After that, the experienced construction companies would be invited to take part in the bidding. The successful bidder would be requested to sign the contract with the company for the construction of a biodiesel plant (bid opening and contract making). Similarly, the experienced utilities installation companies would be invited to take part in the bidding for the plant utilities installation. Again, the successful bidder would be requested to sign the contract with the company to install the necessary utilities. Next, it would be followed by the clearing of the undergrowths growing on the piece on land and the filling of the earth in order to level the land for the plant construction (land preparation). When the land is prepared, the plant construction would begin. After the plant has been constructed, the specified utilities would be installed. Finally, the plant would be handed-over to the company from the contractor. For this work package, most of the activities would mainly be responsible by the outsourced contractor under the supervision of the project manager and the project industrial engineer. In Figure 9.3, it illustrates the activities sequence of plant structure and utilities.

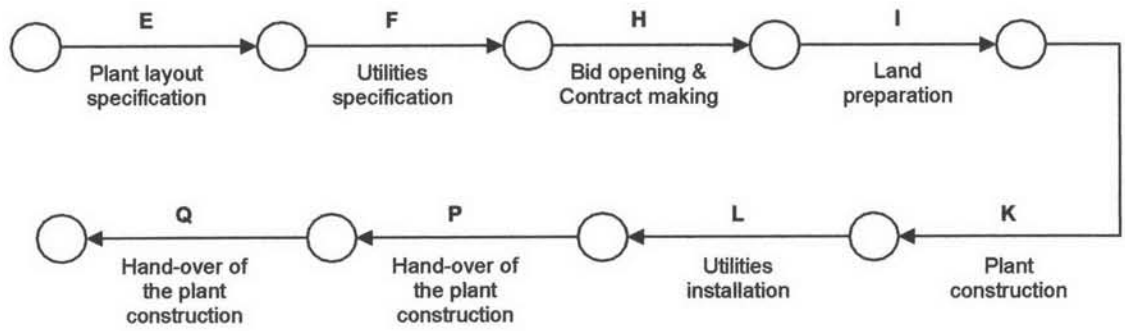

Figure 9.3: The activities sequence of plant structure and utilities

9.4.2 Equipments and machineries

For the equipments and machineries work package, it sets off with the production specification. With known production capacity, the equipments and machineries would be specified in term of the type and the number required (equipments and machineries specification). Next, after knowing the type and the number of equipments and machineries are required, the company would seek and identified as many suppliers as possible. As soon as the company has chosen the desired suppliers, the company would issue the equipments and machineries purchasing order for the required equipments and machineries. Later, the ordered equipments and machineries would arrive at the factory and would be tested individually for their performances. If they pass with the testing, the inspected equipments and machineries would then be installed at their designated places. Nearly the last step of this process, the biodiesel production would be on trial and inspected for the product quality. Finally, it is the start of the biodiesel production (commencement of the actual production). Most of this work package would mainly be responsible by the project manager, the project production engineer, and the project mechanical engineer. In Figure 9.4, it illustrates the activities sequence of equipments and machineries.

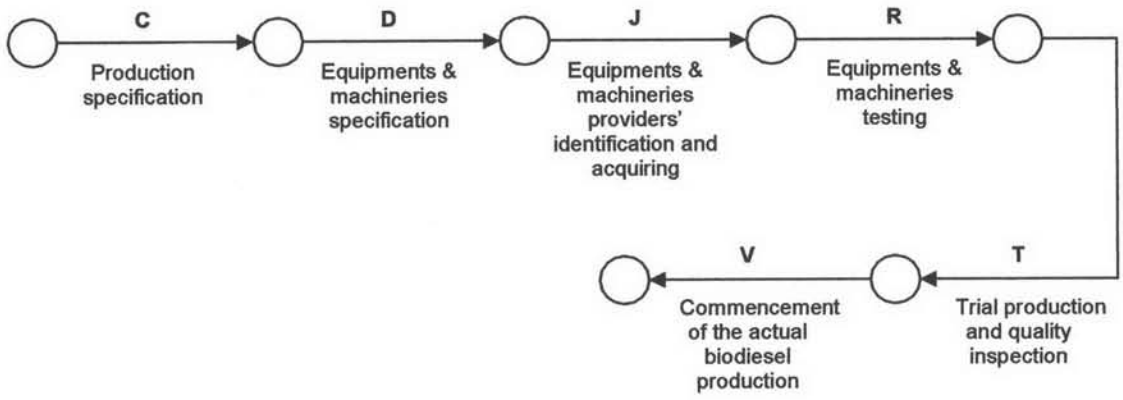

Figure 9.4: The activities sequence of equipments and machineries

9.4.3 Raw material

For the raw material work package, it concerns with the identification of as many potential raw material suppliers as possible in order to strengthen the raw material security. After few chosen suppliers have been contacted to supply the raw material, they would then be issued with the raw material purchasing order. As specified in the purchasing order, the raw material would be delivered accordingly for trial production. Soon after, another batch of raw material would be delivered for actual production. Most of this raw material work package would mainly be responsible by the project manager, the project purchasing officer, and the project budgeting and planning officer. In Figure 9.5, it illustrates the activities sequence of raw material.

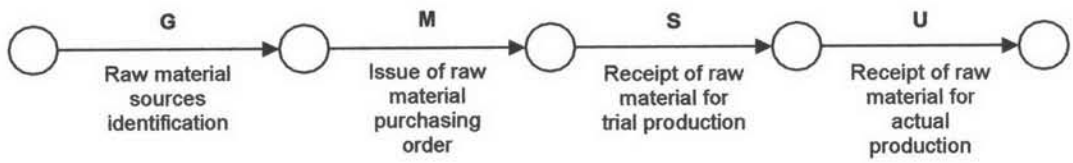

Figure 9.5: The activities sequence of raw material

9.4.4 Human resources

For the human resources work package, it involves initially with the establishment of the project team and consultant selection. Moreover, another key responsibility of human resources would be to train all the personnel; involving from training program preparation to the training for all the staff prior to the actual operation. Hence, most of the human resources work package would mainly be responsible by the project manager and the project human resource officer. In Figure 9.6, it illustrates the activities sequence of human resources.

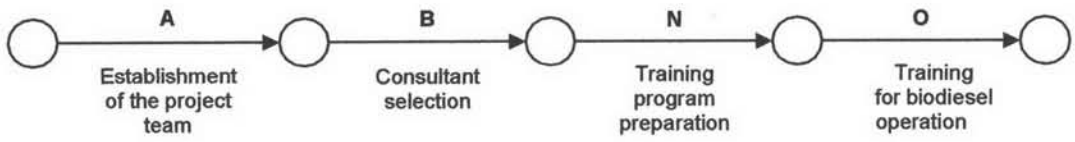

Figure 9.6: The activities sequence of human resources

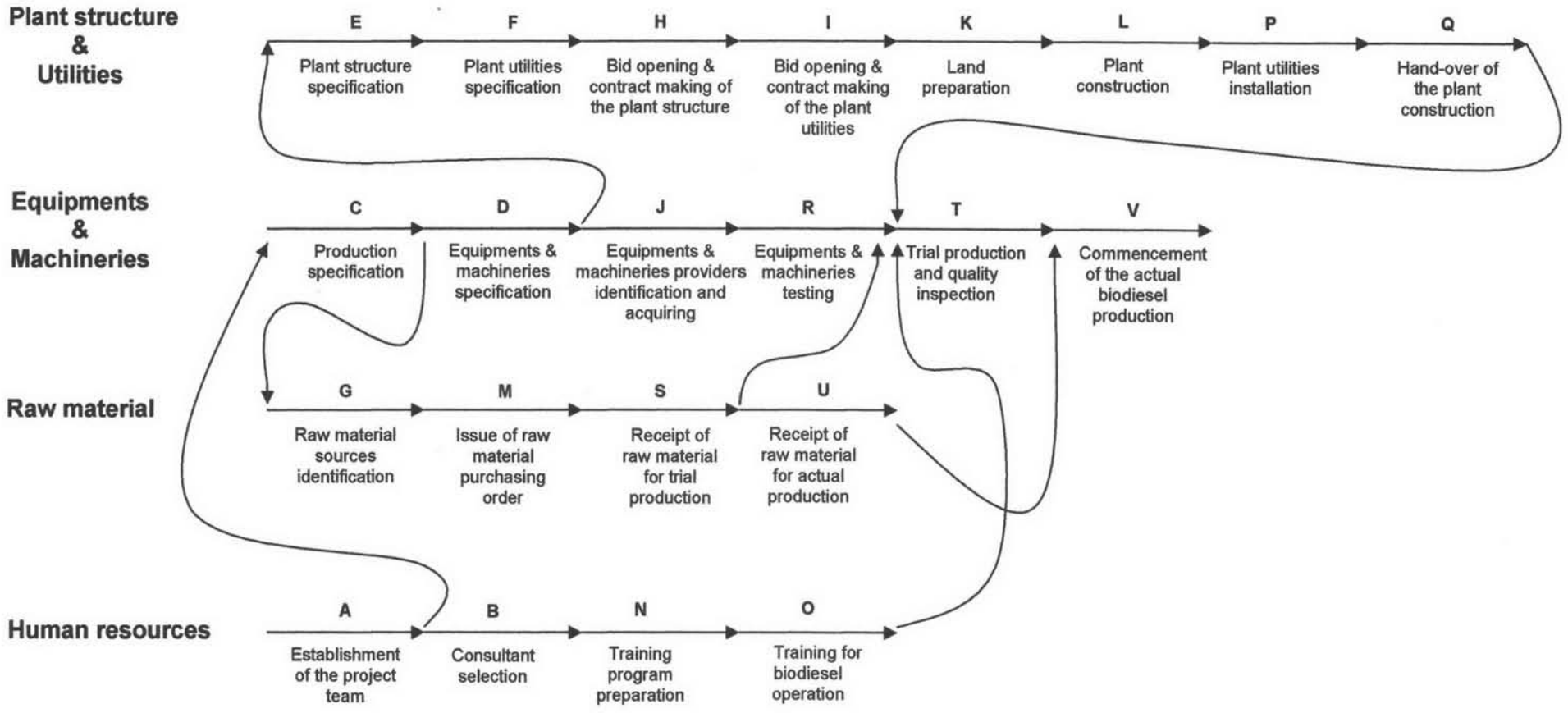

Figure 9.7: The activities sequence of the whole project in the set-up a biodiesel factory

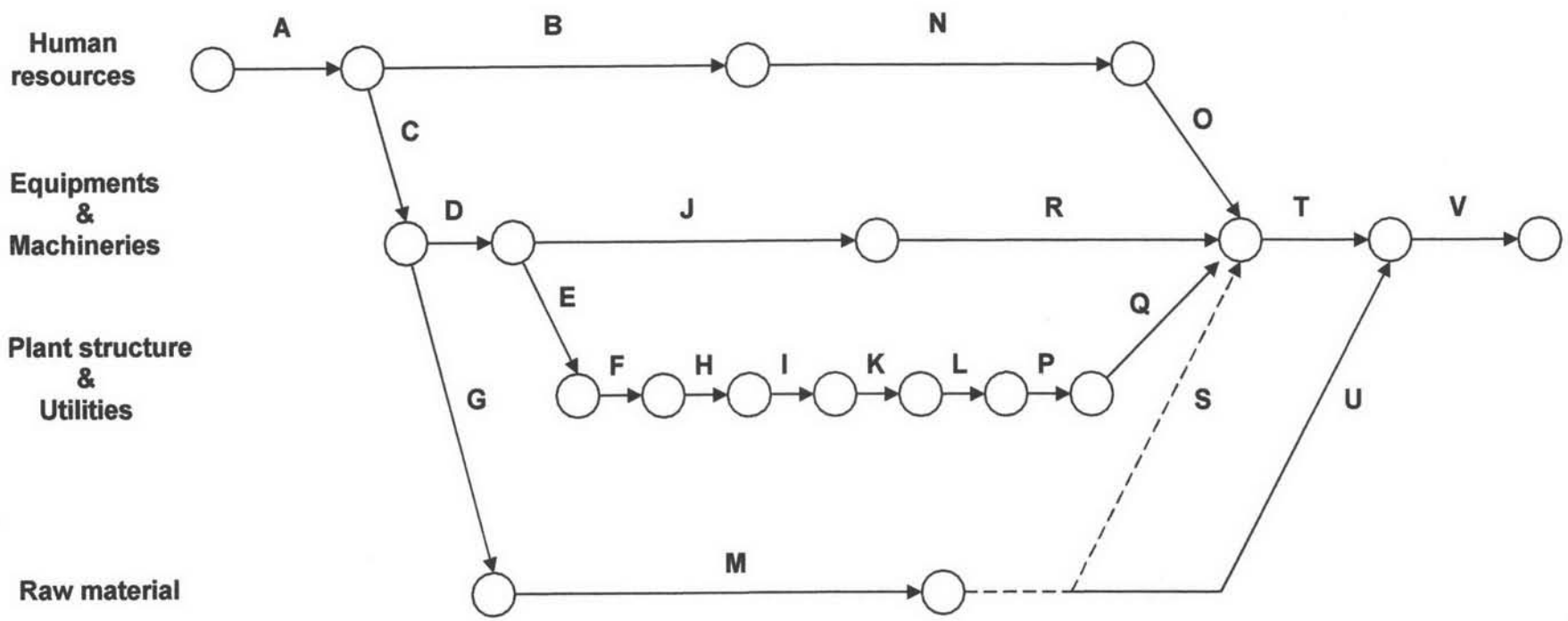

Figure 9.8: The network diagram of setting up a biodiesel factory

9.5 Resources allocation

In managing resources, today human resource is viewed as one of the important resources of all. According to the Wikipedia website (46), human resource management has three significance roles: firstly, it is to maximize the utilization of the employed personnel by put the right man to the right job in order to achieve the business objectives; secondly, to perform necessary activities involving the workforce such as, recruiting, monthly payroll, employees' benefits, career path development, educational development, and etceteras; and thirdly, to provide or arrange necessary training programs when there is a need to equip the employees with requisite skills to do his or her jobs. Hence, to manage human resources, it is about knowing how to deploy the personnel within an organization to achieve maximum efficiency and effectiveness. Similarly for this project, one of the important steps in the set-up a biodiesel factory is the formation and the management of the project members in order to achieve the business goal with the given budget and specified time.

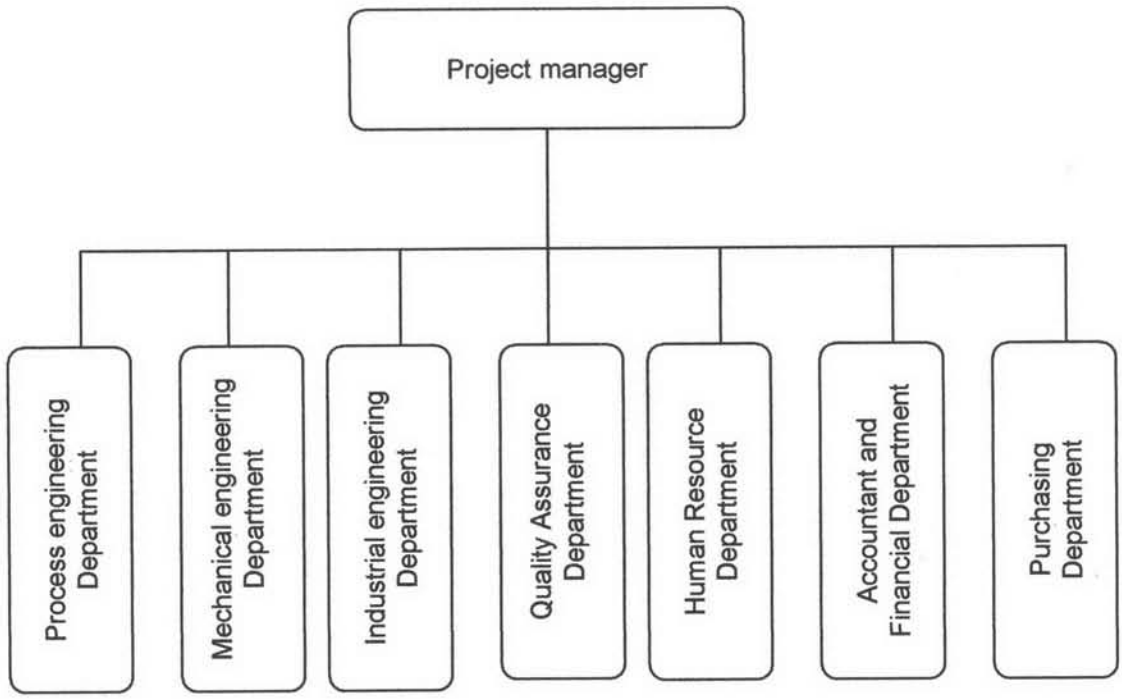

Figure 9.9: Illustration of all the project members of setting up a biodiesel factory

There are altogether eight identified project members involving in the set-up of this biodiesel factory. The description of each of the eight identified parties is illustrated as followed:

i. Project manager

This position is responsible for all the activities in the set-up of a biodiesel factory. Project manager would be responsible from the forming of a project team, supervising the plant construction, to the control and monitoring of the project budget and cost. Hence, this position is the most important position of all and would require a person who can work in a team environment, has a strong management background, be able to make good and fast decision.

ii. Process engineer department

For the process engineer, this position would be responsible for the set-up of a biodiesel production process; from specifying production, equipments and machineries, plant structure, equipments and machineries testing, trial production, to the actual production. Hence, this position would require a person who has a strong background in biodiesel production, be a good coordinator with the selected consultant.

iii. Mechanical engineer department

For mechanical engineer department, the responsible activities would be similar to the process engineer except that it focuses particularly on equipments and machineries. A mechanical engineer would be responsible from specifying production, equipments and machineries, plant structure, and plant utilities, equipments and machineries sourcing and testing, trial production, to the actual production. Thus, the position would require a person with some years of experience in handling of equipments and machineries; that can work in a team environment and has some background in biodiesel production.

iv. Industrial engineer department

An industrial engineer would be a helping hand of the project manager. The position is responsible for all the activities in the set-up of a biodiesel factory from specifying production, equipments and machineries, plant structure, and plant utilities, equipments and machineries sourcing, land clearing, plant constructing, training, trial production, to the actual production. Thus, this position would require a person who has some experience in new project development, can work in a team environment and has some background in biodiesel production.

v. Quality assurance department

A quality assurance staff would be responsible for all the quality-related issues. Their jobs are to ensure that incoming raw material or received equipments and machineries meet the agreed criteria upon issuing of the purchasing orders. Moreover, quality assurance personnel would oblige to regulate the quality of the produced product (the biodiesel) and the valuable by-product (the glycerin); ensuring that both the products; biodiesel and glycerin, meet the standard required by the Thai legislative law. Thus, this position would require a person who has some years of experience in quality monitoring and control.

vi. Accountant and Financial department

This position is responsible for all financial-related activities. Accountant and Financial officer would be responsible from updating and control of the balance account in order to inform the management level of all the financial transaction to the monitoring of the project budget and cost. Hence, this position would require a person who is upright and meticulous.

vii. Human resource department

For the human resource department, this position is responsible for all the employee-related activities such as recruitment, training, performance evaluation, and lastly, to ensure that all personnel conform to the company's rules and regulations. Hence, this position would require a person who can maintain the functionality of the project teamwork.

viii. Purchasing department

This position is responsible mainly for the procuring of all the raw material used for biodiesel production as well as the equipments and machineries required for the production. The role of a purchasing officer will include price/risk calculation, contracting, and supplier development. Hence, this position would require a person who can coordinate well of both within and outside of the project.

After the project members have been identified, each of them would be allocated to do their requisite tasks in order to complete this project. The following table (Table 9.2) would show the relationship between the identified activities to complete the project and the responsible personnel for each activity.

Table 9.2: The relationship between the identified activities and their responsible personnel

Task	Related personnel/departments							
	Project manager	Process engineer Department	Mechanical engineer Department	Industrial engineer Department	Quality Assurance Department	Accounting & Financial Department	Human resource Department	Purchasing Department
A	1							
B	1						1	
C	1	1	1	1				
D	1	1	1	1				
E	1	1	1	1				
F	1		1	1				
G	1				1	1		1
H	1					1		1
I	1					1		1
J	1	1	1	1		1		1

Table 9.2: The relationship between the identified activities and their responsible personnel (continued)

Task	Related personnel/departments							
	Project manager	Process engineer Department	Mechanical engineer Department	Industrial engineer Department	Quality Assurance Department	Accounting & Financial Department	Human resource Department	Purchasing Department
K	1			1				
L	1	1	1	1				
M	1				1	1		1
N	1			1		1		
O	1			1		1		
P	1	1	1					
Q	1							
R	1	1	1		1			
S	1			1	1	1		1
T	1	1	1	1	1			
U	1			1	1	1		1
V	1	1	1	1	1	1	1	1

9.6 Project Scheduling

With reference to The Project Management Team of the University of Washington (47), they indicated that an essential element of project management is to schedule the project. Scheduling project helps to clarify viewers of when each task is expected to be completed. At the same time, project scheduling also revealed the time-related dependencies between different project tasks. Similarly, to determine this project scheduling, each of the activities would be required to specify both the duration and their predecessors' activities; as shown in Table 9.3, to be able to show the project time-related and task-related dependencies.

Table 9.3: Activity duration and its predecessor activity

Activity	Description	Duration (days)	Predecessors
A	Establishment of the project team	3	-
B	Consultant selection	5	A
C	Production specification	4	A
D	Equipments and machineries specification	7	C
E	Plant structure specification	7	D
F	Plant utilities specification	3	E
G	Raw material sources identification	30	C
H	Bid opening and contract making of the plant construction	14	F
I	Bid opening and contract making of the plant utilities installation	7	H

Table 9.3: Activity duration and its predecessor activity (continued)

Activity	Description	Duration (days)	Predecessors
J	Equipments and machineries providers identification and acquiring	75	D
K	Land preparation	7	I
L	Plant construction	45	K
M	Issue of raw material purchasing order	5	G
N	Training program preparation	14	B
O	Training for biodiesel operation	30	N
P	Plant utilities installation	21	L
Q	Hand-over of the plant construction	7	P
R	Equipments and machineries testing	14	J
S	Receipt of raw material for trial production	3	M
T	Trial production and quality inspection	15	O,Q,R,S
U	Receipt of raw material for actual production	3	S
V	Commencement of the actual biodiesel production	1	T,U

Moreover, to schedule a project, it would require the specification of a starting date. For this project, the starting date would be assumed to commence on Tuesday, the 1st of January 2008. The project would be operating from Monday to Friday; from 8:30 am to 16:30 pm. Saturday and Sunday would be the non-working days. Similarly, if any of the 15 annual public holidays (as shown in Table 9.4) falls on the weekdays, it would be declared automatically as the non-working day. If these annual holidays fall on the Sunday, the next Monday would be a substituted holiday. A list of the 15 annual public holidays is shown as followed:

Table 9.4: A list of the 15 annual public holidays

Holidays	Date
1. New Year's Day	Tuesday, 1st January 2008
2. Makha Bucha Day	Thursday, 21st February 2008
3. Chakri Memorial Day (Substitution Day)	Monday, 7th April 2008
4. Songkran Festival day	Sunday, 13th – Tuesday, 15th April 2008
5. National Labour Day	Thursday, 1st May 2008
6. Coronation Day	Monday, 5th May 2008
7. Ploughing Ceremony	Friday, 9th May 2008
8. Wisakha Bucha Day	Monday, 19th May 2008
9. Asarnha Bucha Day	Thursday, 17th July 2008
10. Buddhist Lent Day	Friday, 18th July 2008
11. H.M. The Queen's Birthday	Tuesday, 12th August 2008
12. Chulalongkorn Memorial Day	Thursday, 23rd October 2008
13. H.M. The King's Birthday	Friday, 5th December 2008
14. Constitution Day	Wednesday, 10th December 2008
15. New Year's Eve	Wednesday, 31st December 2008

9.7 Network Diagram

An activity on node (AON) diagram is the most popular means used to illustrate a project's network diagram. Consequently, an AON diagram would be constructed to determine this project network; whereby the project stating date would be scheduled on Tuesday, the 1st of January 2008 and it would expectedly be finished by Monday, the 7th of July 2008. The whole project would consume a total of 128 days.

Using the Microsoft project software, to obtain an activity on node diagram, firstly the information would be input as shown in Table 9.5. At the same time, with the input of the data, the Gantt chart would be constructed as shown in Figure 9.10. Finally, using the critical path mode, an activity on node diagram would be obtained using the Microsoft project software as shown in Figure 9.11. From the obtained activity on node diagram, it results that there are altogether 13 critical tasks on the critical path. These tasks include: A – C – D – E – F – H – I – K – L – P – Q – T – V. Correspondingly, this project has been scheduled using Finish-to-Start dependency. According to JCV Management Inc. (48), it is the most commonly used mode to determine the relationship between activities.

Table 9.5: Project tasks information regarding Early Start, Early Finish, Late Start, Late Finish, Total Slack, Free Slack, and Resource Names

ID	Task Name	Duration	Early Start	Early Finish	Late Start	Late Finish	Total Slack	Free Slack	Resource Names
1	A	3 days	Wed 1/2/08	Fri 1/4/08	Wed 1/2/08	Fri 1/4/08	0 days	0 days	Project Mgr.
2	B	5 days	Mon 1/7/08	Fri 1/11/08	Tue 4/1/08	Mon 4/7/08	60 days	0 days	Project Mgr.,HR
3	C	4 days	Mon 1/7/08	Thu 1/10/08	Mon 1/7/08	Thu 1/10/08	0 days	0 days	Project Mgr.,PE,ME,IE
4	D	7 days	Fri 1/11/08	Mon 1/21/08	Fri 1/11/08	Mon 1/21/08	0 days	0 days	Project Mgr.,PE,ME,IE
5	E	7 days	Tue 1/22/08	Wed 1/30/08	Tue 1/22/08	Wed 1/30/08	0 days	0 days	IE,Project Mgr.,PE,ME
6	F	3 days	Thu 1/31/08	Mon 2/4/08	Thu 1/31/08	Mon 2/4/08	0 days	0 days	Project Mgr.,ME,IE
7	G	30 days	Fri 1/11/08	Fri 2/22/08	Fri 4/18/08	Tue 6/3/08	67 days	0 days	Project Mgr.,QA,A&F,Pur.
8	H	14 days	Tue 2/5/08	Mon 2/25/08	Tue 2/5/08	Mon 2/25/08	0 days	0 days	Project Mgr.,A&F,Pur.
9	I	7 days	Tue 2/26/08	Wed 3/5/08	Tue 2/26/08	Wed 3/5/08	0 days	0 days	Project Mgr.,A&F,Pur.
10	J	75 days	Tue 1/22/08	Mon 5/12/08	Mon 2/4/08	Mon 5/26/08	9 days	0 days	Project Mgr.,PE,ME,IE,A&F,Pur.
11	K	5 days	Thu 3/6/08	Wed 3/12/08	Thu 3/6/08	Wed 3/12/08	0 days	0 days	Project Mgr.
12	L	45 days	Thu 3/13/08	Wed 5/21/08	Thu 3/13/08	Wed 5/21/08	0 days	0 days	Project Mgr.,PE,ME,IE
13	M	5 days	Mon 2/25/08	Fri 2/29/08	Wed 6/4/08	Tue 6/10/08	67 days	65 days	Project Mgr.,QA,A&F,Pur.
14	N	14 days	Mon 1/14/08	Thu 1/31/08	Tue 4/8/08	Tue 4/29/08	60 days	0 days	Project Mgr.,IE,A&F
15	O	30 days	Fri 2/1/08	Fri 3/14/08	Wed 4/30/08	Fri 6/13/08	60 days	60 days	Project Mgr.,IE,A&F
16	P	12 days	Thu 5/22/08	Fri 6/6/08	Thu 5/22/08	Fri 6/6/08	0 days	0 days	Project Mgr.,PE,ME,IE
17	Q	5 days	Mon 6/9/08	Fri 6/13/08	Mon 6/9/08	Fri 6/13/08	0 days	0 days	Project Mgr.,IE
18	R	14 days	Tue 5/13/08	Mon 6/2/08	Tue 5/27/08	Fri 6/13/08	9 days	9 days	Project Mgr.,PE,ME,QA
19	S	3 days	Mon 6/9/08	Wed 6/11/08	Wed 6/11/08	Fri 6/13/08	2 days	2 days	Project Mgr.,IE,QA,A&F,Pur.
20	T	15 days	Mon 6/16/08	Fri 7/4/08	Mon 6/16/08	Fri 7/4/08	0 days	0 days	Project Mgr.,PE,ME,IE,QA
21	U	3 days	Mon 6/30/08	Wed 7/2/08	Wed 7/2/08	Fri 7/4/08	2 days	2 days	Project Mgr.,IE,QA,A&F,Pur.
22	V	1 day	Mon 7/7/08	Mon 7/7/08	Mon 7/7/08	Mon 7/7/08	0 days	0 days	Project Mgr.,PE,ME,IE,QA,A&F,HR,Pur.

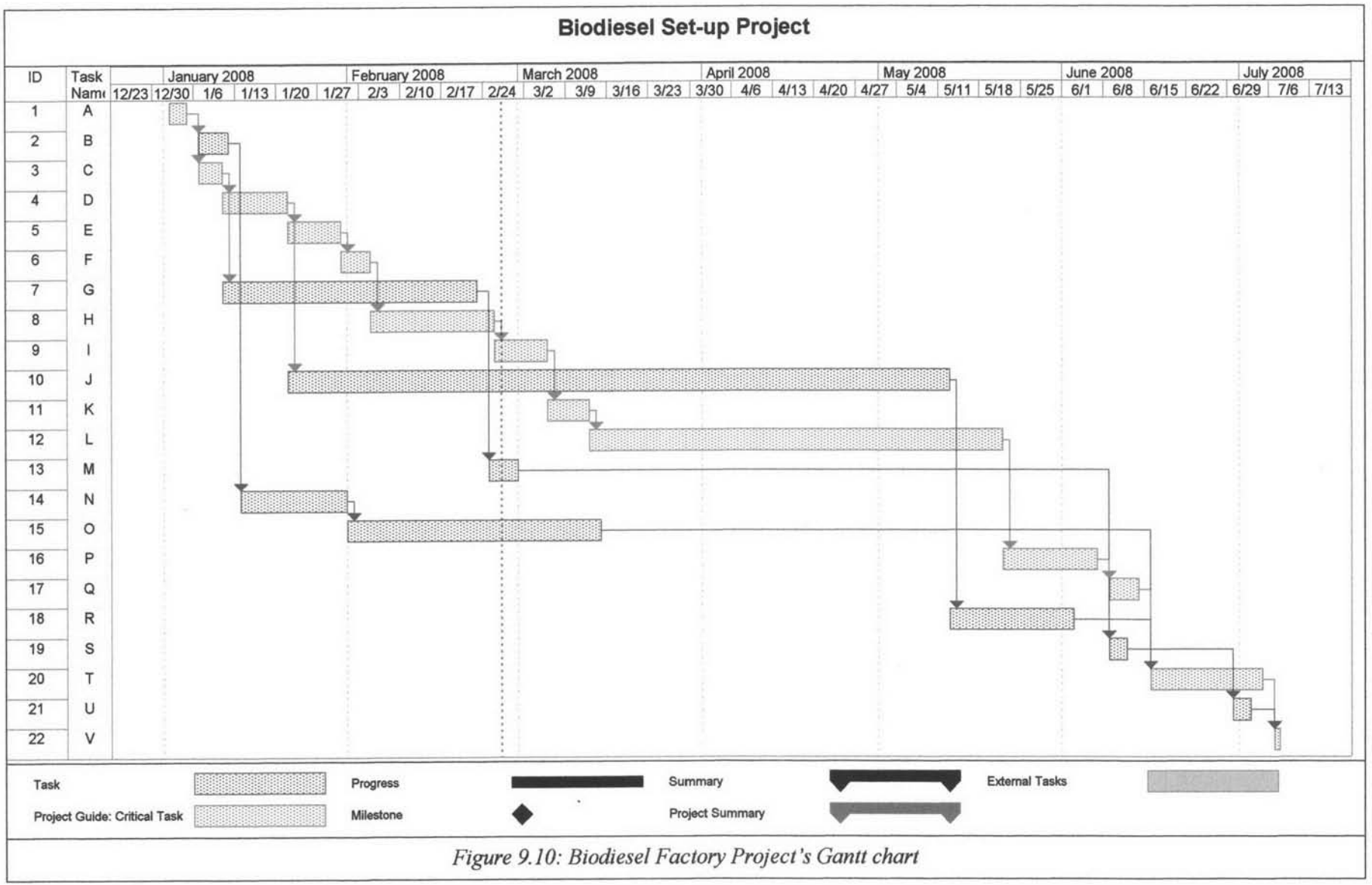

Figure 9.10: Biodiesel Factory Project's Gantt chart

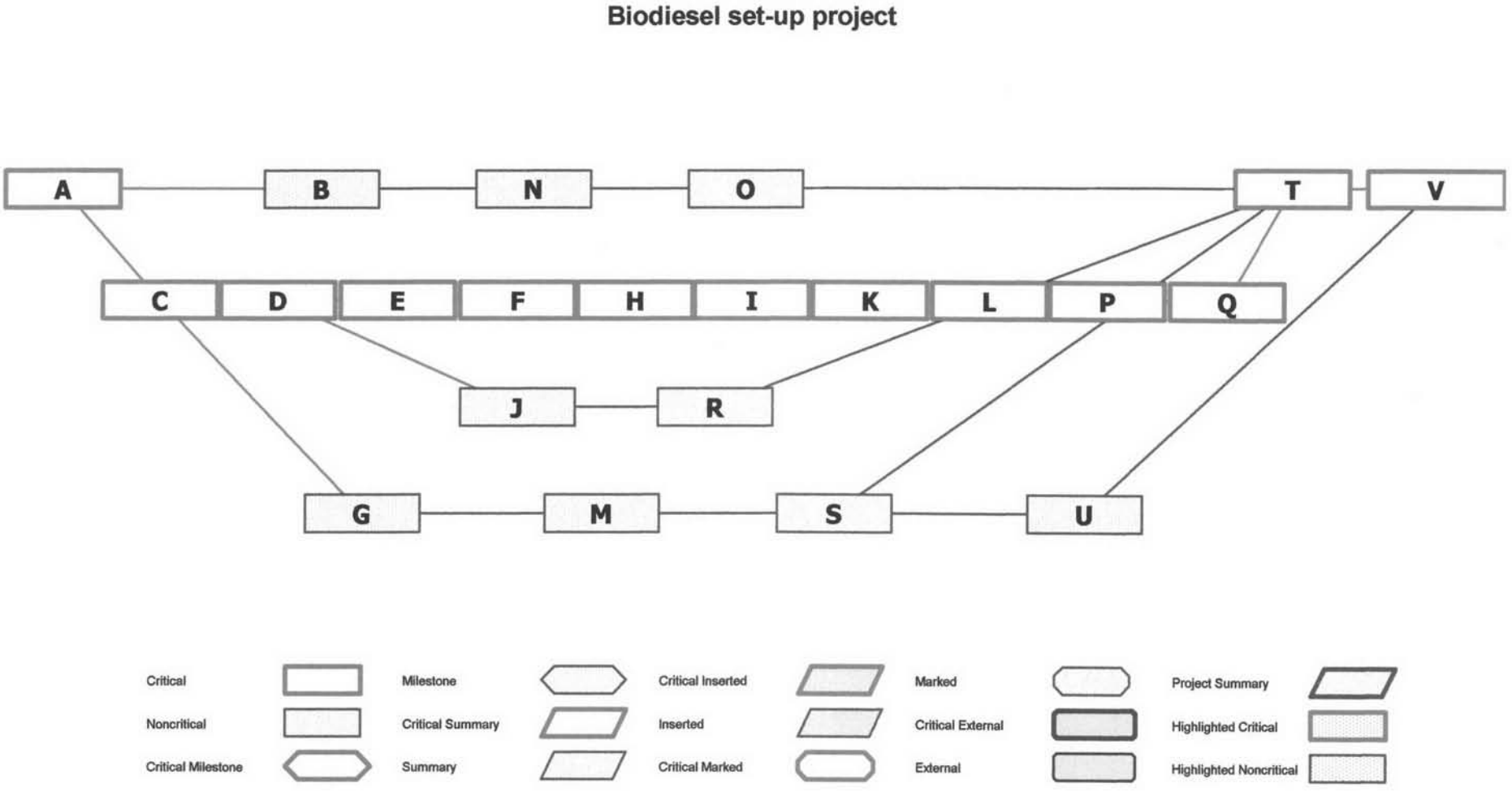

Figure 9.11: Biodiesel Factory Project's Critical Path Method (CPM)

9.8 Project cost estimation

The last component of project planning would be to manage the project total cost. According to Wideman (49), he has defined a project cost estimate as, "a quantitative assessment of the cost of all resources required to complete part or all of a project". With the provided definition, it could be concluded that one way to determine the total project cost estimate is to add up all the costs of the consumed resources used in the project. This is accord with what Chapman (50) has suggested – that in order to calculate the project cost, it could be done by adding up each of the discrete project elements to obtain the total cost.

Similarly for this project, the total project cost estimation would be calculated by summing up the five identified project elements costs. These five project elements include human resource involvement, construction of the factory structure and machine foundation, installation of utilities, required equipments and machineries, and other miscellaneous expenses. Each of these costs would primarily be computed. Then, they would later be added up together to determine the whole project cost estimate for this project of setting up a biodiesel factory.

Moreover, Bottom-Up Cost Estimating would also be employed to determine the project cost plan. With reference to Wideman (49), Bottom-Up Cost Estimating could be calculated by summing up each of the detailed estimate of every task included in the Work Breakdown Structure (WBS) to create the cost plan of this project of setting up a biodiesel factory.

9.8.1 Cost of Human resource involvement

For the pre-operational period of this biodiesel project, there would be approximately eight recruited employees working full-time on the project. The employees would be paid on an average industry rate as shown in Table 9.6. From the calculation, the total cost required for all the eight identified positions is accumulated up to 111,000 Baht per month.

Consequently, since the project would take about 7 months and 7 days to be completed, the total expense for human resource involvement in this project would be as much as 812,317 Baht; as shown in Table 9.7.

Table 9.6: Income structure of the project human resources involvement

Position	Salary per month (Baht)	No. required per position	Total (Baht)
Project manager	30,000	1	30,000
Process engineer	15,000	1	15,000
Mechanical engineer	15,000	1	15,000
Industrial engineer	15,000	1	15,000
Quality Assurance officer	12,000	1	12,000
Accountant and Financial officer	8,000	1	8,000
Human Resource officer	8,000	1	8,000
Purchasing officer	8,000	1	8,000
Total		**8**	**111,000**

Table 9.7: Human resources expenses for the whole project

Position	Salary for the whole project (7 months 7 days)	Total (Baht)
Project manager	30,000 x 7.3181818	219,545
Process engineer	15,000 x 7.3181818	109,773
Mechanical engineer	15,000 x 7.3181818	109,773
Industrial engineer	15,000 x 7.3181818	109,773
Quality Assurance officer	12,000 x 7.3181818	87,818
Accountant and Financial officer	8,000 x 7.3181818	58,545
Human Resource officer	8,000 x 7.3181818	58,545
Purchasing officer	8,000 x 7.3181818	58,545
Total		**812,317**

9.8.2 Cost of Factory structure and Machine foundation

For the project's factory structure and machine foundation, it would be constructed as shown in Figure 9.12. The factory structure and machine foundation are to be built on an area of 250 m^2, 5 meter-high with steel structure. From the Krabi's model biodiesel plant, the total plant construction expenses of both the factory structure and the machine foundation, is added up to 3,350,000 Baht as shown in Table 9.8.

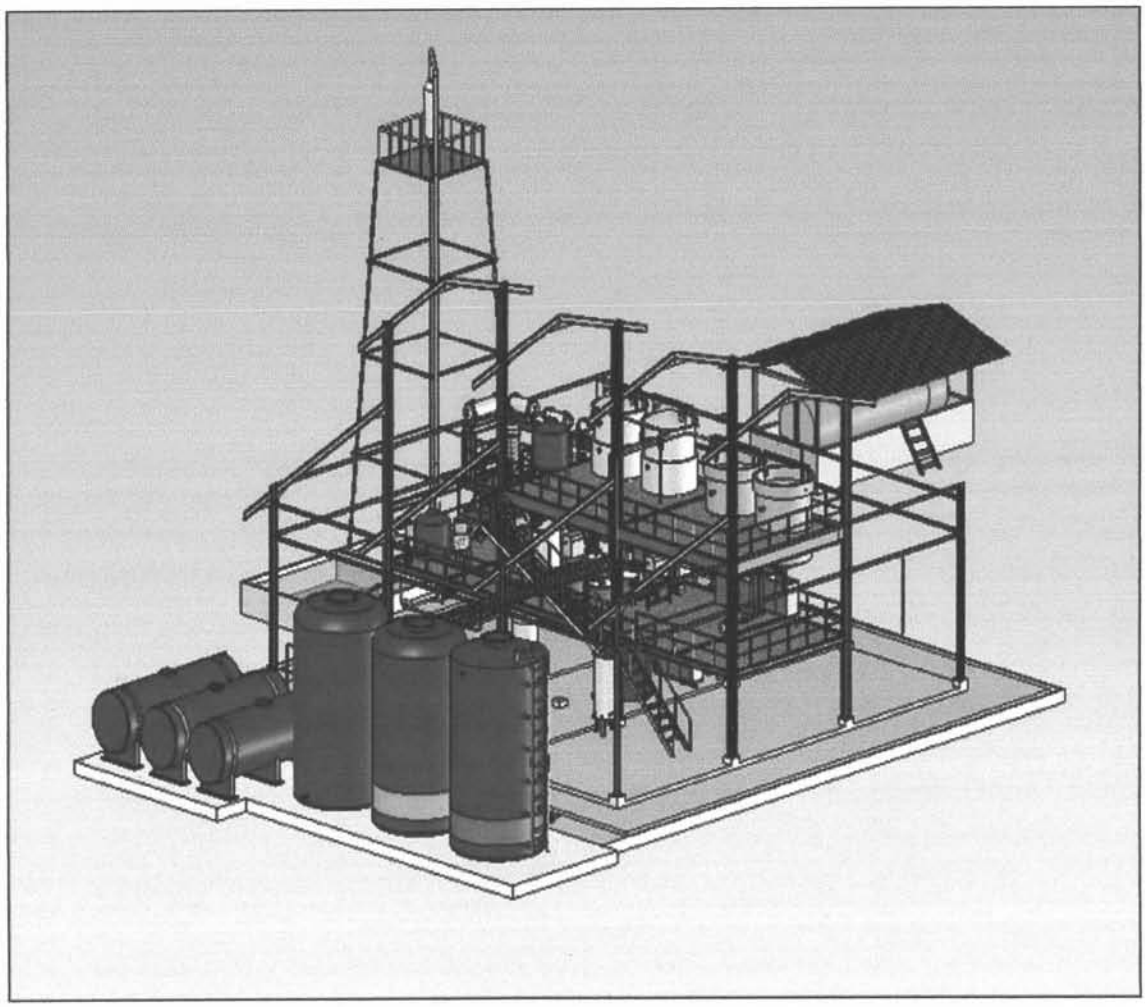

Figure 9.12: Biodiesel plant layout of 10,000 litres per day production capacity (51)

Table 9.8: The project's plant construction expenses

No.	Plant construction	Amount	Price (Baht)
1	Plant structure	1	2,200,000
2	Machine foundation	1	1,150,000
Total			**3,350,000**

9.8.3 Cost of Plant utilities

For the project's plant utilities expenses, it includes the five costs of water system, vacuum water ejector system, heating system, pipes, valves and insulation system, electrical system with an electric controller. The total plant utilities' cost would conclude up to 6,330,000 Baht; as shown in Table 9.9.

Table 9.9: The project's plant utilities expenses

No.	Utilities installation	Amount	Price (Baht)
1	Water system	1	180,000
2	Vacuum water ejector system	1	350,000
3	Heating system	1	1,200,000
4	Pipes, valves and insulation system	1	3,000,000
5	Electrical system with an electric controller	1	1,600,000
Total			**6,330,000**

9.8.4 Cost of Equipments and machineries

For the project's plant equipments and machineries expenses, the total cost concludes up to 5,413,600 Baht. The detail of equipments and machineries expenses is shown in Table 9.10 as followed:

Table 9.10: The project's equipments and machineries expenses

No.	List of equipments and machineries	Amount	Price (Baht)
1	1,000-Litre soap storage tank with integrated heater	1	79,000
2	500-Litre sodium hydroxide and water mixing tank	1	2,600
3	200-Litre hydrochloric acid dissolving container	1	550
4	Pre-filtration oil storage tank	1	5,700
5	1,500-Litre pre-filtration glycerol storage tank	1	4,700
6	1,500-Litre neutralizing tank	4	11,200
7	2,000-Litre pre-dehydration glycerol storage tank	1	5,700
8	1,200-Litre methanol and sodium hydroxide mixing tank	1	40,000
9	Wash tank	4	120,000
10	Clothe-filter (10 pairs)	1	13,000
11	15,000-Litre crude glycerol storage tank	1	150,000
12	50,000-Litre crude palm oil storage tank with integrated heater	1	500,000
13	50,000-Litre alkalized palm oil storage tank with integrated heater	1	500,000
14	500-Litre acid-water mixing tank	1	500,000
15	1,500-Litre organic separating tank	1	70,000

Table 9.10: The project's equipments and machineries expenses (continued)

No.	List of equipments and machineries	Amount	Price (Baht)
16	15,000-Litre liquid glycerol storage tank	1	135,000
17	5,000-Litre closed reactor	2	550,000
18	5000-Litre alkalized tank and wash tank	2	600,000
19	Condenser	1	650,000
20	15,000-Litre pure glycerol storage tank	1	150,000
21	Glycerol bleacher	1	350,000
22	Chiller	2	625,000
23	50,000-Litre biodiesel storage tank	1	500,000
24	1,600-Litre alcohol and water evaporator	1	350,000
25	Vacuum pump; with high flow rate and with water separation valve	1	600,000
26	1,600-Litre vacuum distillation tower	1	600,000
27	20,000-Litre methanol storage tank	1	400,000
28	Air pump	1	12,000
29	Pumps	1	450,000
30	500-Litre septic tank	1	24,000
31	Hot water tank	1	100,000
32	Phosphoric mixing tank	1	2,600
Total			**5,413,600**

9.8.5 Cost of Consultation expense

For the project's consultation expense, it would cost about 10% of the total project budget. In this case, with the project budget of 18,500,000 Baht, the consultation fee is around 1,850,000 Baht throughout the whole project; from the consultants brought-in to the commencement of the biodiesel production.

9.8.6 Cost of Project's other expenses

For the last part of the project expense – the miscellaneous expense, the total expense concludes up to 700,000 Baht. Miscellaneous expense is the expense that uses to facilitate the project task; in additional to the assets costs, human resources involvement costs, or whether the consultation cost. The detail of the miscellaneous expense is shown in Table 9.11 as followed:

Table 9.11: The project's miscellaneous expenses

Miscellaneous expenses	**(Baht)**
Advertising expense for recruitment	10,000
Advertising expense for bidders' invitation	10,000
Training materials	25,000
Communications expense for raw material acquisition	20,000
Communications expense for equipments and machineries acquisition	35,000
Lab tests for biodiesel quality assessment prior to commercial operation	600,000
Total	**700,000**

9.9 Project's Bottom-Up Cost Estimating

To calculate the project cost plan using the bottom-up cost estimating technique, it would be determined by adding up all of the costs of each discrete activity. The illustration of the bottom-up cost estimating is shown in Table 9.12 as followed:

Table 9.12: Project's Bottom-Up Cost Estimating

Task	Description	Asset Costs (Baht)	HR & consulting Costs (Baht)	Other Costs (Baht)	Total (Baht)
A	Establishment of the project team[1]	-	7,615	5,000	12,615
B	Consultant selection[1]	-	12,692	5,000	17,692
C	Production specification	-	33,872	-	33,872
D	Equipments and machineries specification	-	59,276	5,000	64,276
E	Plant structure specification	-	59,276	-	59,276
F	Plant utilities specification	-	25,404	-	25,404
G	Raw material sources identification	-	254,039	10,000	264,039
H	Bid opening and contract making of the plant construction	-	118,552	5,000	123,552
I	Bid opening and contract making of the plant utilities installation	-	59,276	5,000	64,276
J	Equipments & machineries providers identification & acquiring	2,706,800	635,098	25,000	3,366,898

Table 9.12: Project's Bottom-Up Cost Estimating (continued)

Task	Description	Asset Costs (Baht)	HR & consulting Costs (Baht)	Other Costs (Baht)	Total (Baht)
K	Land preparation	-	59,276	-	59,276
L	Plant construction	1,675,000	381,059	-	2,056,059
M	Issue of raw material purchasing order	-	42,340	10,000	52,340
N	Training program preparation	-	118,552	5,000	123,552
O	Training for biodiesel operation	-	254,039	20,000	274,039
P	Plant utilities installation	3,165,000	177,828	-	3,342,828
Q	Hand-over of the plant construction	4,840,000	59,276	-	4,899,276
R	Equipments and machineries testing	2,706,800	118,552	5,000	2,830,352
S	Receipt of raw material for trial production	-	25,404	-	25,404
T	Trial production and quality inspection	-	127,020	600,000	727,020
U	Receipt of raw material for actual production	-	25,404	-	25,404
V	Commencement of the actual biodiesel production	-	8,468	-	8,468
Total		**15,093,600**	**2,662,317**	**700,000**	**18,455,917**

* Note: The notation [1] is to note that consultation expense would not be included in the calculation