

CHAPTER 4

ANALYSIS OF SYSTEM REQUIREMENTS

4.1 Procedure for Defining Information Requirements

To define the information requirements, questionnaires were distributed to managers in each department and section of Wang Noi's organization. These questions as well as the interviews with the managers would reveal their major decision-making responsibilities to their business function, which reflected the ways of thinking about information requirements. There were three sets of questions as follows which according to [1], would lead to the requirements:

1) *What problems do you have and what information is needed for solving them? What decisions do you make and what information do you need for decision making?*

2) *What factors are critical to the success of your activity and what information do you need to achieve success or monitor progress?*

3) *What are the outputs (the ends) from your activities and what information do you need to measure the degree of your successful outputs? What resources are used in producing the output and what information is needed to measure efficiency in use of the resources?*

4.2 Analysis of the Wang Noi Power Plant Information Requirements

From the responses to the questionnaire and the interviews of the management, the user information requirements were analyzed and documented with the Business System Procedure (BSP) [3] as follows:

4.2.1 Defining Business Processes [3]

The procedure to determine the business process in the power plant is as follows:

- 1) Identify the management processes in the power plant that are critical to the success of the business.
- 2) Group processes that have close related activities and write down group definition. According to Wang Noi business, the processes are grouped as Business Plan Development, Operations Management, Performance Analyses, Plant Maintenance, Supplies Management, Finance, and Human Resource Management.
- 3) Relate the processes to concerned organization units and then develop a process/organization matrix.
- 4) Indicate the degree for each organization unit involved in the processes.

Figure 4-1 shows the Wang Noi's organization chart. Figure 4-2 shows the relation among the processes and the organization units (process versus organization matrix). The row of the matrix list processes and the columns list organizations. No letter means there is no involvement in that process. The numbers used to indicate the degree of involvement are:

3 = Major responsibility and decision maker

2 = Major involvement in the process

1 = Some involvement in the process

Figure 4-1. Organization Chart of Wang Noi Power Plant

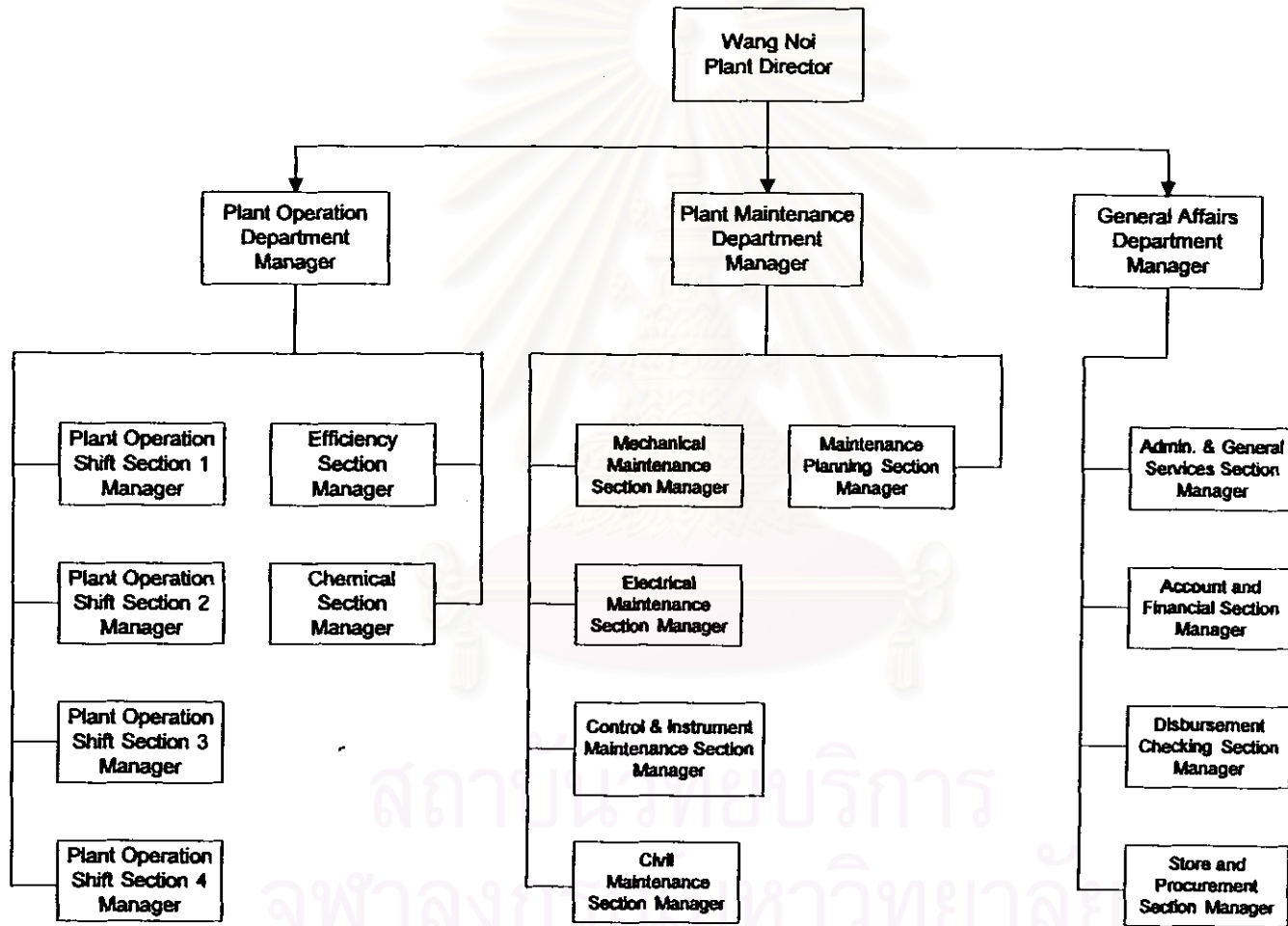


Figure 4-2. Process Versus Organization Matrix

Process \ Organization	Business Plan Development		Operation Management						Performance Analysis				Plant Maintenance Management							
	Business Policy Development	Forecast Load	Power Generation Scheduling	Control Power Production	Turn Operational Efficiency of Generation Units	Account for Energy Transactions	Monitor Plant Operations	Identify Operation Problem & Create Work Order	Support Plant Service	Request Chemical Material	Analyze Plant Performance	Analyze Performance	Respond to Plant Problems	Plan Detailed Execution of Work	Assign Work and Resources	Release Work for Execution	Perform Maintenance	Close Out Work	Report Maintenance Performance	Project Management
Plant Director	3	2	1	2	2	2	2	2			1	1	2						1	2
Assistant Plant Director	3	2	1	2	2	2	2	2	1		1	1	2						1	2
Plant Operation Department Manager	2	3	3	3	2	3	2	2	1		2	1	2		1			1	1	2
Plant Operation Shift Section Manager		2	2	2	3	2	3	3	2	2	2	2	3			2	1			
Efficiency Section Manager		2	2	2	3	2	2	2	2		3	3	2	2	2	2	1		1	2
Chemical Section Manager			1		2		2	2	3	3	2	2	2							
Plant Maintenance Department Manager	1	1	1		1		1				1	1			1			1	1	2
Maintenance Section Manager			1					1	2		1		3	3	3	3	3	3		3

3 = Major responsibility and decision maker

2 = Major involvement in the process

1 = Some involvement in the process

Figure 4-2. Process Versus Organization Matrix (Cont.)

Process \ Organization	Business Plan Development			Operation Management				Performance Analysis				Plant Maintenance Management								
	Business Policy Development	Forecast Load	Power Generation Scheduling	Control Power Production	Turn Operational Efficiency of Generation Units	Account for Energy Transactions	Monitor Plant Operations	Identify Operation Problem & Create Work Ord	Support Plant Service	Request Chemical Material	Analyze Plant Performance	Analyze Performance	Respond to Plant Problems	Plan Detailed Execution of Work	Assign Work and Resources	Release Work for Execution	Perform Maintenance	Close Out Work	Report Maintenance Performance	Project Management
General Affairs Department Manager						1											1			
Admin & General Services Section Manager																				
Account and Financial Section Manager						1														
Disbursement Checking Section Manager																				
Store and Procurement Section Manager									2								1			

3 = Major responsibility and decision maker

2 = Major involvement in the process

1 = Some involvement in the process

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

Figure 4-2. Process Versus Organization Matrix (Cont.)

Process \ Organization	Supplies Management				Financial Management							Human Resource Management					
	Manage Inventories	Manage Vendor Relationship	Operate Warehouse	Purchasing	Process Financial Transaction (General Ledger)	Perform Fixed Asset Record Keeping	Maintain Accounts Receivable	Maintain Accounts Payable	Settlements	Budgeting	Perform Cash Management	Financial Reporting	Personnel	Manage Payroll	Time Recording	Recruitment	Training
Plant Director	2	2			2	2	3	3	1	3	3	1	2				
Assistant Plant Director	2	2			2	2	3	3	1	3	3	1	2				
Plant Operation Department Manager				1	2	2	1	1	1	3	2	2	2	2			1
Plant Operation Shift Section Manager												1			2		2
Efficiency Section Manager												1			1		2
Chemical Section Manager				1								1			1		2
Plant Maintenance Department Manager				2			1	1	1	3	2	2	2	2	2		1
Maintenance Section Manager	1			2						1					2		2
Maintenance Planning Section Manager	1			1						1							1

3 = Major responsibility and decision maker

2 = Major involvement in the process

1 = Some involvement in the process

Figure 4-2. Process Versus Organization Matrix (Cont.)

<div style="text-align: center;"> Process <hr style="border: none; border-top: 1px solid black;"/> Organization </div>	Supplies Management				Financial Management								Human Resource Management				
	Manage Inventories	Manage Vendor Relationship	Operate Warehouse	Purchasing	Process Financial Transaction (General Ledger)	Perform Fixed Asset Record Keeping	Maintain Accounts Receivable	Maintain Accounts Payable	Settlements	Budgeting	Perform Cash Management	Financial Reporting	Personnel	Manage Payroll	Time Recording	Recruitment	Training
General Affairs Department Manager	2	3	2	3	2	2	3	3	1	3	2	2	3	2	3	2	1
Admin & General Services Section Manager		1	1										3	1	3	3	3
Account and Financial Section Manager	1	1	1	2	3	3	3	2		3	3	3		3	2		
Disbursement Checking Section Manager	1	2	1	1	2		2	3	3		2			2			
Store and Procurement Section Manager	3	3	3	3	1	2		1	2								

3 = Major responsibility and decision maker

2 = Major involvement in the process

1 = Some involvement in the process

4.2.2 Defining Business Data [3]

From the identified business processes, the next step is to identify and define their data requirements and their relationships. The steps are:

- 1) Find out which data each process uses and which data each creates
- 2) Classify data which are shared across processes
- 3) Determine data that are necessary but either unavailable or insufficient for process use.
- 4) Determine appropriate data usage and data creation of each process

4.2.3 Defining Information Architecture

After data are identified, the relationship between data and process is charted by the following sequence.

- 1) List the processes down the vertical axis
- 2) List the data across the horizontal axis
- 3) Across the row of each process, place "C" in the column of each data created by that process
- 4) Across the row of each process, place "U" in the column of each data used by that process
- 5) Verify that all required data are presented and that each has only one creating process.

Figure 4-3 shows the relation among the processes and the organization units (process versus organization matrix).

Figure 4-3. Process / Data Matrix

PROCESS		Data																						
		Objective	Policies & Procedures	Organizational Unit Description	External Information	Environment Impact	Forecast Load	Generation Plan	Schedule Energy Generation	Plant Operating Conditions	Historical demand load data	Fuel Cost	Selling Price	Performance of Generation	Chemistry testing result	Plant Operational Statistics	Plant Performance	Operational Changes	Plant Events	Breakdown Maintenance Request	Work Permit	Material Master File	Vendor Master File	
Business Plan Development	Business Policy Development	c	c	c																				
	Power Generation Scheduling				c		u	c	c															
Operation Management	Control Power Production				u				u	c	c													
	Turn Operational Efficiency of Generation Units							u	u	u	u		u			u	u	u						
	Account for Energy Transactions								u			u	c			u								
	Monitor Plant Operations						u			u	u		c		c				c					
	Identify Operation Problem and Create Work Order																		u	c	c			
Performance Analysis	Support Plant Service					c		u			u			c		u								
	Request Chemical Material																							
	Analyze Plant Performance								u	u					u	c								
	Analyze Performance					u		u	u	u					u	u		u						
Plant Maintenance Management	Respond to Plant Problems																			u				
	Plan Detailed Execution of Work																			u				
	Assign Work and Resources																							
	Request Material																				u			
	Release Work for Execution																				u	u		
	Perform Maintenance									u											u	u		

u = data class used by that process

c = data class created by this process

Figure 4-3. Process / Data Matrix (Cont.)

		PROCESS	Data																						
			Material Item Services	Warehouse Requisition No. for Chemical	Purchase Requisition No. for Chemical	Requested Purchased Item for Chemical	Chemical Material Issuing	Warehouse Requisition No.	Material Issuing	Purchase Requisition No.	Requested Purchase Items	Purchase Order	Inquiries	Quotation	Invoice	Stock Status	Material Usage History	Receipt of Goods or Services	Requested Purchase Items for CM	Requested Purchase Items for PM	Drawings	Plant Systems	Equipment Data	Standard Job and Work Instruction	Schedule Preventive Maintenance
Business Plan	Business Policy Development																								
Development	Power Generation Scheduling																								
Operation Management	Control Power Production					u			c													c			
	Turn Operational Efficiency of Generation Units																								
	Account for Energy Transactions																								
	Monitor Plant Operations																							c	
	Identify Operation Problem and Create Work Order																							u	
Performance	Support Plant Service		u	u	u	u	u									u	u								
Analysis	Request Chemical Material		u	c	c	c	c		c							u									
	Analyze Plant Performance																								
	Analyze Performance																						u	u	
Plant Maintenance Management	Respond to Plant Problems																					u	u		
	Plan Detailed Execution of Work																					u			
	Assign Work and Resources																					u			
	Request Material																					u			
	Release Work for Execution																					u	u		
	Perform Maintenance								u												u	u			

u = data class used by that process

c = data class created by this process

Figure 4-3. Process / Data Matrix (Cont.)

PROCESS		Data																						
		Schedule Outage Preventive Maintenance	Equipment Maintenance History	Work Order and Work Order Status	Maintenance History	Maintenance Plan	Project Definition	Actual Maintenance Date and Cost	Unplanned Maintenance	Availability of Plant and Equipment	Reliability of Plant and Equipment	Mean Time Between Failure	Mean Time To Repair	Highlight Recurring Problem	Performance Report	Account Payable	Account Receivable	Account Receivable Invoice	Chart of Account	Investment and Loan Data	Tax and Exchange Rate	Expenditure	Account for Energy Transactions	
Business Plan	Business Policy Development																							
Development	Power Generation Scheduling																							
Operation Management	Control Power Production																							
	Turn Operational Efficiency of Generation Units		u		u				u	u														
	Account for Energy Transactions								u														u	c
	Monitor Plant Operations																						u	c
	Identify Operation Problem and Create Work Order				u				u	c														
Performance Analysis	Support Plant Service																							
	Request Chemical Material																							
	Analyze Plant Performance																							
	Analyze Performance		u	u	u				u	u	c	c	c	c	c									
Plant Maintenance Management	Respond to Plant Problems				u				u															
	Plan Detailed Execution of Work	u	u	c	u	c				u														
	Assign Work and Resources	u	u	u																				
	Request Material	u																						
	Release Work for Execution				u																			
	Perform Maintenance				u				u															

u = data class used by that process

c = data class created by this process

Figure 4-3. Process / Data Matrix (Cont.)

PROCESS		Data																						
		Revenue & Debtor's Invoices	Balances & Budgets	Business Plans	Maintenance Plan	Budget Approval Status	Budget Report	Adjustments	Vendor Invoice Matching	Payment Dates	Checks	Reporting Consolidation Hierarchy	Fixed Assets	Stock Take Dates and Results	Stock Take Reports	Depreciation Schedules	Down Payments	Accounts Payable credit memos	Cash Flow Forecasts	Bank Account	External Financial Information	Daily Cash Flow	Employee Details	
Business Plan Development	Business Policy Development		u	u	u	u																		
	Power Generation Scheduling																							u
Operation Management	Control Power Production																							u
	Turn Operational Efficiency of Generation Units																							
	Account for Energy Transactions																							
	Monitor Plant Operations																							
	Identify Operation Problem and Create Work Order																							
Performance Analysis	Support Plant Service																							
	Request Chemical Material																							
	Analyze Plant Performance																							
	Analyze Performance																							
Plant Maintenance Management	Respond to Plant Problems																							
	Plan Detailed Execution of Work																							
	Assign Work and Resources																							
	Request Material		u																					
	Release Work for Execution																							
	Perform Maintenance																							

u = data class used by that process

c = data class created by this process

Figure 4-3. Process / Data Matrix (Cont.)

		PROCESS	Data																					
			List of Maintenance Staffs & Available sta	Job Description & Job Specification	Staff Appraisal	Employee Salary & Wage	Condition of Payment	Maintenance Time Sheet	Time Sheet	Labor Cost	Condition of Payment	Payment Report	Schedule of Pay Tax	Staff Utilization Reports	Job Vacancies	Schedule of Examination	Interview Reports	Ranked Candidates	Letters to Applicant	Training Need	Available Training Courses	Staff Training History	List of Suitable Attendees	Training Course Schedule
Business Plan	Development	Business Policy Development		u	c	c	c																	
		Power Generation Scheduling																						
Operation Management		Control Power Production																						
		Turn Operational Efficiency of Generation Units																						
		Account for Energy Transactions																						
		Monitor Plant Operations																						
		Identify Operation Problem and Create Work Order																						
Performance Analysis		Support Plant Service																						
		Request Chemical Material																						
		Analyze Plant Performance																						
		Analyze Performance																						
Plant Maintenance Management		Respond to Plant Problems	u																					
		Plan Detailed Execution of Work	u																					
		Assign Work and Resources	c																	c				
		Request Material																						
		Release Work for Execution	u																					
		Perform Maintenance																						

u = data class used by that process

c = data class created by this process

Figure 4-3. Process / Data Matrix (Cont.)

		PROCESS																Data						
		Objective	Policies & Procedures	Organizational Unit Description	External Information	Environment Impact	Forecast Load	Generation Plan	Schedule Energy Generation	Plant Operating Conditions	Historical demand load data	Fuel Cost	Selling Price	Performance of Generation	Chemistry testing result	Plant Operational Statistics	Plant Performance	Operational Changes	Plant Events	Breakdown Maintenance Request	Work Permit	Material Master File	Vendor Master File	
Plant Maintenance Management	Close Out Work																							
	Report Maintenance Performance																							
	Project Management																							
Supplies Management	Manage Inventories																							
	Manage Vendor Relationship																							
	Operate Warehouse																							
	Purchasing																							
Financial Management	General Ledger																							
	Perform Fixed Asset Record Keeping																							
	Maintain Accounts Receivable																							
	Maintain Accounts Payable																							
	Settlements																							
	Budget																							
	Perform Cash Management																							
Financial Reporting																								
Human Resource Management	Personnel																							
	Manage Payroll																							
	Time Recording																							
	Recruitment																							
	Training																							

u = data class used by that process

c = data class created by this process

Figure 4-3. Process / Data Matrix (Cont.)

		PROCESS		Data																				
				Material Item Services	Warehouse Requisition No. for Chemical	Purchase Requisition No. for Chemical	Requested Purchase Item for Chemical	Chemical Material Issuing	Warehouse Requisition No.	Material Issuing	Purchase Requisition No.	Requested Purchase Items	Purchase Order	Inquiries	Quotation	Invoice	Stock Status	Material Usage History	Receipt of Goods or Services	Requested Purchase Items for CM	Requested Purchase Items for PM	Drawings	Plant Systems	Equipment Data
Plant Maintenance	Close Out Work																							
Management	Report Maintenance Performance																				u			
	Project Management																				u			
Supplies	Manage Inventories	u					u									u								
	Manage Vendor Relationship																							
Management	Operate Warehouse	c	u	u		u	u	u							c	c								
	Purchasing			u	u				u	u	c	c	c	c			u	u	u					
Financial Management	General Ledger	u																						
	Perform Fixed Asset Record Keeping																							
	Maintain Accounts Receivable																							
	Maintain Accounts Payable					u					u	u		u	u									
	Settlements																							
	Budget																							
	Perform Cash Management																							
Human Resource Management	Financial Reporting																							
	Personnel																							
	Manage Payroll																							
	Time Recording																							
	Recruitment																							
	Training																							

u = data class used by that process
 c = data class created by this process

Figure 4-3. Process / Data Matrix (Cont.)

PROCESS		Data																					
		Schedule Outage Preventive Maintenance	Equipment Maintenance History	Work Order and Work Order Status	Maintenance History	Maintenance Plan	Project Definition	Actual Maintenance Date and Cost	Unplanned Maintenance	Availability of Plant and Equipment	Reliability of Plant and Equipment	Mean Time Between Failure	Mean Time To Repair	Highlight Recurring Problem	Performance Report	Account Payable	Account Receivable	Account Receivable Invoice	Chart of Account	Investment and Loan Data	Tax and Exchange Rate	Expenditure	Account for Energy Transactions
Plant Maintenance	Close Out Work																						
Management	Report Maintenance Performance	u	u	u	u	u	u	u	u	u	u	u	u	u									
	Project Management	c	u	u	u		c																
Supplies Management	Manage Inventories																						
	Manage Vendor Relationship																						
	Operate Warehouse																		u				u
	Purchasing							u	u														c
Financial Management	General Ledger								u							u	u						u
	Perform Fixed Asset Record Keeping																						
	Maintain Accounts Receivable																c	c		u			u
	Maintain Accounts Payable																c			u			
	Settlements																u	u			c		u
	Budget																			u			
	Perform Cash Management																u	u			u		u
Human Resource Management	Financial Reporting															u	u			u			
	Personnel																						
	Manage Payroll																						
	Time Recording																						
	Recruitment																						
	Training																						

u = data class used by that process
 c = data class created by this process

Figure 4-3. Process / Data Matrix (Cont.)

PROCESS		Data																					
		Revenue & Debtor's Invoices	Balances & Budgets	Business Plans	Maintenance Plan	Budget Approval Status	Budget Report	Adjustments	Vendor Invoice Matching	Payment Dates	Checks	Reporting Consolidation Hierarchy	Fixed Assets	Stock Take Dates and Results	Stock Take Reports	Depreciation Schedules	Down Payments	Accounts Payable credit memos	Cash Flow Forecasts	Bank Account	External Financial Information	Daily Cash Flow	Employee Details
Plant Maintenance Management	Close Out Work																						
	Report Maintenance Performance		u																				
	Project Management		u				u																
Supplies Management	Manage Inventories																						
	Manage Vendor Relationship																						
	Operate Warehouse												u	c	u								
	Purchasing		u				u		c				u	c		u	c						
Financial Management	General Ledger		u				u	c			c	u	u		u	u			c				
	Perform Fixed Asset Record Keeping											c	u	c	c								
	Maintain Accounts Receivable	c																				u	
	Maintain Accounts Payable								u	c	c					c			u			u	
	Settlements																					u	
	Budget		c	u	u	u	u															u	
	Perform Cash Management		u						u	u	u								u	u	c	c	
	Financial Reporting		u	u	u	u	u						u	u	u	u	u		u	u	c	u	
Human Resource Management	Personnel																						c
	Manage Payroll																						u
	Time Recording		u	u	u	u	u																u
	Recruitment																						u
	Training																						u

u = data class used by that process

c = data class created by this process

Figure 4-3. Process / Data Matrix (Cont.)

		PROCESS		Data																				
				List of Maintenance Staffs & Available sta	Job Description & Job Specification	Staff Appraisal	Employee Salary & Wage	Condition of Payment	Maintenance Time Sheet	Time Sheet	Labor Cost	Condition of Payment	Payment Report	Schedule of Pay Tax	Staff Utilization Reports	Job Vacancies	Schedule of Examination	Interview Reports	Ranked Candidates	Letters to Applicant	Training Need	Available Training Courses	Staff Training History	Lists of Suitable Attendees
Plant Maintenance Management	Close Out Work																							
	Report Maintenance Performance	u																						
	Project Management						u	u	u															
Supplies Management	Manage Inventories																							
	Manage Vendor Relationship																							
	Operate Warehouse																							
	Purchasing																							
Financial Management	General Ledger																							
	Perform Fixed Asset Record Keeping									u														
	Maintain Accounts Receivable																							
	Maintain Accounts Payable																							
	Settlements																							
	Budget																u	u	u	u	u			
	Perform Cash Management																							
Human Resource Management	Financial Reporting																							
	Personnel		c	c	u	u		u	u	u	u		u	c					u					
	Manage Payroll	u			c	u	u	u	u	u	c	c												
	Time Recording	u					u	c					c											
	Recruitment	u	u											u	c	c	c	c						
Training		u	u															u	c	c	c	c	c	

u = data class used by that process
 c = data class created by this process

4.2.4 Developing the Flow Diagram [4]

An information flow diagram is developed to understand model and data flow in the power plant. Figure 4-4 shows total information architecture flow diagram and Figure 4-5 to 4-10 show the information flow diagram of each module.



สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

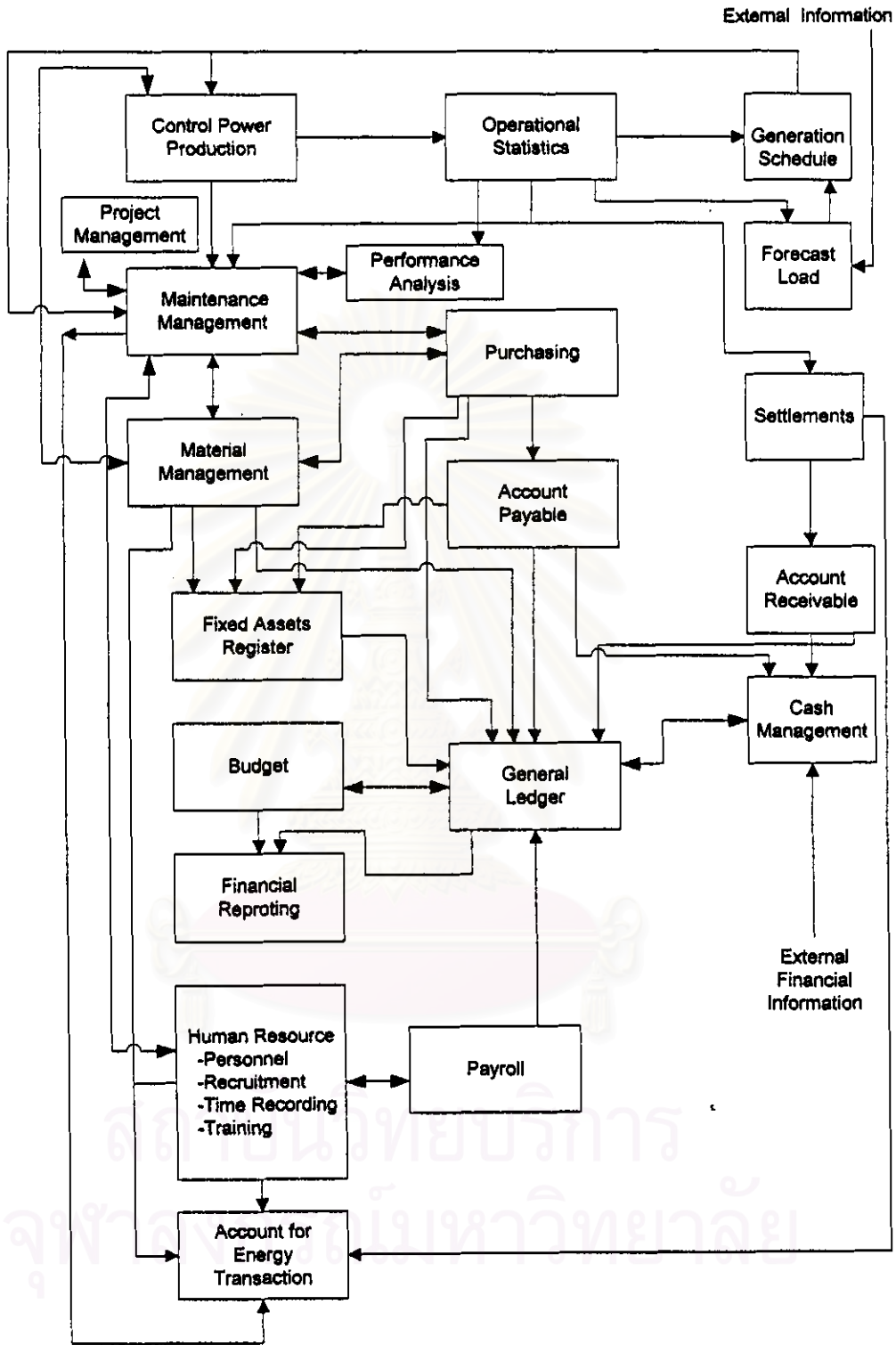


Figure 4-4. Information Architecture Flow Diagram

Operation Management

The operation Management is the process to generate electricity.

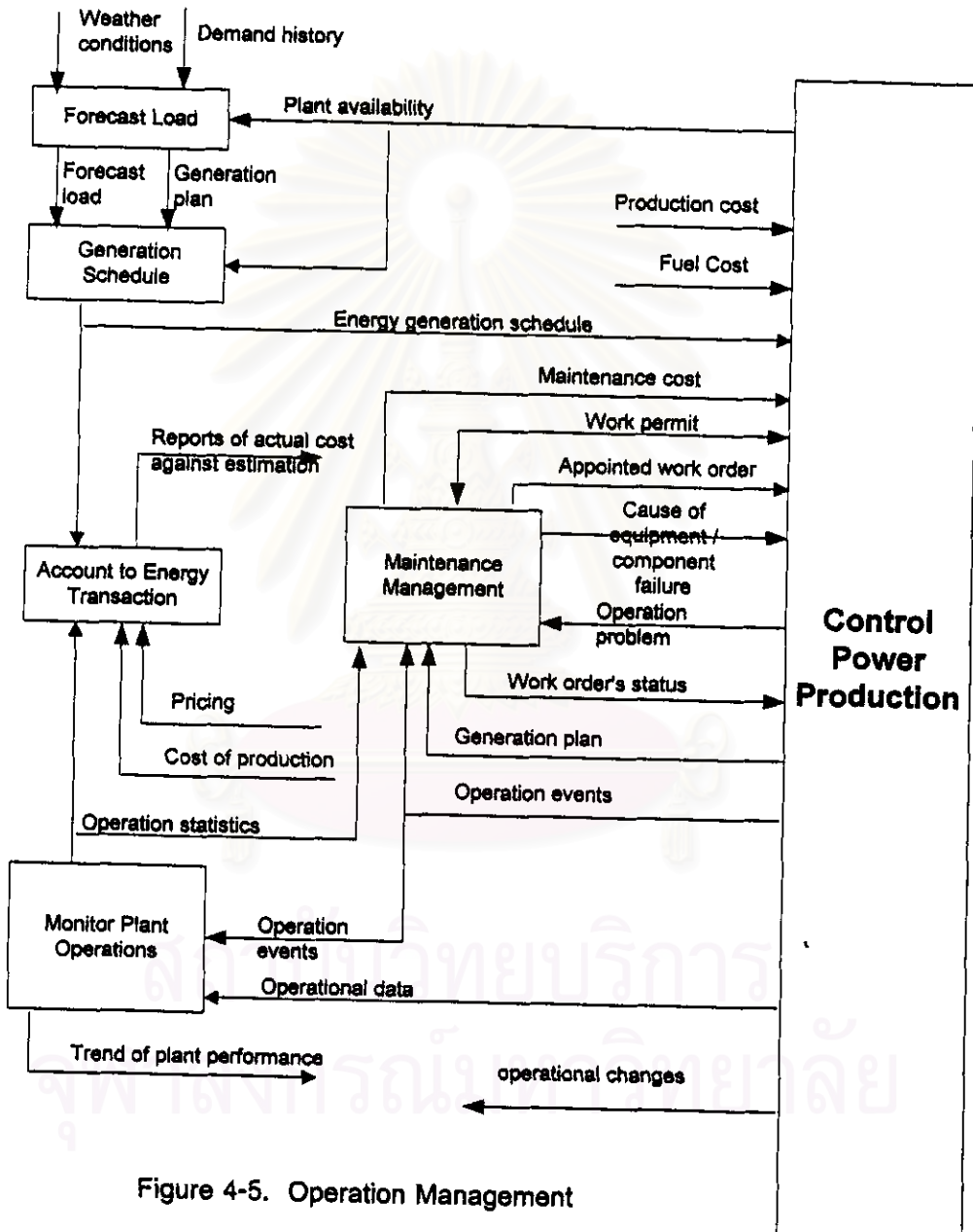


Figure 4-5. Operation Management

Performance Analysis

Performance analysis provides the processes of support plant services, analyze plant performance, and performance analysis.

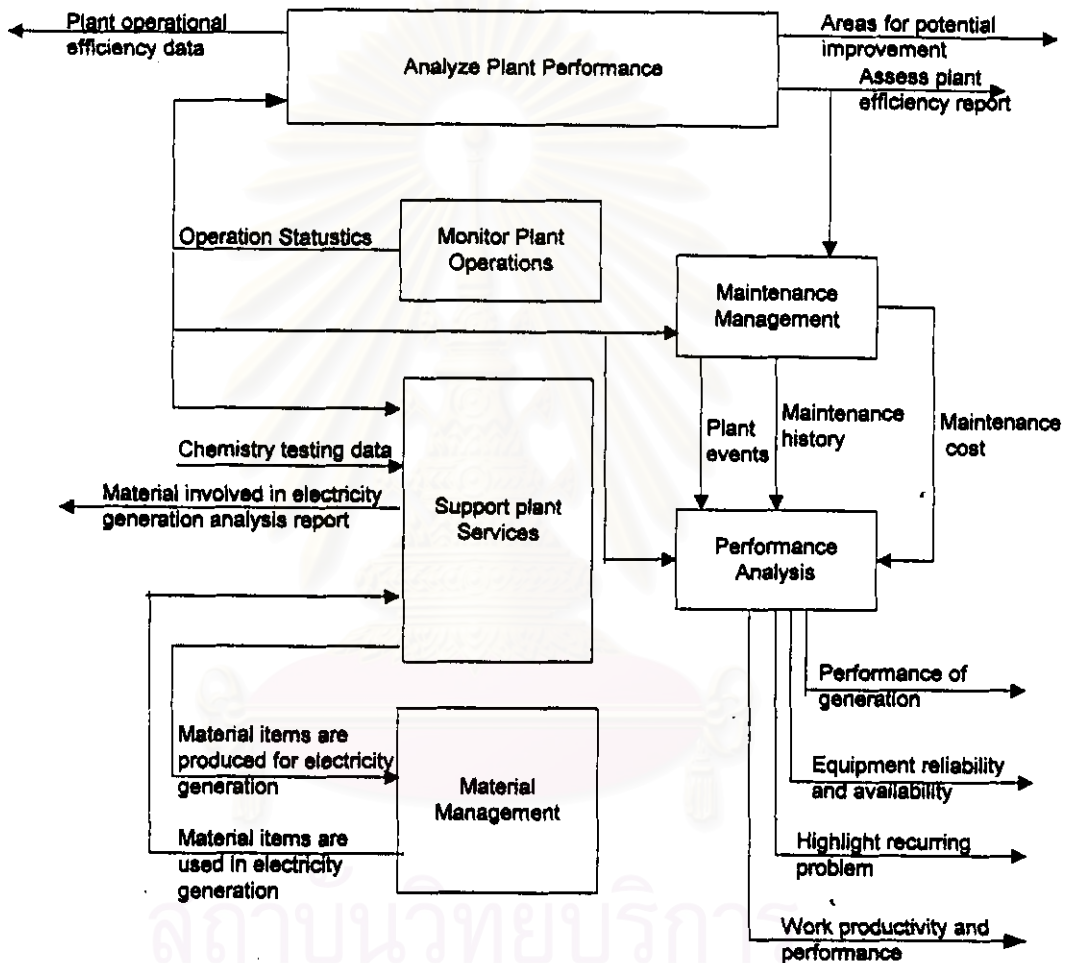


Figure 4-6. Performance Analysis

Plant Maintenance

Plant Maintenance is process for planning, scheduling and control of preventive and corrective maintenance in order to make efficient use of the labor, equipment and material resources

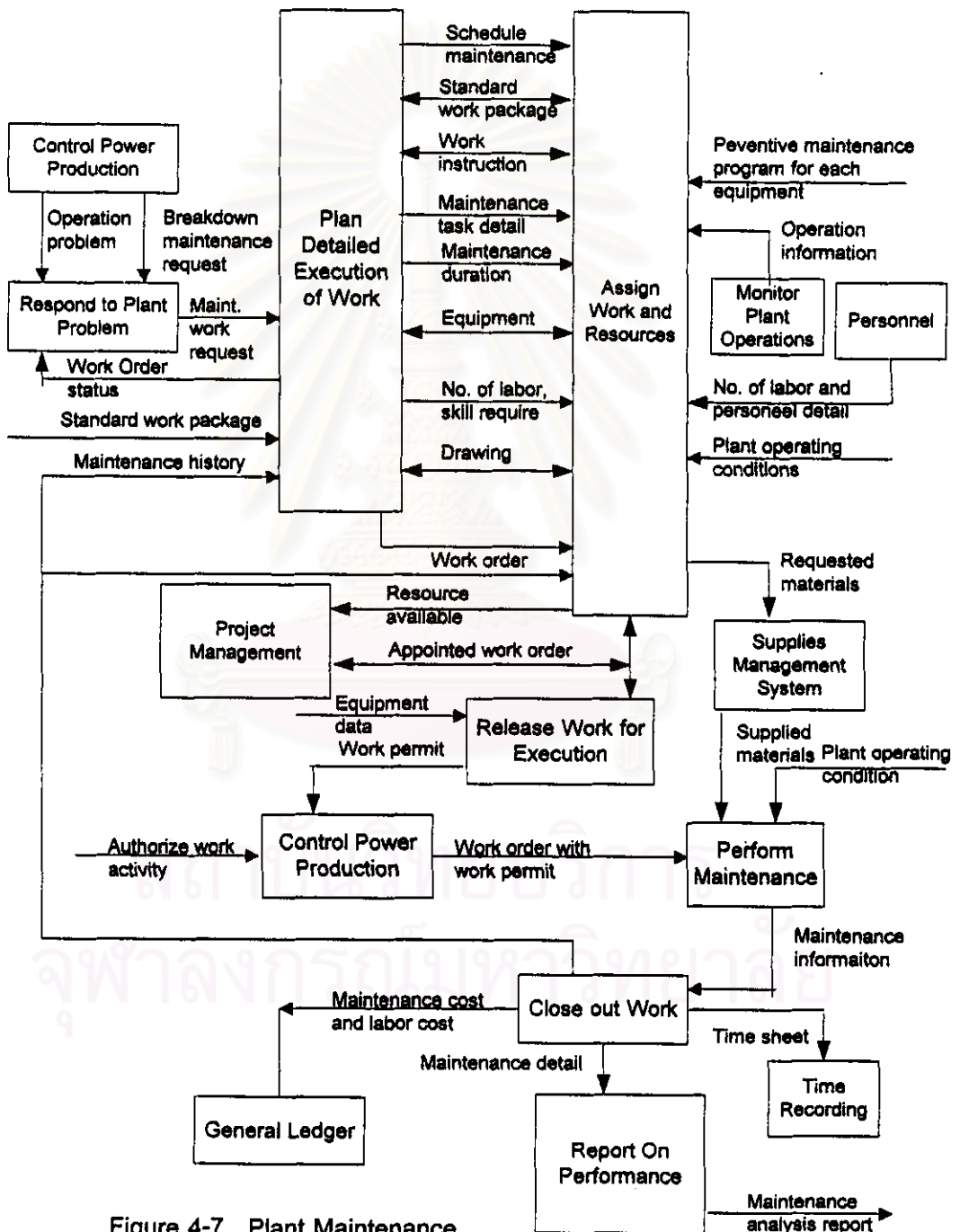


Figure 4-7. Plant Maintenance

Supplies Management

Supplies Management is used to manage inventories and warehouses as well as to ensure effective procurement.

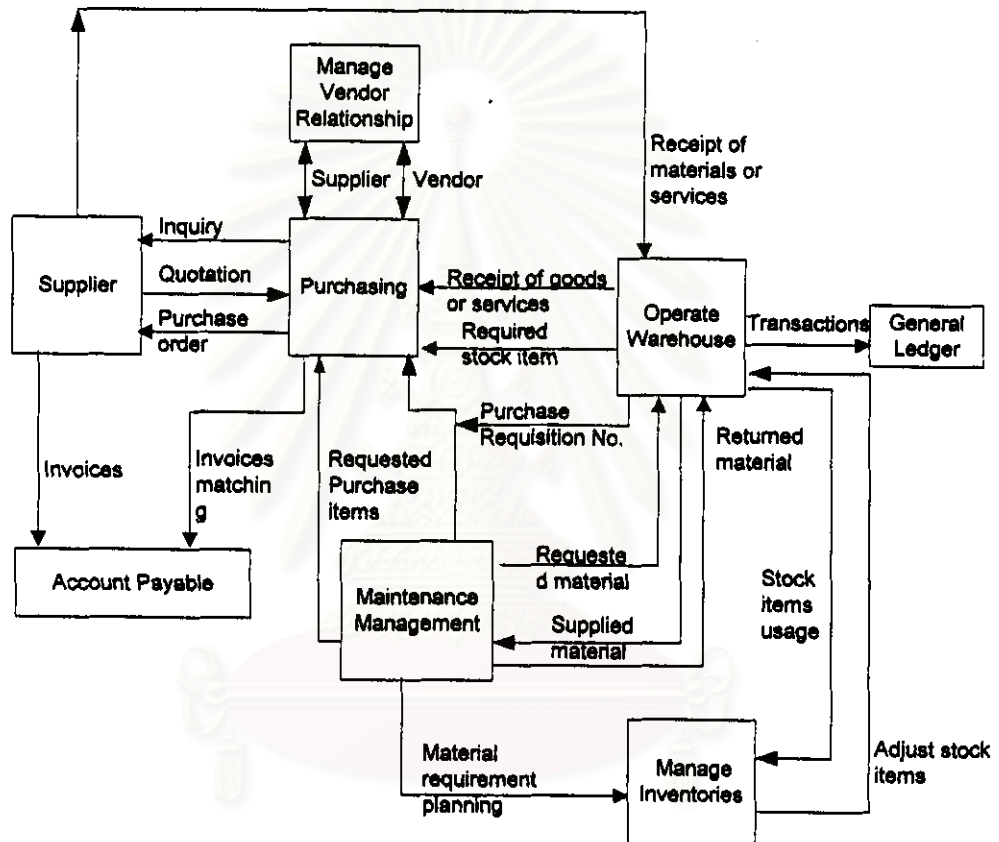


Figure 4-8. Supplies Management

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

Financial Management

Financial Management is a process for accounting data.

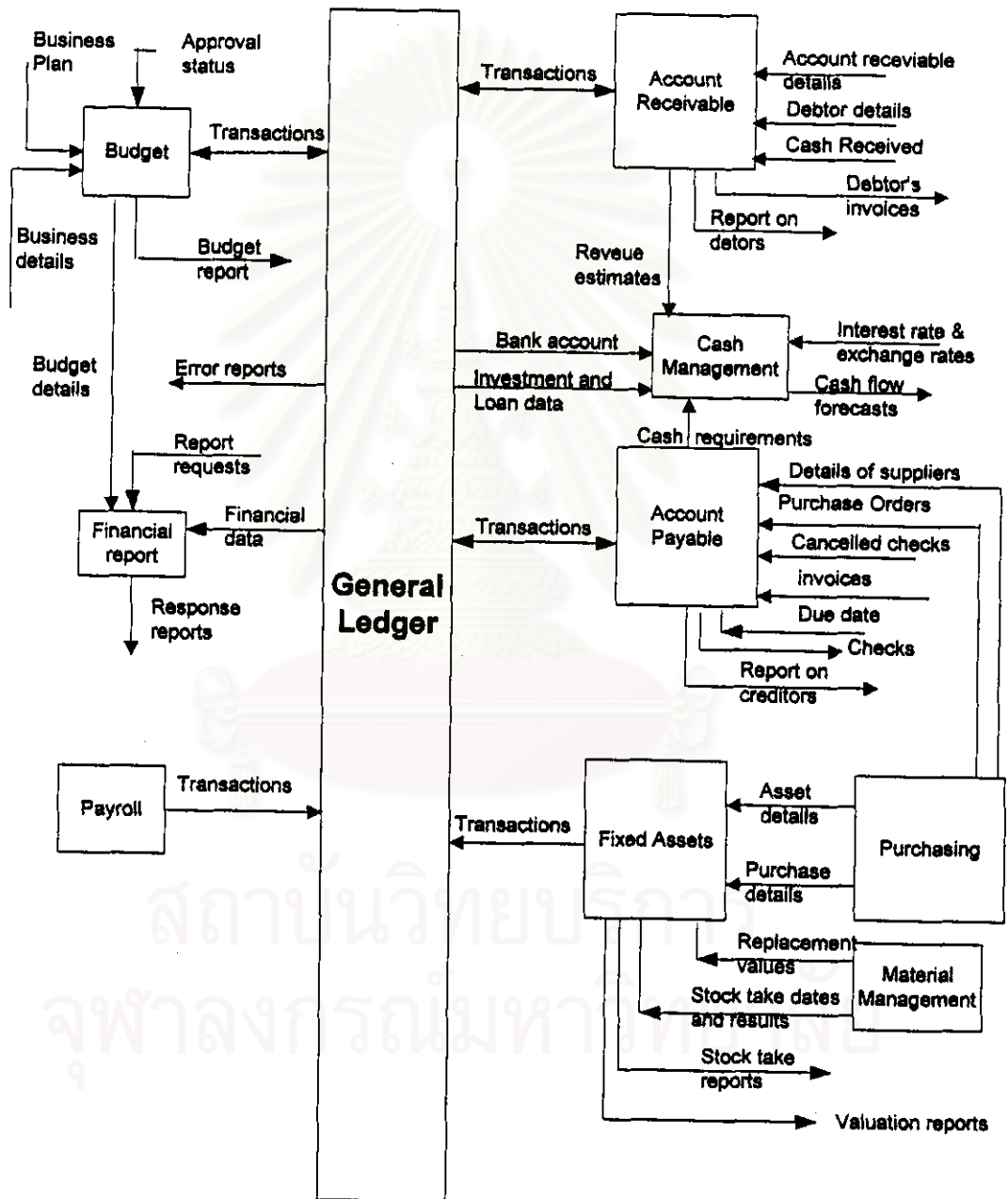


Figure 4-9. Financial Management

Human Resource Management

Human Resource Management System provides management of people, control all salary and wages payment, time sheet record, recruitment, and training.

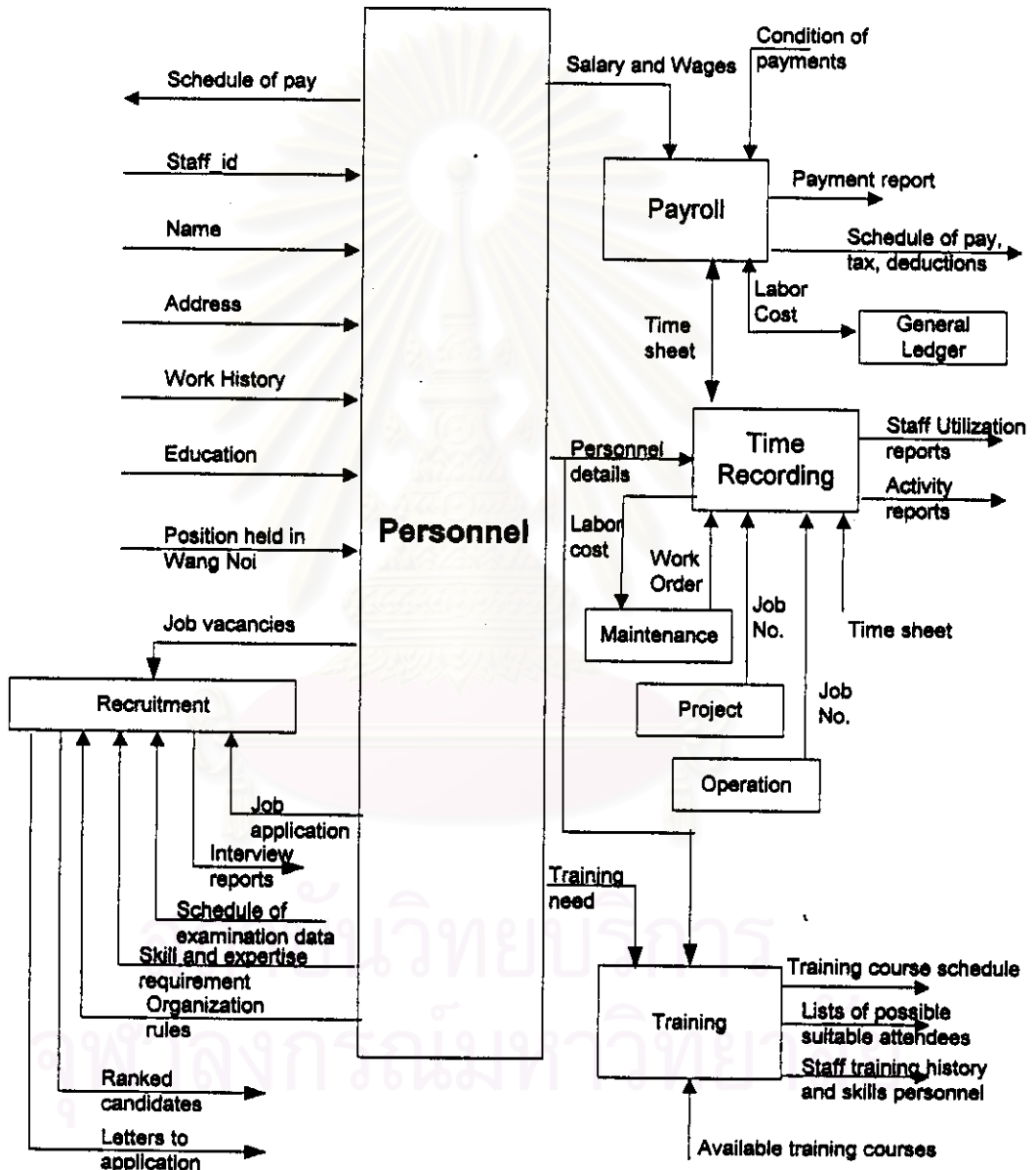


Figure 4-10. Human Resource Management

4.3 Description of Business Processes and Their Requirements of Information

Supports

The following sections describe details of all business processes and their required information support.

4.3.1 Business Plan Development

Business Plan Development is a group of processes that consists of Business Policy Development and Power Generation Scheduling.

1) Business Policy Development

The management determines the target of the business, the corporate strategy, and the business objective. Then it develops performance agreement and promulgate policies. The information to assist decision-making in this process is the main operating performance indicators.

2) Power Generation Scheduling

This process establishes the target of generation and capacity, then informs this commitments, which is called "availability" to EGAT's dispatching center. Finally, EGAT will accept the generation schedule and actual energy generation according to that current situation.

In this process, the power plant shall have two steps income, those are:

- 1) An amount from informing "availability"
- 2) An amount from actual energy generation.

Anyhow, the power plant has to respond to the informed "availability", if it is not able to do according to these conditions, it shall be penalized by EGAT.

- 1) Cannot inform EGAT of its "availability" 22 hours ahead
- 2) Cannot do actual generation in time and/or generate less capacity than informed "availability"
- 3) There is fault during generation.

The information to assist decision-making in this process is Operational Statistics for information considers in generating electricity and outage patterns that are retrieved from the Monitor Plant Operation, Availability of plant and equipment which is retrieved from Performance Analyses, and Report of schedules against actual operation.

4.3.2 Operation Management

The operation management is a group of processes that are on duty of generating electricity. The group consists of Control Power Production, Account for Energy Transaction, Monitor Plant Operation, and Identify Operation Problem and Create Work Order.

4.3.2.1 Control Power Production

This process generates electricity to match load requirements and tune operational efficiency of generating units. The process requires information support to show the performance of the generation output. The information to assist decision-making in this process is Operational statistics and Production cost which is retrieved from Materials Management, Maintenance Management, and Costing systems.

4.3.2.2 Account for Energy Transaction

This process produces documents, which consists of the planned and actual amount of power sales. It determines costs and prices of electricity provided by the power plant, finally the output is issuing pricing analysis against real cost of production. To achieve this, the information to assist decision-making in this process is Operating cost, which are retrieved from Materials Management, Maintenance Management, and Costing systems, Labor cost, which are retrieved from Plant Maintenance and Human Resource, Overheads cost, which are retrieved from Financial, Pricing analysis against real cost of production, MegaWatts of availability generation and MegaWatts of energy generation, Penalty items and value of each penalty item, and Actual cost against estimation.

4.3.2.3 Monitor Plant Operation

This process is the operation that observes plant functions, evaluates operating shifts by trending plant performance, identifies warning or danger points, and alerts concerned parties to operational changes. The information to assist decision-making in this process is plant performance operating trends.

4.3.2.4 Identify Operation Problems and Issue Maintenance Requests

In case fault occurs during generation, the operators shall pass plant operation data to do an analyzing cause of that fault. Then the operators request the breakdown maintenance by issuing a Maintenance Request Report. This process requires On-line breakdown maintenance request to the Plant Maintenance and requires information support to create work order and track the status of break down maintenance

which consists of Plant events, Cause of equipment /component failure, Breakdown maintenance request status and maintenance's cost.

4.3.3 Performance Analyses

Performance analyses is a group of processes that consists of Support Plant Services, Analyze Plant Performance, and Performance Analysis.

4.3.3.1 Support Plant Services

This process performs routine tasks of chemistry testing, waste handling and disposal, clearance coordination and tagging. It also analyzes material involved in electricity generation and the production of some materials to be used in electricity generation. It requires retrieving the Operating Statistics from the process of Monitor Plant Operation, the Supplies, and requires information support to analyze the testing, generation unit performance and control the chemical production items. The information to assist decision-making in this process is History data of chemistry tests, Operating statistics, and Chemical production items and the usage history.

4.3.3.2 Analyze Plant Performance

This process evaluates generation performance trends and assesses plant efficiency, fuel, and operational issues to identify areas for potential improvement. The information to assist decision-making in this process is Plant event history, and Plant maintenance, which consists of mean time to repair, mean time to failure, and maintenance history.

4.3.3.3 Performance Analysis

This process evaluates power plant system and component reliability and availability, assesses recurring problem spots and highlights them for attention, and evaluates work productivity and performance. It requires retrieving information from Production and Operating Statistics and Plant Maintenance. The information to assist decision-making in this process is Plant event history, Plant maintenance costing, mean time to repair, mean time to failure, maintenance history, and Equipment capacity.

4.3.4 Plant Maintenance Management

The objectives of Plant Maintenance Management are manage labor, tools and material to ensure effective maintenance for power plant and perform necessary actions to outage problems, breakdown maintenance, and preventive maintenance. This process group consists of Maintenance Management and Project Management.

4.3.4.1 Maintenance Management

The Maintenance Management process includes planning, scheduling, releasing work orders, performing and managing the execution of works, closing out work and account for work. The detail processes are as follow:

4.3.4.1.1 Respond to Plant Problems

This process identifies operating problems (breakdown maintenance), assigns which maintenance section should response, coordinate external support requirements, and tracks and monitors plant problems through resolution. The information to assist decision-making in this process is Breakdown maintenance request.

4.3.4.1.2 Plan Detailed Execution of Work

There are two types of plant maintenance for Wang Noi's Power Plant. Preventive maintenance is routine maintenance, which means performing of repairs, and component replacement shall be done periodically before the equipment fails. The principal function of management in this field is to ensure that routine maintenance is properly done according to a definite time schedule, which is created, from the maintenance section's experience and the equipment manufacturer's suggestions.

Corrective maintenance is correction when the system is broken down. In fact, event though there is a preventive maintenance and no matter how much time is spent on it, breakdowns still occur. Therefore, the facility, which is available for prompt repairing the equipment, should be considerably built up since preventive maintenance alone cannot eliminate equipment breakdowns.

This process defines maintenance tasks for plant equipment, planning, scheduling and control of preventive and corrective maintenance program. It also defines requirement of materials, equipment, and labor skills. The information to assist decision-making in this process is preventive maintenance program, and maintenance history.

4.3.4.1.3 Assign Work and Resources

This process sequences detailed tasks in the respond to Plant Problems and assigns specific resources to those tasks based on availability and complexity. Finally, the process has to authorize work activity. It requests materials through purchasing for non-stock items and requests materials from inventory for stock items. The information to assist decision-making in this process is Maintenance available staffs, tools and Stock on hand of spare parts and consumable materials.

4.3.4.1.4 Release Work for Execution

This process does readiness form execution and gets the work permit from the Operations. The information to assist decision-making in this process is Work permit's status.

4.3.4.1.5 Perform Maintenance

The maintenance staffs having performed maintenance, they record maintenance details, actual labor, material usage and other expense.

4.3.4.1.6 Close out Work

This process has the duty to update maintenance history file and financial records, balance maintenance account, and close out Work Order. The information to assist decision-making in this process is Work order's status, maintenance cost, and time sheets.

4.3.4.1.7 Report On Performance

This process evaluates maintenance work execution for productivity, quality, effectiveness, work methods, develop recommendations for change, and reports a maintenance execution event to the management with a conclusion of actual cost of each mission.

The Maintenance Management requires to get information from Monitor Plant Operation, Schedule Generation, Forecast Demand, Control Power Production, in the meantime it provides information of time sheet to Time Recording. So The information to assist decision-making in this process is List of plant equipment and components, Production and Operating Statistics, Operations Scheduling, Forecast load.

Plant availability, Plant reliability, Schedule maintenance including standard jobs and work instruction, Pending work orders, Maintenance history, List of maintenance staffs and available staffs, Lists of material in warehouse, Maintenance time sheet, Budgeting for maintenance activities.

4.3.4.2 Project Management

This process plans and controls the outage preventive maintenance in detail down to day-to-day level including tracking and status of the project against cost and times plans. It requires standard tools for project management such as Gantt charting, critical path analysis and recording of project status. It requires linking to Schedule Work and Resource for obtaining the information. The information to assist decision-making in this process is Resource available, Status of projects, Project plans, variations, and Schedule work and resources.

4.3.5 Supplies Management

Supplies Management is a group of processes that performs to manage inventories and warehouses as well as to ensure effective procurement. The processes are Material Management and Purchasing.

4.3.5.1 Material Management

The process of Material Management is to know and control material quantities in order to ensure that materials are available in time of maintenance. The Material Management consists of Manage Inventories, Manage Vendor Relationship, and Operate warehouse.

4.3.5.1.1 Manage Inventories

This process tracks quantity, location of materials, plans any movements and adjustments of inventory then does execution for regulating materials assigned quantities. The information to assist decision-making in this process is material movements and adjustments of inventory.

4.3.5.1.2 Manage Vendor Relationship

This process tracks supplier and vendor performance and maintains supplier and vendor information. The information to assist decision-making in this process is supplier and vendor performance.

4.3.5.1.3 Operate Warehouse

The activities in this process are request of materials through purchasing, reserve materials, verify receipt of materials or services, inspect as required, submit documentation regarding condition and authorization to pay, receive returned material, store material, provide material as requested, and perform services transaction accounting.

The Material Management requires purchase requisition that is created from the Operate Warehouse link to Purchasing System. The information to assist decision-making in this process is Up-to-date stock of equipment and components inventory, Catalogue of stock items used in the power plant, and Material requirement planning which is retrieved from Maintenance Scheduling and Work Orders.

4.3.5.2 Purchasing

Purchasing process is the production of purchase orders to suppliers by the sequence of doing inquiries according to purchase requisitions, evaluating quotation. Next to trace the delivery actions of suppliers, receipt of goods and matching of invoices. It requires the information link to Accounts Payable on receipt of goods and to General Ledger. The information to assist decision-making in this process is Supplier database and conditions of suppliers, Purchase requisition details, and output of purchase order.

4.3.6 Financial Management

Financial is a group of processes that perform all the work associated with the financial operation of the power plant. It includes General ledger, Perform Asset Record Keeping, Account Receivable, Accounts Payable, Budget, Perform Cash Management, and Financial reporting.

4.3.6.1 General Ledger

This process records the financial transactions of the power plant, journalizes activities such as petty cash disbursements, fuel accounting, work order accounting, allocations, and liability recording. It checks the validation, edit and correct of those transactions and their posting to the General Ledger. The process requires Batch posting of transactions from Accounts Payables, Account Receivables, Asset Register, Cash Management, Payroll, Purchasing, and Budget. It also requires On-line entry of corrections and vouchers, automatic entry of standard repeating periodical journal entries, periodic and timely update of General Ledger, and timely output of reports. The information to assist decision-making in this process is Accounting transactions, Journal activities, Investment and loan data, and Budget.

4.3.6.2 Perform Fixed Asset Record Keeping

This process records fixed asset items received from acquisition process, disposal, depreciation and updates of fixed asset value. It requires link to General Ledger, Purchasing, Accounts Payable and Inventory. The information to assist decision-making in this process is List of current fixed asset, Maintenance of replacement values, Depreciation schedules, and Calculation of valuations.

4.3.6.3 Account Receivable

This process produces debtors' invoices, monitor amount receivable and record revenue received. It has to link to General Ledger for receivable transactions. The information to assist decision-making in this process is Debtor details, Issue invoices, and Capture receivables and verify against invoices.

4.3.6.4 Accounts Payable

This process is taking care payments and monitoring amounts owed to creditors. It requires link to Supplies, General Ledger for creating periodic reports. The information to assist decision-making in this process is Payable information from Material and Maintenance management, settlement of purchasing transactions, Verification of goods supplied against invoice received.

4.3.6.5 Settlements

This process calculates the volumes of electricity sold, calculate settlement payments, and issues invoice. It requires link to Monitor Plant Operation, Accounts

Receivable. The information to assist decision-making in this process is Access Operational Statistics for volumes sold and Settlement payments.

4.3.6.6 Budget

The process records planned expenditures for all aspects of the power plant operations, administrative support, maintenance budgets, and plan resource utilization. The information to assist decision-making in this process is Annual plan and Business plans and Actual results.

4.3.6.7 Perform Cash Management

This process does the management of short-term and long-term investments, cash processing, forecast cash flow over a given period and maintain adequate cash reserves. It requires access to Accounts Payable systems for cash requirements. The information to assist decision-making in this process is investment and loan data, External financial information such as interest and currency exchange rates, money market information, and Periodic Cash flow reports.

4.3.6.8 Financial Reporting

The process creates reports, normally monthly reports, showing the comparison between budget and actual expense and variance as well; this assists the management to obtain simple result. It requires information support is Financial information from variety of internal sources.

4.3.7 Human Resource Management

Human resource is a group of processes that do cooperation with internal organization units to investigate member and qualification of staffs, conclude requirement, plan to recruit and proceed accordingly. Finally, it shall take care of the payroll. It consists of information individual of employee (personnel), control all salary and wages payment, time sheet record, recruitment, and training.

4.3.7.1 Personnel

This process record information of individual staff members, e.g. name, addresses, work history, education, position held in the power plant. It requires link to Training System to update employee details, link to Time Recording or Payroll systems for leave entitlements. It requires general information to support the process is Employee details database, Job descriptions, required skill and expertise for all positions in Wang Noi's Power Plant, Skills database, and Staff appraisal database

4.3.7.2 Payroll

The process does manage and control all salary and wage payments and any adjustments to these payments as a result of paying tax, benefits, allowances, including time recording and calculations. It generally links to Personnel System for employee, Time Recording, General Ledger. It requires general information to support the process is Employee salary & wage and Condition of payment.

4.3.7.3 Time Recording

This process manages and evaluates the information of personal timing from time sheet which has work details and time spent by activity against work order. The

process also monitors staff utilization. It shall link to Personnel and Payroll for pay, link to Operations and Plant Maintenance for scheduling and budgeting. It requires general information to support the process is Employee work hours from time sheets and Employee details.

4.3.7.4 Recruitment

This process manages the recruitment of new staff. First it has to know available positions requested from all organization units, then it creates advertisements for applicants to give interviews and provide rules for selections and selecting staff to work on a permanent, temporary or casual basis. The process shall contact to Personnel for getting numbers of skill and expertise requirement. It requires general information to support the process is Selection rule for positions.

4.3.7.5 Training

This process provides details of available training courses, capture of training needs for specific projects and planned future activities. The process should indicate what training courses are most required and match staff with training courses. It is able to provide staff training course history and skill register. It requires connection to Personnel system to identify training needs of staff and to update employee details with completed courses. It requires general information to support the process is Training courses, Training need, Scheduling of training courses to meet needs and Evaluation of each training courses

4.4 Expected Benefit of the MIS for the Process Groups

When the MIS is completely implemented to the power plant, the benefits that each process group is obtains are as follows:

The benefits of the MIS support to the Develop Business Planning are:

- 1) Improve the productivity and quality of human decision making.
- 2) Be able to quickly change plans regarding to the political, economic, or physical environment changes.

The benefits to the Operations and Performance analysis:

- 1) Shorten delivery time by precise production scheduling
- 2) Reduce overall production cost due to optimum utilization of machine capacity, production equipment, facilities, materials and workforce

The benefits to the Plant Maintenance are:

- 1) Reduce the time to manage the equipment data as well as data entry time in maintenance processing
- 2) Easily classify and capture equipment's related information such as specification, serial number, and maintenance history for further inquiry and analysis.
- 3) Possibly detect a performance period of equipment assisting a creation of appropriate monitoring period and making maintenance in order to avoid over or under proceeding preventive maintenance.
- 4) Ensure product quality via time-based inspection and operation standardization.
- 5) Increase plant reliability while reducing work preparation time through several system functions such as real time on-hand material and tools availability checking,

automatic spare parts reservation, automatic generation of purchase requisition from work orders.

6) Increase the maintenance performance resulting to get higher equipment reliability because of an accessible maintenance history that can inform breakdown or/an damage analysis.

The benefits to the Supplies are:

- 1) Improve material requirement planning to have better control of inventory levels
- 2) Reduce warehouse stock, storage that consequently save handling costs
- 3) Reduce obsolete and excessive stocks
- 4) Improve communication with suppliers
- 5) Smoothen the flow of materials
- 6) Improve the availability of accurate information and the efficiency of the procurement functions
- 7) Reduce operational costs and eliminate paper.

The benefits to the Financial are:

- 1) Eliminate the potential of data inconsistencies and redundancies
- 2) Support faster closing of accounting period
- 3) Automatically three-way match among purchase order, goods receipt and invoice that provide accurate and faster processing of invoice and payment
- 4) Better support and analysis by the electronic audit trial than a hard copy audit trial.
- 5) Provide flexibility in preparation of different views of budgets on-line (instead of paper) which enables more effective budget set up and control

- 6) Automatically calculate actual expenditures and do cost allocation budget
- 7) Cost management reports assisting management to have effective decision making.

The benefits to the Human Resource are:

- 1) Facilitate a more effective human resource and manpower planning process.
- 2) Improve employee development and relationship in the organization.
- 3) Improve cost control and labor utilization due to obtaining prompt and accurate information.
- 4) Eliminate the manual effort in data collection and analysis.
- 5) Enable the timeliness, accuracy and completeness of personnel and payroll statistical reporting.
- 6) Allow easy extraction of analytical information on absent, time tracking, and employee benefits.

4.5 Current Capabilities of the Wang Noi Power Plant

The Current Capabilities are a summary of the current organization operational procedure and current information system facilities. The purpose of the current capabilities is to clearly identify the current status of all systems [1].

4.5.1 Current Operational Procedure

Figure 4-11 shows the information flow among organization of Wang Noi Power Plant. Hereunder are the brief performances of each department

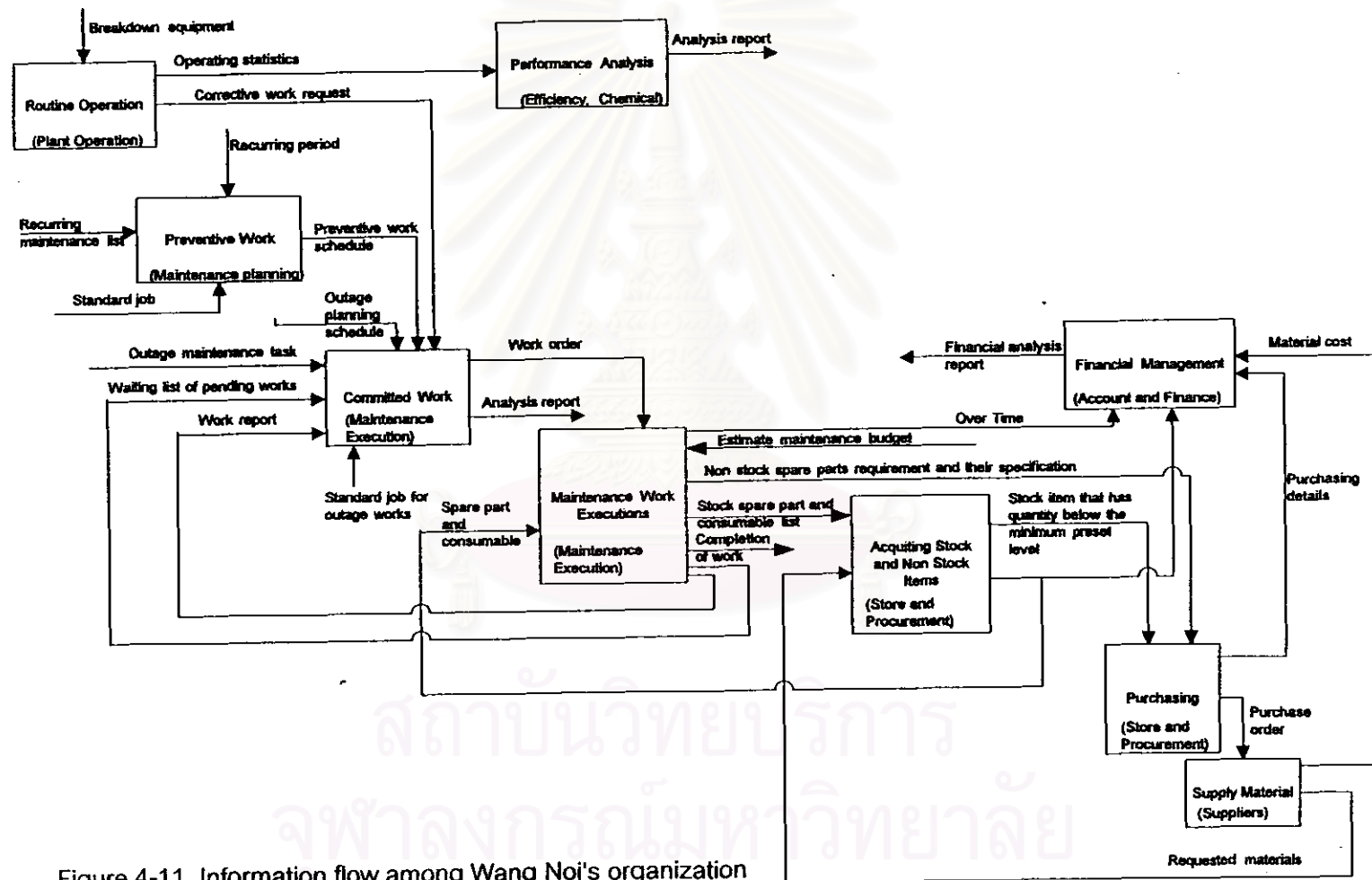


Figure 4-11 Information flow among Wang Noi's organization

4.5.1.1 Plant Operation Section

Operators run the processes of the production and control of power used to supply electricity to customers. They mainly operate and control the generators for producing electricity; they also must record the plant's events in a "log sheet" that is created by Microsoft Access. Such record data will not be utilized in general operation unless there is fault occurrence; they then pass such data to the Efficiency Technical section for analyzing the cause of the fault. In case a fault occurs, the operation will request the breakdown maintenance from Maintenance Planning manager by issuing a Maintenance Request Report. The maintenance that takes place at any cost level does not concern the operators.

4.5.1.2 Efficiency Section

The efficiency staffs use fault occurring record data from operators to analyze the cause of events and also maintain historical data and performance trends. They estimate future load, schedule generators, and analyze plant performance; then they report to the management and distribute to the concerned parties.

4.5.1.3 Chemical Section

The chemists perform routine tasks of chemistry testing, waste handling and disposal. They also analyze the materials used in electricity generation and production.

4.5.1.4 Maintenance Planning Section

The planners manage the preventive maintenance and outage planning work by the recurring period information of equipment and a recommendation of power

plant running period respectively. They also do the planning, scheduling and control of corrective maintenance.

The power plants are scheduled into a tabulation, which is drawn on continuous paper. Meanwhile, the corrective maintenance that is requested by an operator in form of a Corrective Maintenance Request Report, normally considered as an urgent case, will be transferred to the maintenance manager by writing all necessary details in Work Request form.

The planners then will report a maintenance execution event to the top management with a conclusion of the actual cost of each mission.

4.5.1.5 Maintenance Execution Section

The Maintenance staffs, who are assigned by the Maintenance Manager in charge of individual work, execute the works according to Work Order. For works, which require spare parts, they have to fill in the details in Warehouse requisition form, list the spare part items, and send it to the storekeeper via the Maintenance Manager for approval. In case that the required spare parts are not stock items, the storekeeper shall create the Purchase Requisition form and send it to the purchasing unit.

4.5.1.6 Store and Procurement Section

The storekeepers use stock cards to control the stock items in warehouses and will create purchase requests for items that come down to re-order point level. For non-stock items, the maintenance staffs directly create purchase requests to purchase officers.

The purchase officers proceed according to the purchase requests both from storekeepers and maintenance staffs. They find the right vendors and issue

purchase orders to the finally evaluated vendors. Then they are taking care of the receipt of goods and the matching of invoices and necessary documents for their own files and the concerned departments.

4.5.1.7 Account and Finance Section

The accountants do the disbursement checking, PC data entry and edit as required prior and send the data to EGAT head office for proceeding financial functions. They record all fixed assets and revenue received. The staffs provide functionality for making payments, preparation of budget, manage cash flow, and financial information report.

4.5.1.8 Administrative and General Service Section

The administrators conduct administrative and general services such as administration, human resource management functions.

4.5.2 Information System Facilities

A survey of the current capabilities of the power plant in computer hardware, communication network and application software is summarily assessed as follows:

4.5.2.1 Hardware and Communication Network

There are no official standards or identifiable standards recognized for the use of PCs. A Local Area Network (LAN) was installed in the power plant. There are a few specialized engineers to manage this LAN. Figure 4-12 shows the existing hardware and communication network of the power plant.

4.5.2.2 Software

1) Financial management system: Users in Wang Noi use PCs for data entry only. The processing of this system is run at EGAT head office where there are package software (Walker) and an in-house developed application, using COBOL (Mainframe-based) and FoxPro (PC-based). The application is not interfaced with other application.

2) Monitor plant operation: In-house developed solutions based on Microsoft Access are used for performance analysis. The applications are running in stand-alone mode, not interfaced with other applications and there are paper reports only.

3) Project management application: They use Microsoft Project acting in stand-alone mode.

4) Personnel Human resources management: Information is recorded by in-house developed programs based on Microsoft Access. The application is running in stand-alone mode, not interfaced with other application and there are paper reports only.

5) No standard application is used in plant maintenance function.

6) Inventory and procurement management system: No standard application is used in inventory and procurement control.

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

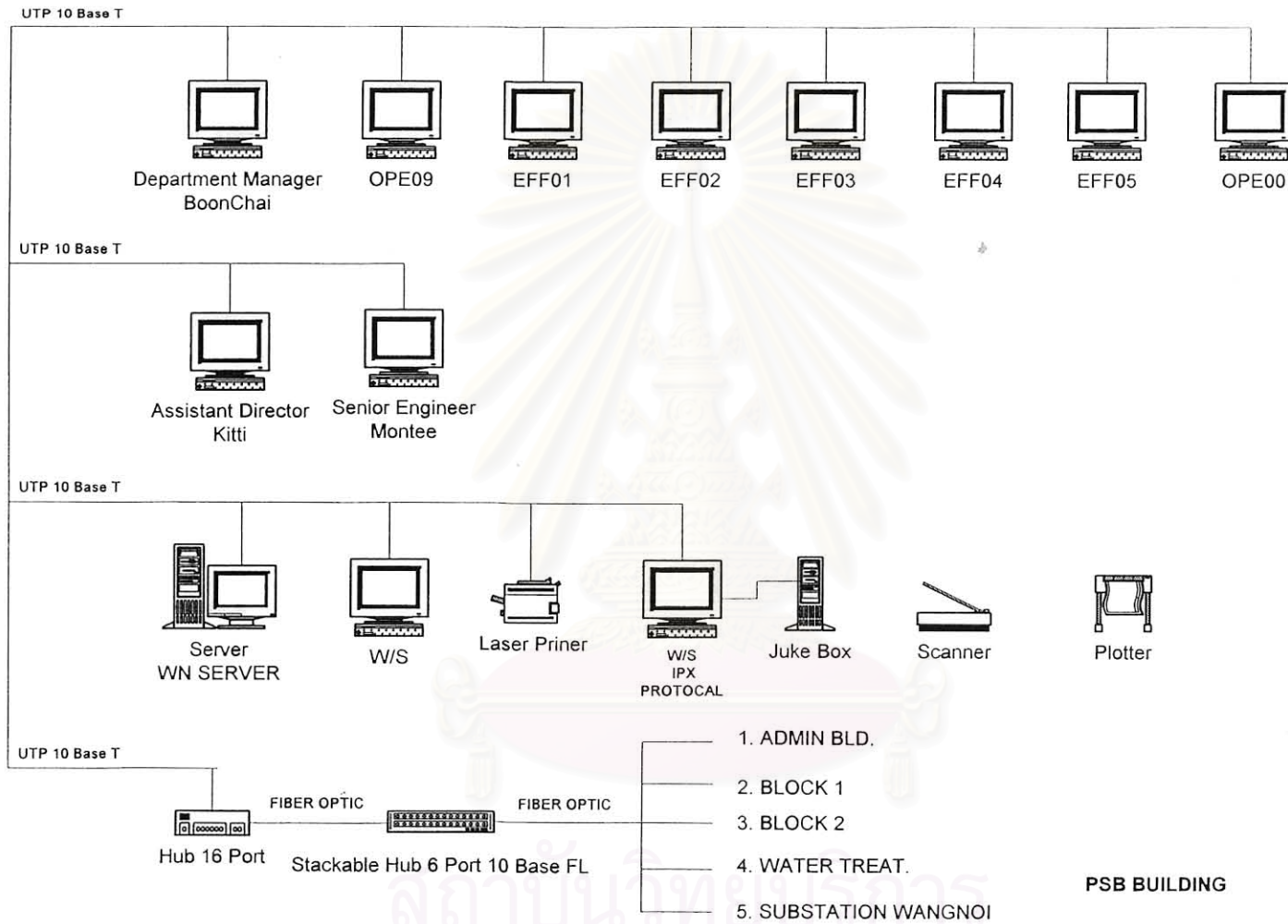


Figure 4-12. The existing hardware and communication network of the Wang Noi Plant

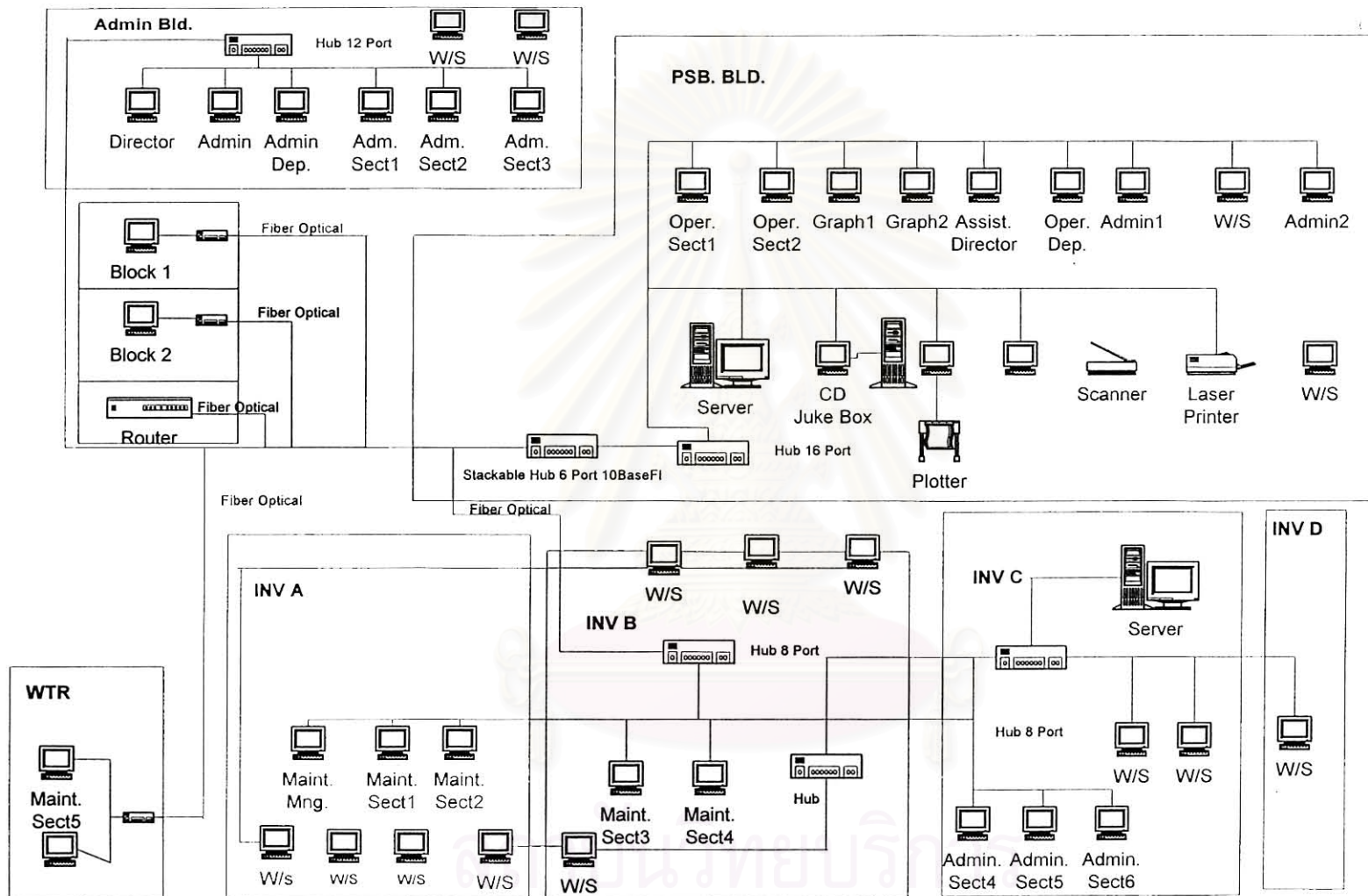


Figure 4-12 (Continue) The existing hardware and communication network of the Wang Noi Plant