Transmission Network Information System of Telecommunication Business

by

Mr. Patapee Sungkrasare

A Final Report of the Three-Credit Course
CS 6998 System Development Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in Computer Information Systems
Assumption University

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Project Title	Transmission Network Information System of Telecommunication Business
Name	Mr. Patapee Sungkrasare
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Academic Year	December 2, 2001

The Graduate School of Assumption University has approved this final report of the three-credit course, CS 6998 System Development Project, submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer Information Systems.

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ABSTRACT

Increased in the term of growing size rapidly, the organizations needed reliability, accuracy, time and information from employee in the organization. The system was necessary to develop the information system to support the whole organizations.

The scope of this project was to analyze the existing system and design the new computer system to meet the requirement of the users, to provide the computerized system to the employees at the transmission network in order to carry out their work accurately and more efficiently. The employees would give up-to-date information to install equipment for the new service.

The field of study focused the entire function of transmission network system. The data flow diagram was the structural tool to use in studying and analyzing. Therefore, the new system was to design in solving the current problems and supporting the decision making at management level. The new system also focused on the user requirements, system design, software and hardware requirements security and control, including the design of input screen which Microsoft Visual Basic 6.0 was chosen as the program development tool on the computer network.

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I. INTRODUCTION

1.1 Background of the Project

At present, the information system played a vital role in the business world. Information nowaday because a weapon to gain advantages over other. To control and maintenance of the network system of each company was a common problem. The transport networks were a major system of the service business function.

The exchanging information was the most critical problem of the company. They had to control the branches to distribute to all provinces. So, they frequently exchanged information with headoffice that provided service, report, and controlled information. Recently, the company's routine tasks were handled with a manual system which was suitable to small jobs. Therefore, the manual system was simple to operate in the past, but when the system growth to larger scale, the management turned to be complicated for managers.

The computerized system was necessary to implement in solving the management problem. It should reduce the communication process and simplify operation with former employee.

1.2 Objectives of the Project

The project of the Network Management Information System were followings:

(1) To study the existing system in order to revise control, document system and design new control for the network

(2) To acquire a more effective work control

(3) To design a computer-based information system to improve documentation system which might help to save time, and reduce report system

(4) To improve failure of report system

(5) To analyze the requirement of system user and system owner

(6) To improve communication system with technician and management department

1.3 Scope of the Project

The scope of the project covered 3 majors parts which were the scope of data, scope of process and scope of interfaces. The details in each area were followings:

(1) The scope of data of this project included all of the data or information that played as input or output in this information system. The names of data were:

(a) Service Information

(b) Customer Information

(c) Network Information

(d) Failure Information

(2) The scope of process of project was an ongoing process which occurred in the Network Management Information System. The name of process were listed below.

(a) Order Service

(b) Generate Work Order

(c) Assign Tech Work

(d) Assign NMS Work

(e) Manipulate Network Status

(f) Generate Report

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(3) The scope of interfaces

To design screen layout for end users, and the external entities concerned with the Network Management Information System were listed below.

(a) Service Division

(b) NMS

(c) Technician

(d) Management

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II. THE EXISTING SYSTEM

2.1 Background of the Organization

Transmission Engineering was a department of Telephone Organization of Thailand to provide and manage the domestic service. The main service was fixed-line telephone, mobile phone and data communication. In every provinces of Thailand there was an office to maintenance the transmission network. The management center network was in Bangkok but it was located in different site.

As the result of the growth in telecommunication business, the network were built to support the high reliability service to customer. In the huge network, should change the weakness part of network. In present, technician recorded the failure in paper. For many sites, it was difficult to operate and manage. So a computer network was needed to fulfill the company's requirement of accurate and efficient operations in the Network system.

2.2 Existing Business Function

The transmission service accommodated departments that had different functions and responsibilities to provide the service. Each department's function was given below: (see organization chart page 7)

(1) The Engineering Department

This department's function was planning, designing, purchasing, and maintenance on the network by using information of every sites to maintain system. Additional, when the equipment got damaged, they would prepare the purchase order to the vendor.

(2) The NMS Department

There were 4 main functions in this department that controlled the system, implementing the new service, doing maintenance the system, and reporting the network status to the engineering department. The operating center was in Bangkok to monitor the system of every sites that had the networks' equipment. When the new service order was implemented, the NMS had imposed order to the technician to proceed. After the service has been implemented, the NMS returned the accepted service to the Sales & Marketing department.

(3) The Technician Department

This department housed the technician to operate in every sites of Thailand and to respond the order by the NMS department. The function of this department concerned with the maintenance the equipment, implemented the new service, and reported the failure.

(4) The Sales & Marketing Department

This main function concerned with customer to receive the service order. There were service points in every provinces and sent the order to the NMS department in Bangkok. Later , they waited for the NMS department to check the service order available for service.

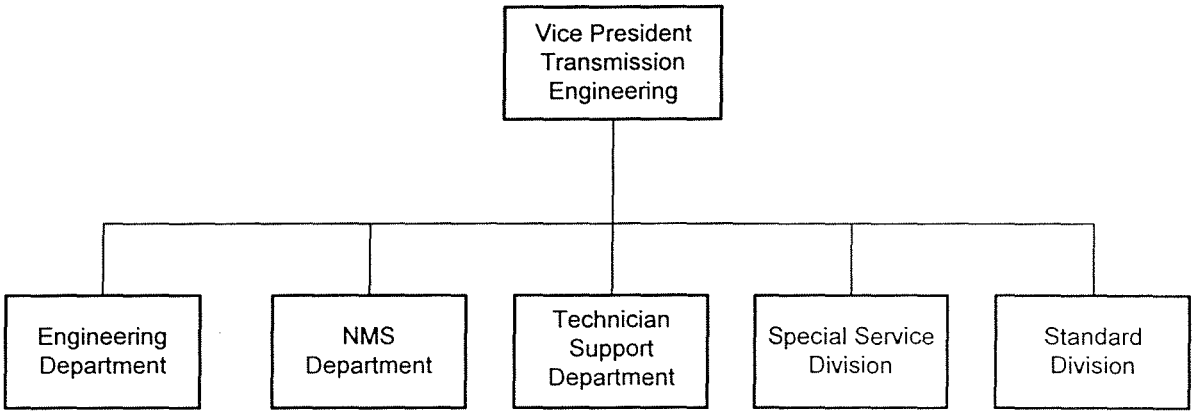

Figure 2.1. Organization Chart of Transmission Network.

2.3 Current Problems and Areas for Improvement

The current problems and areas for improvement of the existing system were as follows:

(1) When implement new service, documents for service department were distribute to every station that concern with this. So it took a long time and more document and fax was used to improve the time.

(2) The failure record is written in department and sending to management of networks. When the management set the summary for service management, it required time to proceed it.

(3) Every incident in the network, was not properly format to processing the information.

(4) The management wanted to check work time for each job. The timestamp was difficult to apply with the paper system.

(5) The communication between the department was excessive and some process was presently not necessary, in selecting to using the information technology.

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III. THE PROPOSED SYSTEM

After defined the problems. the following step was to design the proposed system. including input. output and resources required by new system. The objective of new system was to meet the present and future requirements of Transmission Network as well as sharing the information with other departments.

3.1 Proposed System

The proposed system was required the main categorized according to the needs of the human resource department. The requirements were as the following:

(1) Input Requirements

(a) To provide the automatic data collection in service order to verify the correctness of input data.

(b) To provide the uses familiar to computer program to serve the user who are not use computer so much.

(2) Process Requirements

(a) To update work order of service order list when the service was applied.

(b) To sent work order to staff automatically when service order was issued.

(3) Output Requirements

(a) To provide the update and reliable information which was important to the management department.

(b) To provide the on time accessing of the information.

(c) To provide the security for the computer system by the unauthorized users.

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(d) To reduce the paper transportation time.

3.2 System Design

The system design for Transmission Network proposed alternative solutions to find the best way to manage the inventory information. which. each evaluation of alternative solution could be divided into 3 major parts as following:

3.2.1 Input Design

The form of input for the new information system would include.

(1) New service form

(2) Service information form

(3) Customer form

(4) Technician work order form

(5) Failure form

(6) Equipment form

(7) Optical form

(8) NMS work order form

(9) Employee form

(10) Management query form

(11) Inventory form

3.2.2 Output Design

Output was mostly in the form of reports which could also

(1) Station service highlight report

(2) Network Failure report

(3) Work order report

(4) Equipment failure report

(5) Customer highlight report

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(6) Failure report

(7) Optical report

(8) Equipment report

(9) Service report

(10) Failure service report

(11) Station capacity report

3.2.3 Screen Design

The design of the screen would be the object-oriented screen to every department in the organization. But in some department, the designs would be different. The interface design would be shown in Appendix J.

3.2.4 Process Design

The proposed process was based on Data Flow Diagram (DFD). The designing of the proposed process to analyze the existing process and to improve the new DFD which were shown in Appendix H. The detail of the new system could be described as follows.

(1) Order service

(2) Generate work order

(3) Assign Tech work

(4) Assign NMS work

(5) Manipulate network status

(6) Generate report

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3.3 Hardware and Software Requirement

Hardware and software requirement for the new system was to provide the effective access, to update, to create and to achieve data. So the new system network had to be linked together via communication lines, and the data processing was a centralized system by using one computer file server to serve the entire organization.

In this project, on the network system was focused changing from the stand alone PC to be a network in order to use the computer more efficiently. While the data were kept in the form of database, the information could be shared.

The following were the details of hardware and software requirement for the new network system.

3.3.1 Hardware Requirement

In the new proposes system hardware requirement could be classified as following:

(1) Hardware Specification for Server

(a)	Processor	Pentium III 550 MHz.
(b)	Cache	1 MB
(c)	Memory	128 MB SD-RAM
(d)	Harddisk	10 GB
(e)	Floppydisk	1.44 MB
(f)	CD-ROM Drive	55X
(g)	Network Adapter	LANCARD 10/100Mbps
(h)	Display	17" Monitor
(i)	Display Adapter	SVGA CARD

(2) Hardware Specification for Workstation

(a)	Processor	Pentium II
(b)	Cache	256 kB
(c)	Memory	32 MB
(d)	Harddisk	1 GB
(e)	Floppydisk	1.44 MB
(f)	CD-ROM Drive	10X
(g)	Network Adapter	LANCARD 10/100Mbps
(h)	Display	14" Monitor
(i)	Display Adapter	VGA CARD

(3) Other Hardware Specification

(a)	Printer	HP LASERJET 1100
(b)	Scanner	HP SCANJET 5200C
(c)	UPS	LEONICS 1 kVA
(d)	Router	cisco 5200

3.3.2 Software Requirement

In the new proposed system software requirement could be classified as following:

(a) Windows NT 5.0

(b) Windows 98

(c) Microsoft Visual Basic 6.0

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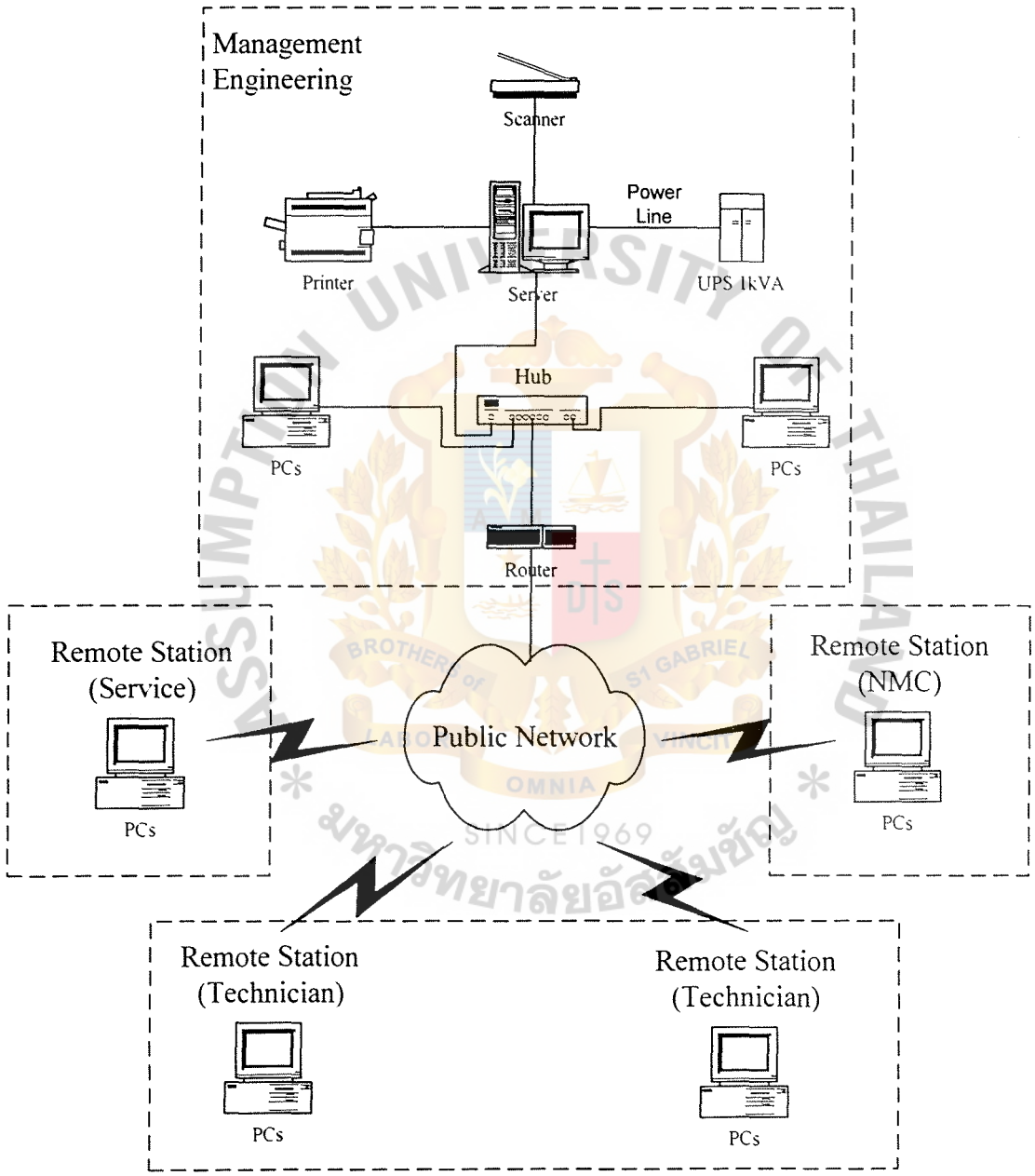
3.4 Network Configuration

For the network configuration for this project, the remote access passed the public telephone network and, the server connected to access point by the lease line. All



workstation could share the database and other resources by the network.

Figure 3.1. Network Configuration.

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3.5 Database Design

The database of the propose system had to be developed by preparing the data model in the simple form. non-redundant and using the entity relationship diagram (ERD) technique which was shown in Appendix B. The data would be in the 3rd normal form after the ERD technique was used and then employing the database scheme to present the technical implementation of the logical data model. It was presented in Appendix I.

3.5.1 Security of Data

Accessing and sharing data. including reading. writing. executing and manipulation had to be concerned with the following:

(a) Each department owned its accessing security for accessing the database

(b) Using the password to protect unauthorized access

3.5.2 Physical Security of Equipment

The physical equipment was able to support the flow of day to day data. On account that data was the assets of the organization. data had to be protected and managed.

(a) Unstable of electricity had to be concerned. UPS was used to keep computer working all time and to protect losing of data.

(b) Using the password for accessing all computers.

3.5.3 Protection of the Integrity of System and Data

The accessing of the system should include protection so that data could be accurate.

(a) Using the backup tools

(b) Authorized person had to work on the maintenance of the system only.

3.6 Security and Control

Security in the computer was the most important issue for every company because the major assets of the computer system were software, hardware, and data which were vulnerable to damages. So the security of the computer system should start from login to the system. There had to be passwords for login security control to prevent unauthorized users from accessing the system. However, the attack to the computer data could be defined as the most serious problem in computing security. Therefore data had to be input on the same day or after the transactions occurred and the data connection had to be made immediately when found the error in the system. The following and control method were proposed for the information system.

3.6.1 Encryption

In the network operating system, there were various programs and data files, transforming and processing in each day. The security of coding was very important and had to determine the person who could access to the programs, to prevent damages of the data files and computer system.

3.6.2 Software Control

Programs had to be secured enough to prevent the outside attack. They had to cover all general controls. For example, the internal program control which controlled the part of enforced security restrictions and operating system control which protected the system user from the unauthorized users, and also concerned with the development control which covered the quality and standards of the system that the company used.

3.6.3 Hardware Control

The hardware devices, which used to assist in computer security had to implement the encryption to prevent the unauthorized user, protection from the theft and control access to disk drive in PCs.

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3.6.4 Physical Control

The physical control was to use the telecommunications such as door locks, guards at entry points, back up of important data and protection from natural disasters such as power supply had to be provided in the system control.

3.7 Cost and Benefit Analysis

Security was important to the company, especially information. Thus, keeping information in secret should be provided. Protected unauthorized persons from crime and abuse. The system had to be designed for the security control in the proposed system.

3.7.1 Benefit Analysis

Table 3.1. The Benefit from New System, Baht.

Cost Items	Cost
Reduction of 2 personnel staff per annual	240,000
Reduction of 2 key operator staff per annual	144,000
Reduction of communication cost	200,000
Reduction of utility cost	10,000
Reduction of office equipment	1,000
Reduction of stationery cost	9,000
Reduction of overtime paid	120,000
Total tangible benefits	724,000

3.7.2 Calculation of Payback Period

$$\text{Payback Period} = \frac{I}{(1 - T)\,R}$$

I = Investment Cost

R = Average annual return on the investment

(tangible benefit substracted by operating cost)

T = Corporate tax rate in percentage (30%)

$$\text{Payback Period} = \frac{2{,}832{,}600}{(1 - 0.3)(2{,}832{,}600 - 724{,}000)}$$

Payback Period = 1.91

Payback period (after tax) for the proposed system is 1 year 11 months

3.7.3 Calculation of Return on Investment

The result of payback analysis in proposed system cause from resulting of return on investment by comparing benefit by new system and investment cost. The result is showed by percentage. The expected value of ROI must be than 20%, but ROI of new system is 25%, satisfy.

$$\text{Return On Investment} = \frac{\text{Benefit by New System}}{\text{Investment Cost}}$$

$$= \frac{724{,}000}{2{,}832{,}600} \times 100$$

$$= 25\%$$

IV. PROJECT IMPLEMENTATION

4.1 Installation

Before starting to implement the new system, the management had to accept the proposed system, because there were many factors concerned. The most significant factor was costs versus benefits comparison. The computer hardware, software and personnel were also involved in the installation of the new system. The project schedule was the important one. Appendix J showed the project schedule. From the chart, it was to estimate the time that would be used in each job and enable the analysts to utilize their work more efficiently and effectively.

4.2 Conversion

The project implementation was the installation of the new system and removal of the current system. Then the main activity of implementing a new system was training, conversion and post-implementation review.

4.2.1 Training

The one critical success of the new system was the quality of training system. No matter how good a system the company posses, it would be useless if users were not ready to utilize the operation and features of well-designed and developed system. The good training system was very important to help to ensure the people could interact with the new system efficiently.

4.2.2 Conversion

Convert the existing data of new system, parallel conversion was recommended for this new system. The parallel approach allowed the existing system operated along with the proposed system until the new system had proven its reliability. So this method was appropriate for replacing the manual system with the computerized system and

offered greatest security, then could ensure that all the error of problem of the new system had been solved before the old system was discarded.

4.2.3 Post-Implementation Review

When the implementation of the new system and conversion was complete, the review of the system is conducted to ensure that the system was acceptable or whether adjustments were needed. The important thing that had to be concerned during post-implementation review was whether it met the objective plan or not. The information could be collected by questionnaire, interview, sampling and observation.

4.3 Testing

Testing was the process for measuring the quality of the computerized system with intent of finding an error. System testing was a significant part of the system. One could estimate the cost of software project related to testing. Testing process was conducted to detect and correct the errors and to test the unification of each module in the entire system. It would test from the general level to move specific level in order to ensure that the program runs in the expected way. The following were the other varieties of testing.

4.3.1 Program Testing

Testing the program and making sure that perform satisfactorily. The programmer had to create the valid and invalid test data and test all possible situations that might occur in the future.

4.3.2 Peak Load Testing

To determine whether the system was able to handle the volume of activities that occurred when the system was at the peak of its processing demand.

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4.3.3 Storage Testing

Determine the capacity of the system to store transaction data on disk or in the other files. when there were a lot of information to store.

4.3.4 System Testing

To test the program running properly and the users were able to use the data properly when all the programs were interconnected.

4.3.5 Performance Time Testing

To test the system processing time. to find out the proper length of time that the system used to process transaction data.

4.3.6 Human Factors Testing

To test how users would sue the system efficiently when they perform their work.

4.4 Complete the Documentation

After completion of the test. completeness documentation of the proposed system was needed. By a common failure to document as an ongoing activity during the life cycle. the best quality and completeness of documentation was important. Everyone could easily understand the frame work and inner working of the whole system. and it also could reveal strengths and weaknesses of the system over the other. Over time. the company also could bring the old information to rethink or might create the new concept easily and also be useful for the future.

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V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Service area of transmission network information system covered all provinces in Thailand. Each province had service office. So, the management and engineering department had to co-operate with it, and it was very complicated to control the network with the paper system.

In order to solve the existing system, this new system was developed to help management to work more easily and many parts of the program would run automatically. The new system also had been designed to develop work flow and reduced work processing time (develop an effectiveness and efficiency of the work) with provided accurate information.

Maintaining the computer to work properly was important. The system maintenance needed to know how to control the new system and how to manage maintenance when there were problems.

However the new system could provide the better function of working rather manual system. Although the investment cost of the first year was high, it would save in the long term.

Furthermore, the networking of the new system provided more standard and security control. Because the information was an asset of the organization, it had to be carefully managed and protected.

The new system supported the use of information. As the information was stored in the database, it was quite accurate. One could use that information to generate a reliable report for analysis.

Table 5.1. Degree of Achievement of the Proposed System.

Process	Existing System	Proposed System
Verify Service Process	2 hrs.	20 mins.
NMS Work Order Process	1 hr.	1 min.
Technician Work Order Process	1 hr.	15 mins.
Inventory Order Process	4 hrs.	15 mins.
Report Process	12 hrs.	4 hrs.
Total	20 hrs.	4 hrs. 51 mins.

In the proposed system is the online system which customer can send their requirement directly to process at the center database. The general staff able to manager the problem not necessary to have the technician support. In the Verify Service Order we expect to reduce the time to be 20 minute for each processing. The proposed system can reduce the manpower and the time for search the information.

NMS work order process use the Computer NTW for exchange the information between NMS and Computer Service. Normally this process have to send the customer service document to NMS. Orders which have verified will send very quickly which reduce the time for sending and responding. The proposed system speculate that NMS will use only 1 minute for finish the order.

Technician work order process the customer information will send to the service station. When the information had sent to each station , the technician will reading and going to install the equipment. We expect to use only 15 minute for technician to finish their job.

Inventory order process ,the inspector in each station will pass the order through the central. The inspector will provide the type and quantity of each equipment in order to reduce the complicate of the document. The Central will manage the order by purchase only one time , they will waiting the order from all station. We expect to use only 15 minutes.

The operation information for all station will send to the Head Quarter by NTW immediately. The information will save at the Headquarter when we want to do the report it is not necessary to send the order again. The station we have 70 station , we will reduce the time for sending and manage the information in a series each station only 15 minutes by which I mean we can reduce the time 16 hours. We expect that the time for doing the different report must not over 4 hours.

5.2 Recommendations

In order to improve the transmission network information system efficiently and effectively and able to carry out the activities related to the organization, the company should realize the following:

(a) The company had to set up the person who would be responsible for which position and provide the good training facilities for them to improve their skill to be able to work on the new system.

(b)Ensure that the proposed system was fully functioning before stopping the current system.

(c) The selected technology, both hardware and software should be planned for the future expansion and being possible for improvement future.

(d)Frequently review and keep up to date of the user requirements to correct the mistake and development in the future.

(e) Prepare the required report as often as possible

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However. the further development to be the fully computerized system should be established in all sections of the company and each department could develop individually and integrated by using WAN (Wide Area Network) to connect the system. So the proposed computerized system should be planned for the long term use not just for the improvement of day-to-day. It was one important thing that the management had to be concerned with.

APPENDIX A

PAYBACK ANALYSIS

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Table A.1. Payback Analysis, Baht.

Cost items	Years				
	1	2	3	4	5
Investment Cost	-2,832,600				
Operation Cost		-2,128,000	-2,240,800	-2,364,880	-2,501,368
Discount Factor for 10%	1.000	0.909	0.826	0.751	0.683
Time-adjusted cost	-2,832,600	-1,934,545	-1,851,901	-1,776,769	-1,708,468
Accumulative Time-adjusted cost over lifetime	-2,832,600	-4,767,145	-6,619,046	-8,395,816	-10,104,284
Benefits derived from operation of new system		4,286,700	4,715,370	5,186,907	5,705,598
Discount Factor for 10%	1.000	0.909	0.826	0.751	0.683
Time-adjusted cost		3,542,727	3,220,661	2,927,874	2,661,703
Accumulative Time-adjusted cost over lifetime		3,542,727	6,763,388	9,691,262	12,352,966
Accumulative lifetime time adjusted cost+benefit	-2,832,600	-1,224,418	144,342	1,295,447	2,248,682

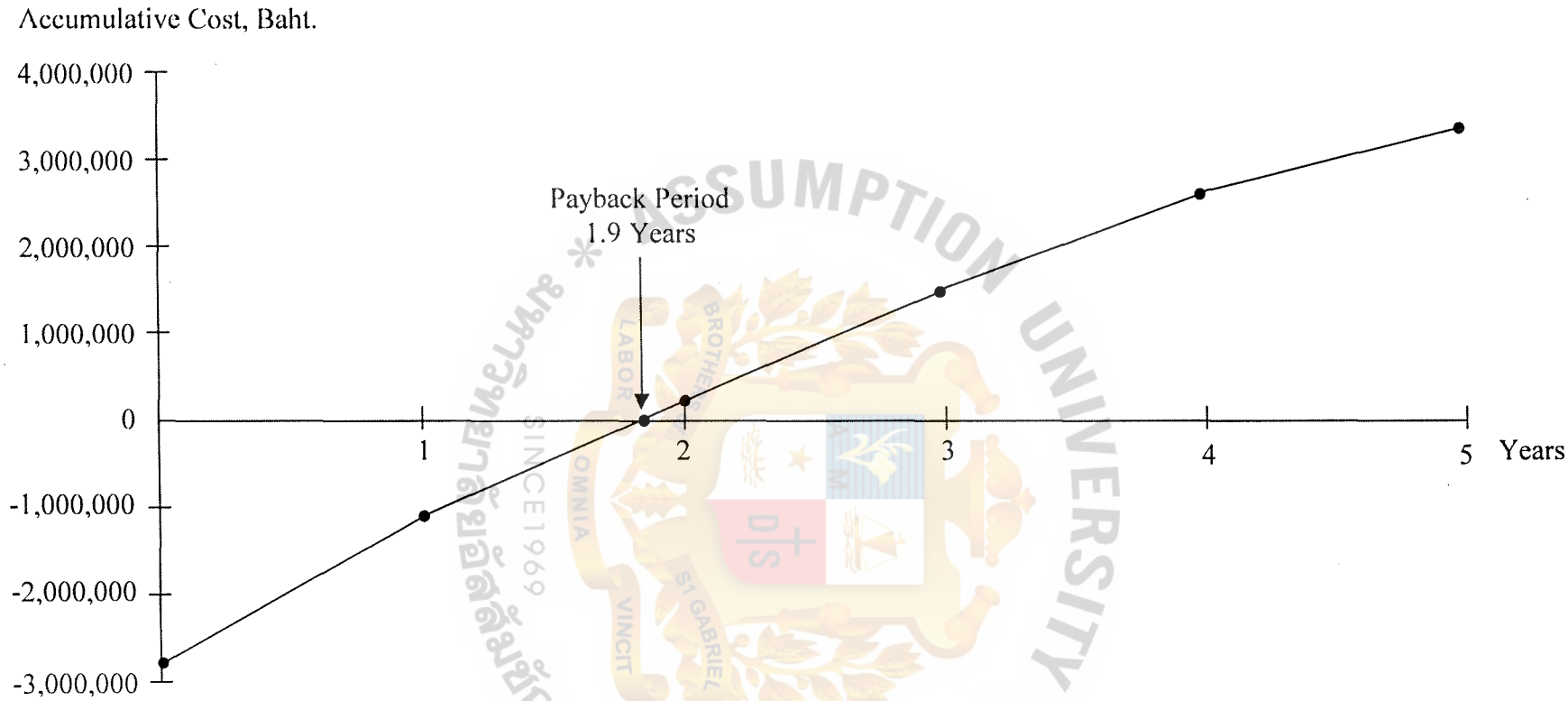

Figure A.1. Payback Analysis Graph.

Table A.2. Existing System Cost Analysis, Baht.

Cost Items	Years				
	1	2	3	4	5
Operating Cost					
Salary:					
Manager 1 unit@ 35,000	35,000	38,500	42,350	46,585	51,244
Personal office 6 units@ 10,000	60,000	66,000	72,600	79,860	87,846
Key operators 2 units@ 6,000	12,000	13,200	14,520	15,972	17,569
Total Monthly Salary Cost	107,000	117,700	129,470	142,417	156,659
Total Annual Salary Cost	1,284,000	1,412,400	1,553,640	1,709,004	1,879,904
Office Supplies & Utility Cost:					
Stationary Cost	27,000	29,700	32,670	35,937	39,531
Office Equipment Cost	36,000	39,600	43,560	47,916	52,708
Utility Cost	48,000	52,800	58,080	63,888	70,277
Communication Cost	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Maintenance Cost	18,000	18,000	18,000	18,000	18,000
Total Annual Off. Sup. & Utility Cost	1,329,000	1,340,100	1,352,310	1,365,741	1,380,515
Total Annual Operating Cost	2,613,000	2,752,500	2,905,950	3,074,745	3,260,420
Total Existing System Cost	3,897,000	4,164,900	4,459,590	4,783,749	5,140,324
Accumulative Cost	3,897,000	8,061,900	12,521,490	17,305,239	22,445,563

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Table A.3. Proposed System Cost Analysis, Baht.

Cost Items	Years				
	1	2	3	4	5
Fixed Cost					
Hardware Cost:					
Computer Server 1 unit@ 100.000	100.000	100.000	100.000	100.000	100.000
Workstation Cost 5 units@ 45.000	225.000	225.000	225.000	225.000	225.000
Laserjet Printer 1 unit@ 25.000	25.000	25.000	25.000	25.000	25.000
Deskjet Printer 1 unit@ 10.000	10.000	10.000	10.000	10.000	10.000
Scanner 2 units@ 10.000	20.000	20.000	20.000	20.000	20.000
HUB 1 unit@ 2.000	2.000	2.000	2.000	2.000	2.000
UPS, 1kVA 1 unit@ 30.000	30.000	30.000	30.000	30.000	30.000
UTP cable	600	600	600	600	600
Total Hardware Cost	412.600	412.600	412.600	412.600	412.600
Software Cost:					
Window NT Server 4.0	50.000	50.000	50.000	50.000	50.000
Window 98	10.000	10.000	10.000	10.000	10.000
Office 97	10.000	10.000	10.000	10.000	10.000
Visual Basic 6.0	50.000	50.000	50.000	50.000	50.000
Total Software Cost	120.000	120.000	120.000	120.000	120.000
Implement Cost:					
Software Development Cost	500.000	500.000	500.000	500.000	500.000
Basic Training Cost	800.000	800.000	800.000	800.000	800.000
Development and Installation Cost	1.000.000	1.000.000	1.000.000	1.000.000	1.000.000
Total Implementation Cost	2.300.000	2.300.000	2.300.000	2.300.000	2.300.000
Total Fixed Cost	2.832.600	2.832.600	2.832.600	2.832.600	2.832.600
Operating Cost					
People-Ware Cost:					
Manager 1 unit@ 35.000	35.000	38.500	42.350	46.585	51.244
Personal office 4 units@ 10.000	40.000	44.000	48.400	53.240	58.564
Administrator 1 unit@ 13.000	13.000	14.300	15.730	17.303	19.033
Total Monthly Salary Cost	88.000	96.800	106.480	117.128	128.841
Total Annual Salary Cost	1.056.000	1.161.600	1.277.760	1.405.536	1.546.090
Office Supplies & Utility Cost:					
Stationary Cost	18.000	19.800	21.780	23.958	26.354
Office Equipment Cost	24.000	26.400	29.040	31.944	35.138
Utility Cost	30.000	33.000	36.300	39.930	43.923
Lease Line Connection	240.000	240.000	240.000	240.000	240.000
Internet Access	760.000	760.000	760.000	760.000	760.000
Total Annual Off. Sup. & Utility Cost	1.072.000	1.079.200	1.087.120	1.095.832	1.105.415
Total Annual Operating Cost	2.128.000	2.240.800	2.364.880	2.501.368	2.651.505
Total Proposed System Cost	4.960.600	2.240.800	2.364.880	2.501.368	2.651.505
Accumulative Cost	4.960.600	7.201.400	9.566.280	12.067.648	14.719.153

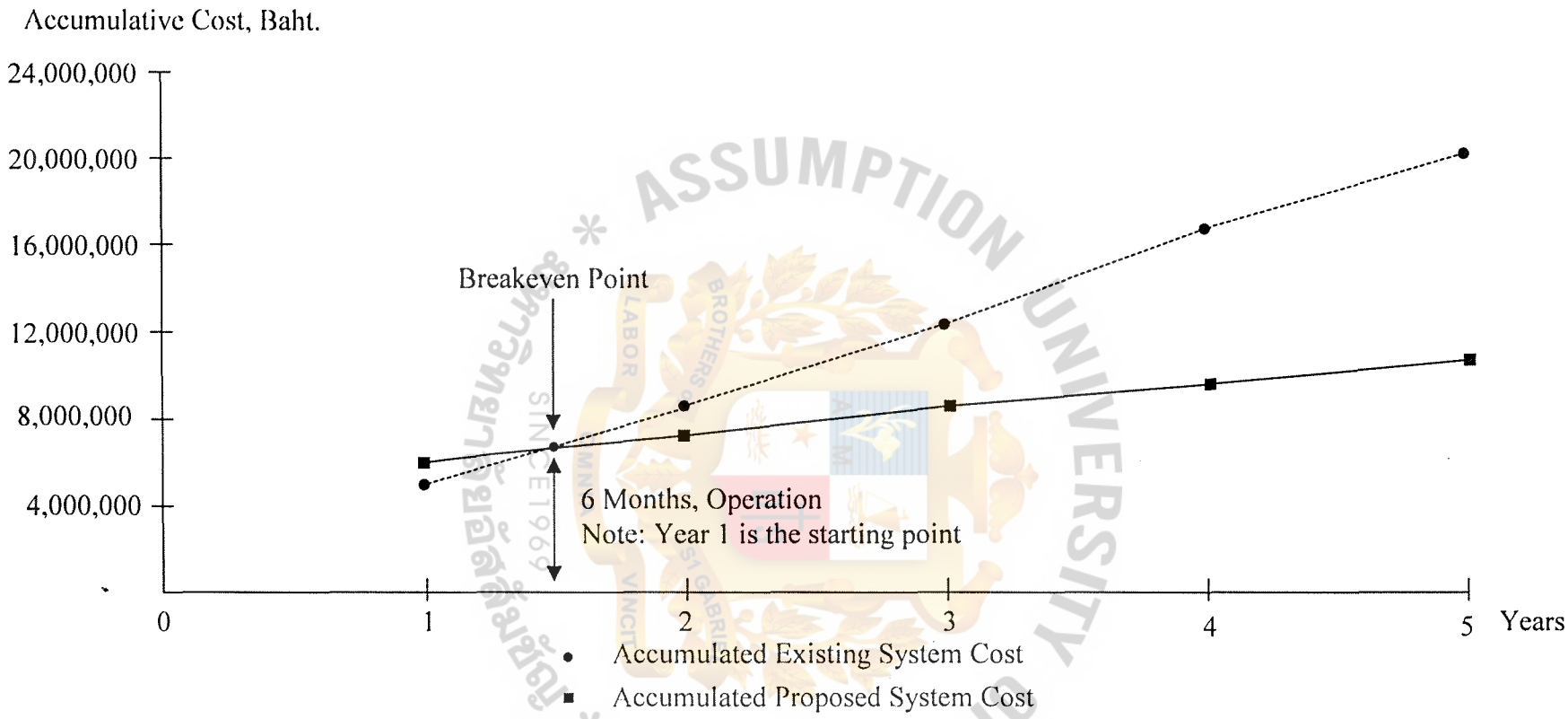

Figure A.2. Break-Even Chart.

APPENDIX B

CONTEXT DIAGRAM

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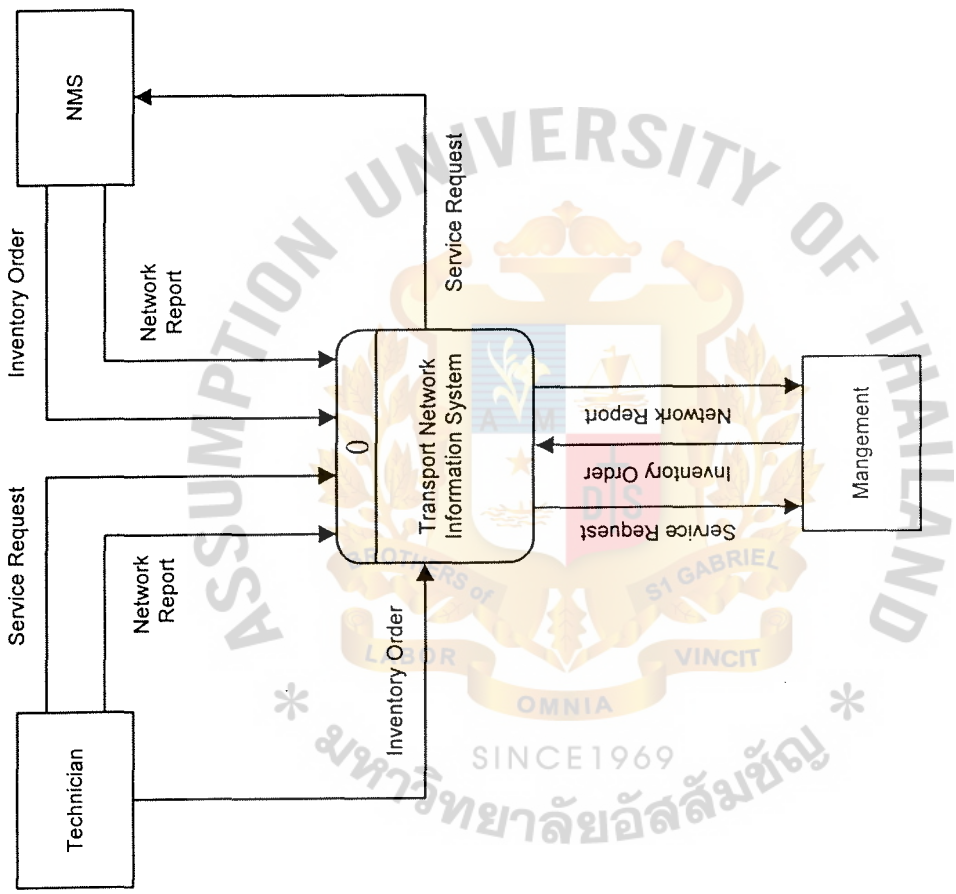

Figure B.1. Context Diagram of Existing System.

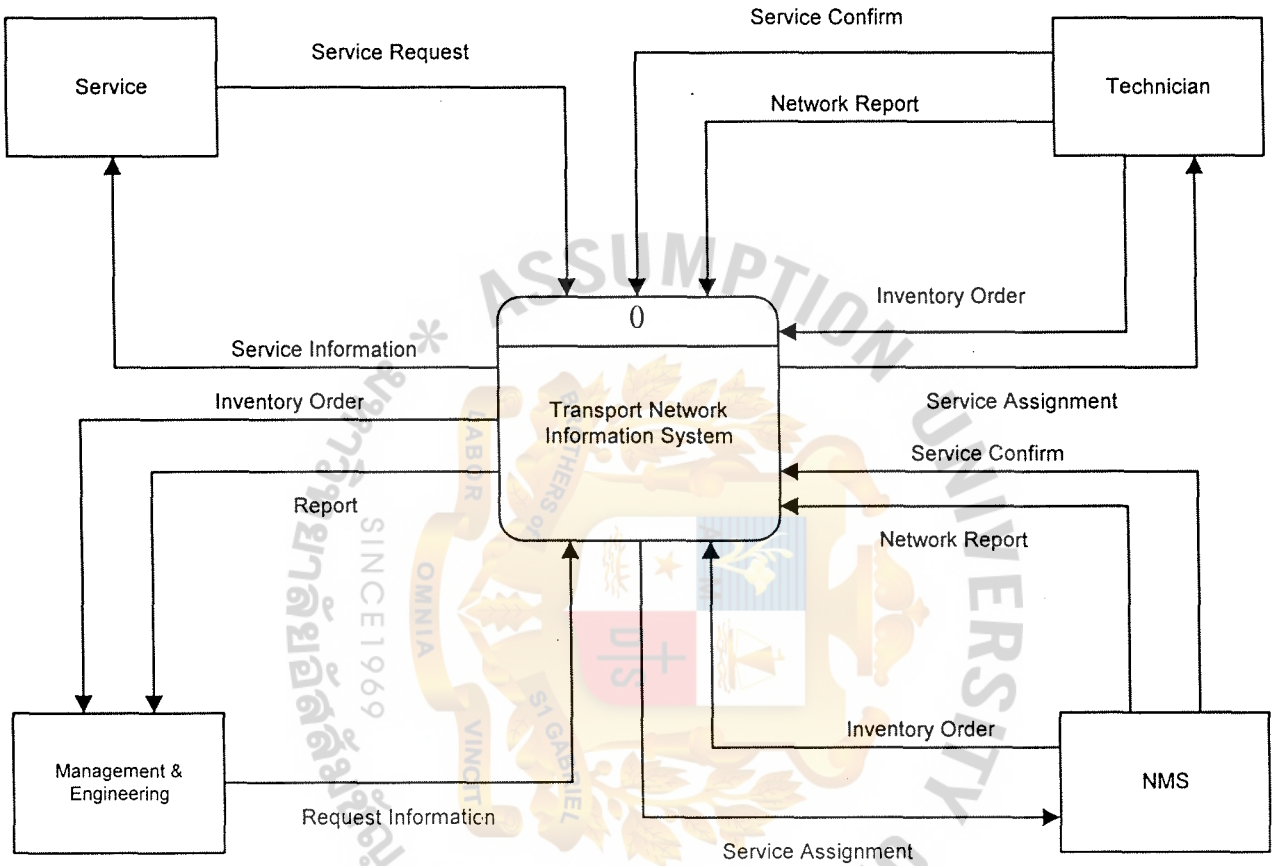

Figure B.2. Context Diagram of Proposed System.

APPENDIX C

DATA FLOW DIAGRAM

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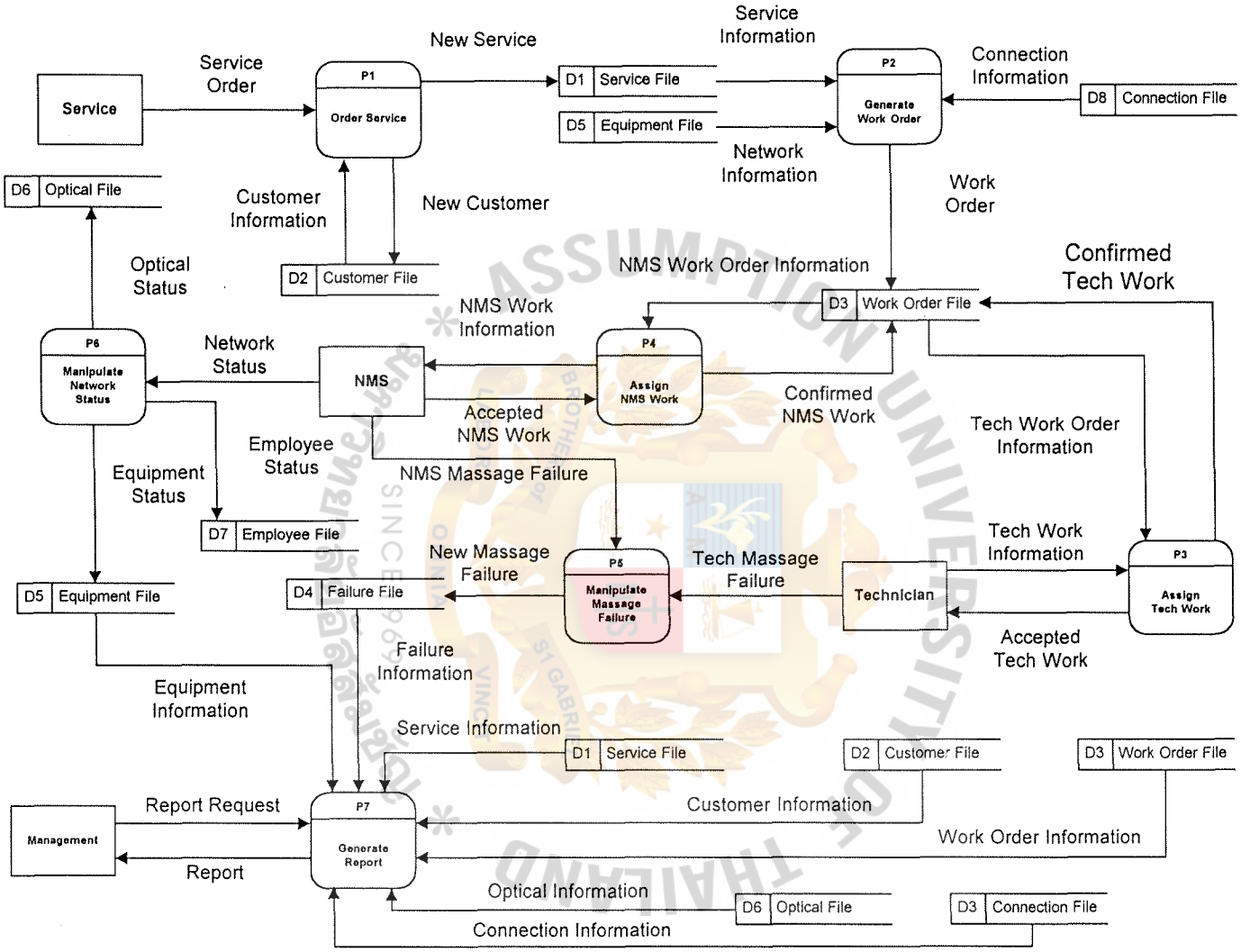

Figure C.1. Data Flow Diagram Level 0.

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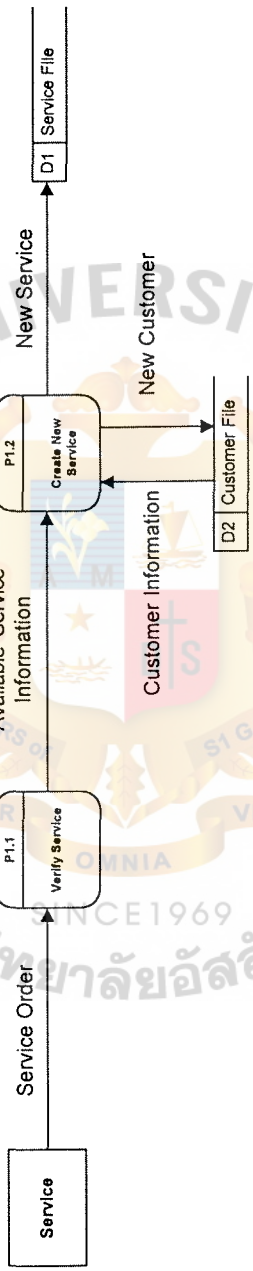

Figure C.2. Data Flow Diagram Level 1 (Order Service).

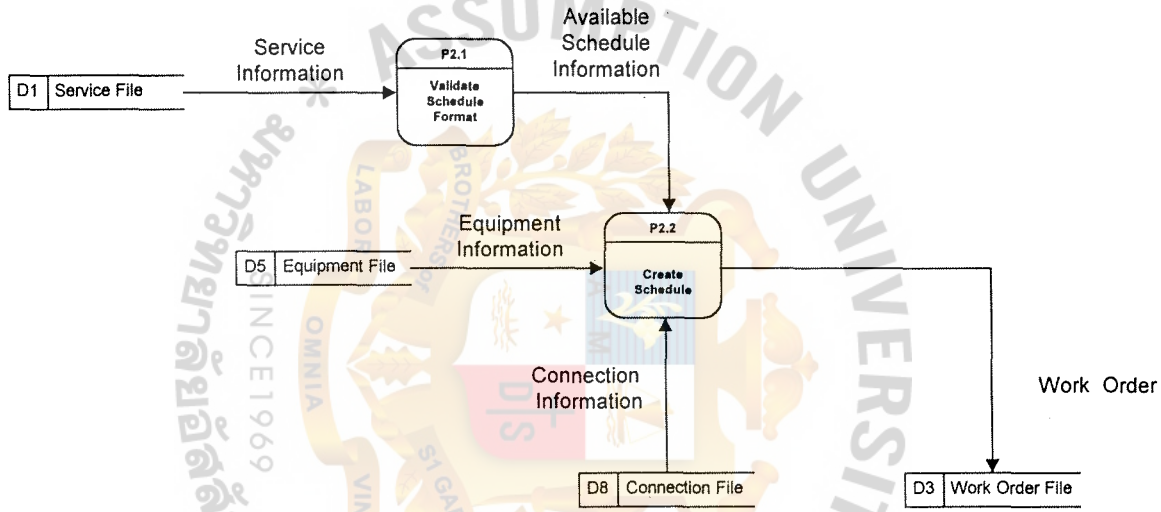

Figure C.3. Data Flow Diagram Level 1 (Generate Work Order).

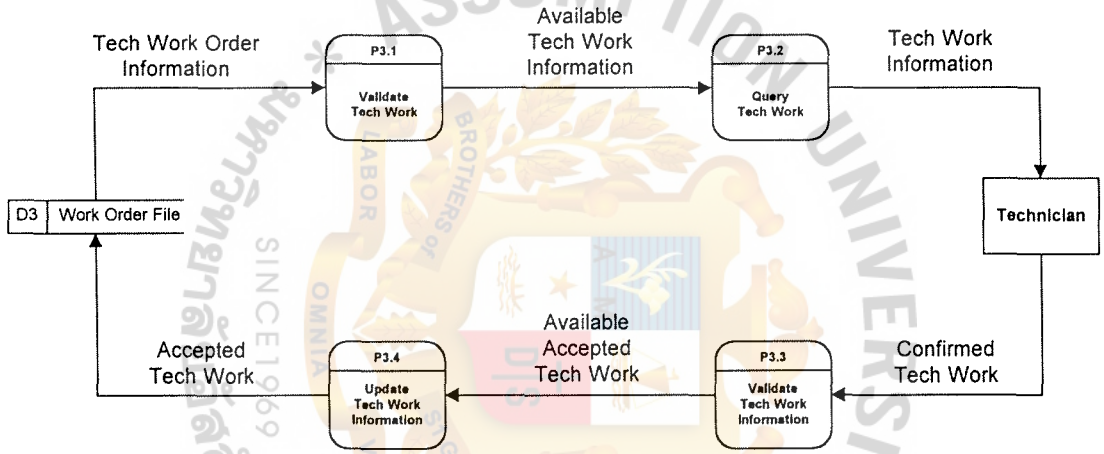

Figure C.4. Data Flow Diagram Level 1 (Assign Tech Work).

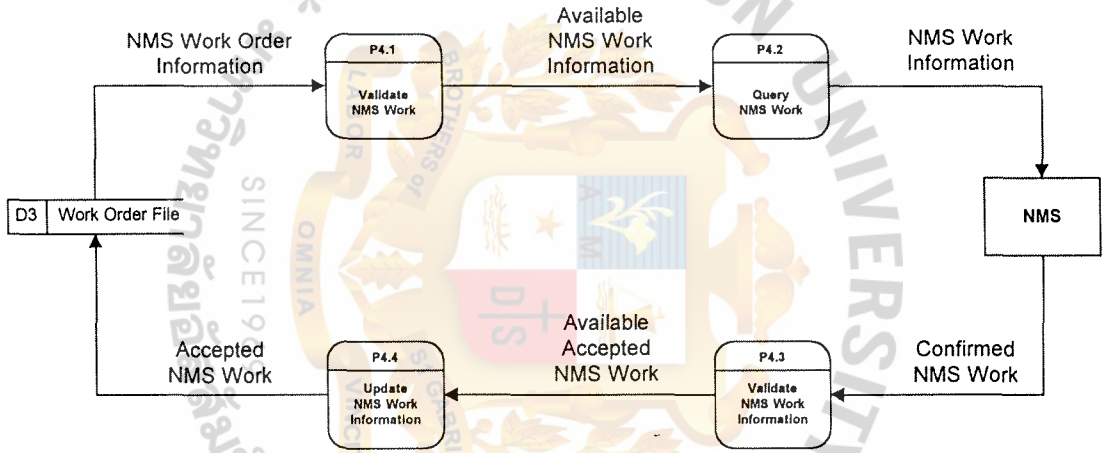

Figure C.5. Data Flow Diagram Level 1 (Assign NMS Work).

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Figure C.6. Data Flow Diagram Level 1 (Manipulate Massage Failure).

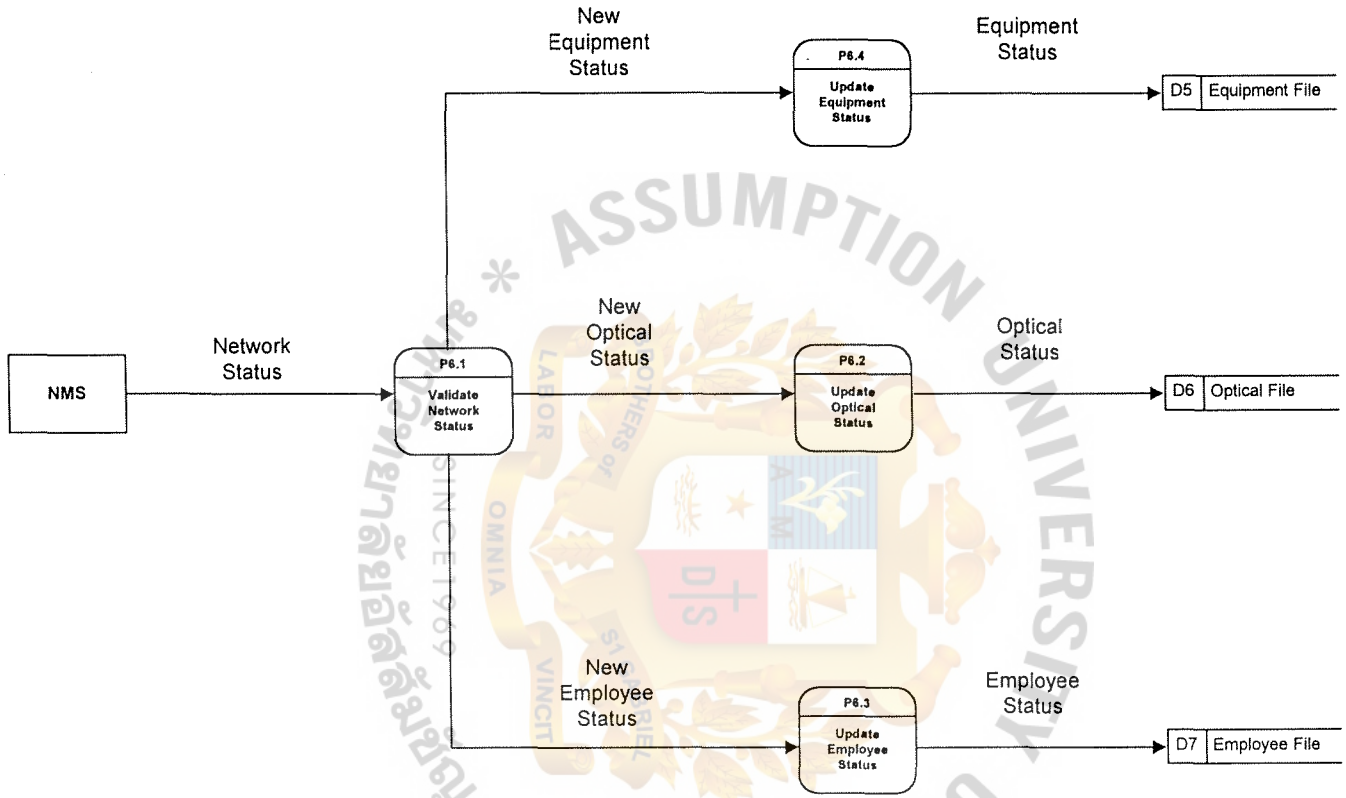

Figure C.7. Data Flow Diagram Level 1 (Manipulate Network Status).

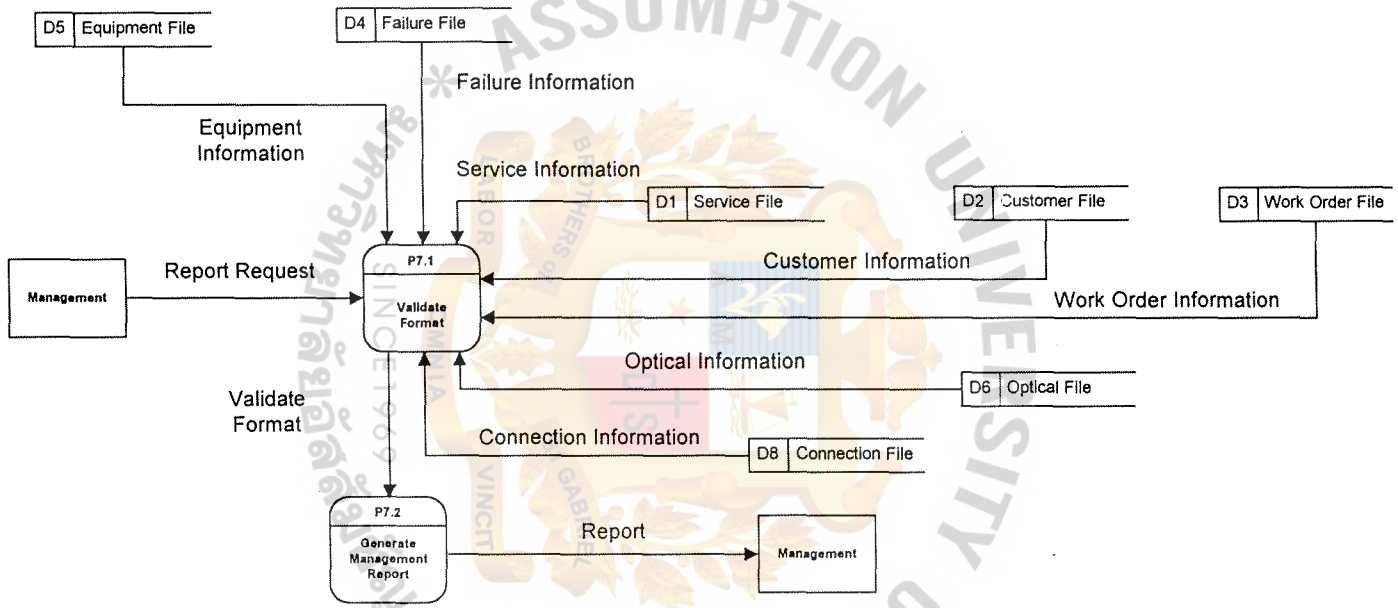

Figure C.8. Data Flow Diagram Level 1 (Generate Report).

APPENDIX D

STRUCTURE CHART

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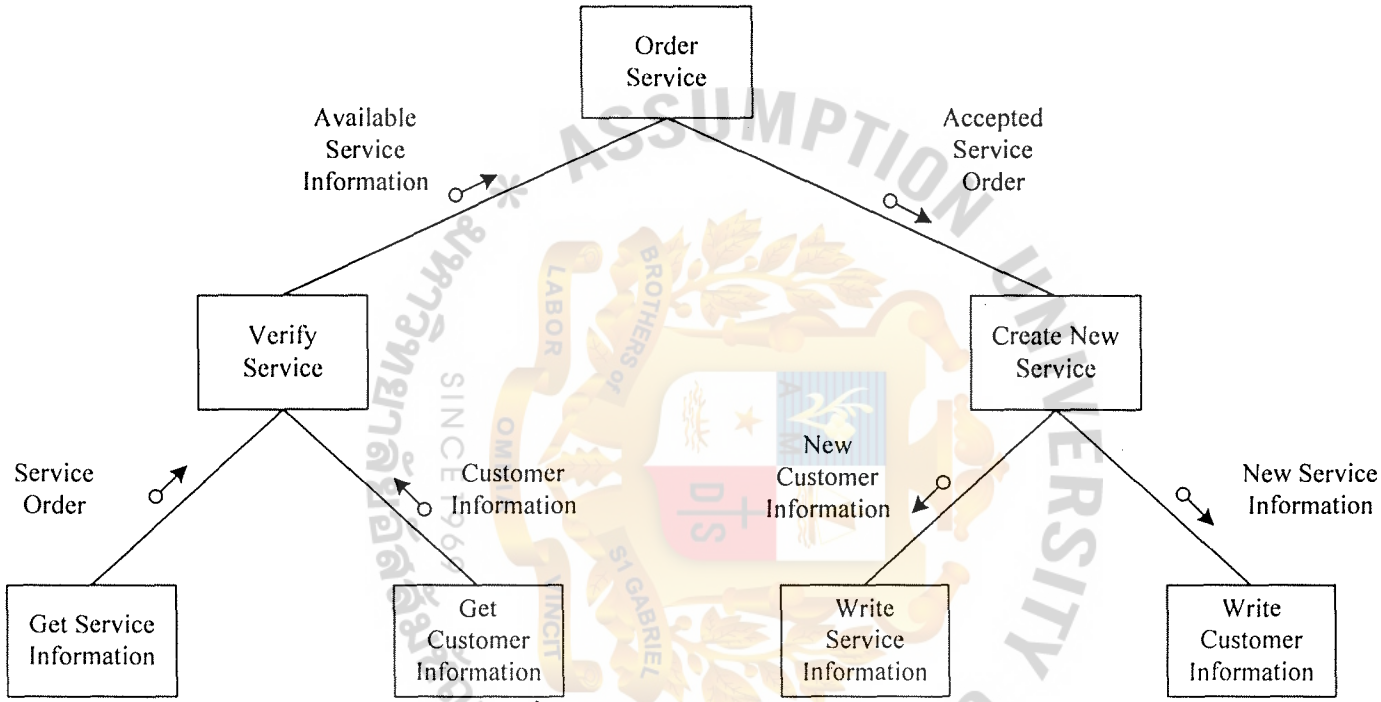

Figure D.1. Structure Chart of Order Service.

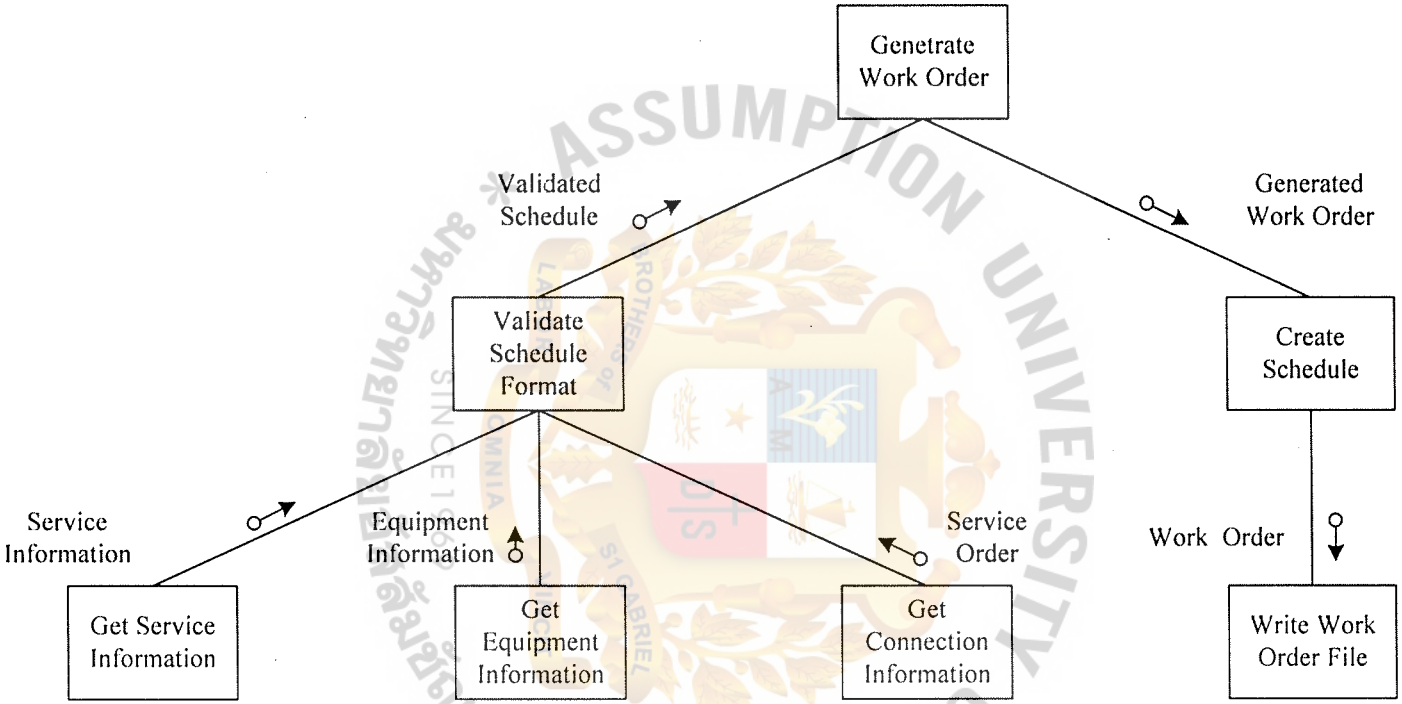

Figure D.2. Structure Chart of Generate Work Order.

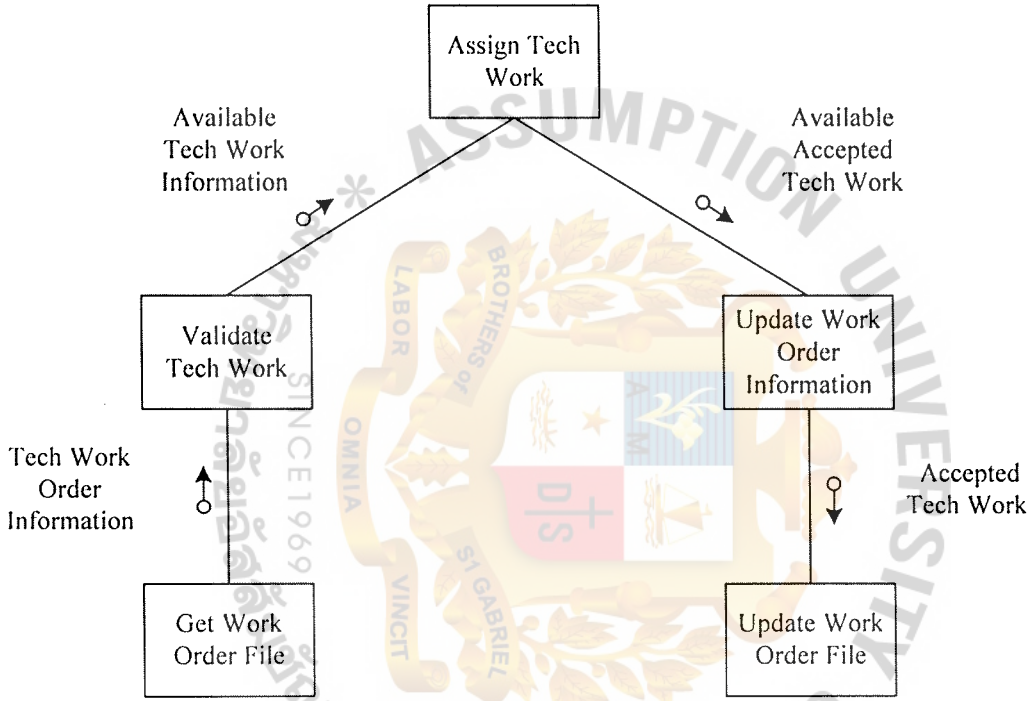

Figure D.3. Structure Chart of Assign Tech Work.

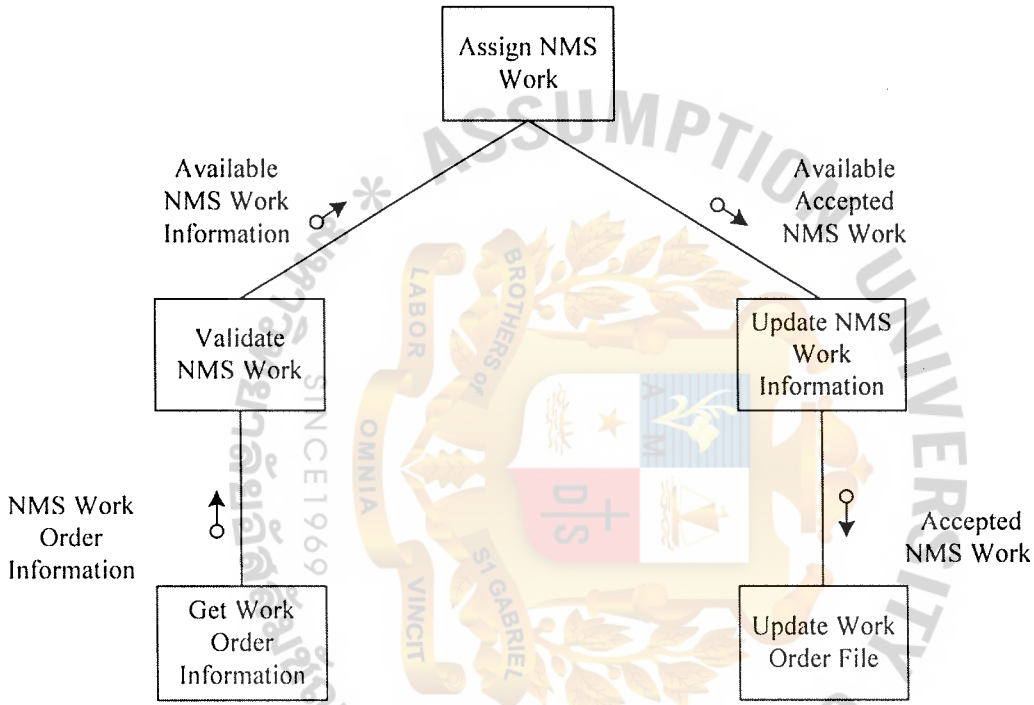

Figure D.4. Structure Chart of Assign NMS Work.

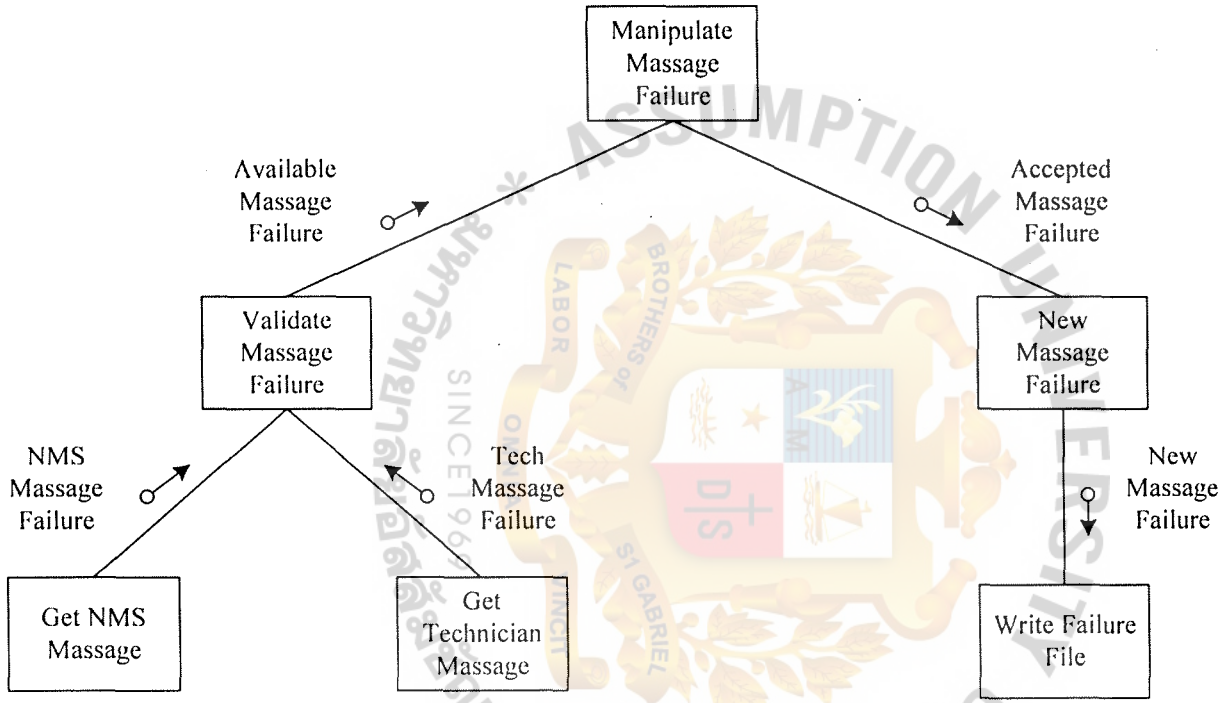

Figure D.5. Structure Chart of Manipulate Massage Failure.

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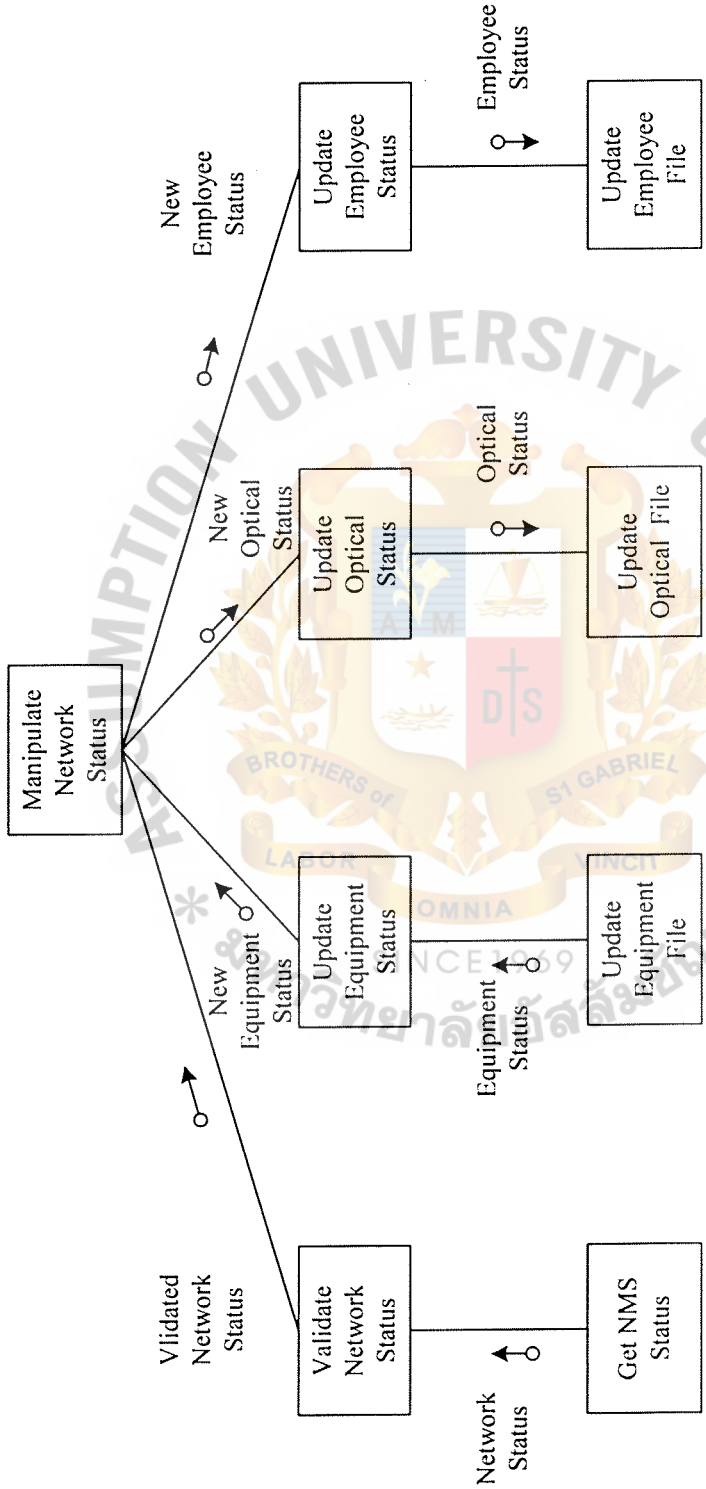

Figure D.6. Structure Chart of Manipulate Network Status.

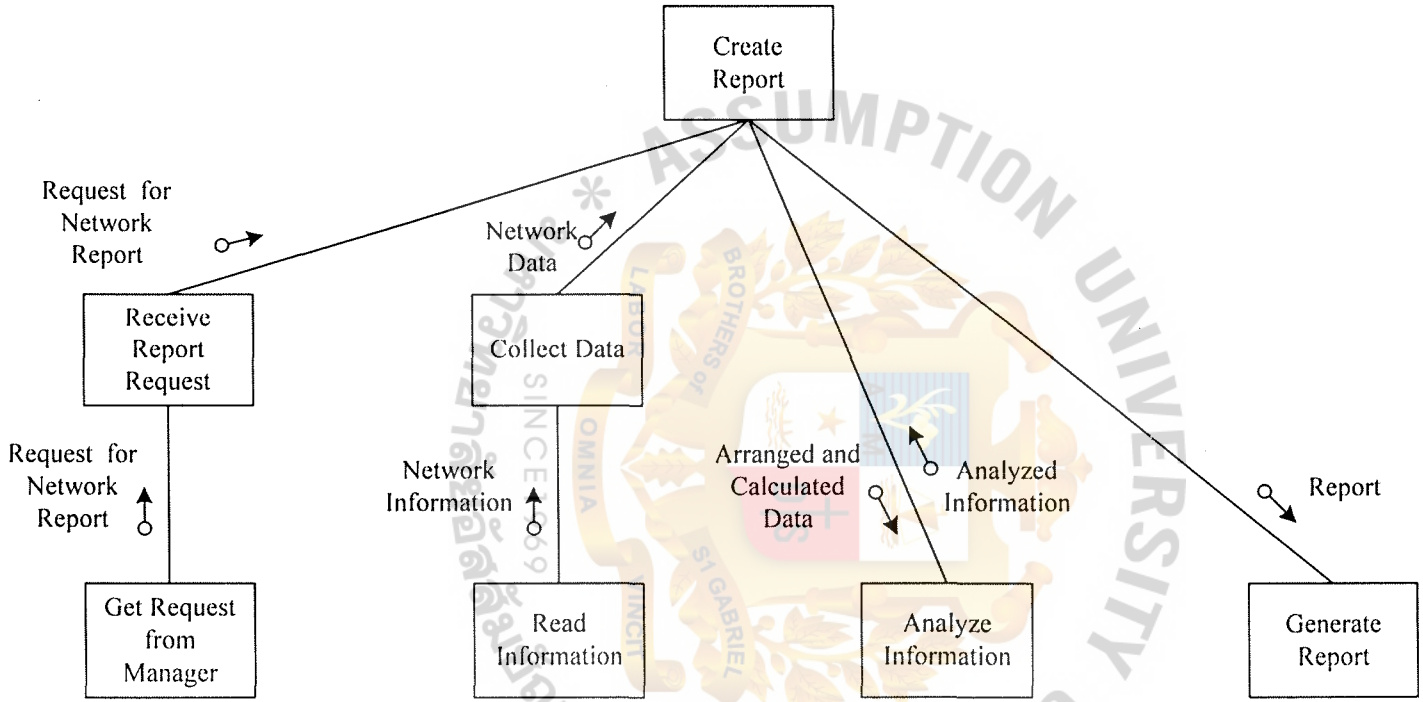

Figure D.7. Structure Chart of Create Report.

APPENDIX E

FILE STRUCTURE

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Table E.1. File Structure of Failure.

Field Name	Type	Width	Dec
FAIL_NO	CHARACTER	10	
PROD_NO	CHARACTER	10	
DATE BEGIN	DATE	10	
TIME BEGIN	TIME	10	
DATE END	DATE	10	
TIME BEGIN	TIME	10	
DESCRIPTION	CHARACTER	50	

Table E.2. File Structure of Equipment.

Field Name	Type	Width	Dec
EQP_ID	CHARACTER	10	
EQP_NAME	CHARACTER	30	
VENDOR	CHARACTER	30	
EQP_TYPE	CHARACTER	30	
EQP_STA	CHARACTER	5	
EQP_PORT	CHARACTER	5	
EQP_STAT	CHARACTER	10	

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Table E.3. File Structure of Connection.

Field Name	Type	Width	Dec
SRV_ID	CHARACTER	10	
C_EQP_A_ID	CHARACTER	10	
C_EQP_PORT_A	CHARACTER	10	
C_EQP_B_ID	CHARACTER	10	
C_EQP_PORT_B	CHARACTER	10	
WORK_ID	CHARACTER	10	

Table E.4. File Structure of Work.

Field Name	Type	Width	Dec
SRV_ID	CHARACTER	10	
SEQ	NUMERIC	2	
EMP_ID	CHARACTER	10	
W_STAT	CHARACTER	5	
W_TYPE	CHARACTER	30	

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Table E.5. File Structure of Employee.

Field Name	Type	Width	Dec
EMP_ID	CHARACTER	10	
EMP_NAME	NUMERIC	30	
ADDR2	CHARACTER	50	
TEL2	CHARACTER	20	

Table E.6. File Structure of Customer.

Field Name	Type	Width	Dec
CUS_ID	CHARACTER	10	
CUS_NAME	NUMERIC	30	
C_ADDR	CHARACTER	50	
C_TEL	CHARACTER	20	

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Table E.7. File Structure of Service.

Field Name	Type	Width	Dec
SRV_ID	CHARACTER	10	
S_EQP_A_ID	CHARACTER	10	
S_EQP_PORT_A	CHARACTER	10	
S_EQP_B_ID	CHARACTER	10	
S_EQP_PORT_B	CHARACTER	10	
S_CUS_ID	CHARACTER	10	
DATE START	DATE	10	
DATE END	DATE	10	

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Table E.8. File Structure of Optical.

Field Name	Type	Width	Dec
OPT_NO	CHARACTER	10	
OPT_A_STA	CHARACTER	10	
OPT_EQP_A	CHARACTER	10	
OPT_PORT_A	CHARACTER	10	
OPT_B_STA	CHARACTER	10	
OPT_EQP_B	CHARACTER	10	
OPT_PORT_B	CHARACTER	10	
OPT_TYPE	CHARACTER	30	
OPT_STAT	CHARACTER	5	
DIST	NUMERIC	10	2

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APPENDIX F

DATA DICTIONARY

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DATA DICTIONARY

FAILURE

FAIL_NO	= Number that indicate failure event
PROD_NO	= The equipment ot optical number that fail
DATE BEGIN	= The beginning date that failure occurred
TIME BEGIN	= The beginning time that failure occurred
DATE END	= The ending date that failure occurred
TIME BEGIN	= The ending time that failure occurred
DESCRIPTION	= The details of the failure

EQUIPMENT

EQP_ID	= The identification number used as equipment reference number
EQP_NAME	= The equipment name
VENDOR	= The supplier name for this equipment
EQP_TYPE	= The type of equipment
EQP_STA	= The station name the equipment is installed
EQP_PORT	= The port of the equipment
EQP_STAT	= The equipment status

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CONNECTION

SRV_ID	= The indentification number of service
SEQ	= The sequence of connection for service
C_EQP_A_ID	= The equipment that service used in origin side
C_EQP_PORT_A	= The equipment port tht service used in origin side
C_EQP_B_ID	= The equipment that service used in end side
C_EQP_PORT_B	= The equipment port tht service used in end side
WORK_ID	= The order of connection for the service

WORK

W_STAT	= The work status
W_TYPE	= The work type

EMPLOYEE

EMP_ID	= The identification number used as employee reference number
EMP_NAME	= The full name of the employee
ADDR2	= The address of the employee work
TEL2	= The office's telephone number fo the employee

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CUSTOMER

CUS_ID	= The identification number used as customer reference number
CUS_NAME	= The name lof the customer
C_ADDR	= The customer's address
C_TEL	= The customer's telephone number

SERVICE

SRV_ID	= The identification number used as work reference number
S_EQP_A_ID	= The equipmet that service connected at the origin station
S_EQP_PORT_A	= The equipmet port that service connected at the origin station
S_EQP_B_ID	= The equipmet that service connected at the end station
S_EQP_PORT_B	= The equipmet port that service connected at the end station
S_CUS_ID	= The customer identification for the service
DATE START	= The date that customer beginning using the service
DATE END	= The date that customer quit using the service

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OPTICAL

OPT_NO	=	The identification number used as optical reference number
OPT_A_STA	=	The station name that the optical connected at origin side
OPT_EQP_A	=	The equipment ID that the optical connected at origin side
OPT_PORT_A	=	The equipment port that the optical connected at origin side
OPT_B_STA	=	The station name that the optical connected at end side
OPT_EQP_B	=	The equipment ID that the optical connected at end side
OPT_PORT_B	=	The equipment port that the optical connected at end side
OPT_TYPE	=	The type of the optical cable
OPT_STAT	=	The station of the optical cable
DIST	=	The distance fo the optical cable

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APPENDIX G

PROCESS SPECIFICATION

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PROCESS SPECIFICATION

Process Name : Order Service

Process Number : 1.0

Input : - Service Order

- Customer Information

Output : - New Service

- New Customer

Process :

BEGIN

- Receive Order Service Detail from Service Order
- FIND Customer Name in Customer File

IF Customer Name not found

THEN Customer ID = the next available Customer ID

ACCEPT Customer Order Details

ELSE Read Customer Information

END IF;

- Write New Service to Service File

END

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Process Name : Generate Work Order

Process Number : 2.0

Input : - Service Information

- NTW Information
- Connection Information

Output : - Work Order

Process :

BEGIN

- Read Service Information, Equipment Information and Connection Information
- Check All Station Name in Equipment File and Connection File

  IF Station Name of Service Order Record = Station Name of NTW Information

  THEN ACCEPT Station Name to Work Order

  END IF;
- Write Work Order Information to Work Order File

END

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Process Name : Assign Tech Work

Process Number : 3.0

Input : - Tech Work Order Information

- Tech Work Information

Output : - Confirm Tech Work

- Accepted Tech Work

Process :

BEGIN

- Read Tech Work Information for this Station Name
- Check Equipment

IF Equipment available

THEN accept the Work Order

ELSE Invalid Work Order

END IF;

- Work Order Inforamtion accepted
- Confirm Tech Work to Work Order File

END

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Process Name : Assign NMS Work

Process Number : 4.0

Input : - NMS Work Order Information

- Accepted NMS Work

Output : - NMS Work Information

- Confirm NMS Work

Process :

BEGIN

- Read NMS Work Order Information File for this Station Name
- Check Equipment

IF Equipment available

THEN accept the Work Order

ELSE Invalid Work Order

END IF;

- Work Order Inforamtion accepted
- Confirm NMS Work Order to Work Order File

END

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Process Name : Manipulate Massage Failure

Process Number : 5.0

Input : - NMS Massage Failure

- Tech Massege Failure

Output : - New Massage Failure

Process :

BEGIN

- GET NMS Massage Failure and Tech Massege Failure
- Write New Massage Failure to Failure File

END

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Process Name : Mainpulate Network Status

Process Number : 6.0

Input : - NTW Status

- Calculated Result

Output : - Optical Status

- Employee Status

- Equipment Status

Process :

BEGIN

- Get NTW Information
- Write Optical Status to Optical File
- Write Employee Status to Employee File
- Write Equipment Status to Equipment File

END

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Process Name : Generate Report

Process Number : 7.0

Input :
- Report Requisition
- Service Information
- Customer Information
- Work Order Information
- Failure Information
- Equipment Information
- Optical Information
- Connection Information

Output :
- Report

Process :

BEGIN
- Receive Requisition Record
- Read Data Record
- Prepapre Report
- Print Report

END

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APPENDIX H

DATABASE DESIGN

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FAILURE

FAIL NO	PROD_NO	DATE BEGIN	TIME BEGIN	DATE END	TIME BEGIN	DESCRIPTION
PK						

EQUIPMENT

EQP ID	EQP_NAME	VENDOR	EQP_TYPE	EQP_STA	EQP_PORT	EQP_STAT
PK						

CONNECTION

SRV ID	SEQ	C_EQP_A_ID	C_EQP_PORT_A	C_EQP_B_ID	C_EQP_PORT_B	WORK_ID
PK	PK					

WORK

SRV ID	SEQ	EMP_ID	W_STAT	W_TYPE
PK	PK	PK		

EMPLOYEE

EMP ID	EMP_NAME	ADDR2	TEL2
PK			

Figure H.1. Database Schema.

CUSTOMER

CUS ID	CUS_NAME	C_ADDR	C_TEL
PK			

SERVICE

SRV ID	S_EQP_A_ID	S_EQP_PORT_A	S_EQP_B_ID	S_EQP_PORT_B	S_CUS_ID	DATE START
PK						
DATE END						

OPTICAL

OPT NO	OPT_A_STA	OPT_EQP_A	OPT_PORT_A	OPT_B_STA	OPT_EQP_B	OPT_PORT_B
PK						
OPT_TYPE	OPT_STAT	DIST				

Figure H.2. Database Schema (Continued).

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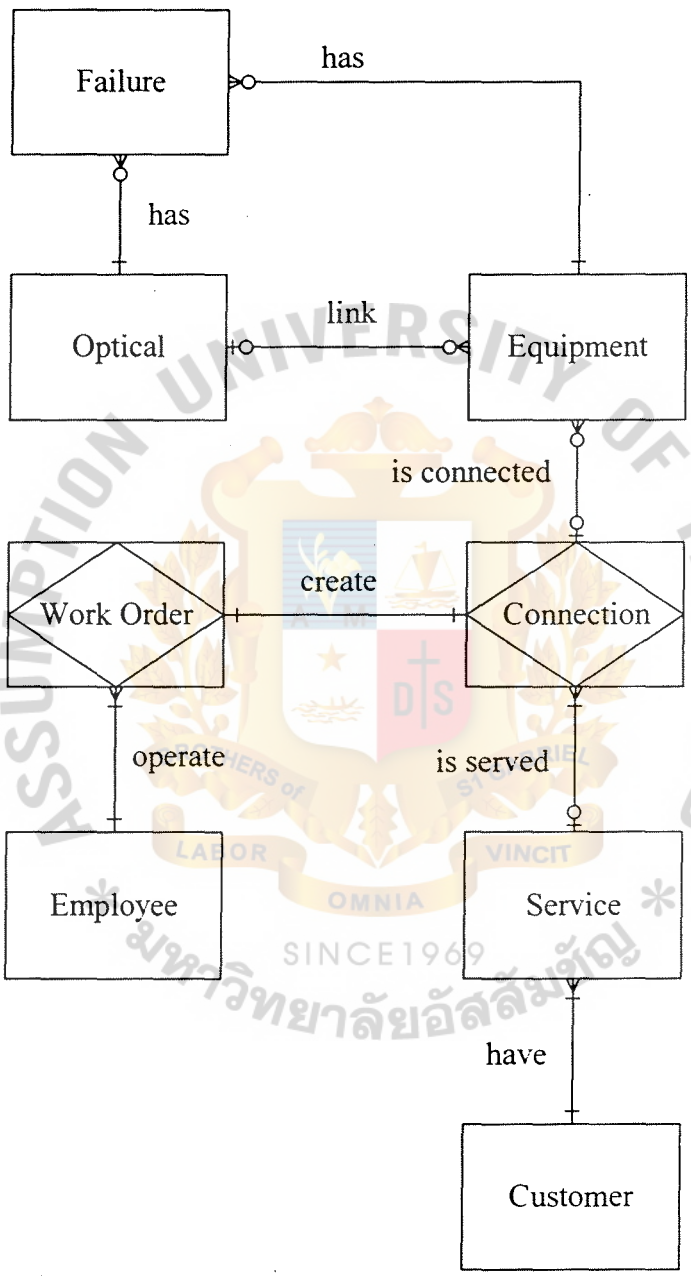

Figure H.3. Context Data Model.

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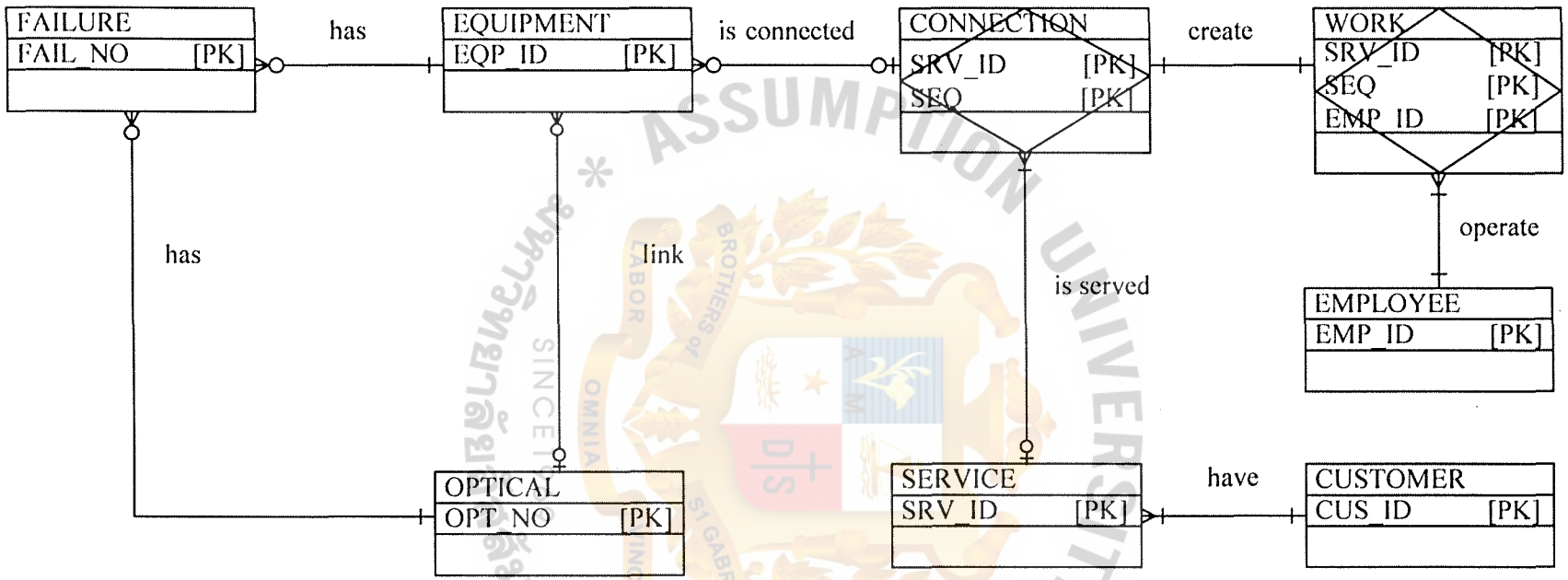

Figure H.4. Key-Based Attribute Data Model.

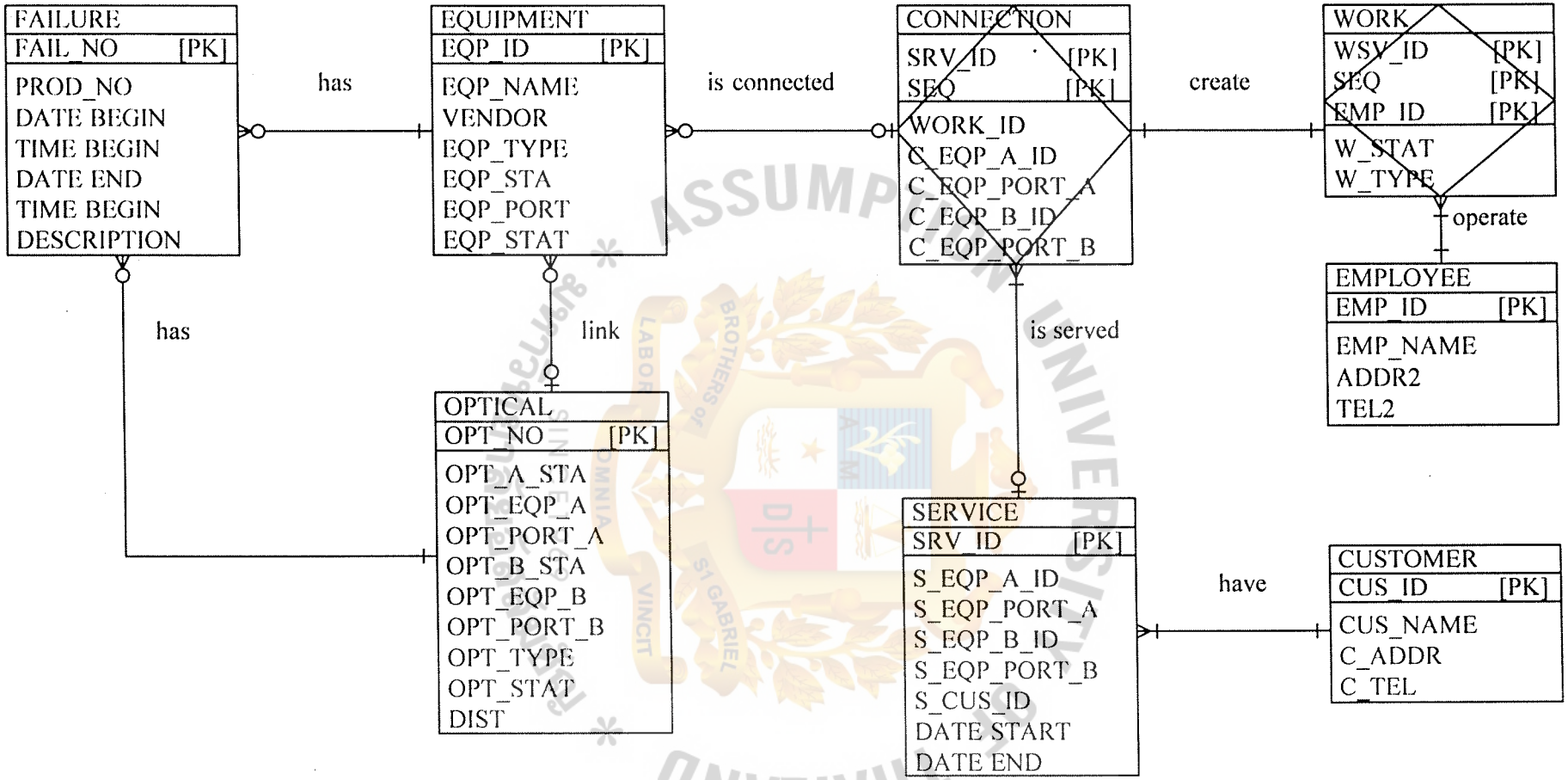

Figure H.5. Fully Attribute Data Model.

APPENDIX I

REPORT DESIGN

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TRANSMISSION NETWORK STATION SERVICE HIGH LIGHT

Month : Mar-01

STATION	CUSTOMER	NEW	CANCEL	CHANGE	% CHANGE
AYA	50	8	2	6	12.00
CBI	97	12	0	12	12.37
CMI	23	3	1	2	8.70
LKS	68	8	3	5	7.35
LTY	56	9	3	6	10.71
PLK	33	4	2	2	6.06

Figure I.1. Station Service Highlight Report.

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TRANSMISSION NETWORK NETWORK FAILURE

Month : Mar-01

STATION	EQUIPMENT FAILURE	OPTICAL FAILURE	TOTAL EQUIPMENT	TOTAL OPTICAL	TOTAL FAILURE	UNAVIALABLE TIME
AYA	8	22	18.4	77	95.4	1.08904
CBI	6	30	13.8	105	118.8	1.35616
CMI	4	45	9.2	157.5	166.7	1.90297
LKS	7	24	16.1	84	100.1	1.14269
LTY	9	23	20.7	80.5	101.2	1.15525
PLK	10	19	23	66.5	89.5	1.02169

Figure I.2. Network Failure Report.

TRANSMISSION NETWORK WORK ORDER

Month : Mar-01

STATION	TRANSMISION	ACCESS	TOTAL
AYA	215	50	265
CBI	120	97	217
CMI	40	23	63
LKS	500	68	568
LTY	326	56	382
PLK	256	33	289

Figure I.3. Work Order Report.

TRANSMISSION NETWORK EQUIPMENT FAILURE

Month : **Mar-01**

EQUIPMENT TYPE	FACTORY MEAN (%)	AMOUNT	ACCUMULTE FAILURE	AVERAGE FAILURE	% OVER MEAN
10A4400101	0.00125	100	18.4	0.0153	11.2667
10A4400102	0.00145	500	13.8	0.0276	18.0345
10A4400103	0.00156	100	9.2	0.0920	57.9744
10A4400104	0.00185	200	16.1	0.0805	42.5135
10A4400105	0.00125	500	20.7	0.0414	32.1200
10A4400106	0.0013	100	23	0.2300	175.9231

Figure I.4. Equipment Failure Report.

TRANSMISSION NETWORK FAILURE REPORT

Month : Mar-01 Station : LKS

PRODUCT ID	DATE BEGIN	DATE END	TIME BEGIN	TIME END	FIX TIME
10A4400101	3-Mar-01	3-Mar-01	13.15	14.00	0.45
10A4400102	4-Mar-01	4-Mar-01	9.15	10.15	1
10A4400103	3-Mar-01	3-Mar-01	11.15	11.30	0.15
10A4400104	3-Mar-01	3-Mar-01	12.45	13.30	0.45
10A4400105	5-Mar-01	5-Mar-01	15.30	16.15	0.45
10A4400106	4-Mar-01	4-Mar-01	10.00	10.30	0.3
TOTAL					2.80

Figure I.5. Failure Report.

TRANSMISSION NETWORK CUSTOMER HIGH LIGHT

Month : Mar-01

CUSTOMER	SERVICE	DATE START	DATE END	STATION START	STATION END
A441010001	44A0110001	4-Mar-01	-	LKS	CBI
A441010001	44A0110002	4-Mar-01	-	LKS	CMI
A441010001	44A0110003	4-Mar-01	-	LKS	LTY
A441010001	44A0110004	10-Apr-01	-	LKS	NMA
A441010002	44A0910001	10-Apr-01	-	CBI	LTY
A441010003	44A0210001	4-Mar-01	-	CMI	LTY

Figure I.6. Customer Highlight Report.

TRANSMISSION NETWORK OPTICAL REPORT

Month : Mar-01

OPTICAL No.	ORG STATION	DES STATION	ORG EQP	ORG PORT	DES EQP	DES PORT	LENGTH	TYPE	STATUS
O36A011001	KKN	NMA	10A4400101	10101	11A4400101	10101	80	A	W
O36A011002	NMA	SBR	11A4400102	10103	10A4400103	10101	45	A	W
O36A011003	SBR	AYA	41A4400103	10103	33A4400109	10101	60	A	W
O36A011004	AYA	LKS	22A4400104	10103	21A4400104	10103	45	A	W
O36A011005	LKS	LTY	15A4400105	10101	16A4400105	10103	30	D	W
O36A011006	LTY	KKM	18A4400106	10101	17A4400106	10103	20	D	W

Figure I.7. Optical Report.

TRANSMISSION NETWORK EQUIPMENT REPORT

Month : **Mar-01**

EQUIPMENT No.	EQUIPMENT NAME	VENDOR	STATION NAME	TYPE	UNIT PRICE	DESCRIPTION
10A4400101	LINE 1	ALCATEL	LTY			
10A4400102	AGG 1	ALCATEL	LTY			
10A4400103	AGG 2	ALCATEL	LTY			
10A4400104	AGG 3	ALCATEL	LTY			
10A4400105	CGI	ALCATEL	LTY			
10A4400106	POWER	ALCATEL	LTY			

Figure I.8. Equipment Report.

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TRANSMISSION NETWORK CONNECTION REPORT

Month : Mar-01

SERVICE ID.	EQUIPMENT ID.	EQUIPMENT PORT	STATION	EQUIPMENT ID.	EQUIPMENT PORT	STATION
44A0110001	10A4400101	10101	KKN	11A4400101	10101	NMA
44A0110002	11A4400102	10103	NMA	10A4400103	10103	SBR
44A0110003	41A4400103	10103	SBR	33A4400109	10103	AYA
44A0110004	22A4400104	10103	AYA	21A4400104	10103	LKS
44A0910001	15A4400105	10101	LKS	16A4400105	10101	LTY
44A0210001	18A4400106	10101	LTY	17A4400106	10101	KKM

Figure 1.9. Connection Report.

TRANSMISSION NETWORK SERVICE REPORT

Month : Mar-01

CUSTOMER NAME	CUSTOMER ID.	SERVICE ID.	ORG STATION	DES STATION	ORG EQP	ORG PORT	DES EQP	DES PORT
TT&T	A441010001	44A0110001	KKN	NMA	10A4400101	10101	11A4400101	10101
TT&T	A441010001	44A0110002	NMA	SBR	11A4400102	10103	10A4400103	10103
TT&T	A441010001	44A0110003	SBR	AYA	41A4400103	10103	33A4400109	10103
TT&T	A441010001	44A0110004	AYA	LKS	22A4400104	10103	21A4400104	10103
AIS	A441010002	44A0910001	LKS	LTY	15A4400105	10101	16A4400105	10101
UCOM	A441010003	44A0210001	LTY	KKM	18A4400106	10101	17A4400106	10101

Figure I.10. Service Report.

TRANSMISSION NETWORK FAILURE SERVICE

Month : **Mar-01**

STATION	SERVICE	TIME (min.)	% UNAVIALABLE
AYA	44A0110001	60	0.0014
ATG	44A0110002	75	0.0017
CNT	44A0110003	60	0.0014
NSN	44A0110004	45	0.0010
PLK	44A0910001	30	0.0007
SBR	44A0210001	30	0.0007

Figure I.11. Failure Service Report.

TRANSMISSION NETWORK STATION CAPACITY

Month : Mar-01

STATION	USED PORT	UNUSED PORT	TOTAL
AYA	35	29	64
ATG	10	54	64
CNT	5	27	32
NSN	15	49	64
PLK	100	28	128
SBR	20	44	64

Figure I.12. Station Capacity Report.

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APPENDIX J

SCREEN DESIGN

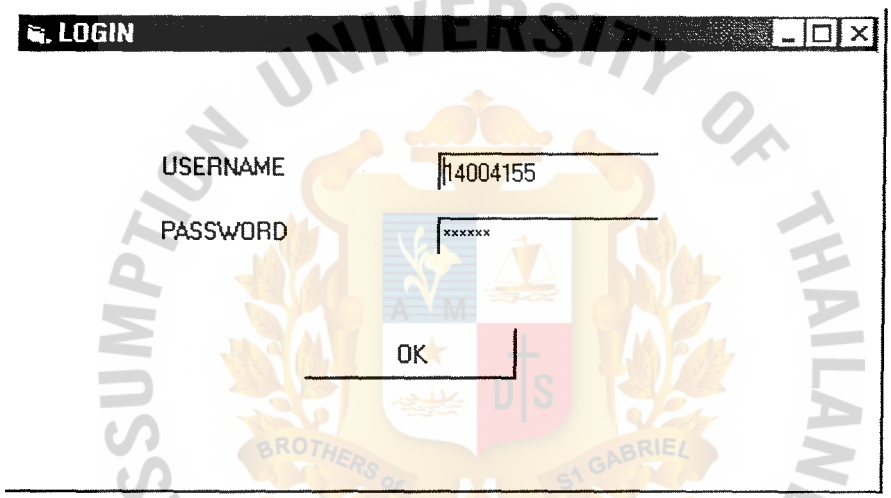

Figure J.1. Login Screen.

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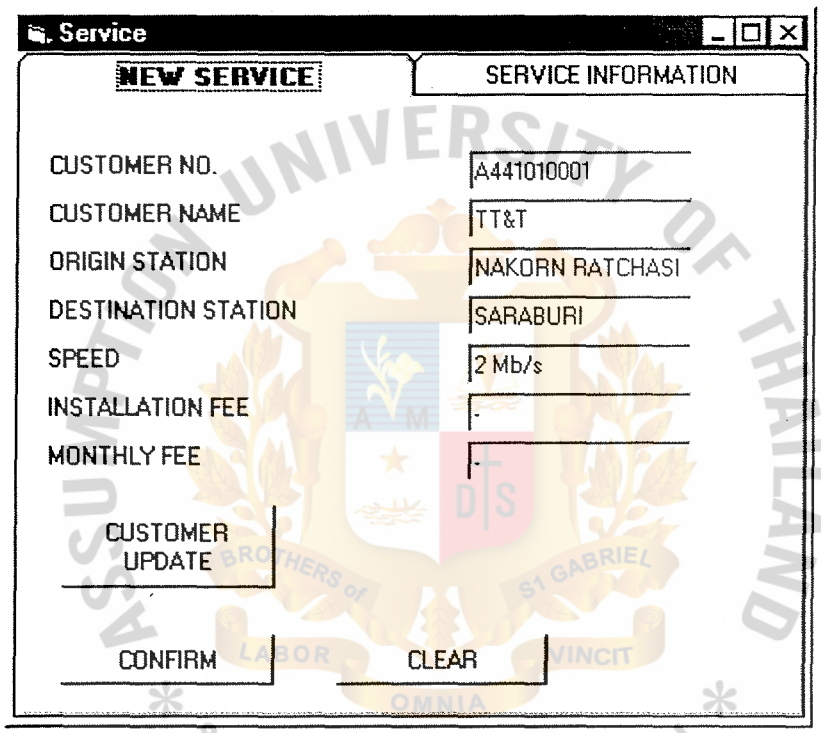

Figure J.2. New Service Screen.

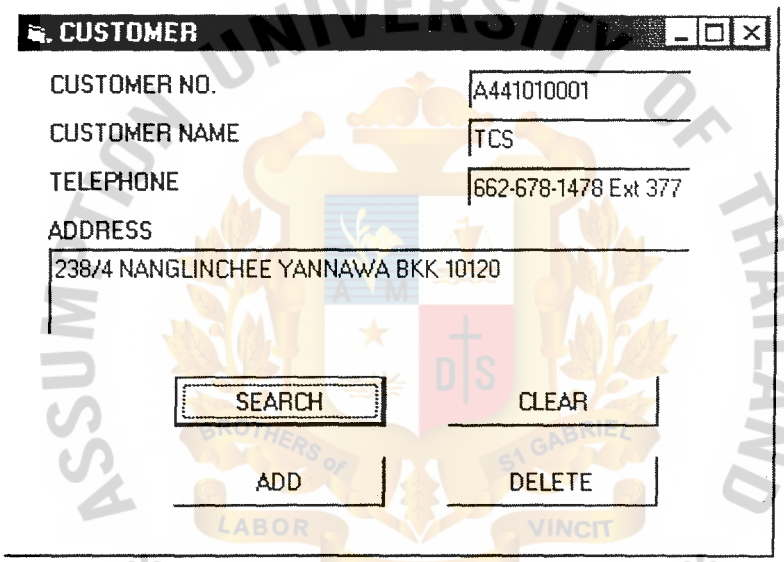

Figure J.3. Customer Screen.

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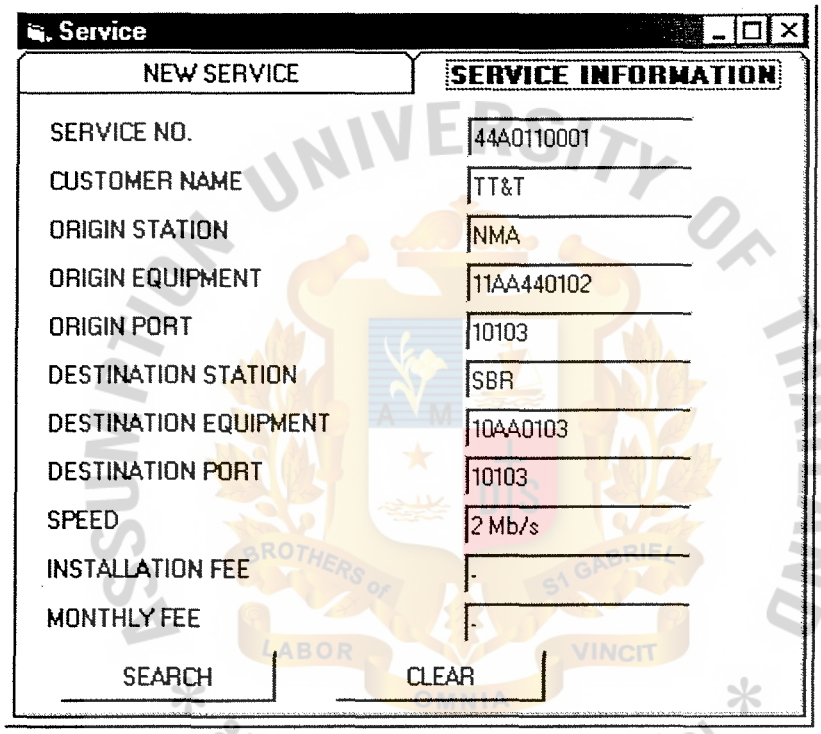

Figure J.4. Service Information Screen.

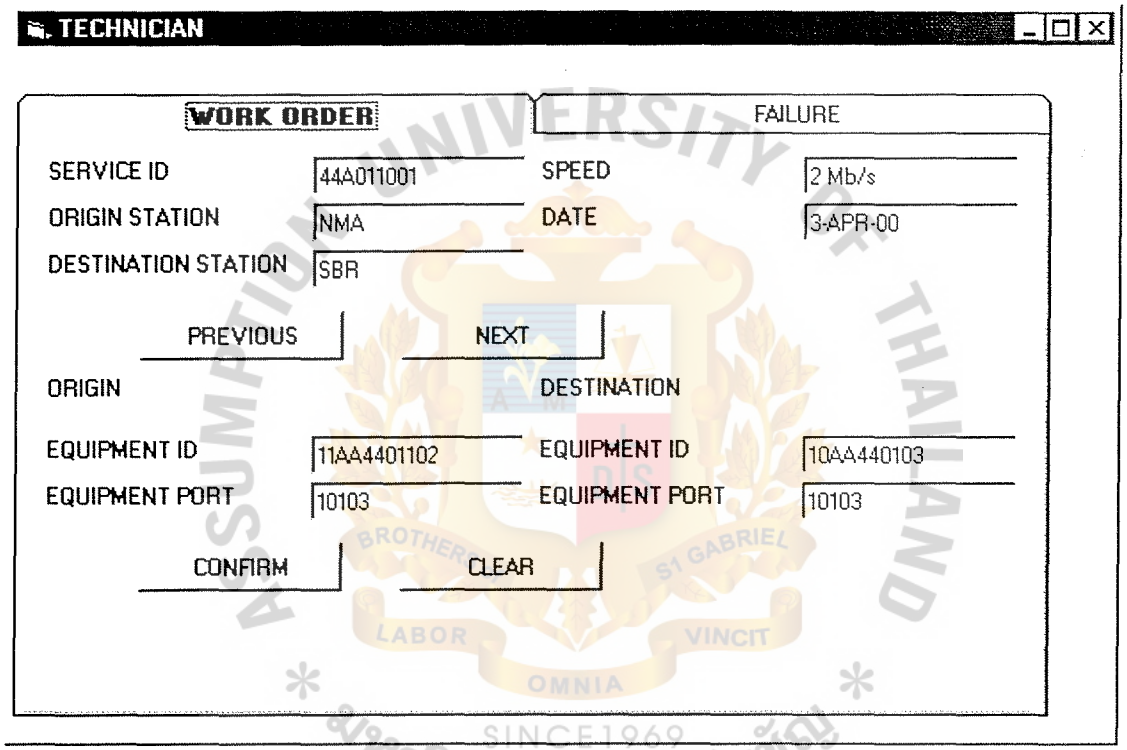

Figure J.5. Technician Work Order Screen.

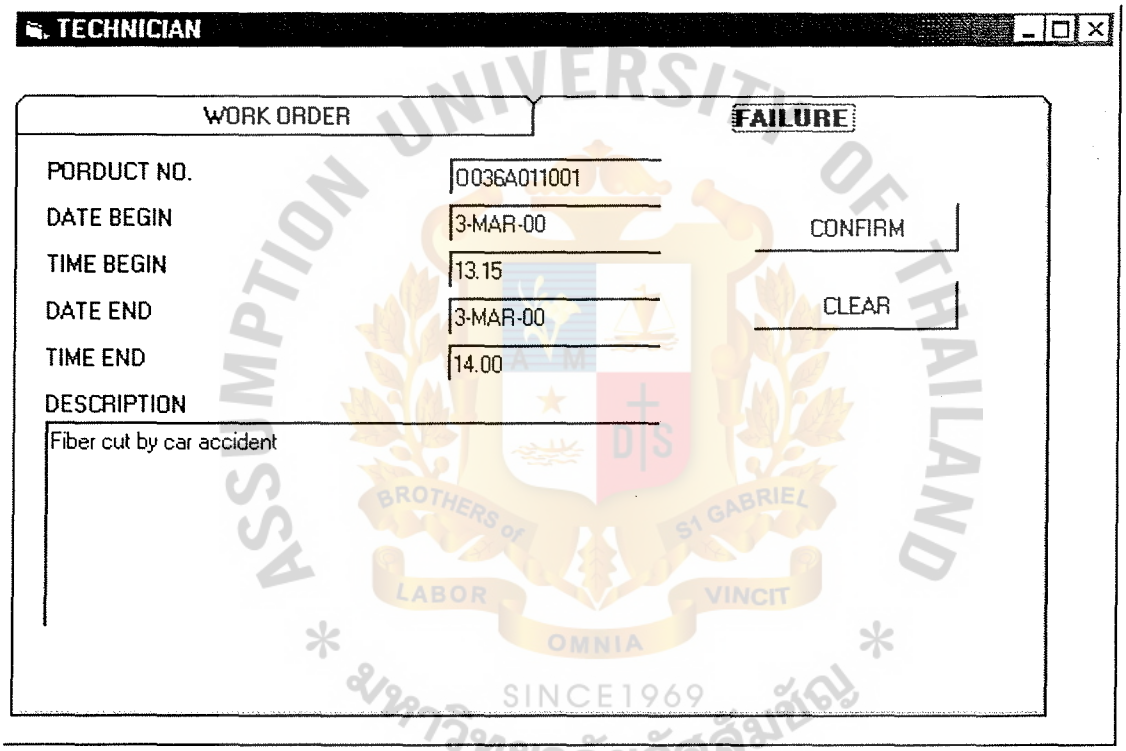

Figure J.6. Technician Failure Screen.

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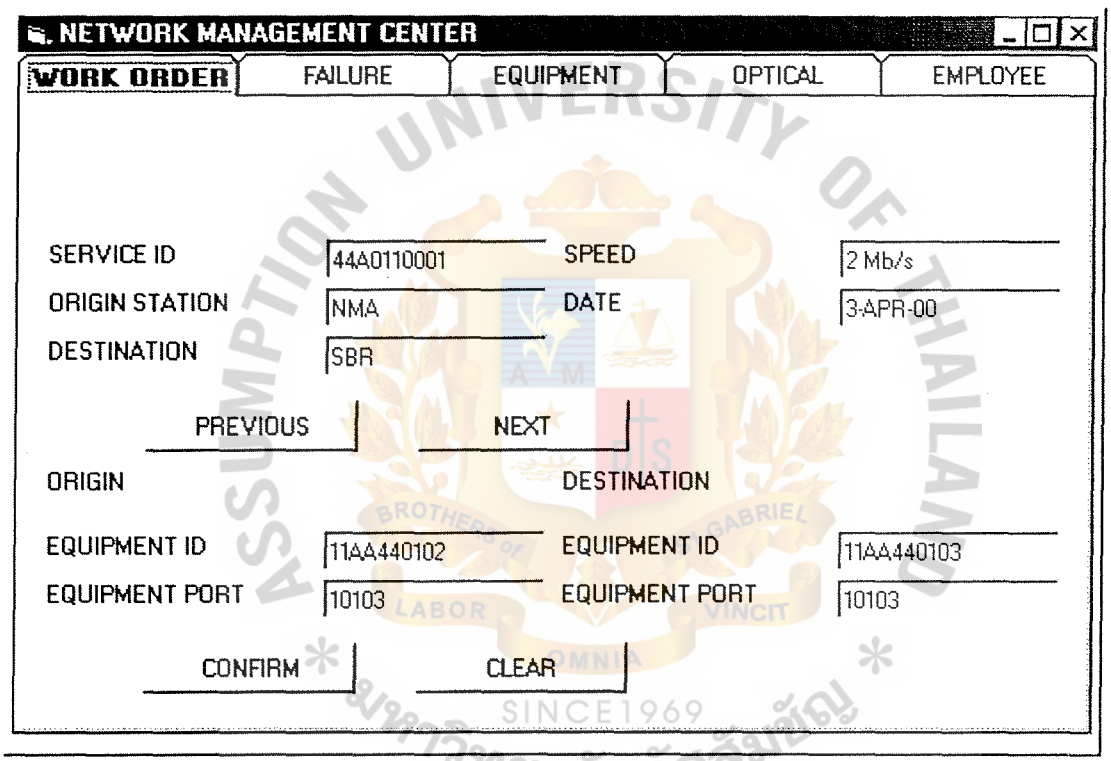

Figure J.7. Work Order Screen.

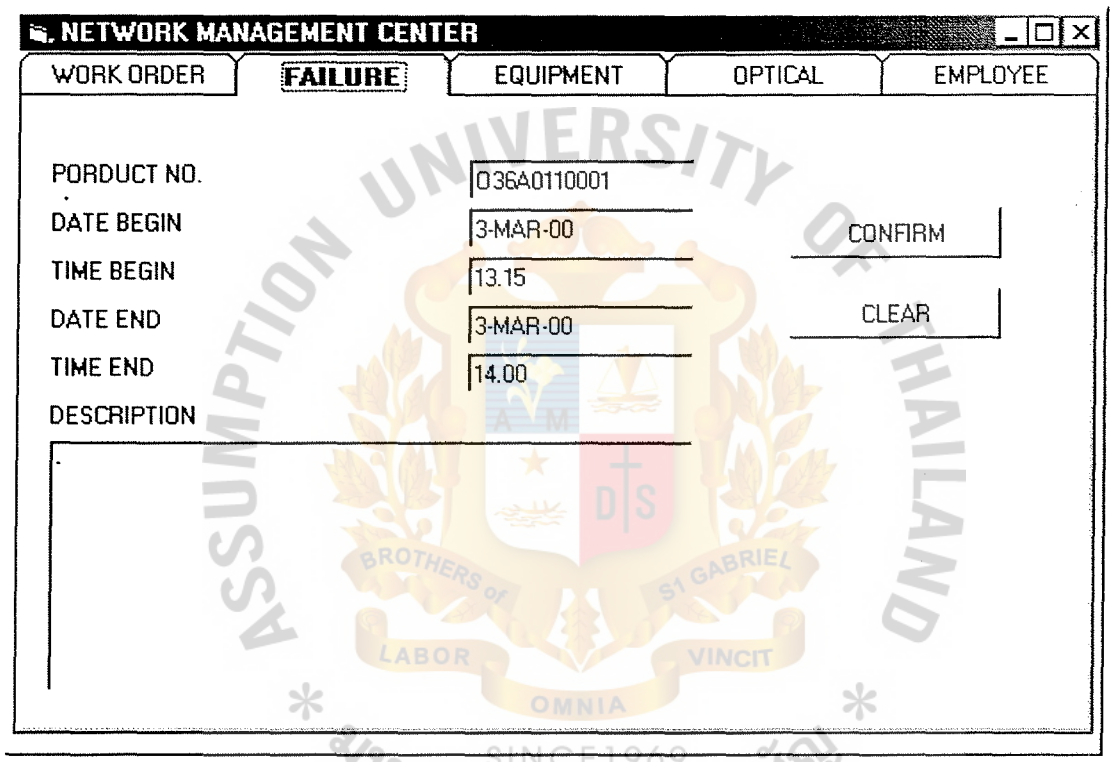

Figure J.8. Failure Screen.

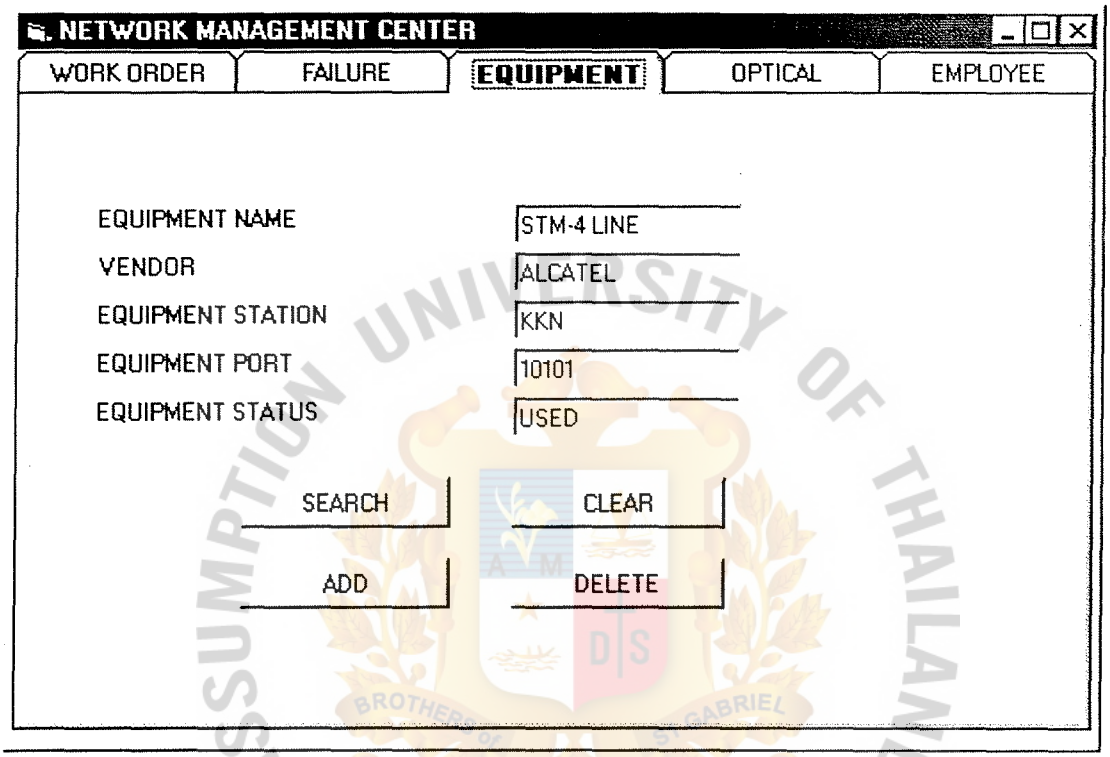

Figure J.9. Equipment Screen.

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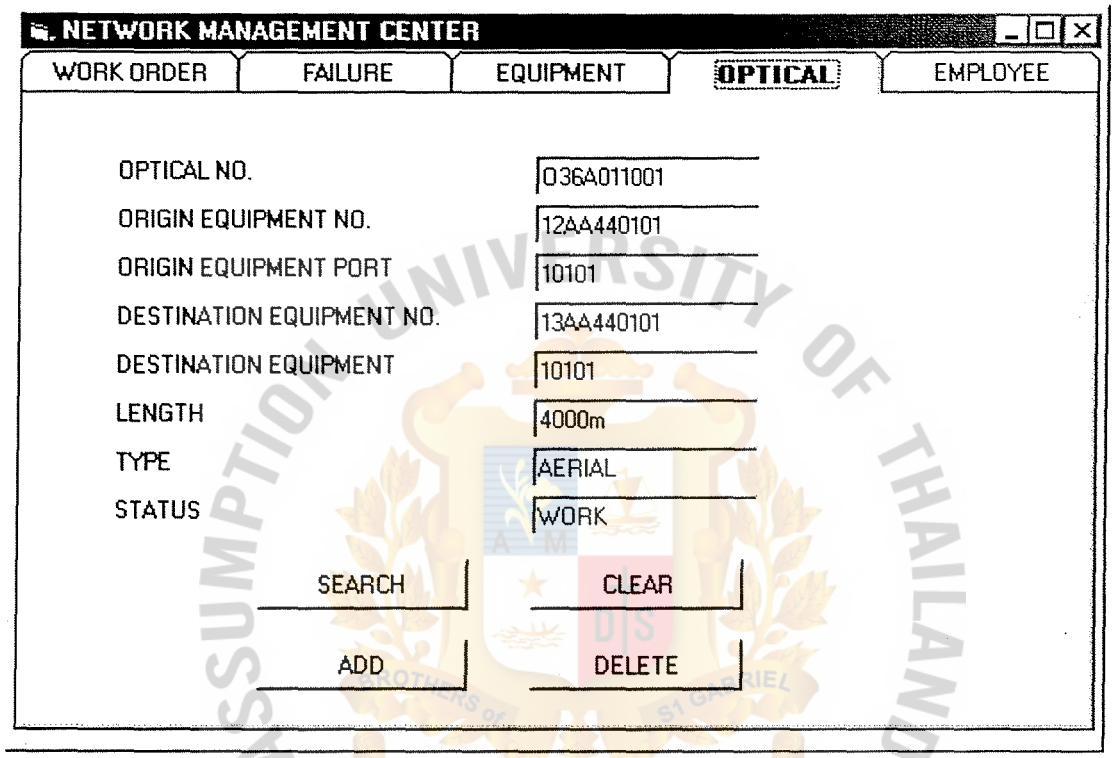

Figure J.10. Optical Screen.

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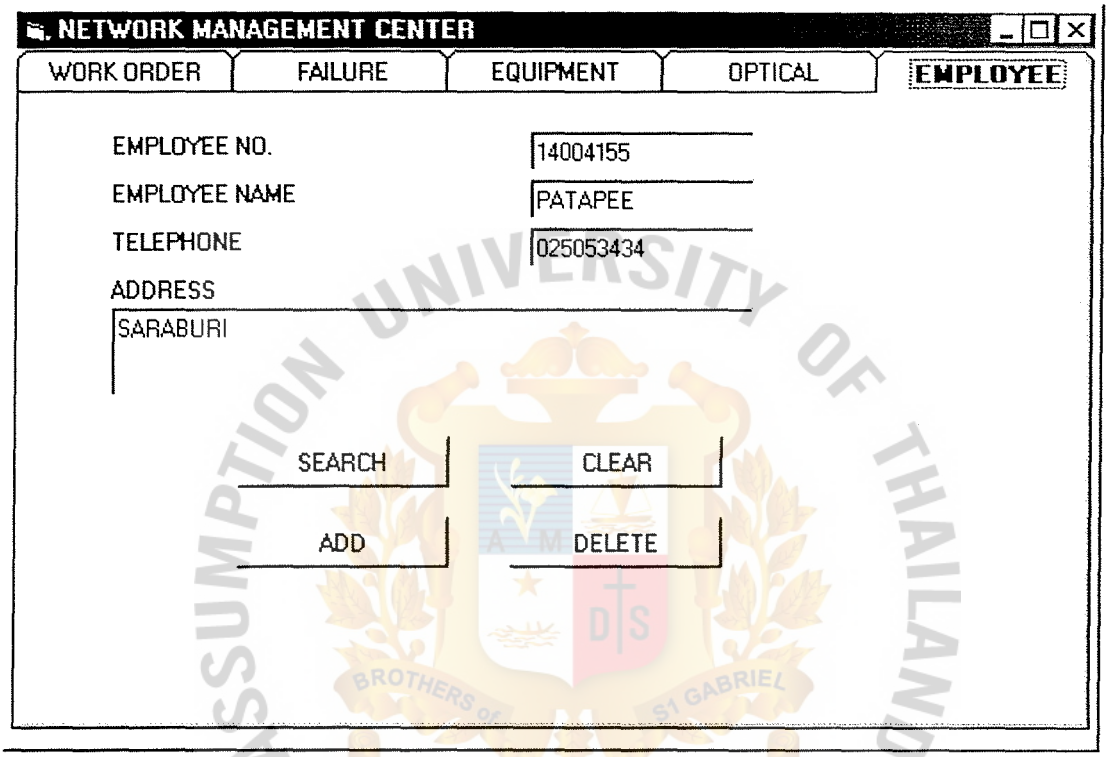

Figure J.11. Employee Screen.

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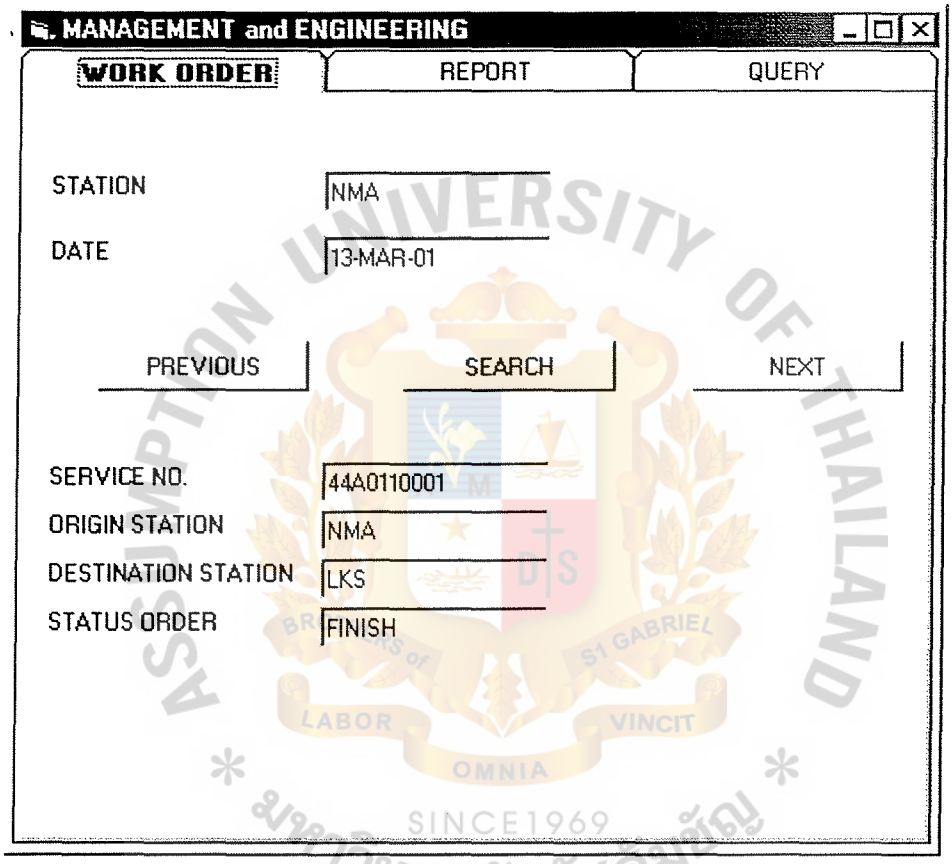

Figure J.12. Work Order for Management Screen.

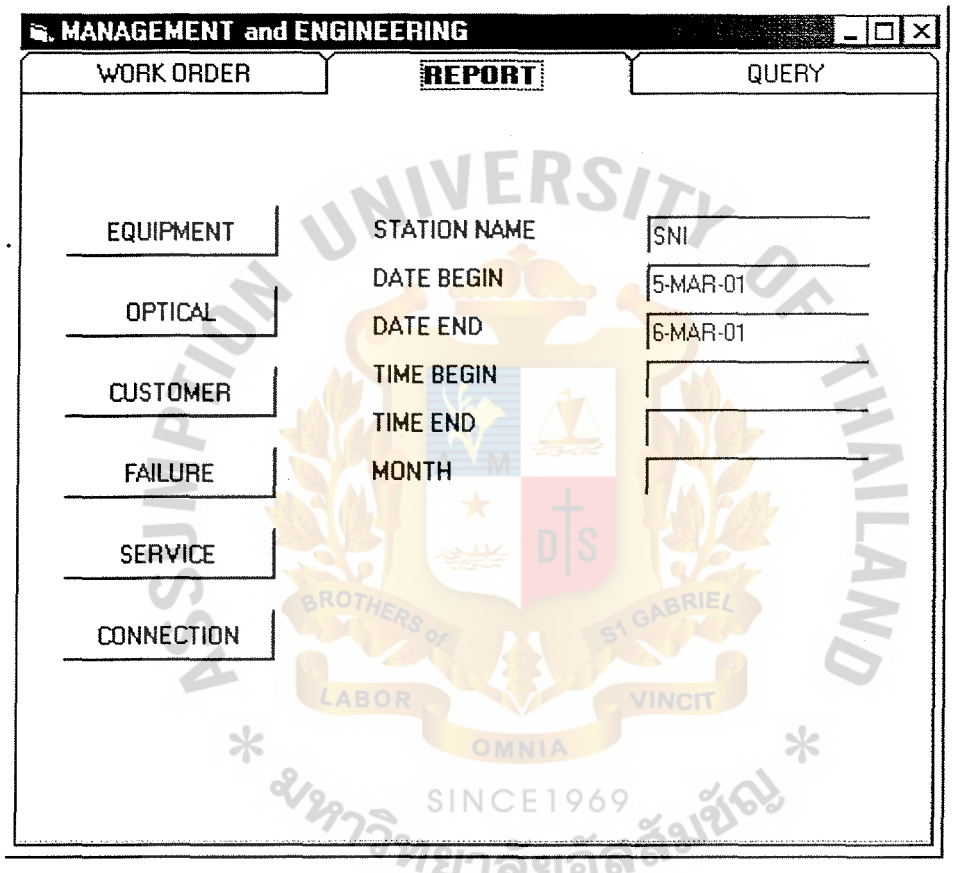

Figure J.13. Report Screen.

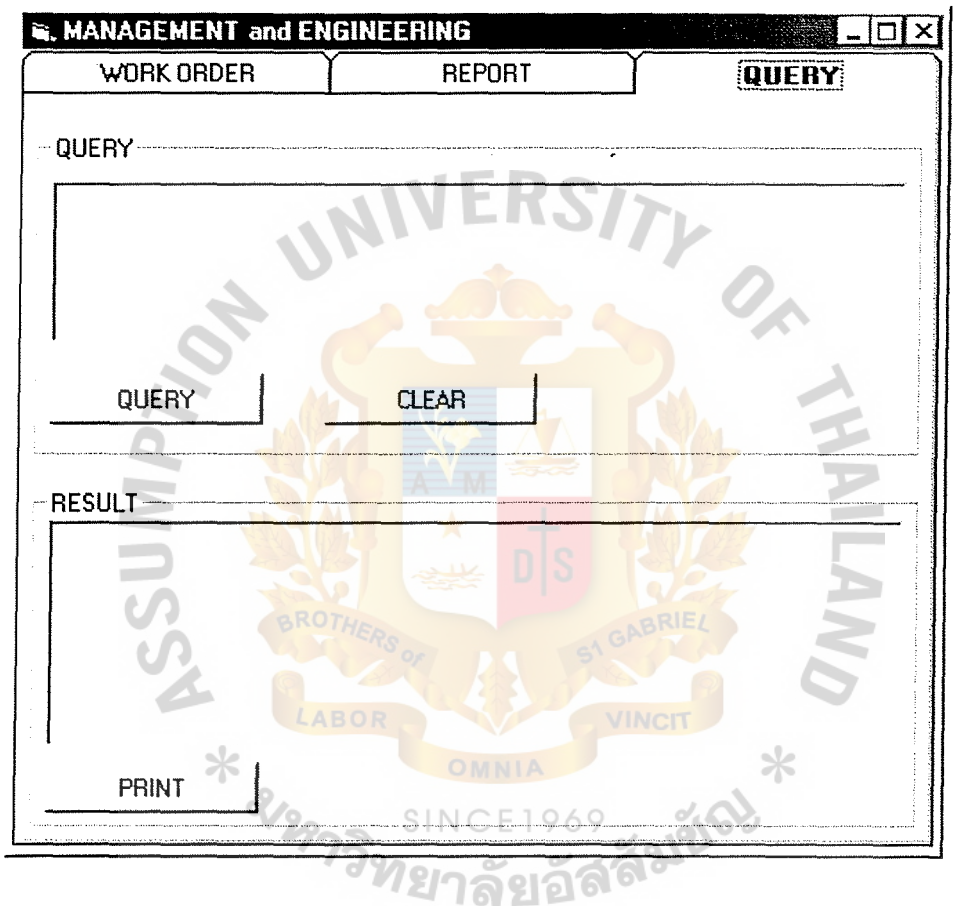

Figure J.14. Query Screen.

APPENDIX K

PROJECT PLAN

ASSUMPTION UNIVERSITY OF THAILAND
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No.	Task Name	October				November				December				January			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
	I. Analysis of the Existing System																
1	Define the Objective and Scope																
2	Study the Existing Problems																
3	Identify the Existing Problems																
4	Studying the Existing Computer System																
	II. Analysis and Design of the Proposed System																
5	Report Design																
6	Cost & Benefit Analysis																
7	Database Design																
8	Network Design																
9	Program Design																
	III. Implementation of the Proposed System																
10	Testing																
11	Hardware Installation																
12	Software Installation																
13	Conversion																

Figure K.1. Project Plan.

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