Logistic Control System for ISET Engineering Co., Ltd.

by

Mr. Chatchai Tantiwatchayanon

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
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Project Title	Logistic Control System for ISET Engineering Co., Ltd.
Name	Mr. Chatchai Tantiwatchayanon
Project Advisor	Assoc.Prof.Dr. Ouen Pin-Ngern
Academic Year	March 17, 2002

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.

Approval Committee:

(Assoc.Prof.Dr. Ouen Pin-Ngern)
Advisor

(Prof.Dr. Srisakdi Charmonman)
Chairman

(Air Marshal Dr. Chulit Meesajjee)
Dean and Co-advisor

(Asst.Prof.Dr. Vichit Avatchanakorn)
Member

(Assoc.Prof. Somchai Thayarnyong)
MUA Representative

March 17, 2002

ABSTRACT

Nowadays, human lifestyles change and as a result, society also changes . Time is a very important factor which affects human life. With this reason, people must work against time. People must complete more jobs in shorter time with higher efficiency. Humans being try to invent something to make them more comfortable. The result of this invention is computer and computer technology.

In today on-site service business, in order to provide efficient service to customers, not only expert engineers are required, a well-organized logistics system, a controller of request and return spare parts as well as stock management, are required as well. An existing logistics system may use a computer as a file server to keep data, but the same data are required by many divisions, therefore, the data must be stored in many computers. Those data are frequently updated, deleted, or inserted. If each division individually modifies the data, the data may be inconsist. So it requires many administrative staffs to maintain the system, and they have to face the general problems of the manual system which is error-prone and has a high maintenance cost. Almost all on-site services need spare parts, requested from the logistics system. The engineers must fill in many forms in order to request spare parts. These problems make on-site service inefficient.

In an attempt to provide efficient on-site service, good logistics system is required. It means database management system together with easy user interfaces should be applied to the logistics system. to reduce the number of administrative staffs, to solve the problem of manual system and to decrease the high maintenance cost.

ACKNOWLEDGEMENTS

Several people have made contributions to this project. The writer would like to acknowledge their efforts and thank them for their contributions.

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I. INTRODUCTION

1.1 Background of the Project

ISET Engineering Co., Ltd. is a system integrator company for computer and communication project. Third Party Maintenance (TPM) is one of the major strategic business areas that ISET Engineering will focus and pay their utmost attention to be qualified as a Service Partner to the International Service Provider. ISET Engineering is now being appointed as a Service Partner to Getronics Solutions(s) PTF Ltd., A European Company which is very active in providing services for computer, networking and systems solution. The mission is to provide TPM to Dell in Thailand for Server, Desktop and Notebook on various service contract types such as Next Business Day, 4 hours response time, 2 hours response time and even 24 hours in 7 workdays a week. Services will be operated mainly in Bangkok as well as in another 3 service centers namely:- Songkla, Chiengmai and Rayong, whereby the service center has been setting up with two assigned engineers on duty at site. Being open, flexible with firm commitment coupled with resources and capabilities, ISET Engineering will be a trustworthy and dependable name for a promising information technology service provider.

The spare part inventory management is the heart of the company which is interrelated to other departments such as service and purchase department. All processes are currently manual and on the spreadsheet basis. Each department owns and develops their data on a microsoft excel format based on the same standard spare part number. The alternative spare parts are also checked and used to replace the out of inventory's spare part, which may be more than one alternative part of each spare part. The process of finding the alternative spare part takes time by looking from the

spreadsheet. Engineers must fill up the spare part request forms of every single part and the visited report for each service order manually before leaving an office. They may need to fill up five spare part request forms to service only one customer. The average of customer service a day is seventy. This implied that at least seventy spare part request forms and seventy visited reports must be filled each day.

Currently, ISET Engineering has realized that they must enhance the performance of their process by focusing on data centralizing, cost reducing, and paperwork, because other companies has jumped into this business. Data centralizing will be developing to be used by all departments to reduce data redundancy, and increase the information accuracy. The spare part inventory database will be stored in the secured area and will also perform daily backup. The alternative spare part based on daily update basis will also be included in the database. It will be easier than before to find the alternative spare part because the new database system can provide the immediately information. The spare part request form and the visited report will be automatically printed out and ready for engineers to take the spare parts, which saves the time. This will increase the average of customer service a day. Therefore, an existing system should be analysis and design to improve system processes and the database system will be designed and developed to enhance the performance of process in order to be competitive in today's market.

1.2 Objectives of the Project

Nowadays, ISET Engineering is competing with other competitors in the same market share. They must enhance the performance of their business process to retain the competition. The following objectives below will make the company competitive.

(a) To reduce data redundancy by developing a good database system that supports well for both current and future changes as well as avoids the possible problems.

(b) To reduce the processing time and paper cost by increasing the efficiency and effectiveness of the workflow, shortening the work process , and letting computer do all routine jobs.

(c) To improve the process of finding the alternative spare part. This means that the information of possible and available alternative spare part is integrated. All information is kept updated since alternative spare part is always kept changing. Therefore, once the service order is received and original spare part is not available, the call planner can detect right a way of which alternative to use.

(d) To reduce time that engineers wasted on writing spare part request forms and visiting report before going onsite services.

(e) To increase the average number of customer services per day while maintaining high quality and appreciated services.

We attempt to design the data file system that is very useful for practice in this business. The design that we create can be improved easily. However, the basic design of the system is very significant to lead to development later.

1.3 Scope of the Project

The spare part inventory management is the heart of the company, which is interrelated to other departments such as service, call planner, store, and order department. All processes are currently manual and on the spreadsheet basis. Each department owns and develops their data on a microsoft excel format based on the same

standard spare part number. The alternative spare parts are also checked and used to replace the out of inventory's spare part, which may be more than one alternative part of each spare part. The process of finding the alternative spare part takes time looking from the spreadsheet. Engineers must fill up the spare part request forms of every single part and the visited report for each service order manually before leaving an office. They may need to fill up five spare part request forms to service only one customer. The average of customer service a day is seventy. This implied that at least seventy spare part request forms and seventy visited reports must be filled each day. The context diagram of the logistic control system is depicted in Figure 1.1.

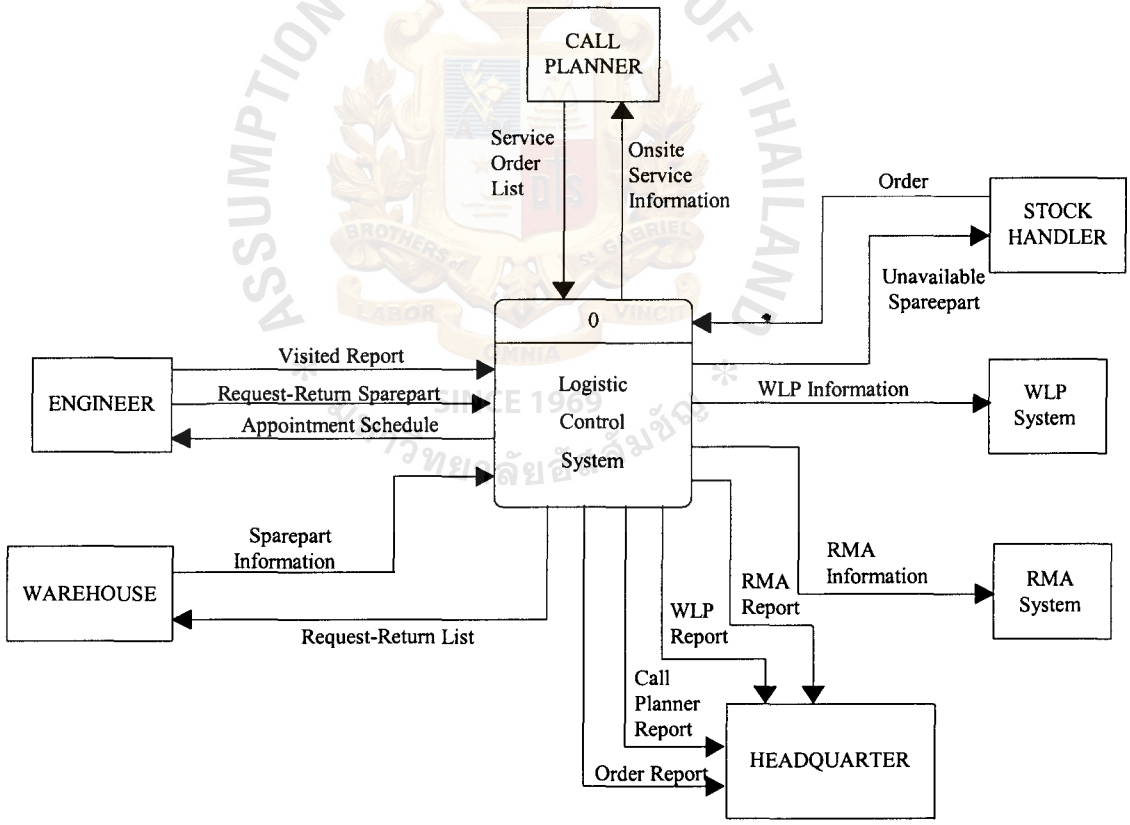

Figure 1.1. The Context Diagram of the Logistic Control System.

1.4 Deliverables

The designed system mostly reduces tedious work of engineers before going on site service and makes the administrator easily manage and retrieve information from a minimum redundancy database. The conflict of information should be eliminated so that time that wasted no debating among storekeepers, stock handlers, and managers is eliminated.

For any system to be effective, the following questions should both be answered in the affirmative: (1) Are the proper data available with which to make good decision? (2) Are good decisions being made? For our purposes, these two questions are asking whether there exists integrity in the data and in the procedures embodied in the system.

Data integrity can be ensured by design and operational efforts. Design effort is intended to prevent erroneous information from entering or existing in the system. Operational effort is expected to make sure that true information continues to exist in the system by detection and correction of errors. There is an analogy between design versus operational and the preventive versus corrective efforts of any quality assurance program. Occasionally, the existence of faulty data will manifest itself. Such symptoms as a negative balance where negative balances are impossible or an reasonably large or small value point to the need for some file maintenance. Similarly, unreasonable derived quantities such as order quantities or forecasts suggest that the fundamental data from which the quantities were derived are incorrect. Correction is usually straightforward. A well designed system will catch some logically detectable errors at point of input, refusing acceptance of such data into the system. "Unreasonable" values can be made logically detectable by programming in acceptable value ranges for computer comparison. Other vulnerable data generation points are at receiving and issuing. Vigilance is required to ensure that stock received is accounted for, especially

since vendor packing lists are not divinely inspired. Issuing frequently involves packing material from a large quantity. Even if all transactions are correctly recorded, errors will occur in proportion to the delay in time between transaction occurrence and recording. The trend toward interactive, immediate-response (terminal-based) systems is no doubt due to in part to the resulting reduction of stale information in the system.

Procedural integrity is ensured both by design (prevention) and by operation (correction). In this case, procedural design is intended to minimize the occasion of error, while corrective measures are supposed to detect the control procedures that are generating error. The most important idea to keep in mind in designing integrity assurance measures is that procedural integrity is primarily a people problem. It is the human being on whom integrity depends. Thus, the design which ensures procedural integrity is the design which minimizes opportunity for error or fraud. The operational assurance of integrity takes the form of human performance appraisal.

It turns out that if a system is designed with procedural integrity in mind, then performance appraisal is also enhanced. Such a system will have built-in checks and balances which in the short run result in rapid correction of mistakes. Then, in the long run, the record of mistake corrections provides the basis for performance appraisal.

1.5 Project Plan

A project plan of the Logistic Control System is given in Figure 1.2.

No.	Task Name
	I. Analysis of the Existing System
1	Define the Objective and Scope
2	Study the Existing System
3	Identify the Existing Problems
4	Study the Existing Computer System
5	Develop Context Diagram
6	Develop Data Flow Diagram
7	Cost and Benefit Analysis
	II. Analysis and Design of the Proposed System
8	Web Interface Design
9	Report Design
10	Database Design
11	Network Design
12	Program Design
	III. Implementation of the Proposed System
13	Coding
14	Testing
15	Hardware Installation
16	Software Installation
17	Conversion

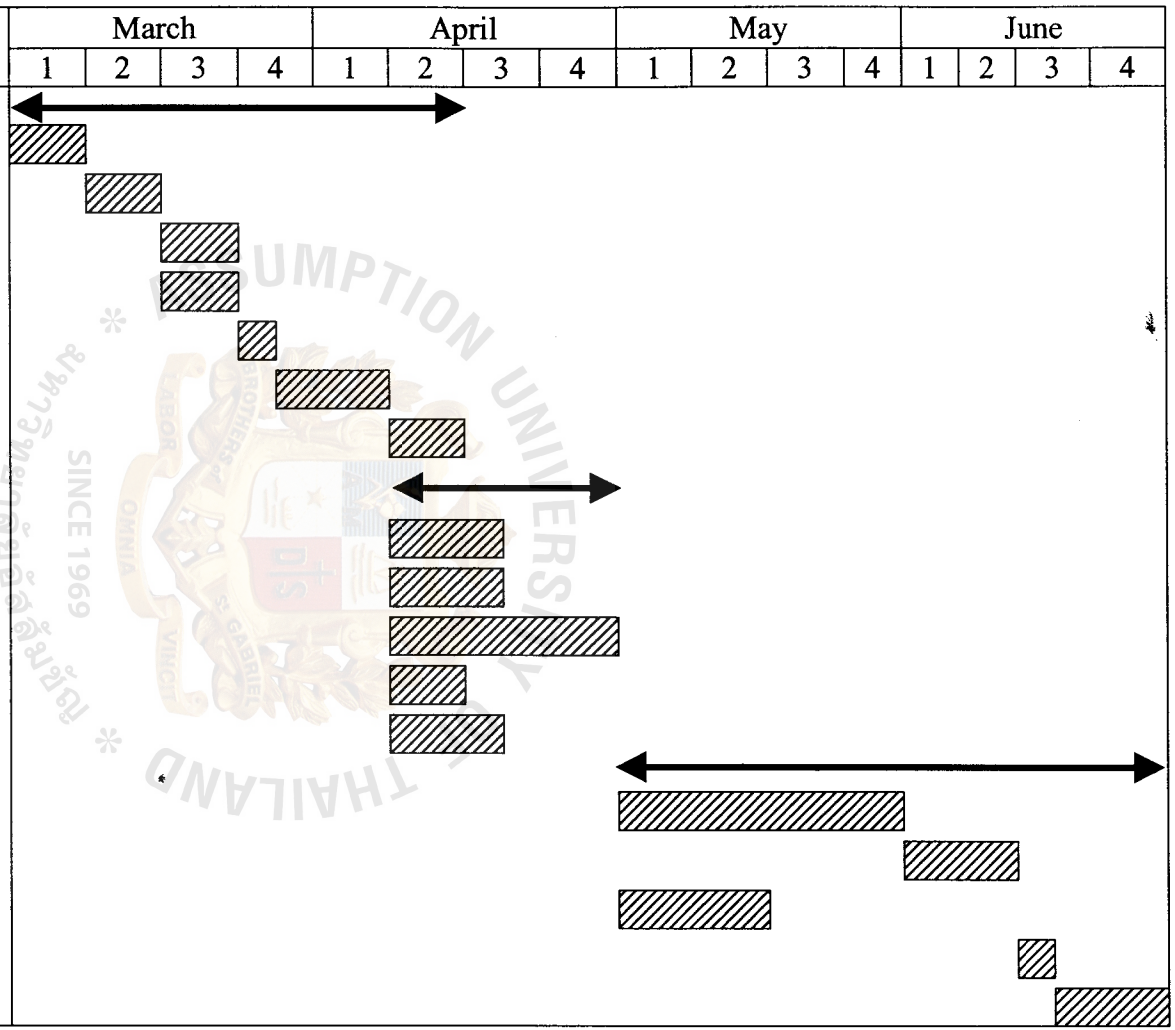

Figure 1.2. Project Plan of Logistic Control System.

II. THE EXISTING SYSTEM

2.1 Background of the Organization

ISET ENGINEERING CO., LTD. is a System Integrator company for computer and communication project. The company was founded in 1988 with a fully paid registered capital of 6 million baht.

As a system integrator, the Company has set its objective to provide with the so-called "total system solution" in a variety of information system projects mainly for its clients in Financial and Banking Sector of both Private and Governmental Institutions. On other front, the Company will also handle PC business with GroupWare solutions including after sales services.

Originally, ISET Engineering was formed in 1988 by a group of veterans who gained practical and commercial experience, know-how over a span of ten more years. They managed sales marketing of reputable turnkey projects mostly including service contracts for nationwide installations. The ten clients included the Bangkok Bank, Krungthai Bank, Government Housing Bank, and Government Savings Bank, the projects are ATM Networks, Retail Banking, and Systems some of which are X.25 networks.

Strategically, the company realized that the life cycle of a modern computer and information system tends to be shorter due to the advancement of new knowledge and technology. To a certain extent, no single brand products can completely fulfill the need and requirements of the customers no matter how small or large the project is. Therefore, to be able to offer first class services with proper price and performance to its clients, a combined strength in terms of peopleware, business and technical capabilities,

and finance will be required. And that will certainly be of benefit which provides assurance to the clients.

(1) Productswise

The company will take the platform from DELL, COMPAQ, IBM, TANDEM computer systems, proven S/W packages i.e. BASE 24 together with local resources and facilities from the alliance for customized UNIX-base S/W development. Arrangement and coordination with overseas suppliers and resources on a specific subject as the case called can also be provided.

(2) Softwarewise

The company can provide support facilities on readymade package such as :- Microsoft windows, windows NT, NetWare, Lotus Notes, CC mail. Certified Engineer who received official certificates from the software owners will handle those support functions.

(3) Data Communication

The other areas which ISET Engineering is very active in are consultation, installation, cabling and maintenance for Local Area Network (LAN), Wide Area Network (WAN), X.25, Frame Relay (FRAD) and Asynchronous Transfer Mode (ATM) switch. Mostly we use the product from 3COM, CISCO, AMP, CS Datacom and MOTOROLA.

(4) Moreover

ISET Engineering is also active in site preparation, computer room renovation including Uninterruptible Power Supply (UPS) supply and installation in some critical areas where needed. ISET Engineering is also

awarded to handle Maintenance Contracts for VISA International (Asia-Pacific) Ltd. and CS Datacom (Thailand) Ltd.

(5) Third Party Maintenance (TPM)

TPM is also another strategic business area where ISET Engineering will focus and pay their utmost attention to be qualified as a Service Partner to the International Service Provider. ISET Engineering is now being appointed as a Service Partner to Getronics Solutions(s) PTF Ltd., A European Company which is very active in providing services for computer, networking and systems solution. The mission is to provide TPM to Dell in Thailand for Server, Desktop and Notebook on various service contract types such as Next Business Day, 4 hours response time, 2 hours response time and even 24 hours in 7 workdays a week. Services will be operated mainly in Bangkok as well as in another 3 services centers namely :- Songkla, Chiengmai and Rayong , whereby the service center has been setting up with two assigned engineers on duty at site.

Being open, flexible with firm commitment coupled with resources and capabilities, ISET Engineering will be a trustworthy and dependable name for a promising information technology service provider. An organization chart of ISET Engineering Co., Ltd. is shown in Figure 2.1.

2.2 Current Problems and Areas for Improvement

After service orders were received, original spare part and/or alternative spare part quantity of each service order are checked and recorded. If all original spare parts of a service order are available, then a call planner will make an appointment with a customer for onsite service. In case that one or more original spare parts are not available, a spare part checker will search for alternative spare parts. If the alternative

spare part numbers are existed in a spare part checker's record, then the spare part checker can immediately report back to the call planner. Else the spare part checker must search for alternative spare parts by contacting a spare part controller at headquarters. This process takes much time in checking alternative spare parts. Every time the storekeeper will reserve either original or alternative or both spare parts once the needed spare part is available, then followed by the call planner to make an appointment with customers for onsite services.

Before engineers go onsite services, they have to spend much time filling in two copies of visited report. These reports consist of customer details, address, machine details, required spare parts, and computer's problems which are almost the same as the service order form that is sent from a technical supporter at the headquarters. Moreover, each engineer is required to make four copies of spare part request form per spare part in order to retrieve the spare part from the storekeeper. The reasons why different spare part should be written on a separate sheet are when any spare part is returned by the engineer, the document can be returned to its source or storekeeper without difficulties in rearranging or making a new report. These four copies of documents are delivered to four different people for record keeping. The first copy is delivered to a storekeeper who manages the stock and maintains the minimum number of each spare part for safety stock. The second copy is transferred to the person who orders the original and alternative spare parts, which will keep track of dynamic stock quantity to be in the safe level as well as plans for order lead-time. The third copy is submitted to WLP reporter who directly interacts and deals with headquarters regarding the information of spare parts that come into and out of a stock. And the last copy is passed to the logistic manager as an evidence when problems occur and for monitoring the overall logistic system.

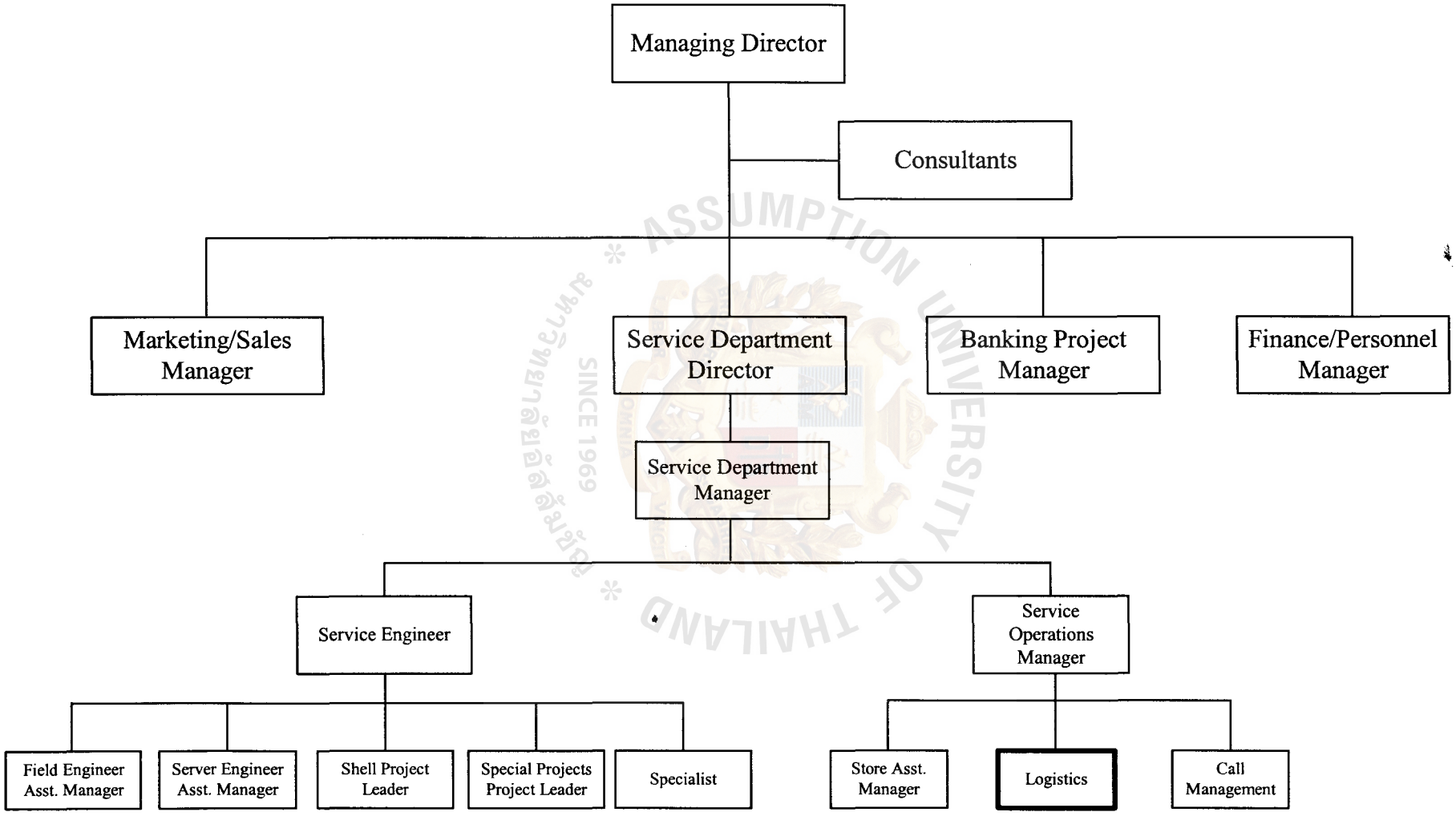

Figure 2.1. Organization Chart of ISET Engineering Co., Ltd.

Each of these people keep his own date that are completely the same information but with different report format. And each person is responsible for updating his or her own record, therefore, there is the discrepancy on the document issued. This multiple updated problem occurs because many transactions happen each day so all of the four data records need to update very frequently and simultaneously. Multiple data record keeping of the company leads to the data inconsistency, which causes the serious problem to the organization. We can conclude and summarize the problems as below:

(1) Redundancy reduces the effectiveness and efficiency of the workflow since all the reports and documents can be issued from one person instead of different people with the help of one good database system.

(2) The second point is the reduction of worker performance due to miscommunication and time wasted on debating and correcting the documents. All documents are issued on the manual basis, which is very inefficient, time consuming, and a waste of office supplies. For example an engineer must fill in many forms before he goes out for onsite service.

(3) The database of original and alternative spare parts are developed separately meaning that they are independent of each other. Therefore, the same information is recorded for more than once. Since their database can not be shared and exchanged, the complexity on the working process occurs.

(4) The complexity and redundancy of workflow causing the service delivered to customer are delay due to the problem of the organization internal system. In the end, the trustworthiness and satisfaction in the service is reduced in the customer point of view.

The summary of problems, opportunities, and directives in terms of urgency, visibility, benefits, priority, and possible solutions is demonstrated in Figure 2.2.

In order to understand the underlying causes and potential side effects of all perceived problems and opportunities, the cause-effect analysis is described in Figure 2.3.

PROBLEM STATEMENT

PROJECT :	Logistics Control System	**PROJECT MANAGER :**	Mr. Chatchai Tantiwatchayanon
CREATED BY :	Mr. Chatchai Tantiwatchayanon	**LAST UPDATED BY :**	Mr. Chatchai Tantiwatchayanon
DATE CREATED	June 3, 2000	**DATE LAST UPDATED :**	June 11, 2000

	Brief Statements of Problem, Opportunity, or Directive	Urgency	Visibility	Annual Benefits	Priority or Rank	Proposed Solution
1.	Response time of finding alternate spare part has increased to an average of 5 seconds.	6 months	Low	50,000	2	New development.
2.	Engineer must fill the spare part request form (one form for one spare part, thereby resulting in less number of onsite services a day)	6 months	Medium	1.2 M	3	New development.
3.	Currently, spare part information are stored redundantly in three different files.	ASAP	High	Unknown	2	New development.
4.	There currently exists data inconsistancies in storekeeper and WLP reporter files.	3 months	Medium	Unknown	1	Quick fix : then new development.
5.	There is an opportunity to automatically generate call planner's service report engineer's visited report, and RMA report from service order.	9 months	Low	250,000	4	New development.
6	The opportunity to create the database system that shares the information of available spare parts in a main office and branch offices.	12 months	Low	Unknow	4	After new system is developed provide users with easy-to-learn program.
7	Storekeeper, stock orderor, and WLP reporter waste time for manually updating their own data file.	6 months	High	Unknown	2	After new system is developed provide users with easy-to-learn program.

Figure 2.2. Problem Statement.

PROBLEMS, OPPORTUNITIES, OBJECTIVES, AND CONSTRAINTS MATRIX

Project :	Logistics Control System	**Project Manager :**	Mr. Chatchai Tantiwatchayanon
Created by :	Mr. Chatchai Tantiwatchayanon	**Last Updated by :**	Mr. Chatchai Tantiwatchayanon
Date Created :	June 3, 2000	**Date Last Updated :**	June 11, 2000

CAUSE-AND- EFFECT ANALYSIS		**SYSTEM IMPROVEMENT OBJECTIVES**	
Problem or Opportunity	**Causes and Effects**	**System Objective**	**System Constraint**
1. Response time of alternative parts is unacceptable.	1. Do not have a system to keep record of alternative spare part information. 2. Communication of alternative spare parts is inefficient. 3. Requirement of spare parts are too difficult to identify.	1. Decrease the time requirement to process alternative part by 30% 2. Implement new system to keep record of all alternative parts. 3. Communicate alternative part information to all concerns. 4. Eliminate alternative parts for as much as 70%	1. New system must be compatible with the existing system. 2. System budget must not be over 100,000 Baht 3. Customer requirement always specify spare part so we have to have many alternative parts. 4. Spare part information always change because of rapid change of technology

Figure 2.3. Problems, Opportunities, Objectives, and Constraints Matrix.

PROBLEMS, OPPORTUNITIES, OBJECTIVES, AND CONSTRAINTS MATRIX

Project :	Logistics Control System	**Project Manager :**	Mr. Chatchai Tantiwatchayanon
Created by :	Mr. Chatchai Tantiwatchayanon	**Last Updated by :**	Mr. Chatchai Tantiwatchayanon
Date Created :	June 3, 2000	**Date Last Updated :**	June 11, 2000

CAUSE-AND- EFFECT ANALYSIS		**SYSTEM IMPROVEMENT OBJECTIVES**	
Problem or Opportunity	**Causes and Effects**	**System Objective**	**System Constraint**
2. Throughput of onsite services per day is unacceptible	1. Engineers must fill the sparepart request forms (one form for one sparepart, thereby resulting in losing at least 1 hour before on site services 2. We have only one staff to look after the warehouse so it takes long for each engineer in waiting for onsite. 3. There are 4 copies of request form that will be sent out to 4 departments, if there is a mistake over the request form, we must follow up the form from 4 departments.	1. Reduce 80% of manual system in logistic control system by computerize system	1. System budget must not be over 100,000 Baht 2. The way to return bad parts restricted by the headquarter is manual 3. New computerized system must be compatible with the existing system

Figure 2.4. Problems, Opportunities, Objectives, and Constraints Matrix (Continued).

PROBLEMS, OPPORTUNITIES, OBJECTIVES, AND CONSTRAINTS MATRIX

Project :	Logistics Control System	**Project Manager :**	Mr. Chatchai Tantiwatchayanon
Created by :	Mr. Chatchai Tantiwatchayanon	**Last Updated by :**	Mr. Chatchai Tantiwatchayanon
Date Created :	June 3, 2000	**Date Last Updated :**	June 11, 2000

CAUSE-AND- EFFECT ANALYSIS		**SYSTEM IMPROVEMENT OBJECTIVES**	
Problem or Opportunity	**Causes and Effects**	**System Objective**	**System Constraint**
3. Data redundancy is unacceptable.	1. Manually process is unreliable which causes wrong input and it wastes user's times to input data. 2. Number of spareparts has increased ,thus leads to data redundancy. 3. Each departments has their own data so updated data is hard to maintain. 4. Data are stored in many files , thereby leading to data inconsistency.	1. Reengineering the organization by computerized the existing manual system. 2. Reorganize the data into one data base 3. Reduce 65% of storing data in manual system by computerize system	1. System budget must not beover 100,000 Baht 2. Some applications are restricted by the headquarter 3. New computerized system must be compatible with the existing system

Figure 2.5. Problems, Opportunities, Objectives, and Constraints Matrix (Continued).

PROBLEMS, OPPORTUNITIES, OBJECTIVES, AND CONSTRAINTS MATRIX

Project :	Logistics Control System	**Project Manager :**	Mr. Chatchai Tantiwatchayanon
Created by :	Mr. Chatchai Tantiwatchayanon	**Last Updated by :**	Mr. Chatchai Tantiwatchayanon
Date Created :	June 3, 2000	**Date Last Updated :**	June 11, 2000

CAUSE-AND- EFFECT ANALYSIS		**SYSTEM IMPROVEMENT OBJECTIVES**	
Problem or Opportunity	**Causes and Effects**	**System Objective**	**System Constraint**
4. Data inconsistencies do not take as the willingness	1. All four copies of spare part forms kept in each department. Consuming more time to collect report and require more people to input data. 2. The differentiate of report format in each department , containing parts that do not stay the same changeable. 3. The same data are sorted with a difference. People waste time to find the correct report. 4. The problem of great complexity in workflow leading to go slow of onsite service which effects directly to the customer satisfaction.	1. Reduce data modification in manual . system by 70% 2. Use the same reporting format to keep all the records. 3. Provide the utilities software to serve the company system.	1. In term of every developing plan, new system should can be existed together. 2. Some applications are enforced by the headquarter 3. In case of network down during data transmission, it is difficult to determine that the data were updated or not. 4. The way to return bad parts restricted by the headquarter is manual

Figure 2.6. Problems, Opportunities, Objectives, and Constraints Matrix (Continued).

PROBLEMS, OPPORTUNITIES, OBJECTIVES, AND CONSTRAINTS MATRIX

Project :	Logistics Control System	**Project Manager :**	Mr. Chatchai Tantiwatchayanon
Created by :	Mr. Chatchai Tantiwatchayanon	**Last Updated by :**	Mr. Chatchai Tantiwatchayanon
Date Created :	June 3, 2000	**Date Last Updated :**	June 11, 2000

CAUSE-AND- EFFECT ANALYSIS		SYSTEM IMPROVEMENT OBJECTIVES	
Problem or Opportunity	**Causes and Effects**	**System Objective**	**System Constraint**
5.The opportunity to automatically generate Call Planner's service report, Engineer's visited report and RMA report form by creating the effectively database system.	1.The manually Call planner's service report will be effected by the increasing rate of service orders from the customers. 2.Filling 4 copies of spare parts request form for each spare part will waste the time and decrease the productivity and effectiveness of engineer services. 3.Separately submiting forms and keep in record of the same information in differents formats. Finally, mistake in updating the data and error on exchanging the information between each deparments and branch offices. 4.Engineer's visited reports are manually created. The redundancy and inaccuracy will definitely occur. 5.The frequency of submitting the RMA report form is very high and also created manually. Not only does it take long time to fill up the form but also the accuracy in checking the record will be more difficult.	1. Saving 70% of time in filling forms by creating the automaically form based on computer system. 2.Increasing 50 % of productivity and effectiveness rate in providing services to customers. 3.Increasing the accuracy of exchanging information for all departments by 90% 4. Decrease 80% of filling forms in manual system by computerize system	1.System budget must not be over 100,000 Baht. 2.All branch offices have to be acknowledged of the new system. 3.Report formats are restricted by the headquarter 4.System and program used in WLP are specified by the headquarter 5.The way to return bad parts is restricted by the headquarter

Figure 2.7. Problems, Opportunities, Objectives, and Constraints Matrix (Continued).

PROBLEMS, OPPORTUNITIES, OBJECTIVES, AND CONSTRAINTS MATRIX

Project :	Logistics Control System	**Project Manager :**	Mr. Chatchai Tantiwatchayanon
Created by :	Mr. Chatchai Tantiwatchayanon	**Last Updated by :**	Mr. Chatchai Tantiwatchayanon
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CAUSE-AND- EFFECT ANALYSIS		**SYSTEM IMPROVEMENT OBJECTIVES**	
Problem or Opportunity	**Causes and Effects**	**System Objective**	**System Constraint**
6. The opportunity to create the database system that shares the information of available spare parts in a main office and branch office.	1.Manually checking the original spare parts or alternative spare parts available take very long time. Net result, the productivity in services and satisfaction of customer will be exactly decreasing. 2.Stock controlling are not effective, not organized and take long time to checking because the system is based on the manual system.	1.Creating the database system to have a real time checking of the available spare parts to reduc 80% of checking the spare parts requested. 2.Reducing 50% in paper tasks and keeping the paper record. 3.Increaing 50% of the productivity in on-site services. 4.Reduce 65% of storing data in manual system by computerize system.	1.The new computerized system must be compatible with the existing system. 2.The important information must be printed out for reference. 3.Some tasks restricted by headquarter are manual 4.Spare part information always changes because of rapid change of technology

Figure 2.8. Problems, Opportunities, Objectives, and Constraints Matrix (Continued).

PROBLEMS, OPPORTUNITIES, OBJECTIVES, AND CONSTRAINTS MATRIX

Project :	Logistics Control System	**Project Manager :**	Mr. Chatchai Tantiwatchayanon
Created by :	Mr. Chatchai Tantiwatchayanon	**Last Updated by :**	Mr. Chatchai Tantiwatchayanon
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CAUSE-AND- EFFECT ANALYSIS		**SYSTEM IMPROVEMENT OBJECTIVES**	
Problem or Opportunity	**Causes and Effects**	**System Objective**	**System Constraint**
7. Waste time in updating data is unacceptable.	1. Data entry is performed and updated manually by each department. Time to process all documents in a day is high. 2. Data are captured redundantly while same data used to generate different report by each department cause the waste resources of both people and computer supplies for processing data. 3. There are multiple updating data in each department. It's risky to create discrepancy on the document issued. 4. Engineers must fill up the spare part request form of every single part manually. Storekeeper, Stock orderor and WLP reporter waste time to wait for completed request form updating into data file.	1. Decrease the time required to process data entry by 50%. 2. Decrease data redundancy occurred in each department by 70%. 3. Reduce time to quest for spare parts. by 50% 4. Decrease data inconsistency due to less individual manual input by 90%.	1. All report format forms are restricted by the headquarter 2. Any system developed must be compatible with the existing softwear and easy to send attached file of report to the headquarter

Figure 2.9. Problems, Opportunities, Objectives, and Constraints Matrix (Continued).

2.3 The existing Computer System

In order to learn enough about the current system to expand the understanding of scope and to establish a common working vocabulary for that scope as well as to verify the team's consensus understanding of the business situation, the system models must be created.

2.3.1 The Process Modeling

The process model is created to show how the data will be captured and used (data in motion) represented by using data flow diagrams. A Figure 2.9 introduces elements of Data Flow Diagram (Use Gane and Sarson Symbol).

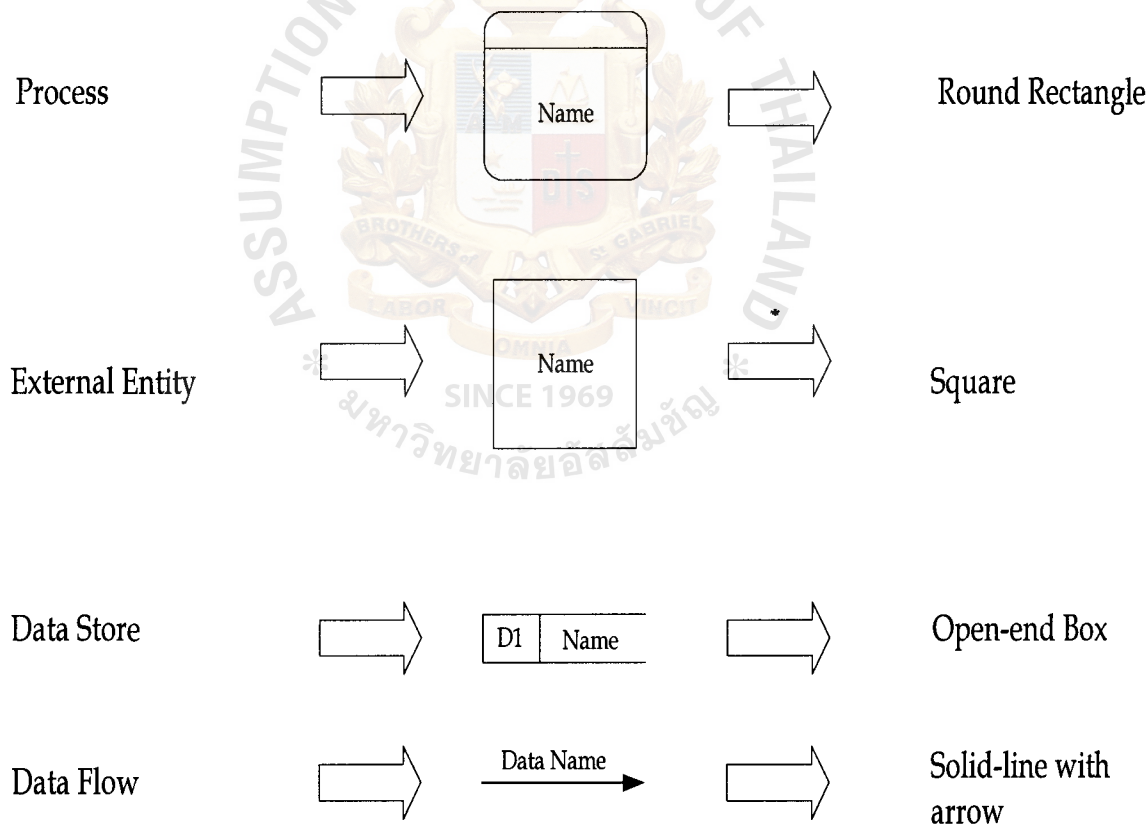

Figure 2.10. Elements of Data Flow Diagram (Use Gane and Sarson Symbol).

(1) The context diagram is constructed to establish the initial project scope. It depicts the system as a whole in correlation with its environment that are the "external entities" involved. The context diagram of the current logistic

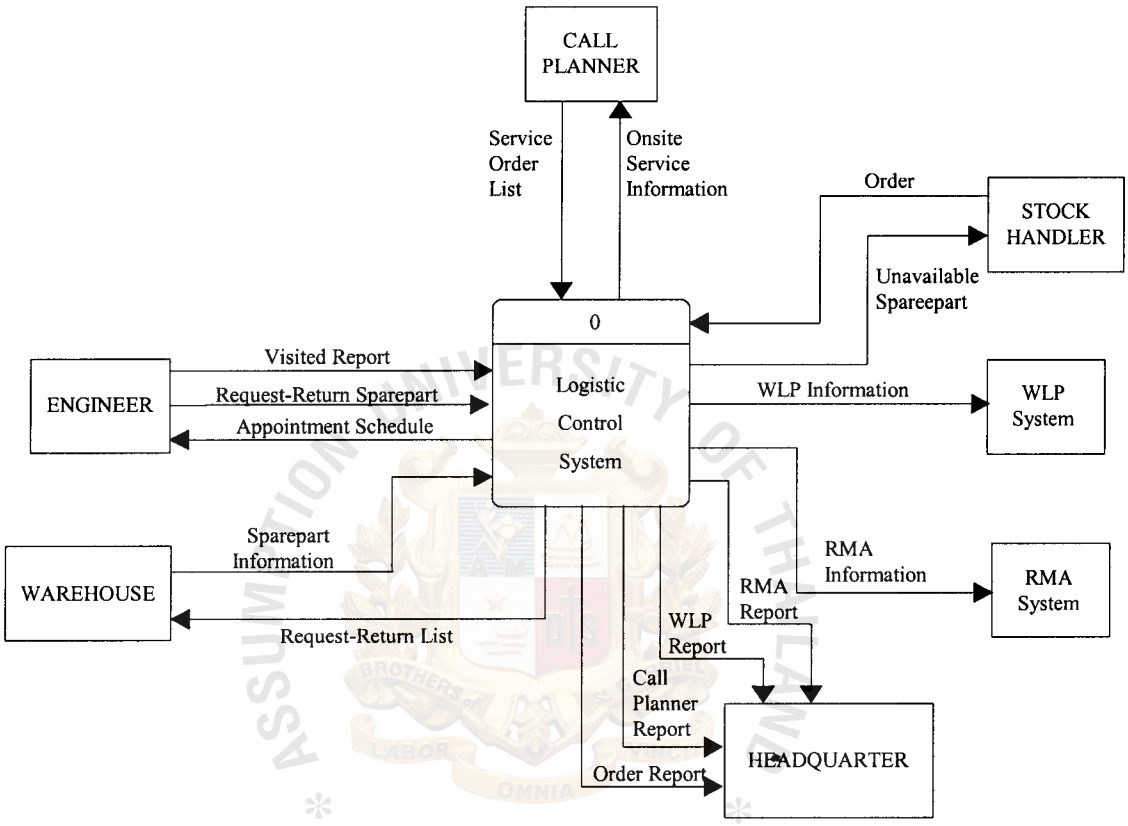

Figure 2.11. The Context Diagram of the Current Logistic Control System.

control system is shown in Figure 2.11 which is the same as Figure 1.1. It composes of seven major external entities. First, an engineer receives appointed services and fills in request forms in order to go onsite service after that he sends visited report to close the services. Second, after a call planner receives service orders via an e-mail, she makes an appointment with customers. The call planner waits for visited reports from engineers in order to generate an onsite service report. Third, in case of unavailable spare

parts, a stock handler generates an order for those spare parts. Forth a WLP system collects all receive and return spare part information to create a WLP report. Fifth a RMA system collects all receive and returns spare part information to create a RMA report. Sixth the headquarter receives all reports from the system. Last a warehouse stores all spare parts that are requested by engineers.

(2) The functional decomposition diagram (FDD) is constructed from the functions of the existing system and will emphasize on the decomposition of the whole system into subsystems or sub-functions till reaching primitive events only. It is obvious that the choice of the decomposition (and thus the selection of the subsystems) is up to the discretion of the analysis and is not unique for a given project. It is very usual that this FDD has to be changed after more checking and discussions. The FDD of the logistic control system is shown in Figure 2.12.

(3) The higher level data flow diagrams (DFDs), which map the subsystems, sub-functions, and primitive events are constructed following the FDD. The DFD level 1 as shown in Figure 2.13, which describes all six major subsystems in the logistic control system: spare part subsystem, order subsystem, call planner subsystem, WLP subsystem, RMA subsystem, and engineer subsystem. The DFDs level 2 describe subprocesses in each subsystem. The spare part subsystem is divided into 2 subprocesses: process spare part transaction and process generate spare part report, as shown in Figure 2.14. The order subsystem is divided into 2 subprocesses: process order transaction and process generate order report, as shown in Figure 2.15. The call planner subsystem is divided into 2 subprocesses: process call

planner transaction and process generate call planner report, as shown in Figure 2.16. The DFDs level 3 divide the subprocesses from DFDs level 2 into smaller processes. The process spare part transaction is divided into process request spare part, process return spare part, process check/reserve spare part, process add spare part, and finally process cut spare part, as shown in Figure 2.17. The process generate spare part report is divided into process generate request spare part report and process generate return spare part report, as shown in Figure 2.18. The process order transaction is divided into process order priority1, process order priority3, process receive spare part, process check minimum stock, and process specify alternate spare part as shown in Figure 2.19. The process generate call planner report is divided into process generate appointment report and process generate call planner report, as shown in Figure 2.20.

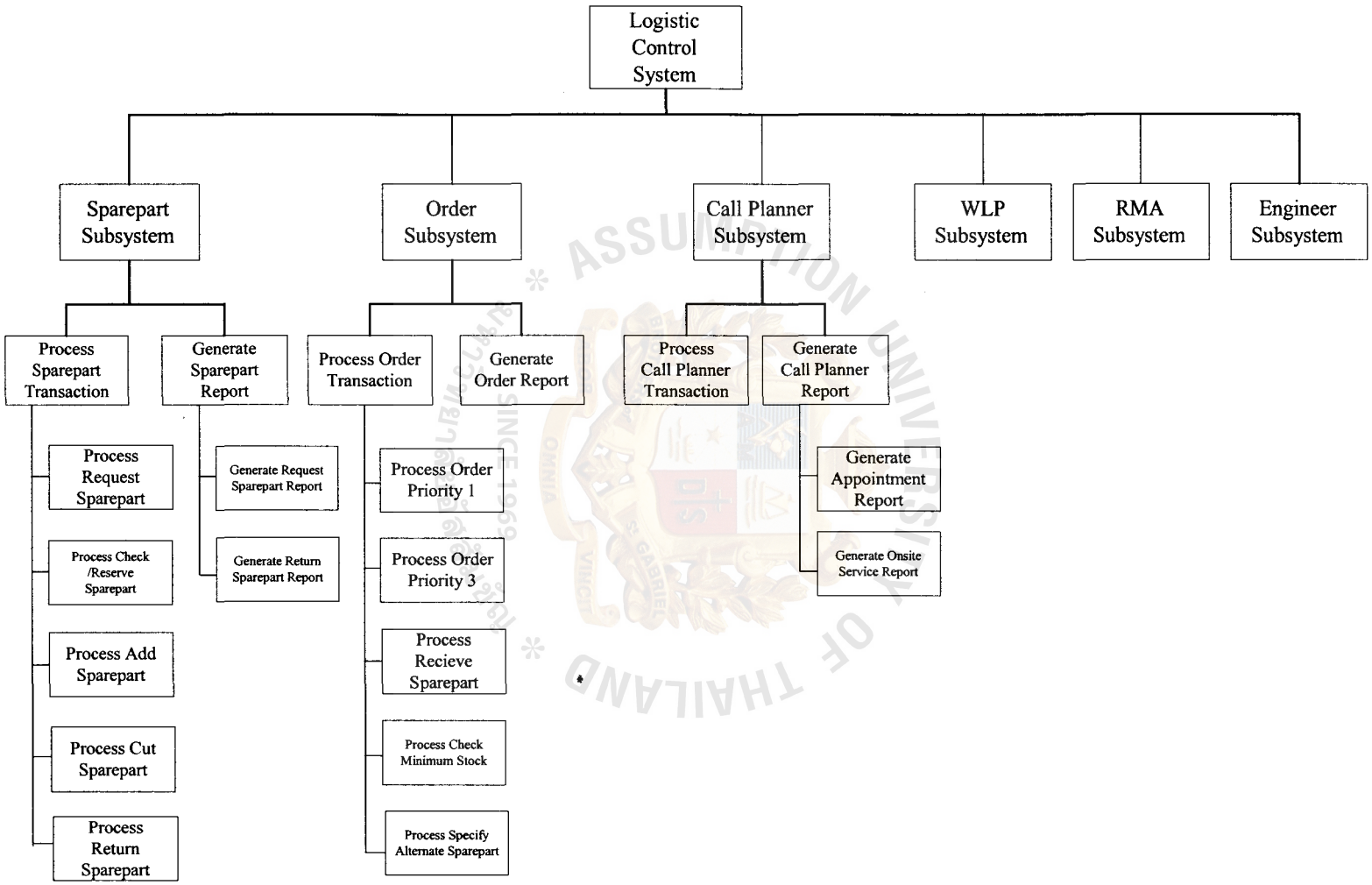

Figure 2.12. Functional Decomposition Diagram of Logistic Control System.

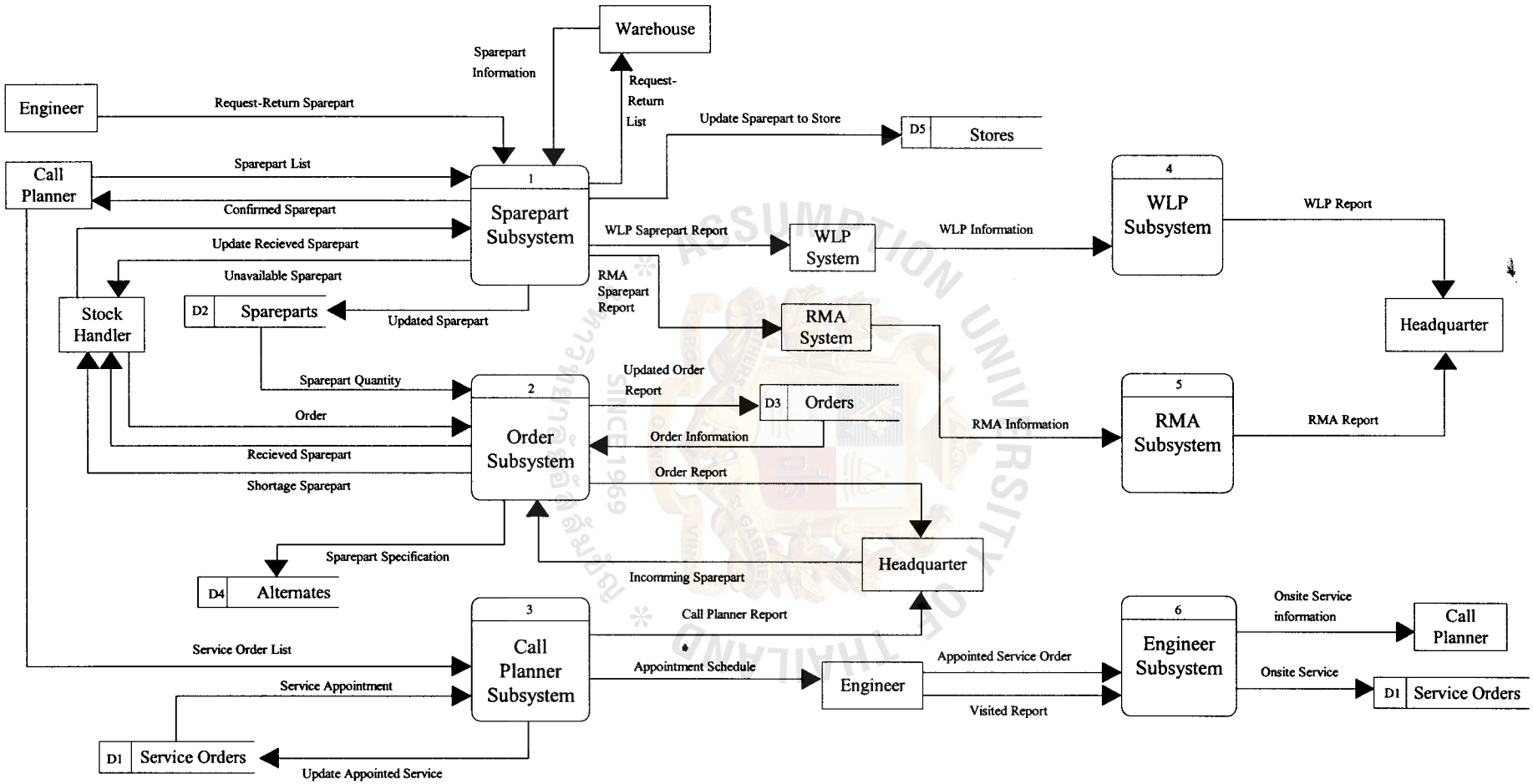

Figure 2.13. First Level DFD (Level 1) of Current LCS.

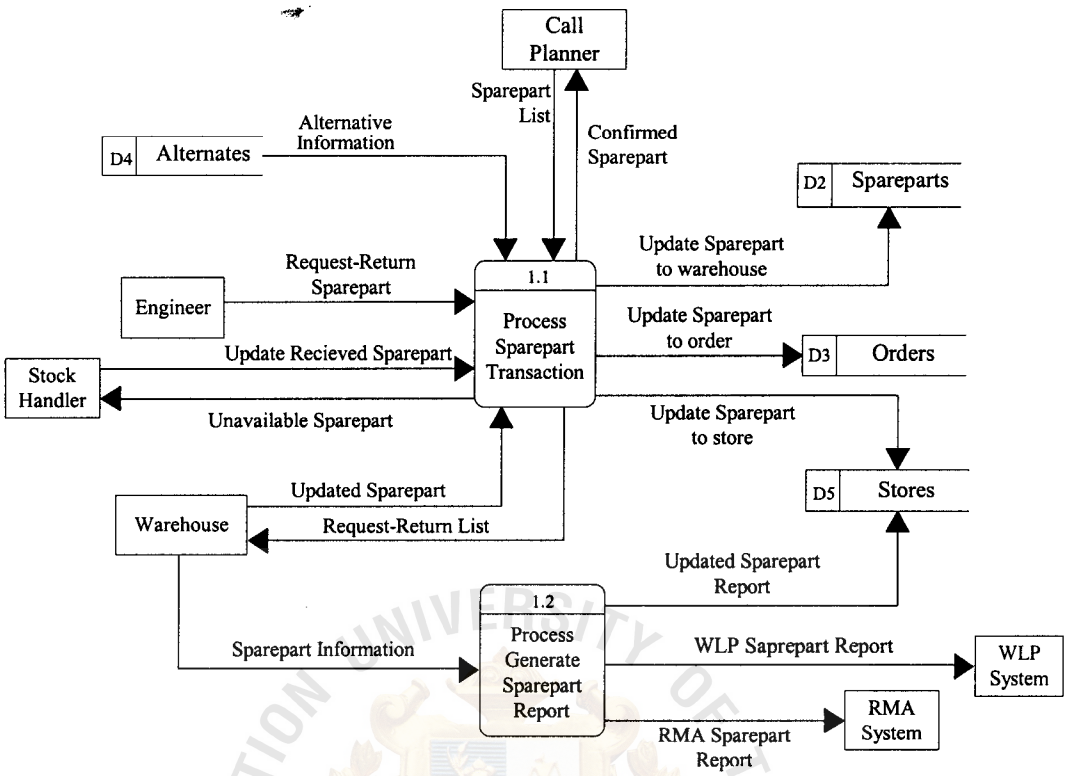

Figure 2.14. Second Level DFD of Spare Part Subsystem.

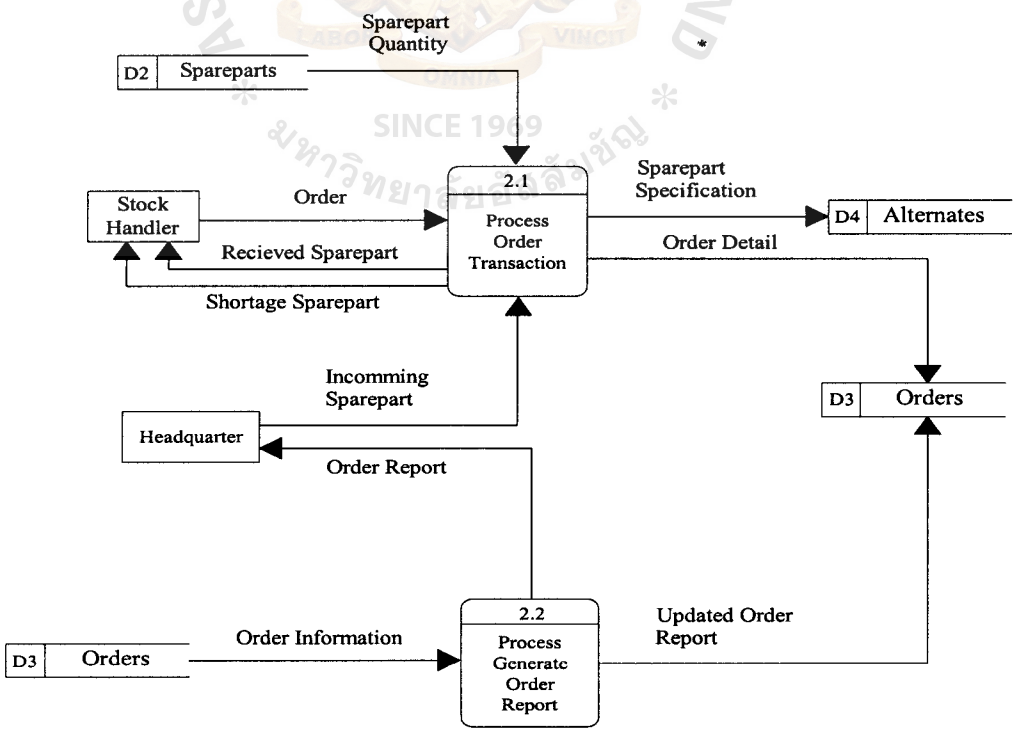

Figure 2.15. Second Level DFD of Order Subsystem.

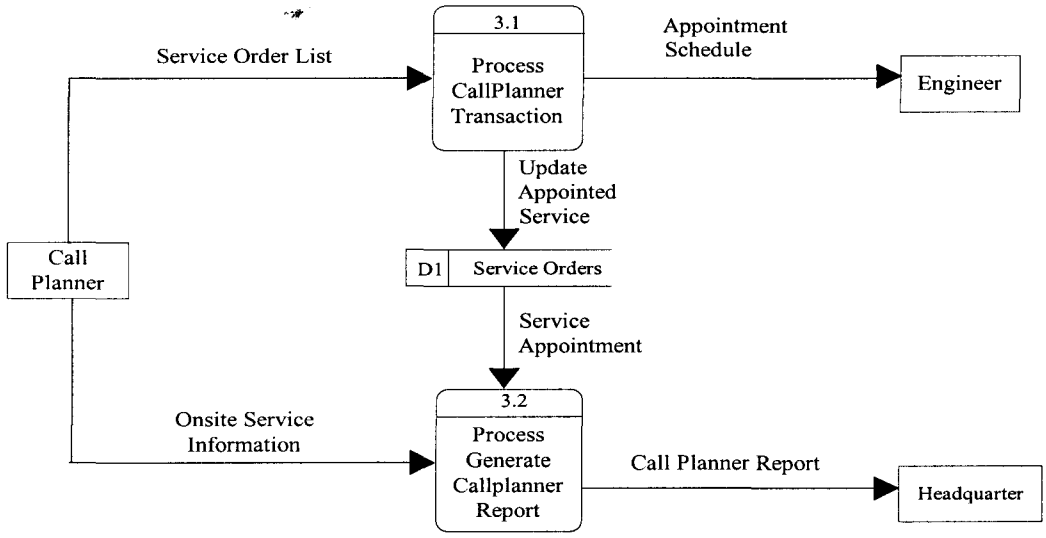

Figure 2.16. Second Level DFD of Call Planner Subsystem.

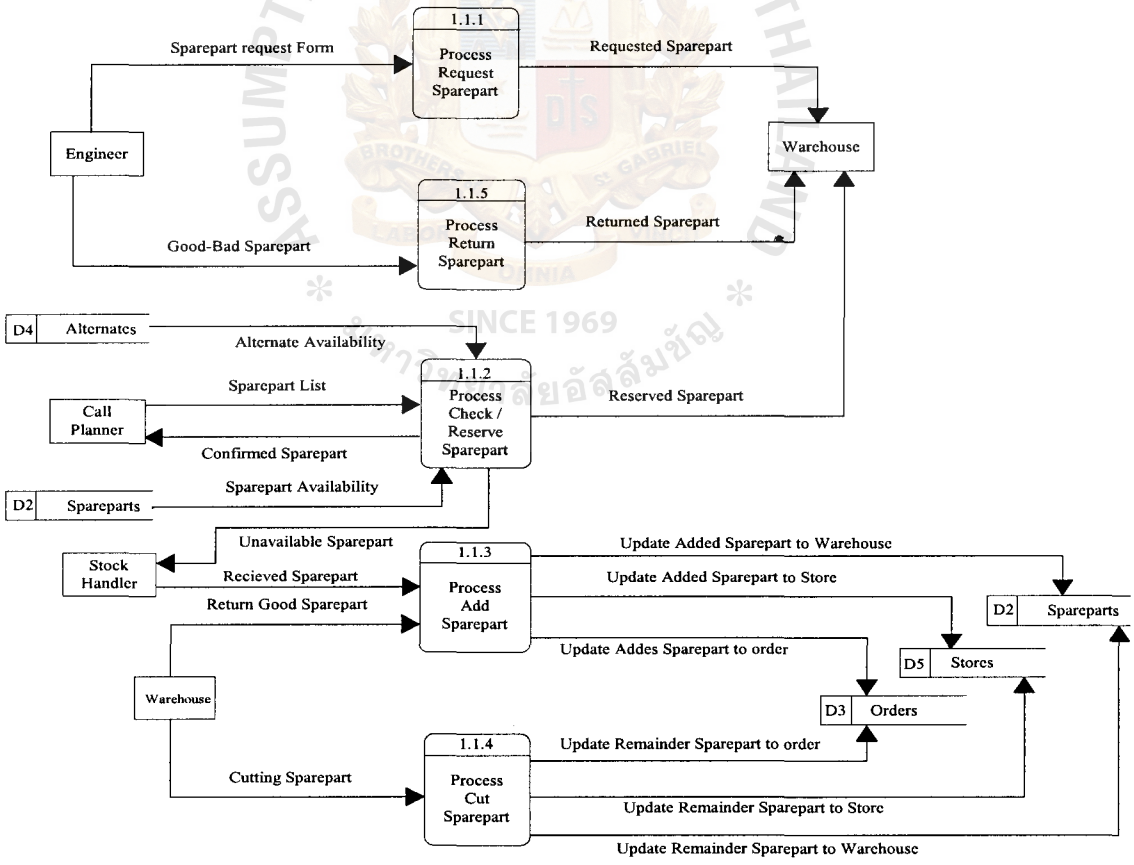

Figure 2.17. Third Level DFD of Process Spare Part Transaction.

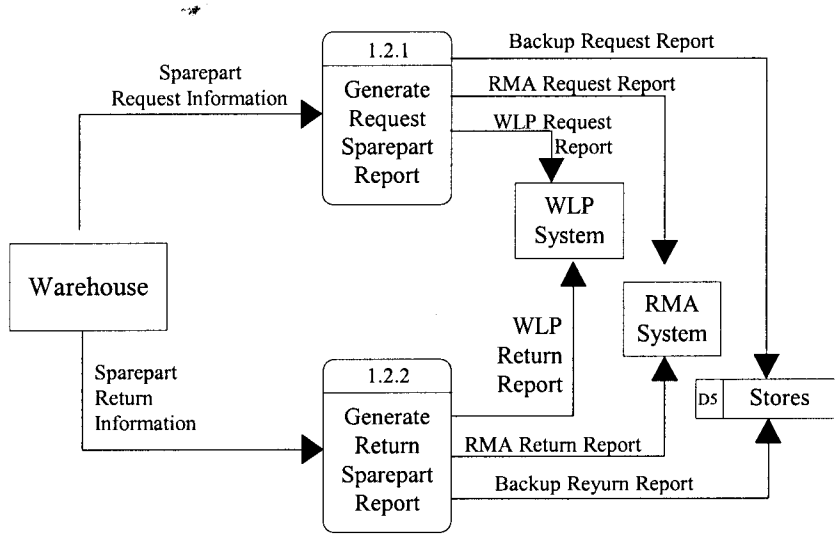

Figure 2.18. Third Level DFD of Process Generate Spare Part Report.

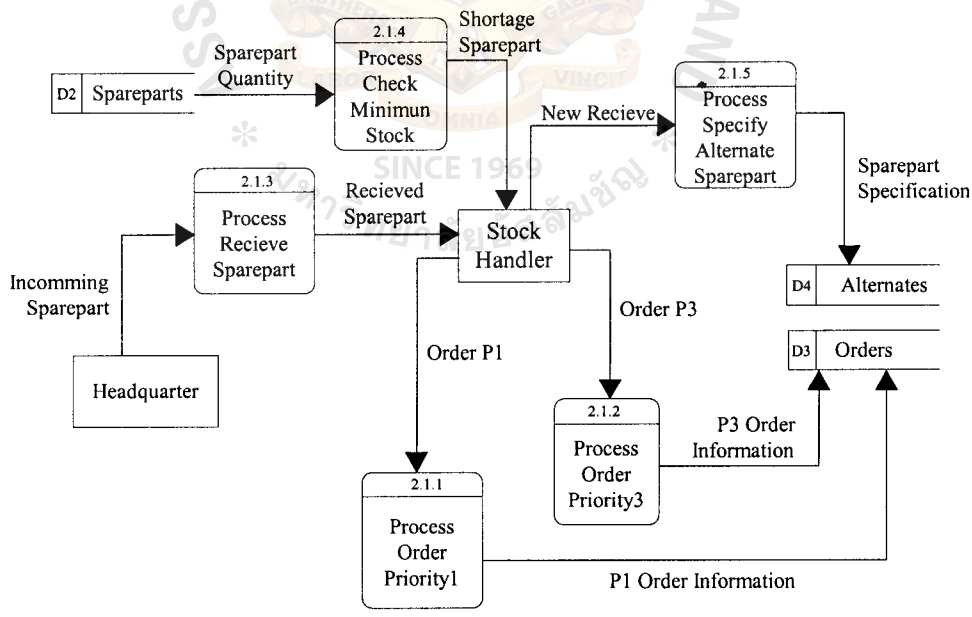

Figure 2.19. Third Level DFD of Process Order Transaction.

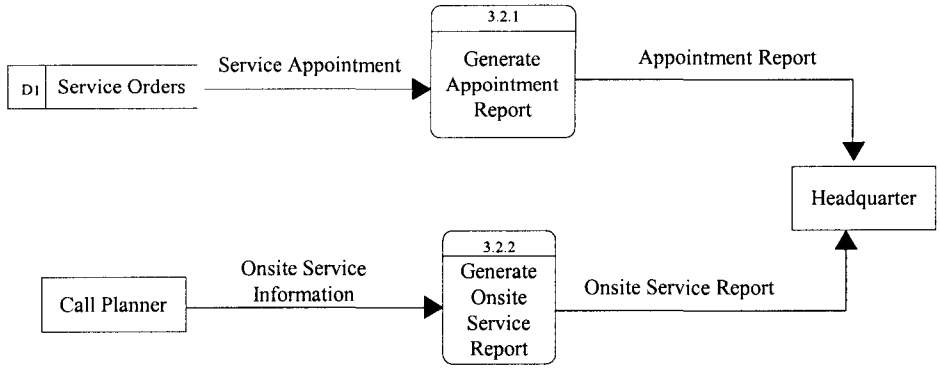

Figure 2.20. Third Level DFD of Process Generate Call Planner Report.

2.3.2 The Data Modeling

The data model concerns with data independently from how the data are captured and used. The entity relationship diagram (ERD) is used to depict data in term of the entities and relationships described by the data.

(1) The context data model includes only entities and relationships, but no attributes. The intent is to refine the understanding of scope, not get in to detail about the entities and business rules. The context data model of the logistic control system is depicted in Figure 2.20. The description of each entity is described below.

(a) SERVICEORDER: The service orders are sent to call planner to make an appointment with customers and to engineers in order to prepare themselves before onsite service.

Note: The major system improvement is to keep all service order information into a database that can be queried later.

(b) ENGINEER: An active engineer in the system whose major responsibility is onsite service.

(c) STORE: A store that keeps spare part records that are used in each service.

Note: System improvement objectives include (1) minimizing the redundancy of spare part records from multiple update, and (2) reducing inconsistency among distributed database system.

(d) ORDER: An order is generated from a stock handler in case of shortage or used spare parts.

Note: In the current system, an order is manually generated, however it can be automatically generated from the spare part and service order information.

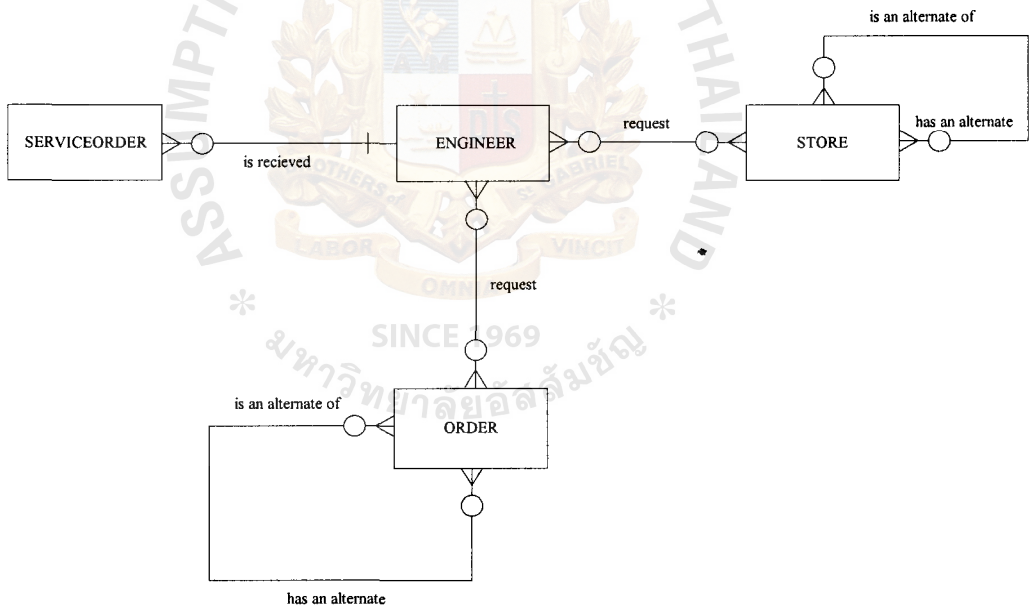

Figure 2.21. The Context ERD of the Current System.

(2) The key-based data model will eliminate nonspecific relationships, and add associative entities, and include primary and foreign keys. This model will also include precise cardinalities and any

generalization hierarchies. The key-based ERD is shown in Figure 2.21.

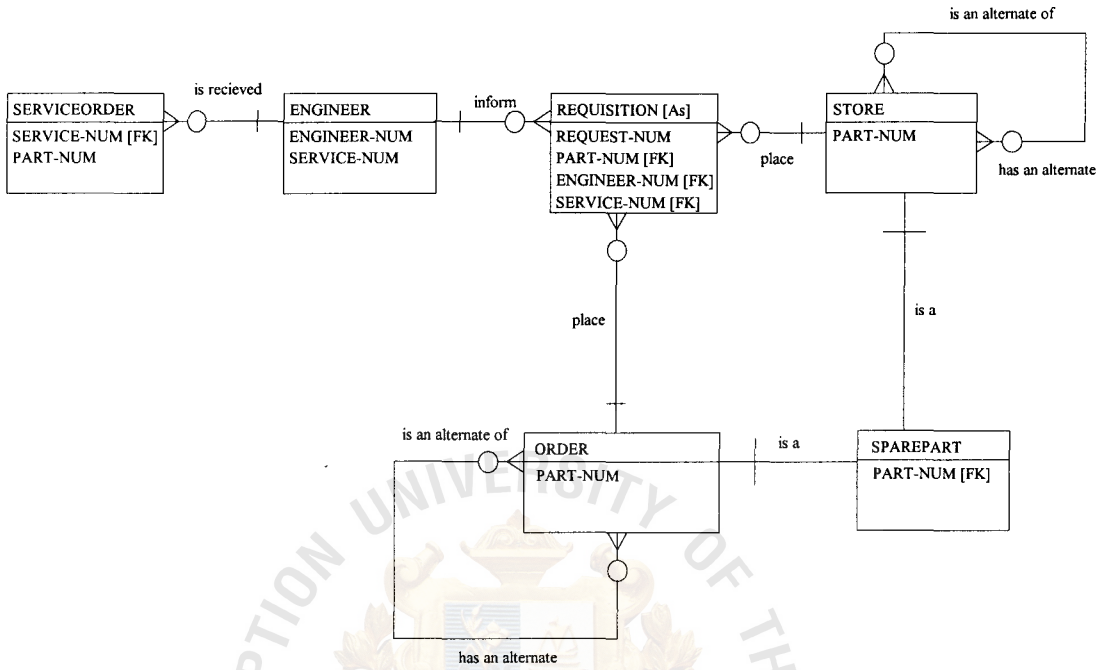

Figure 2.22. Key-based ERD of the Current System.

(3) A fully attributed data model includes all remaining descriptive attributes and subsetting criteria. The fully attributed ERD is shown in Figure 2.23.

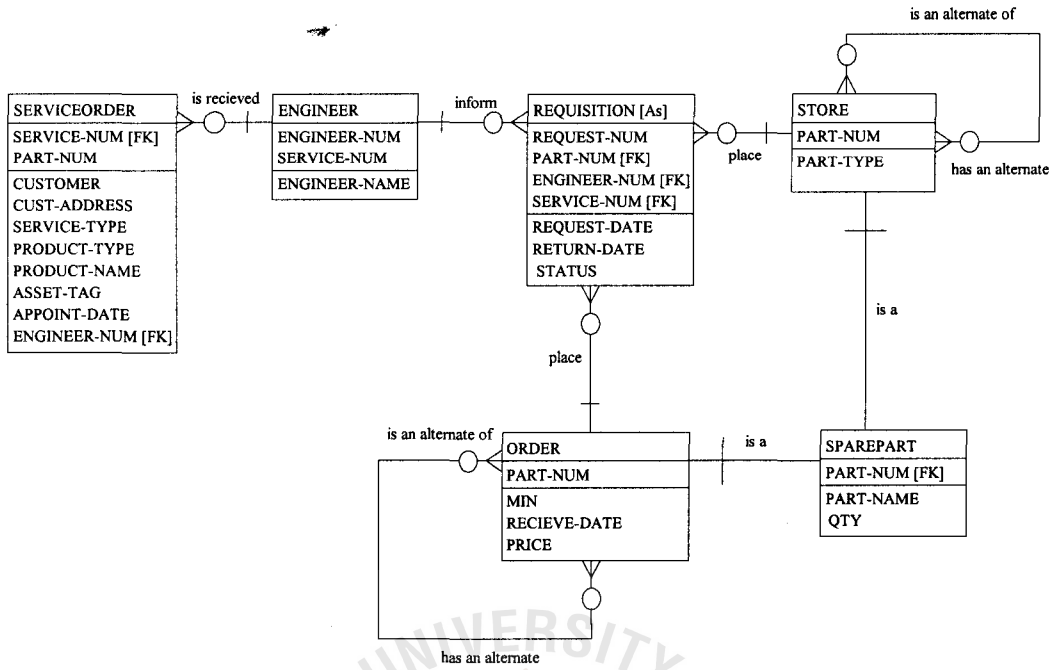

Figure 2.23. Fully Attributed ERD of the Current System.

2.3.3 The Network Modeling

A logical connectivity diagram (LCD), the logical network modeling tool depicts the shape of the system in terms of its users, processes, data, and interfaces location. Although the existing system has some branches but all of them only have an engineer for each branch and all information is transferred to the head office via telephone call, the system will be considered as a LAN configuration

III. THE PROPOSED SYSTEM

3.1 System Specification

According to the previous chapter, ISET Engineering Co., Ltd. now requires an effective Logistic Control System, which can facilitate the various processes of spare part service, and solve the problems occurring from the existing manual system and some ineffective computerized information system.

In order to achieve the target, the alternative candidate solutions of the business requirements defined during systems analysis are identified. The amount of information describing the characteristics of any one candidate solution may become overwhelming. A matrix is a useful tool for effectively capturing, organizing, and communicating the characteristics for candidate solutions. Three candidate solutions of the logistic control system are demonstrated by using a completed candidate matrix as shown in Table 3.1.

Table 3.1. Completed Candidate Matrix.

Characteristics	Candidate 1	Candidate 2	Candidate 3
Portion of system computerized Brief description of that portion of the system that would be computerized in this candidate.	LCS application would be built to fit the requirement of logistic System	Same as candidate 1.	Same as candidate 1.
Benefits Brief description of the business benefits that would be realized for this candidate.	Fully support user required business process for ISET Engineering. Plus more efficient interaction with store and call planner.	This solution is easy to implement because MS Access doesn't need high requirement.	Same as candidate 1.
Servers and Workstations A description of the servers and workstations needed to support this candidate.	Technically architecture dictates Pentium II / III, MS Windows NT Server and Pentium II / III, MS Windows 98 (clients)	Same as candidate 1.	Same as candidate 1.

Table 3.1. Completed Candidate Matrix (Continued).

Characteristics	Candidate 1	Candidate 2	Candidate 3
Software Tools Needed Software tools needed to design and build the candidate (e.g., database management system, emulators, operating systems, languages, etc). Not generally applicable if applications software packages are to be purchased.	MS Access ODBC	MS Access	Internet Explorer (DELPHI)
Application Software A description of the software to be purchased, built, accessed, or some combination of these techniques.	Custom Solution	Same as candidate 1.	Same as candidate 1.
Method of Data Processing Generally some combination of: on-line, batch, deferred batch, remote batch, and real-time.	SQL-Based Client / Server	Resource-sharing LAN	Message-Based Client/ Server
Output Devices and Implications A description of output devices that would be used, special output requirements (e.g., network, preprinted forms, etc.), and output considerations (e.g., timing constraints).	Laser and Dot Matrix Printer (Network Printer)	Same as candidate 1.	Same as candidate 1.
Input devices and Implications A description of input methods to be used, input devices (e.g., keyboard, mouse, etc), special input requirements (e.g., new or revised forms from which data would be input), and input considerations (e.g., timing of actual inputs).	Keyboard & Mouse	Keyboard & Mouse	Keyboard & Mouse
Storage Devices and Implications Brief description of what data would be stored, what data would be accessed from existing stores, what storage media would be used, how much storage capacity would be needed, and how data would be organized.	MS SQL Server DBMS with 60 GB arrayed capability	MS Access act as data management	Same as candidate 1.

After alternative candidate design solutions have been identified, each candidate must be analyzed for feasibility. It should not be limited to costs and benefits, but follow these four sets of criteria.

(1) Technical feasibility: Is the solution technically practical?

(2) Operational feasibility: Will the solution fulfill the user's requirement?

(3) Economic feasibility: Is the solution cost-effective?

(4) Schedule feasibility: Can the solution be designed and implemented within an acceptance time period?

The feasibility analysis is performed on each individual candidate regardless of the feasibility of other candidates in order to evaluate the alternative candidate solutions according to their economic, operational, technical, and schedule feasibility as shown in Table 3.2.

We selected candidate 1 as a target system. The main purpose of this target system is to fully support the user required functionality and system owner satisfaction. The best candidate will be selected base on the cost, benefits, payback period, return on investment, and net present value. The selected system should provide the benefits to the present Logistic Control System as following:

(1) The applications for the new system can be easily obtained and there are varieties of choices to select from. The applications such as Microsoft Access and Window NT will lead to lower application expense than propriety application.

(2) All the functions are displayed by GUI, which is easy to use and has a nice graphic display. The system user and system owner will be highly satisfied.

(3) No training is needed for the new system because all the information and system guide can be easily obtained or searched for. In addition, the new system can be learnt and understood by the users themselves. Thus, the suggested system will not have any additional training cost.

(4) The new DBMS is located at the server. It is capable to calculate and select the best way to draw information from database. Therefore, all data are retrieved very quickly from the database without any traffic problem.

(5) The DBMS at server supports and allows multiuser to retrieve information from database simultaneously. While the DBMS located at client do not support multi user, there will be traffic jam at one terminal. And the work of DBMS will be more sophisticated to distribute the requested information from various users.

(6) The new system is the open system in the sense that all DBMS is based on the standard SQL. Therefore, if all the applications are also written on SQL standard, then these applications can be applied to all kinds of DBMS.

Table 3.2. Completed Feasibility Matrix.

Feasibility Criteria	Weight	Candidate 1	Candidate 2	Candidate 3
Operational Feasibility Functionality. A description of to what degree the candidate would benefit the organization and how well the system would work. Political. A description of how well received this solution would be from both user management, user, and organization perspective.	30%	Fully support user required functionality. Low maintenance cost. Score : 100	Information is not timely to its subsequent use. Same as candidate 1 score : 80	Same as Candidate 1 High maintenance cost. score : 100
Technical Feasibility Technology. An assessment of the maturity, availability (or ability to acquire), and desirability of the computer technology needed to support this candidate. Expertise. An assessment of the technical expertise needed to develop, operate and maintain the candidate system.	30%	Current system are manually tracking data in Excel file and sharing via server file, so we would like to improve by using Access, ODBC base on SQL client server. This solution decreases transactions and increases security however it requires to hire or train on SQL and Ms-access. Ms-SQL expertise and any changing integrity rule of store application will be increased maintenance cost. score : 90	This solution has many traffics of data transaction and security is very low, however this solution is using MS-access which has been understood by current system so it decrease software and training cost. Changing integrity rules of store application will increase maintenance cost score : 70	Same as candidate 1, but it used Internet Explorer (Dell file) instead of MS access and ODBC The maintenance cost of integrity rule of storing application is lower than other solution. But it loads more on the database server, needs to upgrade server (Cost of server is very high, furthermore it requires to hire expertise / training SQL, Dell file, Ms-SQL server and Internet software. score : 95
Economic Feasibility Cost to develop: Payback period (discounted): Net present value: Detailed calculations:	35%	Approximately 352,000 baht Approximately 1.8 years Approximately 657,444 baht See Appendix A. score : 75	Approximately 294,000 baht Approximately 1 year Approximately 892,089 baht See Appendix A. score : 90	Approximately 362,000 baht Approximately 1.9 years Approximately 647,444 baht See Appendix A. score : 50

Table 3.2. Completed Feasibility Matrix (Continued).

Feasibility Criteria	Weight	Candidate 1	Candidate 2	Candidate 3
<u>Schedule Feasibility</u> An assessment of how long the solution will take to design and implement.	5%	4 - 6 months score : 75	2 - 3 months score : 90	9 months score : 50
Ranking	100%	87	81	79

3.2 System Design

Normally, system analysis primarily focuses on the logical, implementation-independent aspects of a system (the requirements), systems design deals with the physical or implementation-dependent aspects of a system (the system's technical specifications). The analyst must select the technology and give the correct information system and knowledge for design. System design addresses Data, Process, Interfaces and Geography from the system designer's perspective. It is the evaluation of alternative solutions and the specification of a detailed computer-based solution. Sometimes it is also called physical design.

3.2.1 Process Modeling

The process model created to show how the data will be captured and used (data in motion) is represented by data flow diagrams. A Figure 3.1 introduces elements of Data Flow Diagram (Use Gane and Sarson Symbol).

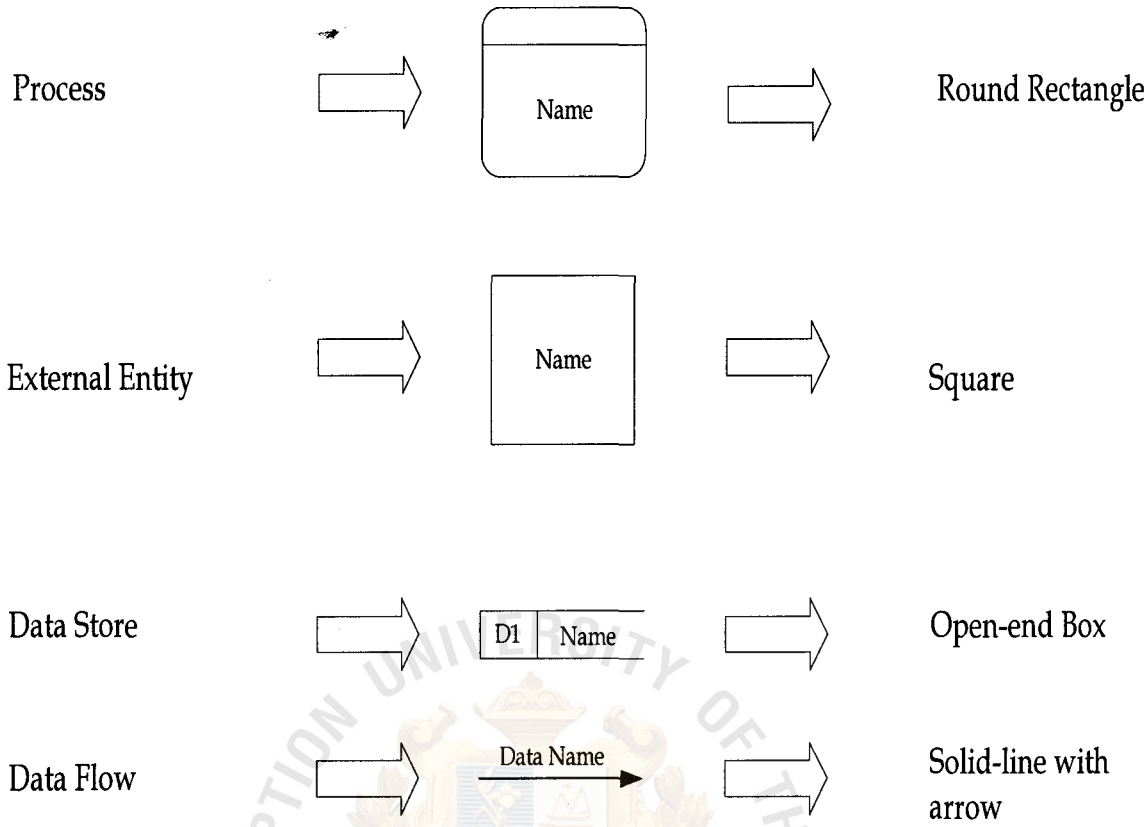

Figure 3.1. Elements of Data Flow Diagram (Use Gane and Sarson Symbol).

(1) The context diagram is constructed to establish the initial project scope. It depicts the system as a whole in correlation with its environment that are the "external entities" involved. The context diagram of the designed logistic control system is shown in Figure 3.2.

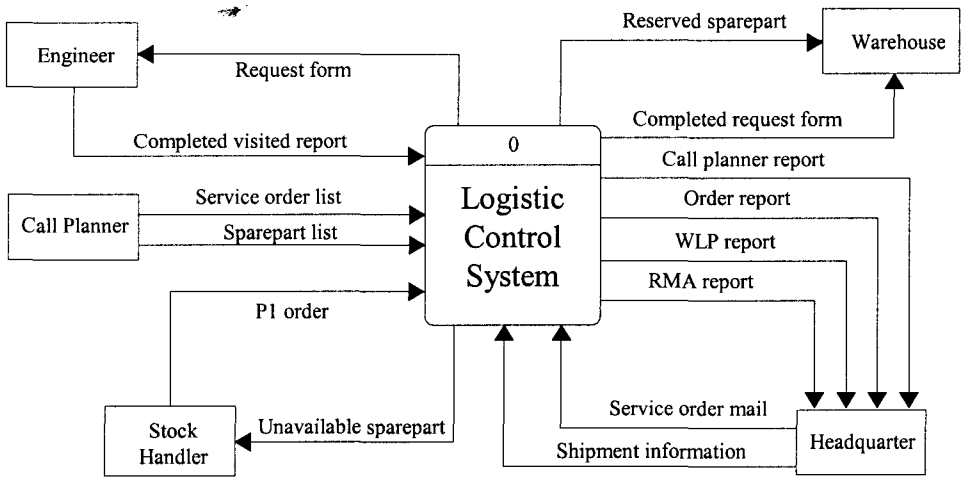

Figure 3.2. Context Diagram of Proposed Logistic Control System.

It composes of five major external entities and two data stores. First an engineer receives appointed services and fills in request forms in order to go onsite service after that he sends visited report to close the services. Second, after a call planner receives service orders via an e-mail, she makes an appointment with customers and put the appointed services into a list. After engineers sent completed visited reports, the system generates a call planner report. Third, in case of unavailable spare parts, a stock handler generates an order for those spare parts. Forth, the headquarter receives all reports automatically generated by the system. Fifth a warehouse store all spare parts that are requested by engineers. The system can retrieve all spare parts and alternate spare parts information from both spare parts and alternates data stores.

(2) The functional decomposition diagram (FDD) is constructed from the functions of the existing system and will emphasize on the decomposition of the whole system into subsystems or sub-functions till reaching primitive

events only. It is obvious that the choice of the decomposition (and thus the selection of the subsystems) is up to the discretion of the analysis and is not unique for a given project. It is very usual that this FDD has to be changed after more checking and discussions. The FDD of the logistic control system is shown in Figure 3.3.

(3) The higher level data flow diagrams (DFDs), which map the subsystems, sub-functions, and primitive events are constructed following the FDD. The DFD level 1 as shown in Figure 3.4 describes all six major subsystems in the logistic control system: warehouse subsystem, order subsystem, call planner subsystem, WLP subsystem, RMA subsystem, and engineer subsystem. The DFDs level 2 describe subprocesses in each subsystem. The warehouse subsystem is divided into 2 subprocesses: process warehouse transaction and process generate request form, as shown in Figure 3.5. The order subsystem is divided into 2 subprocesses: process order transaction and process generate order report, as shown in Figure 3.6. The call planner subsystem is divided into 2 subprocesses: process call planner transaction and process generate call planner report, as shown in Figure 3.7. The DFDs level 3 divide the subprocesses from DFDs level 2 into smaller processes. The process warehouse transaction is divided into process check reserve spare part, process request spare part, and process return spare part, as shown in Figure 3.8. The process order transaction is divided into process order priority 1, process order priority 3, process receive shipment detail, process receive spare part, and finally process specify alternate spare part as shown in Figure 3.9. The process call planner transaction is divided into process received service order, process make appointment, and process

closed call as shown in Figure 3.10. The process generate call planner report is divided into process generate appointment report, process generate visited report and process generate onsite report as shown in Figure 3.11.

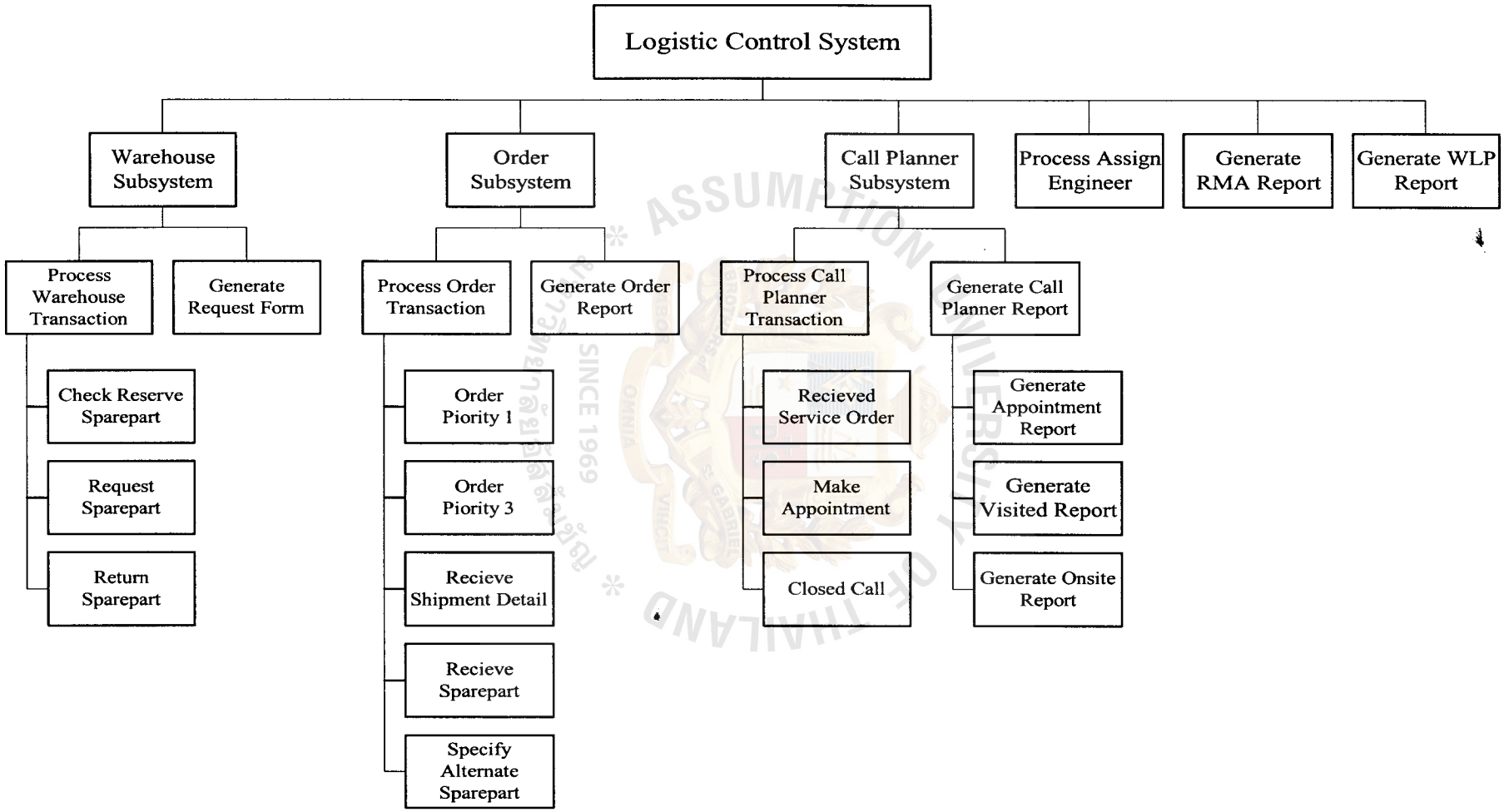

Figure 3.3. Functional Decomposition Diagram of Logistic Control System.

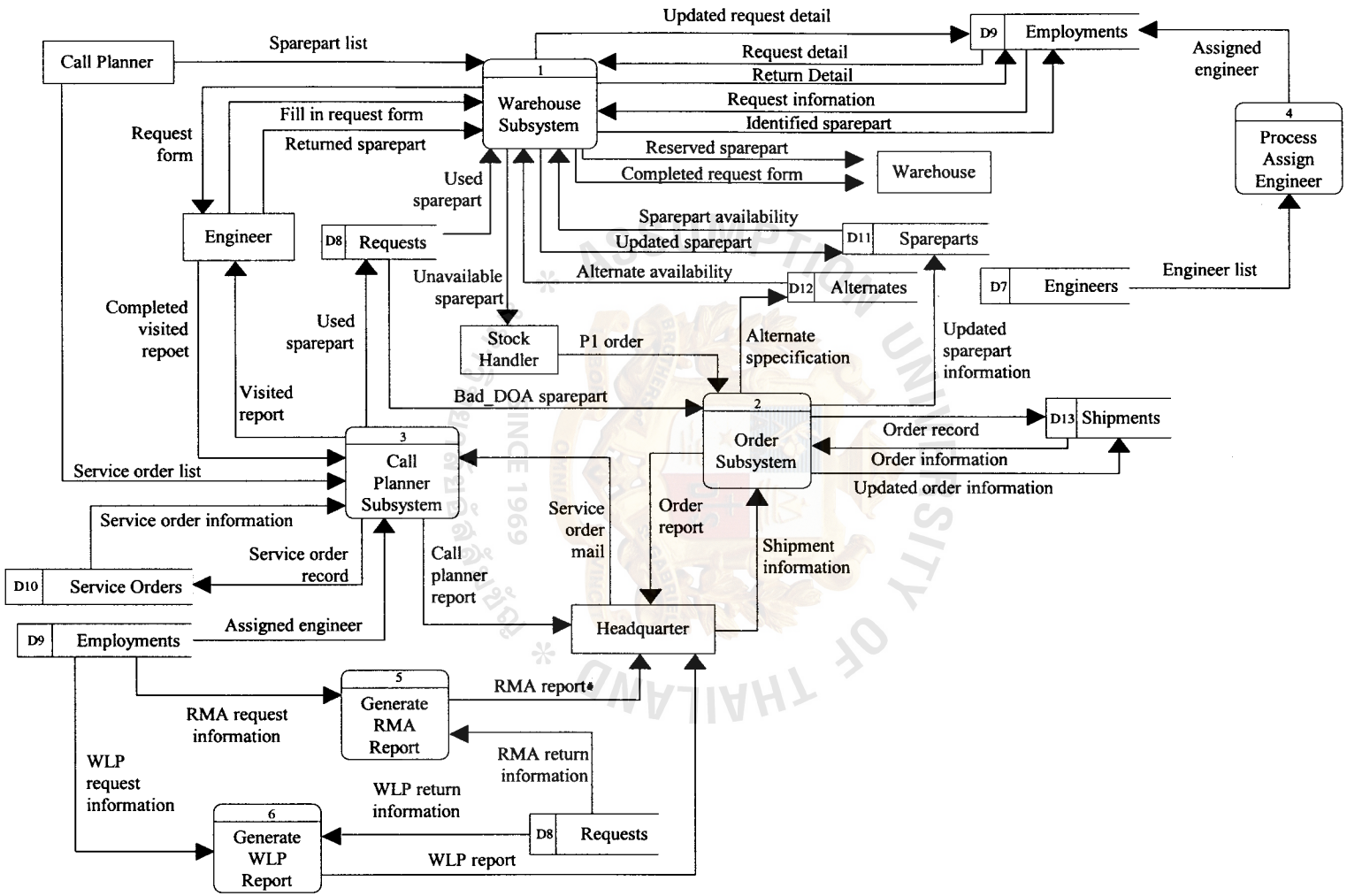

Figure 3.4. First Level DFD of Proposed Logistic Control System.

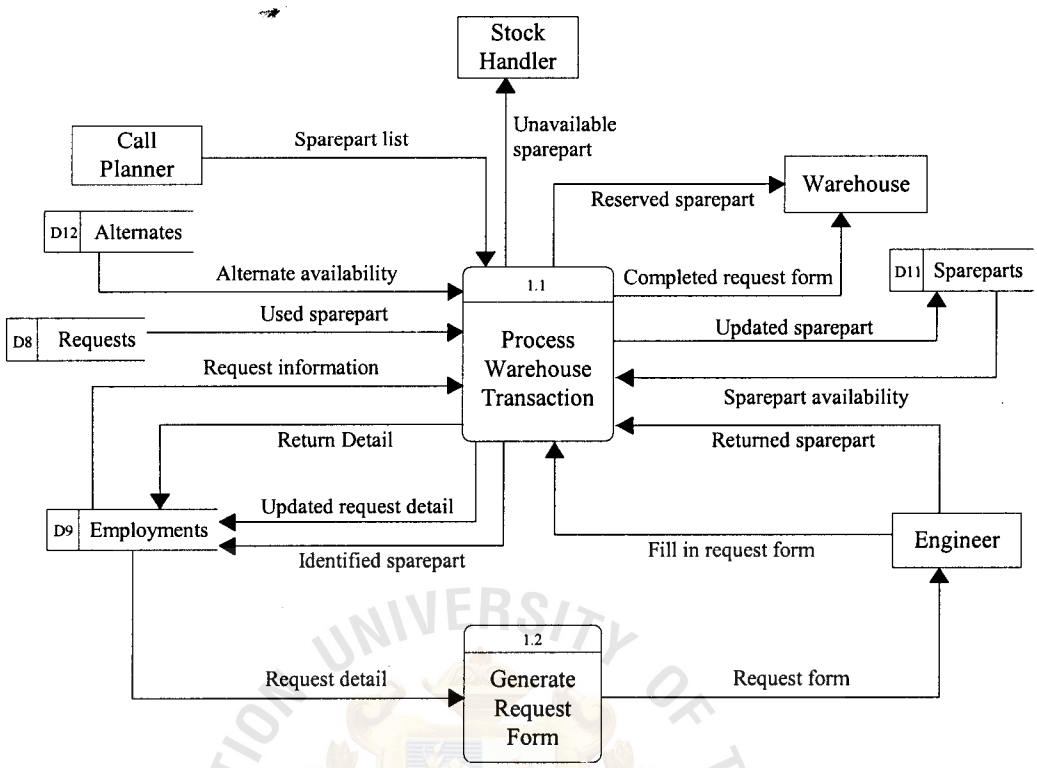

Figure 3.5. Second Level DFD of Warehouse Subsystem.

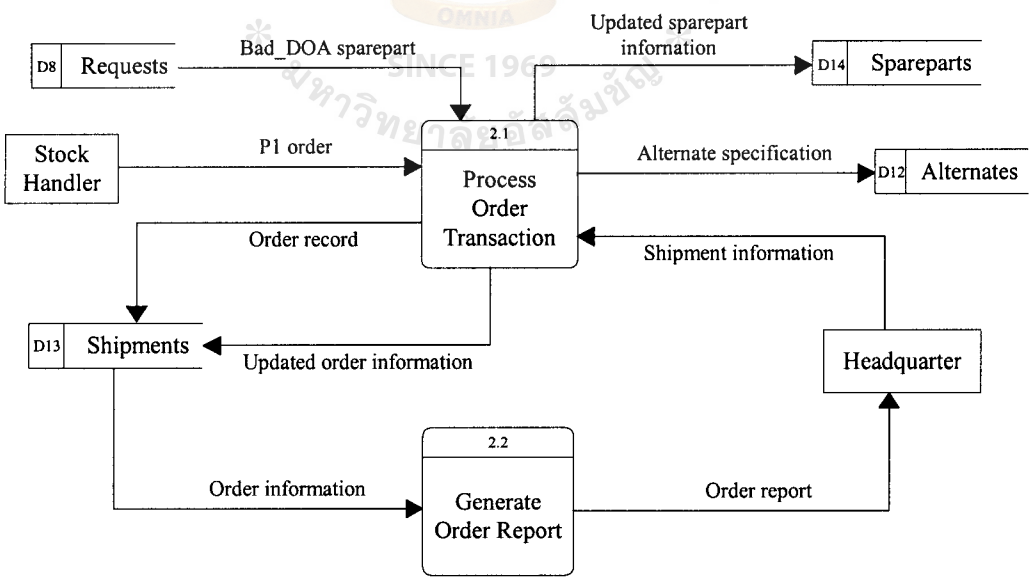

Figure 3.6. Second Level DFD of Order Subsystem.

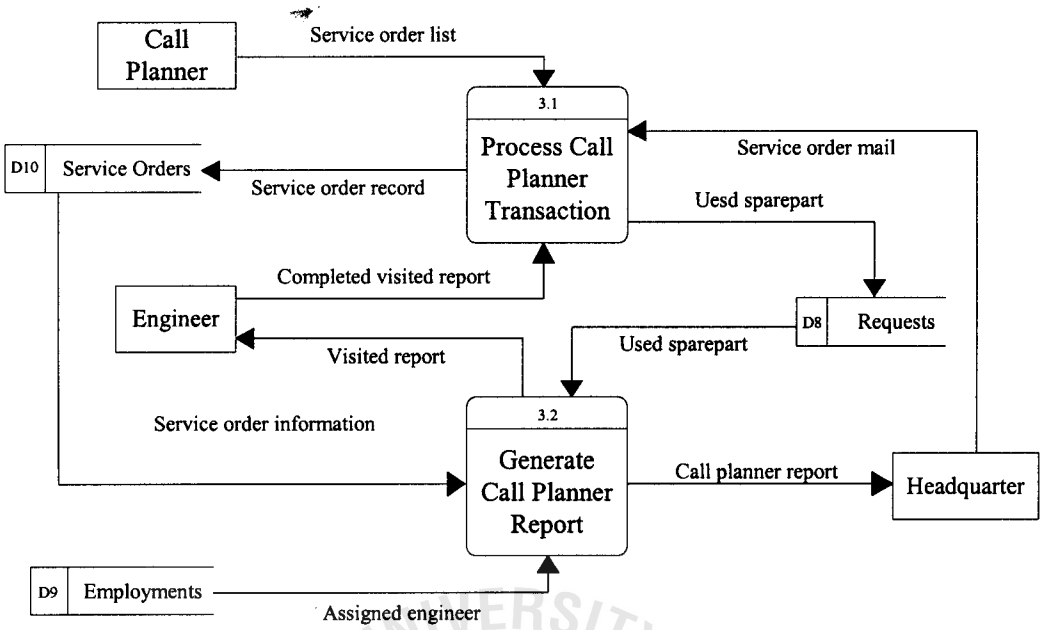

Figure 3.7. Second Level DFD of Call Planner Subsystem.

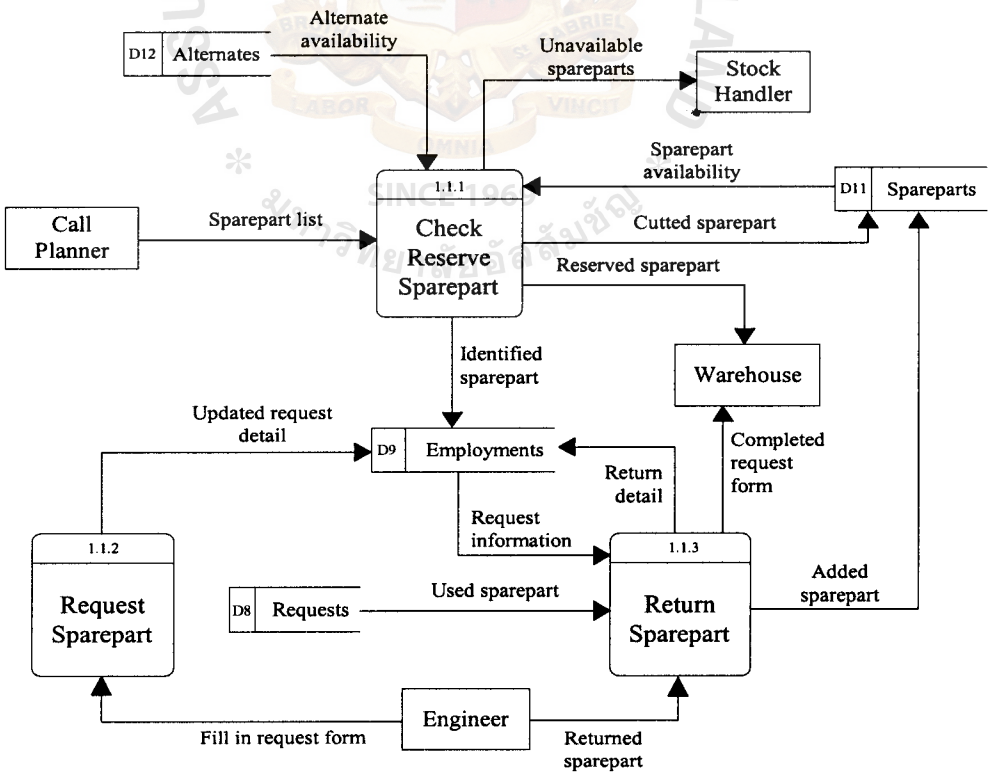

Figure 3.8. Third Level DFD of Process Warehouse Transaction.

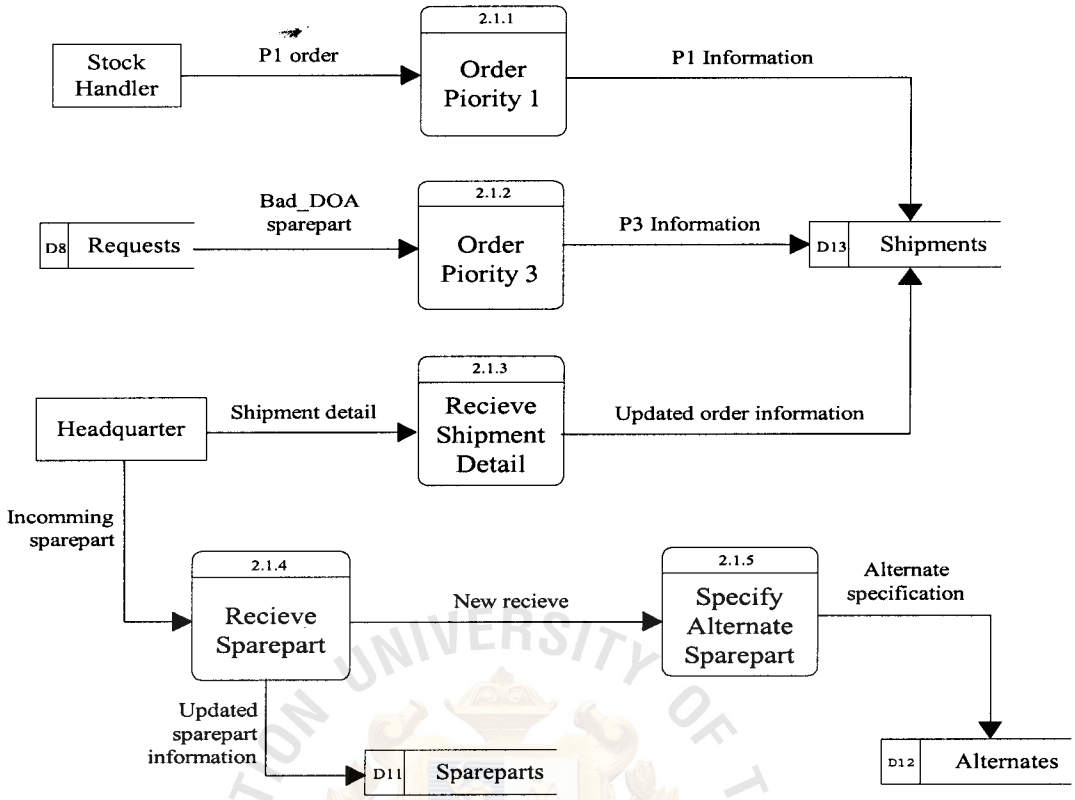

Figure 3.9. Third Level DFD of Process Order Transaction.

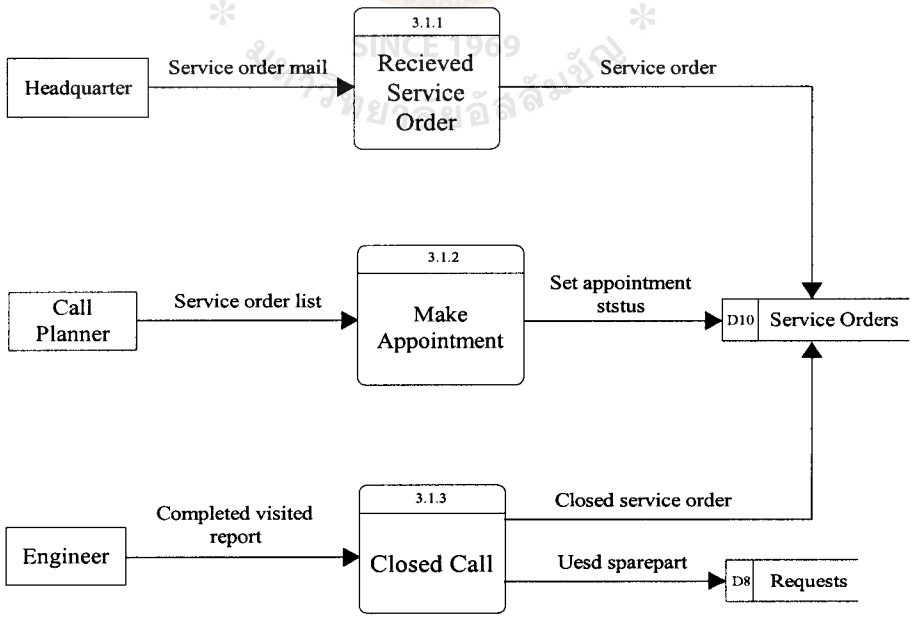

Figure 3.10. Third Level DFD of Call Planner Transaction.

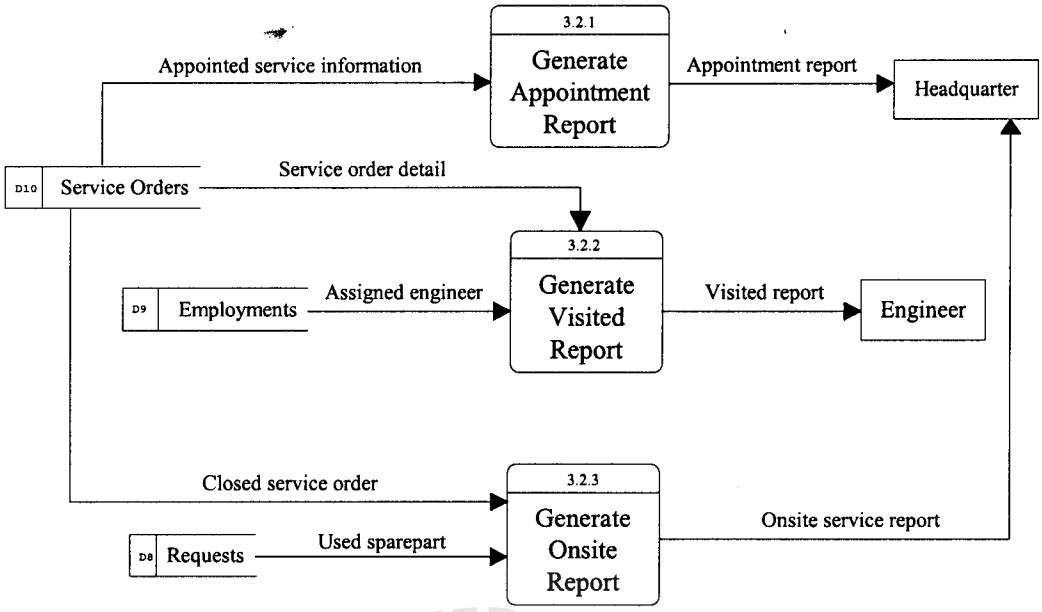

Figure 3.11. Third Level DFD of Process Generate Call Planner Report

3.2.2 Physical Data Flow Diagram

Data flow diagrams (DFDs) introduced earlier were a tool for modeling the essential or logical (meaning non- technical) business requirement LCS. With just a few extensions of the graphical language, we will use DFDs to model the technical and human design decision to be implemented as part of LCS called physical DFDs.

Physical DFDs use the same shapes ad connections as logical DFDs but naming standards (and a few new rules) are changed to extend the language to document technology and design decisions.

Physical process is either a processor or specific work or actions to be performed. The physical process must clearly designate which person or what technology will be assigned to do the work.

Physical data flow represents the planned implementation of an input to or output from a physical process. It can also indicate database action, represent the import data

from or export data to another information system across a network, and represent the data flows between two modules or subroutines within the same program.

Physical external agent is unchanged because external agents were classified during system analysis as outside the scope of the system.

Physical data store represents a single file or single database. Additional physical data stores may be added to represent temporary files or batches necessitated by physical process.

Physical data flows of the Logistic Control System are depicted in many levels as in logical DFDs but we initiate with the first level as shown in Figure 3.12 by refering to the context DFD.in Figure 3.2.

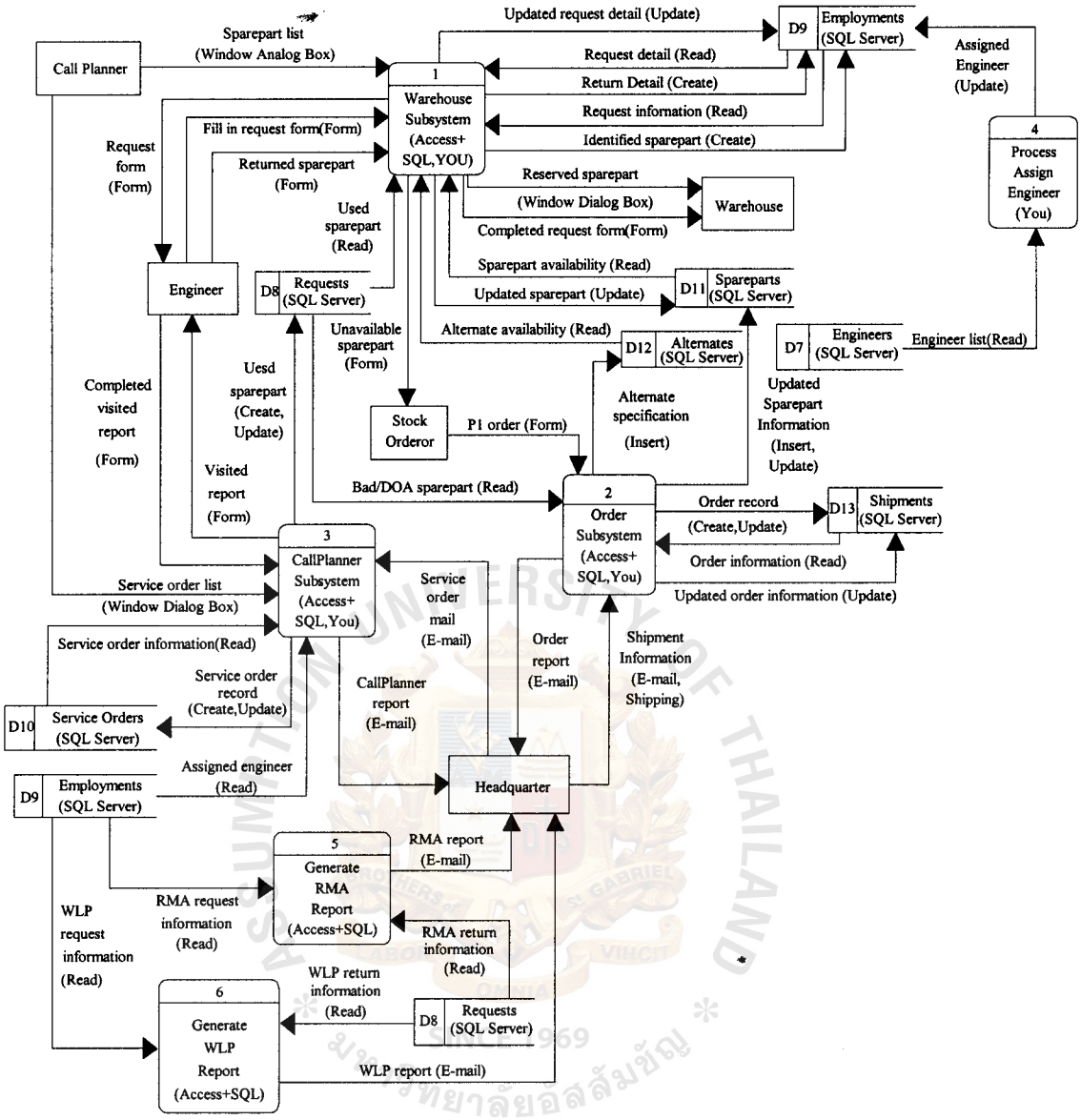

Figure 3.12. Physical DFD of First Level of Logistic Control System.

In level 2 of the LCS, three processes are divided into subsystems. A warehouse subsystem has two subsystems as shown in Figure 3.13. An order subsystem has two subsystems as shown in Figure 3.14. A call planner subsystem has two subsystems as shown in Figure 3.15.

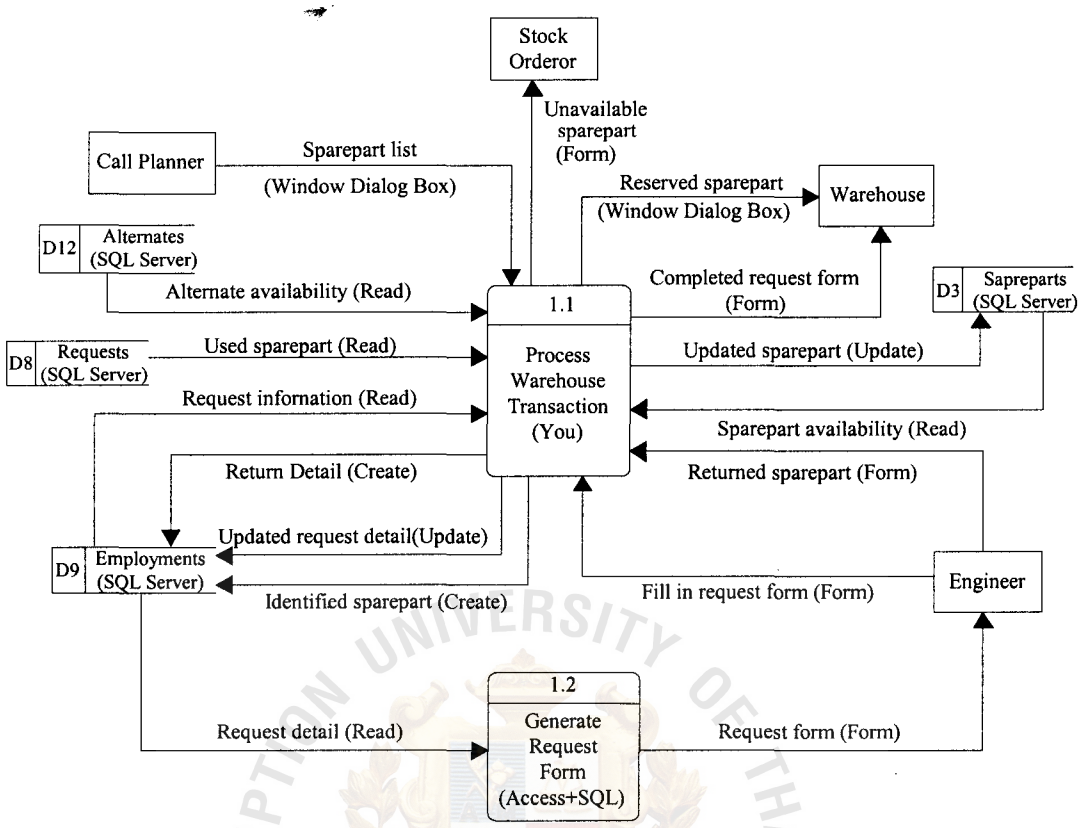

Figure 3.13. Physical DFD of Second Level of Warehouse Subsystem.

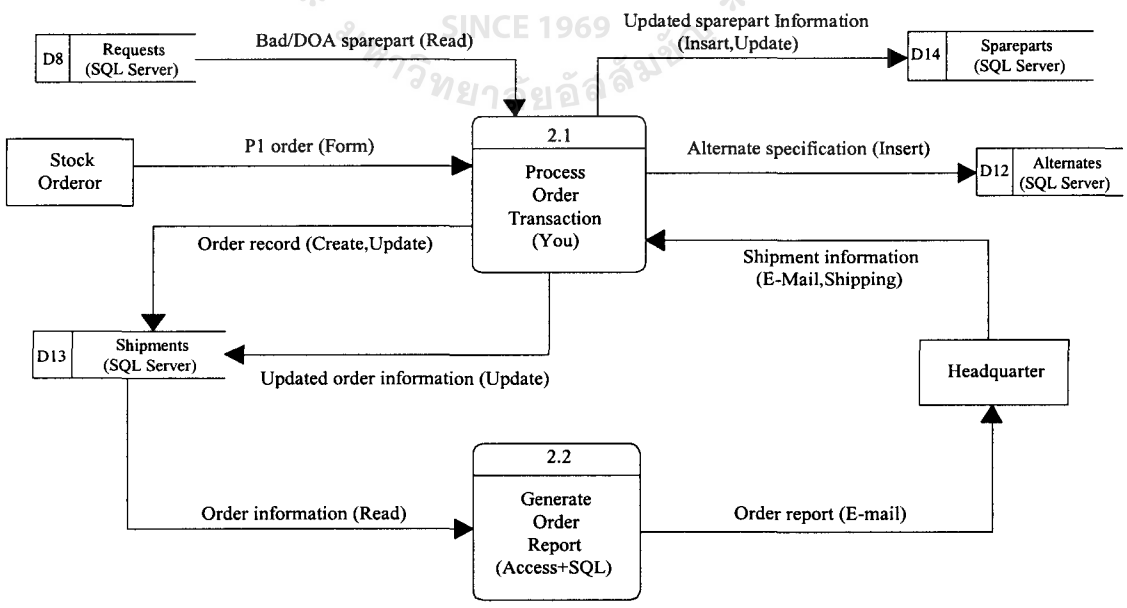

Figure 3.14. Physical DFD of Second Level of Order Subsystem.

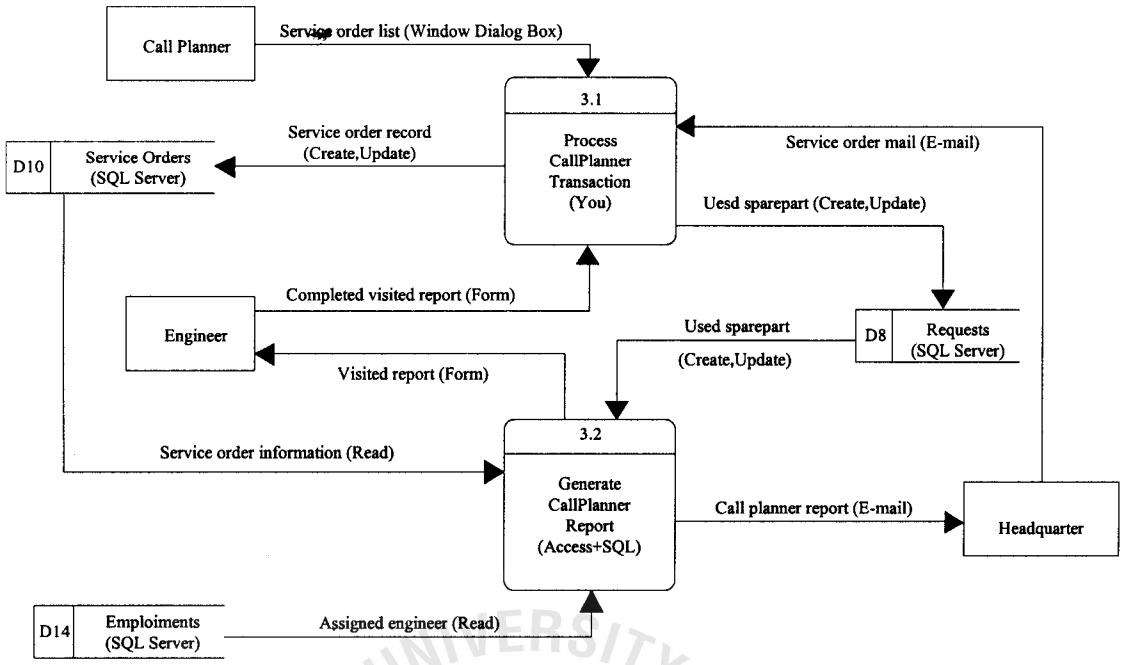

Figure 3.15. Physical DFD of Second Level of Call Planner Subsystem.

In level 3 of the LCS, only four processes have subprocesses. A process warehouse transaction has three sub processes as depicted in Figure 3.16. A process order transaction has five sub processes as depicted in Figure 3.17. A processes call planner transaction has three subprocesses as depicted in Figure 3.18. A processes generate call planner report has three subprocesses as depicted in Figure 3.19.

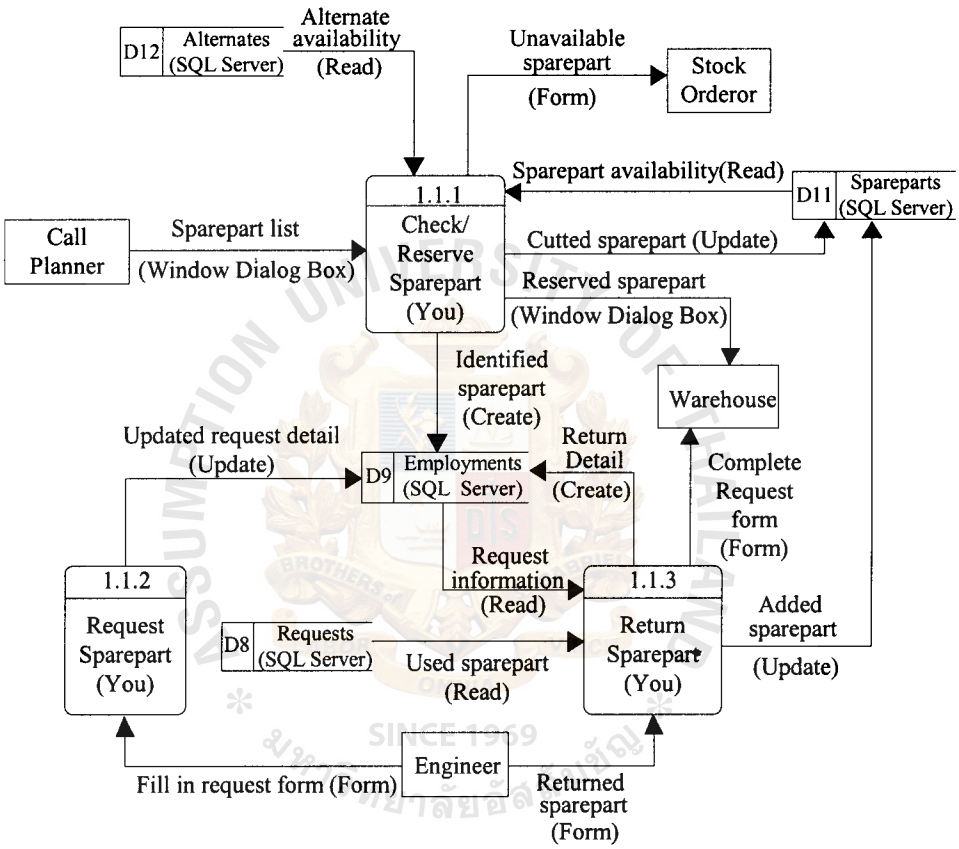

Figure 3.16. Physical DFD of Third Level of Process Warehouse Transaction.

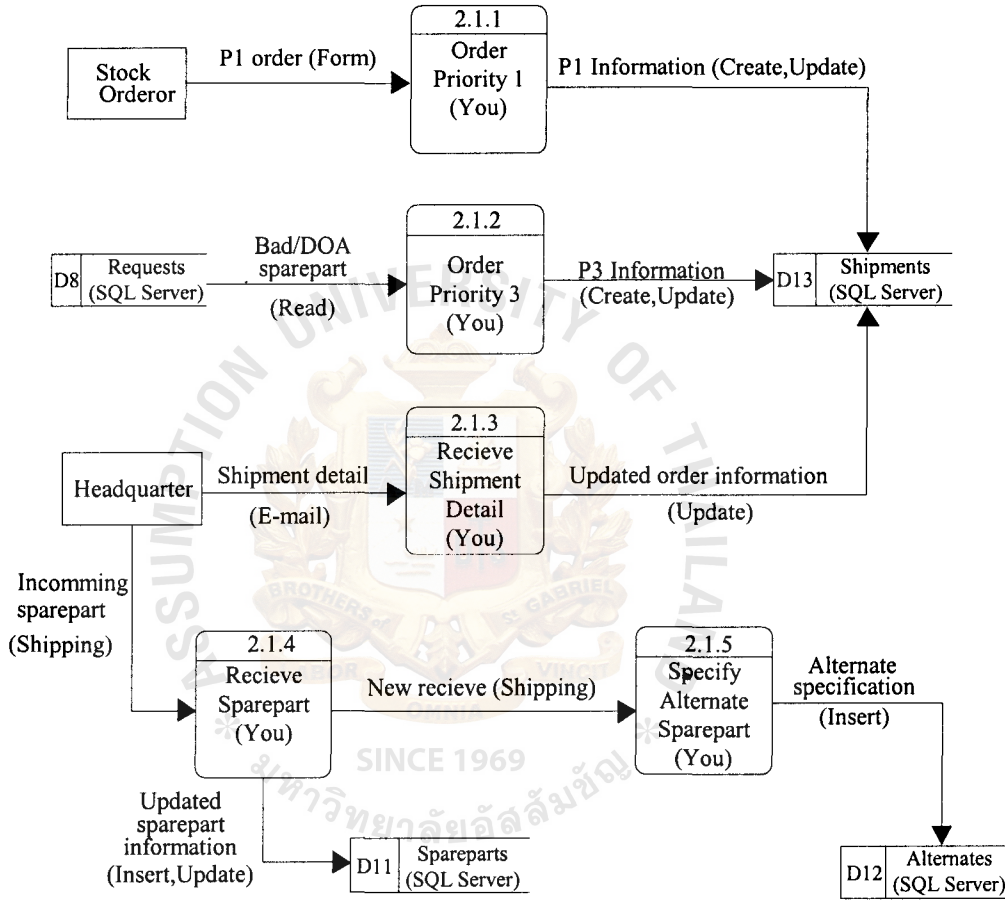

Figure 3.17. Physical DFD of Third Level of Process Order Transaction.

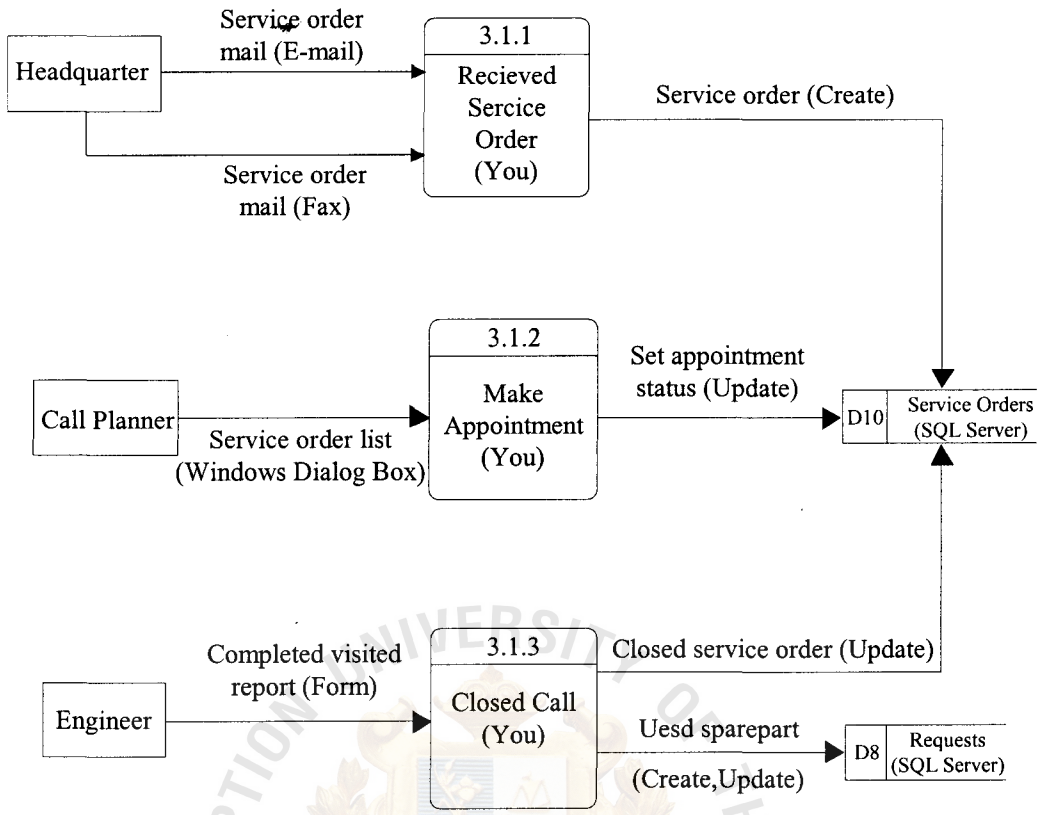

Figure 3.18. Physical DFD of Third Level of Process Call Planner Transaction.

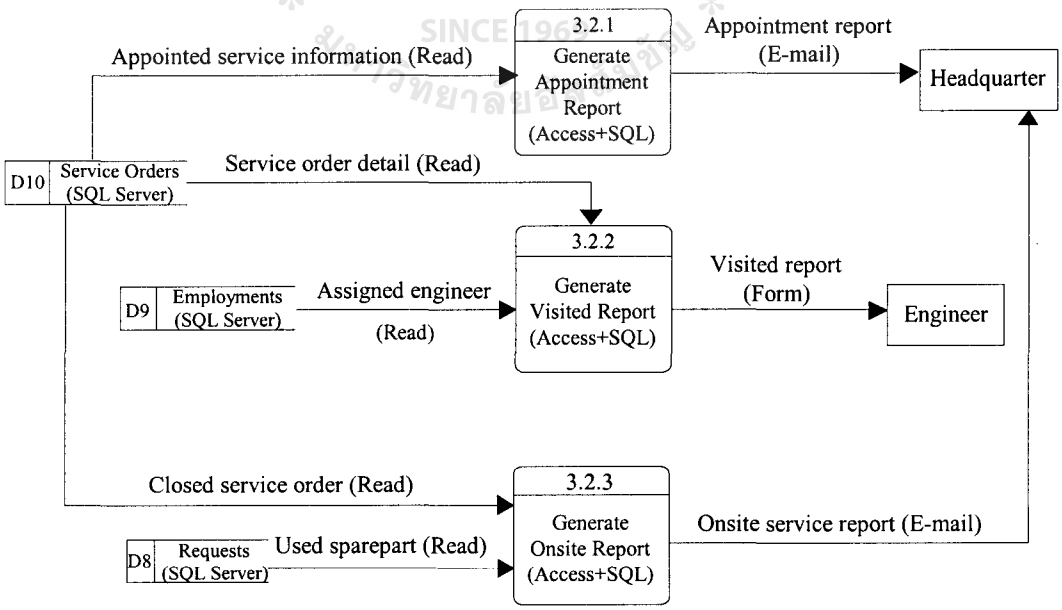

Figure 3.19. Physical DFD of Third Level of Process Generate Call Planner Report.

3.2.3 The Data Modeling

The data model concerns with data independently from how the data are captured and used. The entity relationship diagram (ERD) is used to depict data in term of the entities and relationships described by the data.

(1) The context data model includes only entities and relationships, but no attributes. The intent is to refine the understanding of scope, not get in to detail about the entities and business rules. The context data model of the logistic control system is depicted in Figure 3.20. The description of each entity is described below.

(a) SERVICEORDER: The service orders are sent to call planner in order to make an appointment with customers and to engineers in order to prepare themselves before onsite service.

(b) ENGINEER: An active engineer in the system whose major responsibility is onsite service.

(c) SPAREPART: A spare part that keeps spare part records that are used in each service.

(d) ORDER: An order generated from a stock handler in case of shortage or used spare parts.

(e) EMPLOYMENT: An employment that keeps records of engineers who request spare parts.

(f) SHIPMENT: A shipment records that a headquarter will send spare parts to a stock handler.

(g) REQUEST: A request which keeps all faulty spare parts information received from engineers

(2) The key-based data model will eliminate nonspecific relationships, and add associative entities, and include primary and foreign keys. This model will also include precise cardinalities and any generalization hierarchies. The key-based ERD is shown in Figure 3.21.

(3) A fully attributed data model includes all remaining descriptive attributes and subsetting criteria. The fully attributed ERD is shown in Figure 3.22.

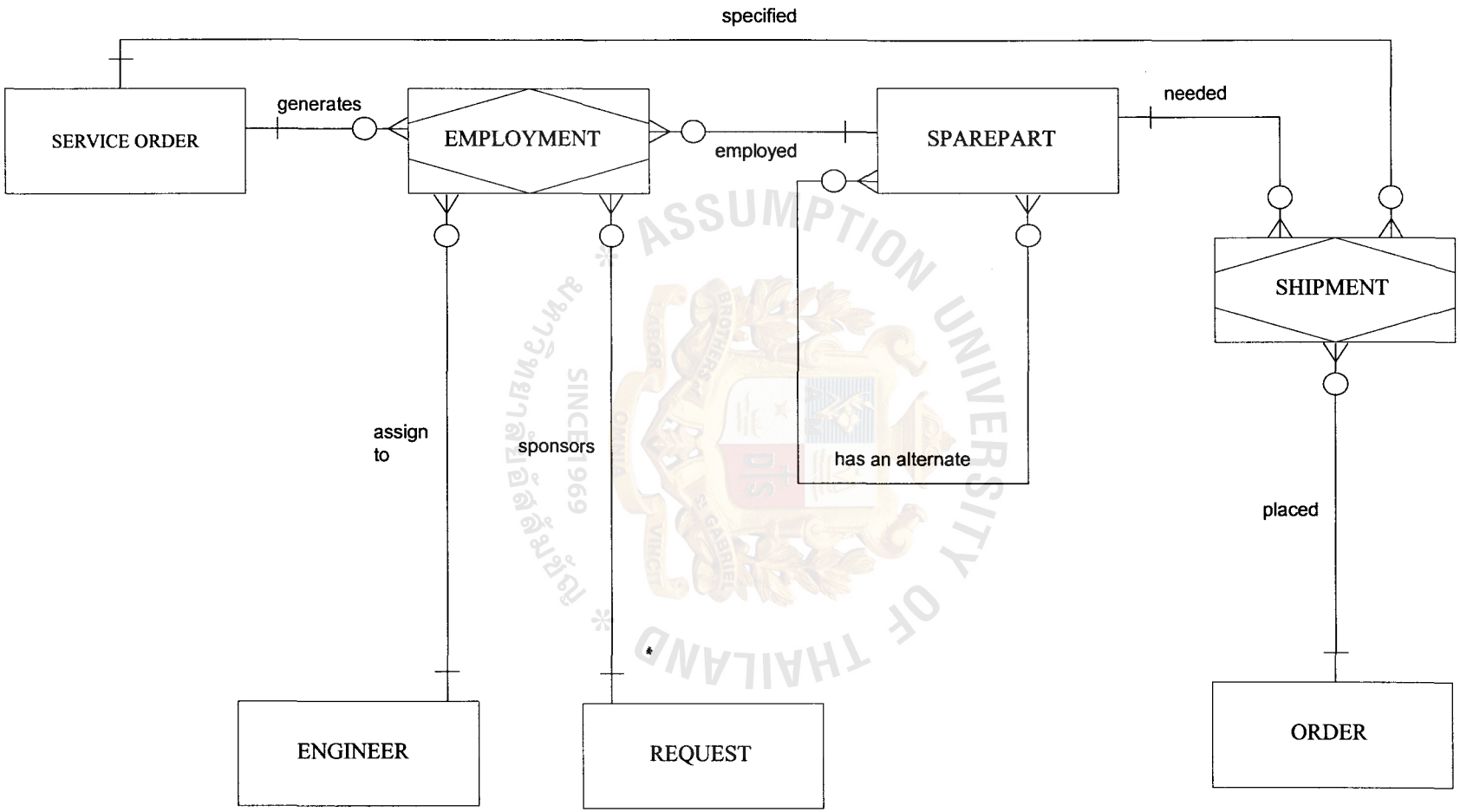

Figure 3.20. The Context ERD of the Proposed System.

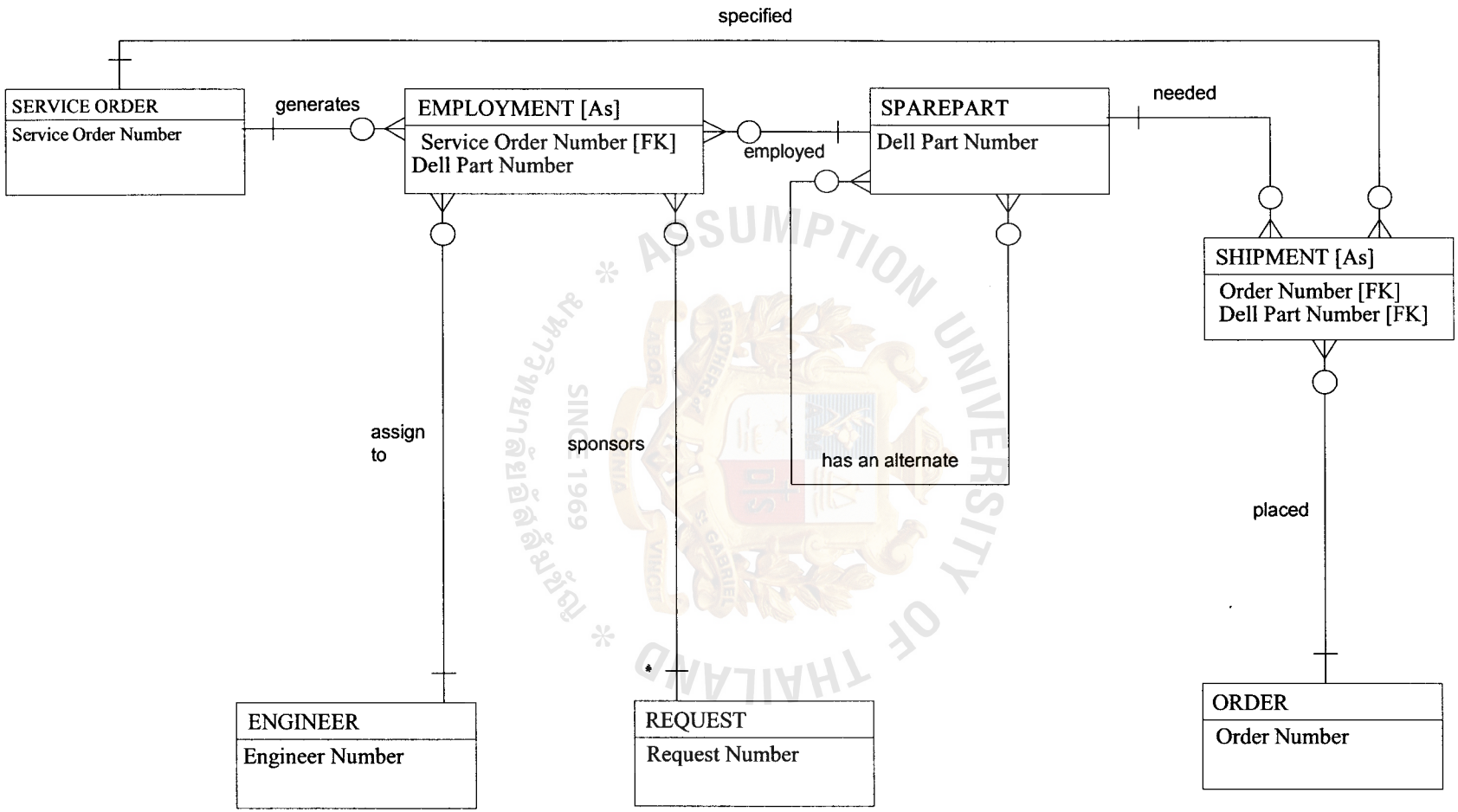

Figure 3.21. Key-based ERD of the Proposed System.

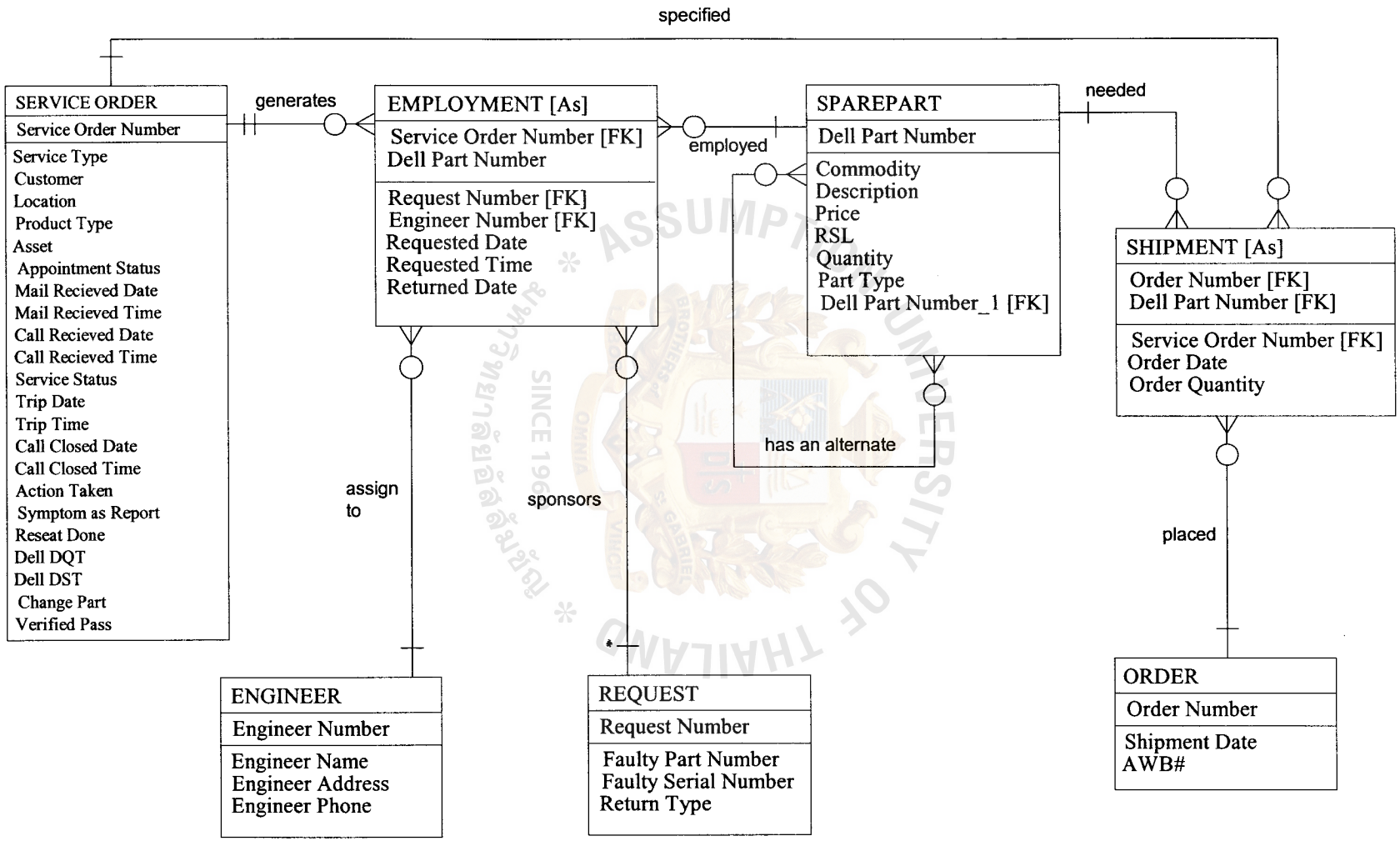

Figure 3.22. Fully Attributed ERD of the Proposed System.

3.3 Hardware and Software Requirement

Microsoft has provided a lot of software, which can transform a normal Intel-based PC server, application server, and database server. The software is designed to integrate with Microsoft Windows NT Server, and is also packed together as Microsoft Back Office suite.

We have decided to use the Microsoft Back Office suite as the major software for our proposed SQL-based client/server system. Therefore, the servers must have the hardware specification, which can run both Microsoft Windows NT and the other software in the suit. The hardware and software specifications for the proposed SQL-based server are shown in Tables 3.3 and 3.4 respectively.

Table 3.3. The Hardware Specification for the SQL-based Server.

Hardware	Specification
CPU	Intel Pentium III 500 MHz or higher
Cache Memory	256 KB or higher
Main Memory (RAM)	128 MB or higher
Hard Disk	60 GB or higher
CD-ROM Drive	16X or higher
Floppy Drive	1.44 MB
Network Adapter	Ethernet 10 Base-T
Display Adapter	SVGA card
Display	15" Monitor
UPS	500 VA
Printer	Dot Matrix and Laser

Table 3.4. The Software Specification for the SQL-based Server.

Software	Specification
Operating System	Microsoft Window NT Server 4.0(Service Pack 6)
Database Server	Microsoft SQL Server 7 & MS Access ODBC
Application Server	Microsoft Exchange Server

In the SQL-based client/server system, the client machines will only have capacity high enough to execute Microsoft Access. Therefore, in general standard, client machines should have hardware specification high enough to run Microsoft Windows 98 and Microsoft Office 97. The hardware and software specifications for each client machine are shown in the Tables 3.5 and 3.6 respectively.

Table 3.5. The Hardware Specification for each Client Machine.

Hardware	Specification
CPU	Intel Pentium I 166 MHz or higher
Cache Memory	256 KB or higher
Main Memory (RAM)	64 MB or higher
Hard Disk	1 GB or higher
CD-ROM Drive	16X or higher
Floppy Drive	1.44 MB
Network Adapter	Ethernet 10 Base-T
Display Adapter	SVGA card
Display	15" Monitor

Table 3.6. The software specification for each Client Machine.

Software	Specification
Operating System	Microsoft Windows 98
Application Software	Microsoft Office 97 Professional Edition and Microsoft Outlook

Other than server and client machines, the connection cannot be established if we do not have network peripherals. The SQL-based client/server system, however, does not use any net work peripherals, which differ from any other general Local Area Network (LAN).

3.4 System Cost Analysis

(1) Cost of Manual System

Table 3.7. Manual System Cost Analysis, Baht.

Cost Items		Years				
		1	2	3	4	5
Fixed Cost						
Desktop computer	3units@20,000	60,000	-	-	-	-
Printer	2units@12,000	24,000	-	-	-	-
Total Fixed Cost		84,000	-	-	-	-
Operating Cost						
Logistic manager	1person@25,000	25,000	27,500	30,250	33,275	36,603
Store keeper	2person@8,500	17,000	18,700	20,570	22,628	24,890
Admin officer	8person@9,000	72,000	79,200	87,120	95,832	105,416
Total monthly salary Cost		114,000	125,400	137,940	151,735	166,909
Total annual salary Cost		1,368,000	1,504,800	1,655,280	1,820,820	2,002,908
Office Supplies & Miscellaneous Cost						
Stationery	Per Annual	4,000	4,400	4,840	5,324	5,856
Paper	Per Annual	9,000	9,900	10,890	11,979	13,177
Utility	Per Annual	5,000	5,500	6,050	6,655	7,320
Miscellaneous	Per Annual	3,000	3,300	3,630	3,993	4,392
Total Annual Office Supplies & Miscellaneous Cost		21,000	23,100	25,410	27,951	30,746
Total Annual Operating Cost		1,389,000	1,527,900	1,680,690	1,848,759	2,033,635
Total Manual System Cost		1,473,000	1,527,900	1,680,690	1,848,759	2,033,635

Table 3.8. Five Years Accumulate Manual System Cost, Baht.

Year	Total Manual Cost	Accumulated Cost
1	1,473,000	1,473,000
2	1,527,900	3,000,900
3	1,680,690	4,681,590
4	1,848,759	6,530,349
5	2,033,635	8,563,984
Total	8,563,984	-

(2) Cost of Computerized system

Table 3.9. Computerized System Cost Analysis, Baht.

Cost Items	Years				
	1	2	3	4	5
Fixed Cost					
Hardware Cost					
Computer Server Cost 2units@135,000/5	54,000	54,000	54,000	54,000	54,000
Workstation Cost 7units@30,000/5	42,000	42,000	42,000	42,000	42,000
Network Cost 105,000/5	21,000	21,000	21,000	21,000	21,000
Total Hardware Cost	117,000	117,000	117,000	117,000	117,000
Maintenance Cost	0	0	18,000	16,200	14,580
Total Maintenance Cost	0	0	18,000	16,200	14,480
Software Cost					
Computer Software Cost 45,000/5	9,000	9,000	9,000	9,000	9,000
Total Software Cost	9,000	9,000	9,000	9,000	9,000
Implementation Cost					
Advance Training Cost	55,000	0	0	0	0
Basic Training Cost	20,000	0	0	0	0
Set up Cost	54,000	0	0	0	0
Total Implementation Cost	129,000	0	0	0	0
Total Fixed Cost	255,000	126,000	114,000	142,200	140,580
Operating Cost					
People Ware Cost					
Logistic manager 1person@25,000	25,000	27,500	30,250	33,275	36,603
Store keeper 1person@9,000	9,000	9,900	10,890	11,979	13,177
Call planner 2person@10,000	20,000	22,000	24,200	26,620	29,282
Stock Handler 1person@10,000	10,000	11,000	12,100	13,310	14,641
Admin officer 1person@9,000	9,000	9,900	10,890	11.979	13,177
Total Monthly Salary Cost	73,000	80,300	88,330	97,163	106,879
Total Annual Salary Cost	876,000	963,600	1.059,960	1,165,956	1,282,548
Miscellaneous Cost					
Stationery	3,000	3,300	3,630	3,993	4,392
Paper	2,000	2,200	2,420	2,662	2,928
Utility	2,000	2,200	2,420	2,662	2,928
Total Miscellaneous Cost	7,000	7,700	8,470	9,317	10,249
Total Operating Cost	883,000	971,300	1,068,430	1,174,913	1,292,404
Total Computerized System Cost	1,642,000	971,300	1.070,230	1,191,113	1,306,984

Table 3.10. Five Years Accumulated Computerized Cost, Baht.

Year	Total Computerized Cost	Accumulated Cost
1	1,642,000	1,642,000
2	971,300	2,613,300
3	1,070,230	3,683,530
4	1,191,113	4,874,643
5	1,306,984	6,181,627
Total	6,181,627	-

(3) The comparison between computerized system cost and manual system cost.

Table 3.11. The Comparison of System Cost, Baht.

Year	Accumulated Manual Cost	Accumulated Computerized Cost
1	1,473,000	1,642,000
2	3,000,900	2,613,300
3	4,681,590	3,683,530
4	6,530,349	4,874,643
5	8,563,984	6,181,627

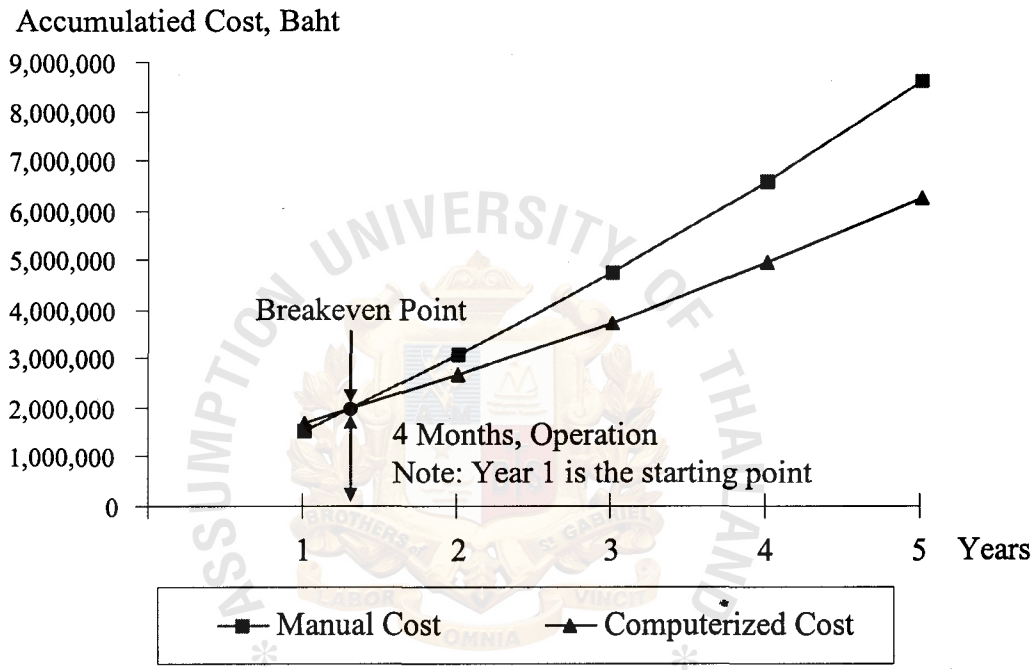

Figure 3.23. Cost Comparison between the Manual and Proposed Systems.

IV. PROJECT IMPLEMENTATION

4.1 Overview of Project Implementation

System implementation is the construction of the new system and the delivery of that system into production (meaning day-to-day operation). The final design should be evaluated first to make sure that the new proposed system can meet the desired goal and objectives, and then the other remaining processes will be performed. The typical activities of the system implementation are:

(1) Build and test network and hardware

(2) Build and test databases

(3) Install or write and test new programs

(4) System testing

(5) Prepare Conversion plan

(6) Personal training

(7) Conversion

Moreover, it also involves fine tuning system elements in order to maximize the system efficiency and productivity.

4.2 Build and Test Network and Hardware

According to the system specification and cost / benefit analysis section in Chapter 3, almost all existing hardware and network are suitable for the proposed system. 128MB RAM and 20 GB hard disk are installed on the existing file server. The network configuration of the proposed system is depicted in Figure 4.1.

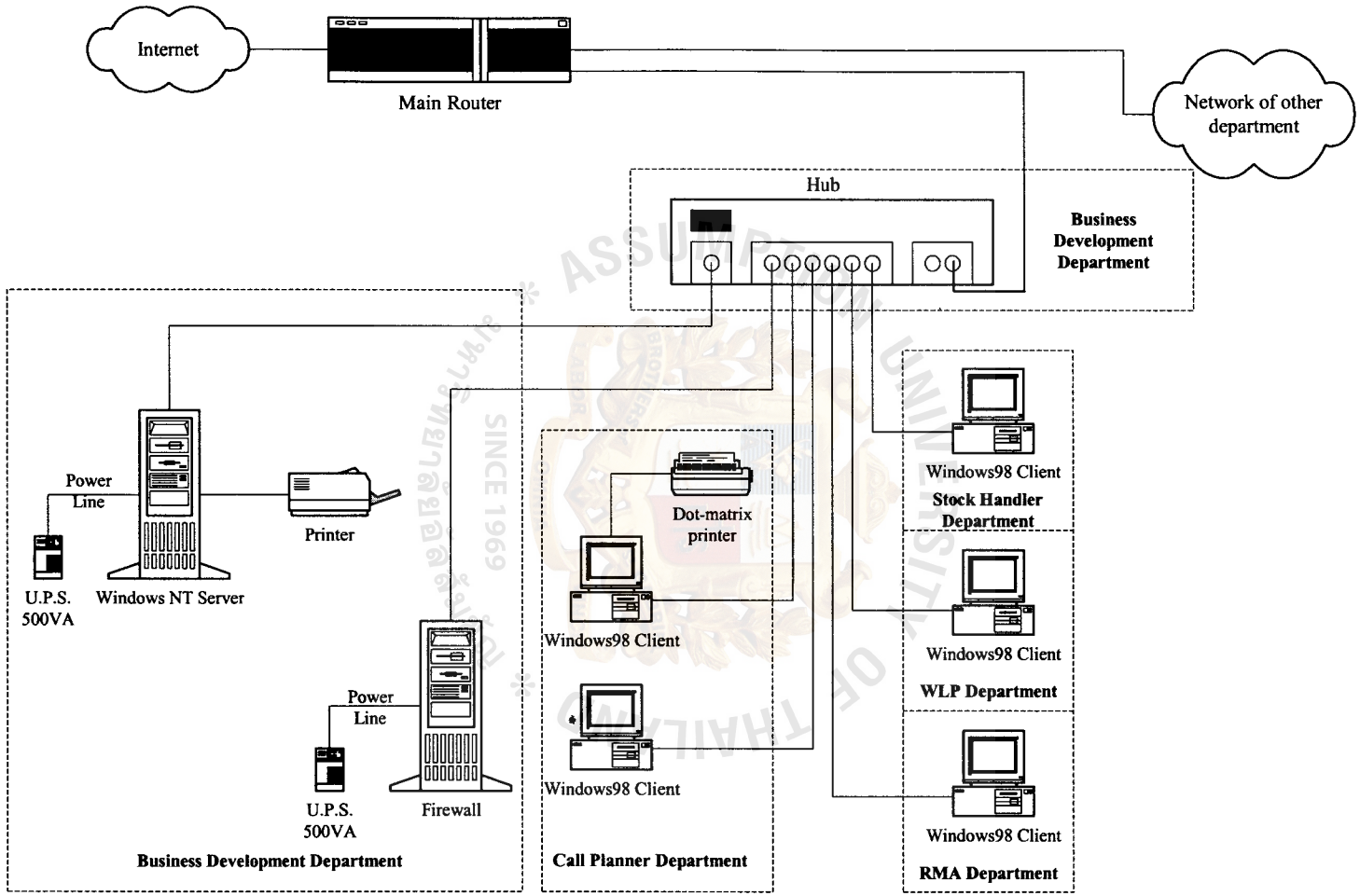

Figure 4.1. The Network Configuration of the Proposed System.

4.3 Build and Test Databases

The database is built following the database design requirements specified in the system design section. Sample data are loaded into tables for testing the databases. The database schema is described below.

```
CREATE TABLE "EMPLOYMENT"
(
  "REQUEST_NUMBER"     DECIMAL(10),
  "SERVICE_ORDER_NUMB"  DECIMAL(12),
  "ENGINEER_NUMBER"    VARGRAPHIC(7),
  "DELL_PART_NUMBER"   VARGRAPHIC(5),
  "REQUESTED_DATE"     DATE DEFAULT Current Date,
  "REQUESTED_TIME"     TIME DEFAULT Current Time,
  "RETURNED_DATE"      DATE DEFAULT Current Date
);

CREATE TABLE "ENGINEER"
(
  "ENGINEER_NUMBER"   VARGRAPHIC(7),
  "ENGINEER_NAME"     CLOB(30),
  "ENGINEER_ADDRESS"  CLOB(60),
  "ENGINEER_PHONE"    DECIMAL(9)
);

CREATE TABLE "ORDER"
(
  "ORDER_NUMBER"  DECIMAL(8)
);

CREATE TABLE "REQUEST"
(
  "REQUEST_NUMBER"     DECIMAL(10),
  "FAULTY_PART_NUMBER"  VARGRAPHIC(5),
  "FAULTY_SERIAL_NUMB"  VARGRAPHIC(15),
  "RETURN_TYPE"        INTEGER DEFAULT 0
);

CREATE TABLE "SERVICE_ORDER"
(
  "SERVICE_ORDER_NUMB"  DECIMAL(12),
  "SERVICE_TYPE"        INTEGER DEFAULT 0,
```

```
  "CUSTOMER"          CLOB(60),
  "LOCATION"          CLOB(15),
  "PRODUCT_TYPE"      INTEGER,
  "ASSET"             VARGRAPHIC(6),
  "APPOINTMENT_STATUS"  INTEGER DEFAULT 0,
  "MAIL_RECIEVED_DATE"  DATE DEFAULT Current Date,
  "MAIL_RECIEVED_TIME"  TIME,
  "CALL_RECIEVED_DATE"  DATE DEFAULT Current Date,
  "CALL_RECIEVED_TIME"  TIME,
  "SERVICE_STATUS"     INTEGER DEFAULT 0,
  "TRIP_DATE"          DATE,
  "TRIP_TIME"          TIME,
  "CALL_CLOSED_DATE"   DATE,
  "CALL_CLOSED_TIME"   TIME,
  "ACTION_TAKEN"       CLOB(200),
  "SYMTOM_AS_REPORT"   INTEGER DEFAULT 1,
  "RESEAT_DONE"        INTEGER DEFAULT 0,
  "DELL_DQT"           INTEGER DEFAULT 0,
  "DELL_DST"           INTEGER DEFAULT 0,
  "CHANGE_PART"        INTEGER DEFAULT 0,
  "VERIFIED_PASS"      INTEGER DEFAULT 1
);

CREATE TABLE "SHIPMENT"
(
  "ORDER_NUMBER"       DECIMAL(8),
  "DELL_PART_NUMBER"   VARGRAPHIC(5),
  "SERVICE_ORDER_NUMB" DECIMAL(12),
  "ORDER_DATE"         DATE,
  "SHIPMENT_DATE"      TIMESTAMP,
  "AWB#"               VARGRAPHIC(10),
  "ORDER_QUANTITY"     DECIMAL(2) DEFAULT 1
);

CREATE TABLE "SPAREPART"
(
  "DELL_PART_NUMBER"   VARGRAPHIC(5),
  "COMMODITY"          CLOB(20),
  "DESCRIPTION"        CLOB(40),
  "PRICE"              DECIMAL(4),
  "RSL"                DECIMAL(2),
  "QUANTITY"           DECIMAL(2),
  "PART_TYPE"          INTEGER DEFAULT 0,
  "DELL_PART_NUMBER_1" VARGRAPHIC(5)
```

```
);

COMMENT ON COLUMN "EMPLOYMENT"."DELL_PART_NUMBER" IS
  'A number of sparepart issued by DELL';

COMMENT ON COLUMN "EMPLOYMENT"."ENGINEER_NUMBER" IS
  'An engineer code number specified by DELL';

COMMENT ON COLUMN "EMPLOYMENT"."REQUEST_NUMBER" IS
  'Number of sparepart request form';

COMMENT ON COLUMN "EMPLOYMENT"."REQUESTED_DATE" IS
  'Date that an engineer requests each sparepart';

COMMENT ON COLUMN "EMPLOYMENT"."REQUESTED_TIME" IS
  'Time that an engineer requests each sparepart';

COMMENT ON COLUMN "EMPLOYMENT"."RETURNED_DATE" IS
  'Date that an engineer returns a sparepart';

COMMENT ON COLUMN "EMPLOYMENT"."SERVICE_ORDER_NUMB" IS
  'Number of service order issued by a headquarter';

COMMENT ON COLUMN "ENGINEER"."ENGINEER_ADDRESS" IS
  'A current address of an engineer';

COMMENT ON COLUMN "ENGINEER"."ENGINEER_NAME" IS 'A name if an engineer';

COMMENT ON COLUMN "ENGINEER"."ENGINEER_NUMBER" IS
  'An engineer code number specified by DELL';

COMMENT ON COLUMN "ENGINEER"."ENGINEER_PHONE" IS
  'A mobile phone or pager number of an engineer that can be used to contact to the
engineer anytime'
  ;

COMMENT ON COLUMN "ORDER"."ORDER_NUMBER" IS
  'Number of each order issued by stock orderor';

COMMENT ON COLUMN "REQUEST"."FAULTY_PART_NUMBER" IS
  'The DELL "s sparepart number of bad or DOA returned sparepart';

COMMENT ON COLUMN "REQUEST"."FAULTY_SERIAL_NUMB" IS
  'The manufacturer "s sparepart number of bad or DOA returned sparepart';
```

```
COMMENT ON COLUMN "REQUEST"."REQUEST_NUMBER" IS
  'Number of sparepart request form';

COMMENT ON COLUMN "REQUEST"."RETURN_TYPE" IS 'Type of a returned sparepart';

COMMENT ON COLUMN "SERVICE_ORDER"."ACTION_TAKEN" IS
  'Everything that engineer does to fix customer"s problems';

COMMENT ON COLUMN "SERVICE_ORDER"."APPOINTMENT_STATUS" IS
  'Show the status of service order that is appointed';

COMMENT ON COLUMN "SERVICE_ORDER"."ASSET" IS 'Machine serial number ';

COMMENT ON COLUMN "SERVICE_ORDER"."CALL_CLOSED_DATE" IS
  'The date that a a service order is completed';

COMMENT ON COLUMN "SERVICE_ORDER"."CALL_CLOSED_TIME" IS
  'Time that a service order is completed';

COMMENT ON COLUMN "SERVICE_ORDER"."CALL_RECIEVED_DATE" IS
  'The date that a technical support at a headquarter recieves a call for a service from an
user'
  ;

COMMENT ON COLUMN "SERVICE_ORDER"."CALL_RECIEVED_TIME" IS
  'Time that a technical support at a headquarter recieves a call for a service from an user'
  ;

COMMENT ON COLUMN "SERVICE_ORDER"."CHANGE_PART" IS
  'A status asked to define whether an engineer changes spareparts';

COMMENT ON COLUMN "SERVICE_ORDER"."CUSTOMER" IS
  'Customer address and contacted name of each service ';

COMMENT ON COLUMN "SERVICE_ORDER"."DELL_DQT" IS
  'A status asked to define whether the service gets pass result from testing by dell
diagnostic quick test before repair'
  ;

COMMENT ON COLUMN "SERVICE_ORDER"."DELL_DST" IS
  'A status asked to define whether the service get pass result from testing by dell
diagnostic specific test before repair'
  ;
```

```
COMMENT ON COLUMN "SERVICE_ORDER"."LOCATION" IS
  'Customer "s location specified into province';

COMMENT ON COLUMN "SERVICE_ORDER"."MAIL_RECIEVED_DATE" IS
  'The date that call planner recieves a service order mailed by the headquarter'
  ;

COMMENT ON COLUMN "SERVICE_ORDER"."MAIL_RECIEVED_TIME" IS
  'Time that call planner recieves a service order mailed by the headquarter'
  ;

COMMENT ON COLUMN "SERVICE_ORDER"."PRODUCT_TYPE" IS
  'Dell "s mechine type such as optiplex desktop , lattitude notebook ,ect.'
  ;

COMMENT ON COLUMN "SERVICE_ORDER"."RESEAT_DONE" IS
  'A status asked to define whether the peoblem is gone after reseat spareparts'
  ;

COMMENT ON COLUMN "SERVICE_ORDER"."SERVICE_ORDER_NUMB" IS
  'Number of service order issued by a headquarter';

COMMENT ON COLUMN "SERVICE_ORDER"."SERVICE_STATUS" IS
  'A status used to identify whether a sevice is completed';

COMMENT ON COLUMN "SERVICE_ORDER"."SERVICE_TYPE" IS
  'Type of each service such as NBD ( Next Business Day ) , 4HR ( Complete within 4 hours )
,ect.'
  ;

COMMENT ON COLUMN "SERVICE_ORDER"."SYMTOM_AS_REPORT" IS
  'A status asked to define whether problems are same as define in a service order'
  ;

COMMENT ON COLUMN "SERVICE_ORDER"."TRIP_DATE" IS
  'Date that an engineer goes onsite';

COMMENT ON COLUMN "SERVICE_ORDER"."TRIP_TIME" IS
  'Time that an engineer goes onsite';

COMMENT ON COLUMN "SERVICE_ORDER"."VERIFIED_PASS" IS
  'A status asked to define whether all problems are gone after repair';
```

```
COMMENT ON COLUMN "SHIPMENT"."AWB#" IS
  'A shipment number that is issued by the headquarter to ensure an order of stock orderor'
  ;

COMMENT ON COLUMN "SHIPMENT"."DELL_PART_NUMBER" IS
  'A number of sparepart issued by DELL';

COMMENT ON COLUMN "SHIPMENT"."ORDER_DATE" IS
  'The date that stock orderor launches an order to a headquarter';

COMMENT ON COLUMN "SHIPMENT"."ORDER_NUMBER" IS
  'Number of each order issued by stock orderor';

COMMENT ON COLUMN "SHIPMENT"."ORDER_QUANTITY" IS
  'A quantity of each sparepart to be ordered';

COMMENT ON COLUMN "SHIPMENT"."SERVICE_ORDER_NUMB" IS
  'Number of service order issued by a headquarter';

COMMENT ON COLUMN "SHIPMENT"."SHIPMENT_DATE" IS
  'Date that spareparts should reach warehouse';

COMMENT ON COLUMN "SPAREPART"."COMMODITY" IS
  'Type of sparepart such as HDD ,FDD , Moniter ect.';

COMMENT ON COLUMN "SPAREPART"."DELL_PART_NUMBER" IS
  'A number of sparepart issued by DELL';

COMMENT ON COLUMN "SPAREPART"."DELL_PART_NUMBER_1" IS
  'A number of sparepart issued by DELL';

COMMENT ON COLUMN "SPAREPART"."DESCRIPTION" IS
  'A specific detail of each sparepart';

COMMENT ON COLUMN "SPAREPART"."PART_TYPE" IS
  'Used to identify that a sparepart belongs to which type of service';

COMMENT ON COLUMN "SPAREPART"."PRICE" IS 'Net price of a sparepart';

COMMENT ON COLUMN "SPAREPART"."QUANTITY" IS
  'Amount of sparepart that remains in the store ';

COMMENT ON COLUMN "SPAREPART"."RSL" IS
  'Quantity of each sparepart that shoud remains in a stock ';
```

```
COMMENT ON TABLE "ENGINEER" IS 'An onsite service engineer';

COMMENT ON TABLE "ORDER" IS
  'A daily event whereby bad or DOA spareparts are returned or shortaged spareparts are
needed '
  ;

COMMENT ON TABLE "REQUEST" IS
  'A request generated whereby an engineer requests spareparts to go onsite service '
  ;

COMMENT ON TABLE "SERVICE_ORDER" IS
  'A requested call for onsite service that is sent after customer informed problems to
technical support at a headquarter'
  ;

COMMENT ON TABLE "SPAREPART" IS
  'Inventoried spareparts available for engineer to employ with service orders'
  ;

ALTER TABLE "EMPLOYMENT" ADD

  PRIMARY KEY ( "DELL_PART_NUMBER", "SERVICE_ORDER_NUMB" );

ALTER TABLE "ENGINEER" ADD

  PRIMARY KEY ( "ENGINEER_NUMBER" );

ALTER TABLE "ORDER" ADD

  PRIMARY KEY ( "ORDER_NUMBER" );

ALTER TABLE "REQUEST" ADD

  PRIMARY KEY ( "REQUEST_NUMBER" );

ALTER TABLE "SERVICE_ORDER" ADD

  PRIMARY KEY ( "SERVICE_ORDER_NUMB" );

ALTER TABLE "SHIPMENT" ADD

  PRIMARY KEY ( "ORDER_NUMBER", "DELL_PART_NUMBER" );
```

```
ALTER TABLE "SPAREPART" ADD
  PRIMARY KEY ( "DELL_PART_NUMBER" );
ALTER TABLE "EMPLOYMENT" ADD
  FOREIGN KEY ( "SERVICE_ORDER_NUMB" ) REFERENCES "SERVICE_ORDER";
ALTER TABLE "EMPLOYMENT" ADD
  FOREIGN KEY ( "DELL_PART_NUMBER" ) REFERENCES "SPAREPART";
ALTER TABLE "EMPLOYMENT" ADD
  FOREIGN KEY ( "ENGINEER_NUMBER" ) REFERENCES "ENGINEER";
ALTER TABLE "EMPLOYMENT" ADD
  FOREIGN KEY ( "REQUEST_NUMBER" ) REFERENCES "REQUEST";
ALTER TABLE "SHIPMENT" ADD
  FOREIGN KEY ( "SERVICE_ORDER_NUMB" ) REFERENCES "SERVICE_ORDER";
ALTER TABLE "SHIPMENT" ADD
  FOREIGN KEY ( "DELL_PART_NUMBER" ) REFERENCES "SPAREPART";
ALTER TABLE "SHIPMENT" ADD
  FOREIGN KEY ( "ORDER_NUMBER" ) REFERENCES "ORDER";
ALTER TABLE "SPAREPART" ADD
FOREIGN KEY ( "DELL_PART_NUMBER_1" ) REFERENCES "SPAREPART";
```

The built database is depicted in Figure 4.2.

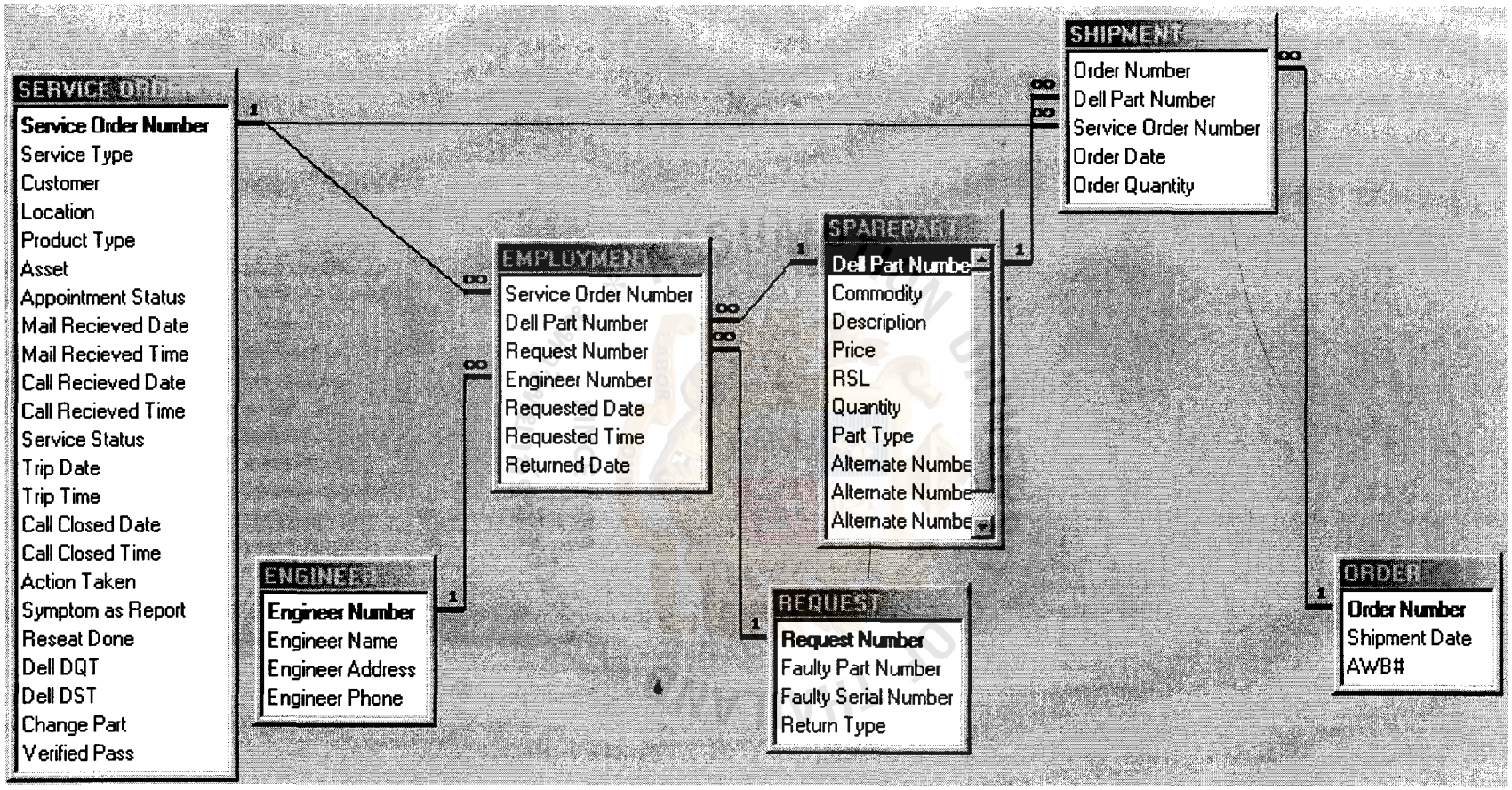

Figure 4.2. The Built Database of the Proposed System.

4.4 Conversion

Once a network and a database testing have been completed, we can begin preparations to place the new system into operation. We selected "Parallel Conversion" strategy. Under this approach, both the old and new systems are operated for some time period, therefore we offered group training to representative before initiating this strategy. We use this strategy to ensure that all major problems in the new system have been solved before the old system is discarded and to minimize the risk of major flaws in the new system causing irreparable harm to the business. We introduced verification testing which runs the system in a simulated environment using simulated data to look for errors and omissions regarding end-user and design specifications that were specified in the earlier phases but not fulfilled during construction. Validation testing runs the system in a live environment using real data as a final opportunity for end-users, management, and information system operations management to accept or reject the system. During this validation, we are testing a number of items such as systems performance, peak workload processing performance, human engineering test, backup and recovery test.

V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Table 5.1 shows the time performance on each process of the proposed system compared with the existing system.

Table 5.1. The Degree of Achievement of the Proposed System.

Process	Existing System	Proposed System
RMA Report Generating Process	1.25 hrs	40 mins.
Spare part Searching Process	15 mins.	2 mins.
Engineer Process	1 hr.	15 mins.
Call Planner Process	45 mins.	20 mins.
Order Process	30 mins	15 mins
Total	3 hrs. 50 mins	1 hr. 32 mins

After the proposed system is implemented, because of the new implemented database spare parts that are kept in the database server are not redundant and consistent anymore, all reports can automatically be generated by the system. RMA only spent a few minutes to cross check its reports before sending them to headquarter therefore the time that RMA needs to generate report reduces. Numbers of unavailable spare parts is immensely reduced because stock handler can faster order used and shortage spare parts by querying those data from the database and alternate spare part information also be easily retrieved from the system. Engineers can only spend a few minutes to fill only date and signature in request forms before they go onsite service. Time spent to request spare parts is very short because all requested spare parts are previously prepared for each service order. Therefore, a number of onsite services increase to 5 - 7 services per engineer per day. Engineers do not need to fill entire visited report because some of them are automatically generated by the system, hence time, which an engineer spends

APPENDIX A

FEASIBILITY ANALYSIS

for a service, is reduced. Service orders, received from headquarter via an electronic mail, can automatically be stored in the database without manual process, therefore the wrong input problem which occurs by manual process is eliminated.

The overall performance of a company is approximately 60 percent increased due to the reduction of miss call ,unavailable spare parts and wrong requested spare parts.

5.2 Recommendations

As one year contract between ISET and headquarter, the headquarter has more choices of subcontractor for on-site service. ISET must keep and improve its performance to a rate that can be accepted by the headquarter. To improve the performance in a next few years, the Internet-based client / server system may be adapted to be used at a head office in BKK in order to make all branches more easily access to the system and a better database management system product should be used. Advance input devices such as barcode reader may be applied for storing spare part database.

This is an international strategy that other logistic systems can apply this Logistic Control System with some modification especially in computer service businesses. In brief, the report suggests that to be a player in the global marketplace, management must be deeply committed to global strategic thinking. It must:

(1) Focus on how the firm creates value and how it fits the local conditions.

(2) Understand how to adapt the company internal capabilities to fit targeted branches.

(3) Develop high-level strategies for targeted branches.

(4) Have a global vision statement and implementation priority.

FEASIBILITY ANALYSIS

A.1 Operational Feasibility

Is the problem worth solving?

Table A.1. How Do the End Users and Managers Feel about the Problem (Solving)?

Candidate 1	Candidate 2	Candidate 3
1. Throughput of work is moderate in case of many traffic in each account. 2. Open program, make easy and compatible to modify application program. 3. Cheap and easy to upgrade application program.	1. Throughput of work is low, in case of many traffic in each account. 2. Same as candidate 1 3. very cheap and easy to upgrade application program.	1. Throughput of work is the highest, in case of many traffic in each account. 2. Close program, difficult for updating the application program. 3. very expensive for upgrade each program.

Table A.2. Usability Analysis.

Candidate 1	Candidate 2	Candidate 3
- Easy to insert each record in database more than insert directly into table.	- Same as Candidate 1	- Graphical interface make easier for using than candidate 1 & 2
- Ability to manage all records in one form (screen).	- Same as Candidate 1	- Same as Candidate 1
- Input and Output screen, more user friendly.	- Same as Candidate 1	- Same as Candidate 1
- Facilitate to create required report.	- Same as Candidate 1	- Same as Candidate 1

A.2 Technical Feasibility

A.2.1 SQL-based Client/Server Architecture

Microsoft SQL Server is a Structured Query Language (SQL) based client/server relational database. In a client/server system, a server is in a central location that

manages a resource used by many people. When individuals need to use the resource, they connect over the network from their computers, or clients, to the server. In the client/server database architecture, the database files and DBMS software reside on a server. A communications component is provided, so applications can run on separate clients and communicate via Open Database Connectivity (ODBC) to the database server over a network.

(1) Security: Have ability to create authorization for each user. We can protect unconcern user and manage level of access to database.

(2) Transaction: Decrease transaction traffic. After send SQL, the system will return the result. But this solution don't have program to check condition so if there are N conditions, they have to send SQL N times and also return the result N times.

(3) Changing integrity rule of store application will be increased maintenance cost which require to hire and train SQL, MS Access, MS SQL expertise.

A.2.2 Resource Sharing LAN Architecture

A data file is a storage place for data. The user runs an application that accesses data from the database and presents it to the user in an understandable format. When working with data files, an application must be coded to work with the specific structure of each data file. There are a lot of data file so required server for storing database on resource sharing LAN, which use both Windows 98 on workstation and Window NT on server. Checking each prerequisite make manipulate of DBMS in workstation have more traffics of data transaction. However, these solutions are using MS Access, which has been familiarized by current system so it decreases software training cost. Changing integrity rules of store application will be increased the maintenance cost.

A.2.3 Client/Server Architecture with Web Application

This architecture is close to SQL-based, but the application will be Web platform on Internet Explorer by using JAVA language programming instead of MS Access and ODBC. This looks similar to the concept of distributed presentation, which lead to less traffic transaction load:

(1) The maintenance cost of integrity rule of storing application is lower than other solution because it has the program to check condition. However, if the condition is not much, it is no need to have this program.

(2) Requirement to hire the specialist or well-trained staff.

(3) Some part of this implementation is a proprietary system because the program in both client and server needs to communicate under the same environment (Matching software).

(4) If there are more loads on the database server side, it needs to upgrade database sever which is expensive, especially on a new DBMS.

A.3 Economic Feasibility

Table A.3. Benefits Derived from the Operation of New System, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Reduced Workforce						
- RMA @ ฿ 12,000	12,000	12,600	13,230	13,891	14,586	15,315
- WLP @ ฿ 12,000	12,000	12,600	13,230	13,891	14,586	15,315
Reduced Preprinted Form						
(160 x 12 @ 2.5 ฿)	4,800	5,000	5,200	5,400	5,600	5,800
Penalty For Late Service						
(27,000 ฿ / month)	324,000	324,000	324,000	324,000	324,000	324,000
Total	352,800	354,200	355,660	357,182	358,772	360,430

The calculation of payback period, net present value (NPV), and return on investment (ROI) of each candidate is describe below.

For a candidate 1, Estimated Costs for Client-Server System Alternative is shown in Table A.4.

Table A.4. Estimate Project Cost of Candidate1, Baht.

Cost Items	Description	Amount	Unit Price (/Hr.)	Price
1.Development Cost:	1.1 Personnel Cost			
	System Analysts (20 hrs. /ea.)	1	400	8,000
	Programmer/Analysts (90 hrs. /ea.)	2	250	45,000
	Database Specialist (12 hrs. /ea.)	1	500	6,000
	Network Specialist (18 hrs. /ea.)	1	500	9,000
	Subtotal 1:			68,000
	1.2 New Hardware and Software Cost			
	Development Server (Pentium III)	1	250,000	250,000
	MS SQL Client Access License	5	32,00	16,000
	MS SQL Server 7.0 Software	1	18,000	18.000
	Subtotal 2 :			284,000
	Total Development Cost			352,000
2.Operating Cost:	2.1 Personnel Cost			
	Programmer/Analysts (50 hrs. /ea.)	2	250	25,000
	Subtotal 1:			25,000
	2.2 Maintenance Cost			
	Maintenance Agreement for MS.SQL	1	9,000	9,000
	Preprinted Form (15,840 /yrs)	3	13,200	39,600
	Subtotal 2:			48,600
	Total Operating Cost			73,600
	Total Project Annual Cost			425,600

For the candidate 1, The net present value analysis is shown in Table A5 and the payback analysis is shown in Table A.6.

Table A.5. Net Present Value Analysis of Candidate 1 (Rounded to Nearest 1), Baht.

Cash Flow description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Development cost	(352,000)	-	-	-	-	-	
Operations and maintenance cost	-	(73,600)	(74,600)	(75,600)	(76,600)	(77,600)	
Discount factors for 12%	1.000	0.893	0.797	0.712	0.636	0.567	
Present value of annual costs	(352,000)	(65,725)	(59,456)	(53,827)	(48,718)	(43,999)	
Total present value of lifetime costs							(623,725)
Benefits derived from operation of new system:	0	352,800	354,200	355,660	357,182	358,772	
Discount factors for 12%	1.000	0.893	0.797	0.712	0.636	0.567	
Present value of annual benefits	0	315,050	282,297	253,230	227,168	203,424	
Total present value of lifetime benefits							1,281,169
NET PRESENT VALUE OF THIS ALTERNATIVE							657,444

Table A.6. The Payback Analysis of Candidate 1 (Rounded to nearest 1), Baht.

Cash Flow description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development cost	(352,000)	-	-	-	-	-
Operations and maintenance cost	-	(73,600)	(74,600)	(75,600)	(76,600)	(77,600)
Discount factors for 12%	1.000	0.893	0.797	0.712	0.636	0.567
Time-adjusted cost (adjusted to PV)	(352,000)	(65,725)	(59,456)	(53,827)	(48,718)	(43,999)
Cumulative time-adjusted costs over lifetime	(352,000)	(417,725)	(477,181)	(531,008)	(579,726)	(623,725)
Benefits derived from operation of new system	0	352,800	354,200	355,660	357,182	358,772
Discount factors for 12%	1.000	0.893	0.797	0.712	0.636	0.567
Time-adjusted cost (adjusted to PV)	0	315,050	282,297	253,230	227,168	203,424
Cumulative time-adjusted costs over lifetime	0	315,050	597,348	850,578	1,077,745	1,281,169
Cumulative lifetime time-adjusted costs + benefits	(352,000)	(102,674)	120,167	319,570	498,020	657,444

For a candidate 2 Estimated Costs for Client-Server System Alternative is shown in Tables A.7.

Table A.7. Development Costs of Candidate 2, Baht.

Cost Items	Description	Amount	Unit Price (/Hr.)	Price
1.Development Cost:	1.1 Personnel Cost System Analysts (20 hrs. /ea.) Programmer/Analysts (120 hrs. /ea.) Database Specialist (12 hrs. /ea.)	 1 1 1	 400 250 500	 8,000 30,000 6,000
	Subtotal 1:			44,000
	1.2 New Hardware and Software Cost Development Server (Pentium III)	1	250,000	250,000
	Subtotal 2 :			250,000
	Total Development Cost			294,000
2.Operating Cost:	2.1 Personnel Cost Programmer/Analysts (60 hrs. /ea.)	1	250	15,000
	Subtotal 1:			15,000
	2.2 Maintenance Cost Preprinted Form (15,840 /yrs)	3	13,200	39,600
	Subtotal 2:			39,600
	Total Operating Cost			54,600
	Total Project Annual Cost			348,600

For the candidate 2 the net present value analysis is shown in Figure A.8 and the payback analysis is shown in Figure A.9.

Table A.8. Net Present Value Analysis of Candidate 2 (Rounded to nearest 1), Baht.

Cash Flow description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Development cost	(294,000)	-	-	-	-	-	
Operations and maintenance cost	-	(24,600)	(25,600)	(26,600)	(27,600)	(28,600)	
Discount factors for 12%	1.000	0.893	0.797	0.712	0.636	0.567	
Present value of annual costs	(294,000)	(21,968)	(20,403)	(18,939)	(17,554)	(16,216)	
Total present value of lifetime costs							(389,080)
Benefits derived from operation of new system	0	352,800	354,200	355,660	357,182	358,772	
Discount factors for 12%	1.000	0.893	0.797	0.712	0.636	0.567	
Present value of annual benefits	0	315,050	282,297	253,230	227,168	203,424	
Total present value of lifetime benefits							1,281,169
NET PRESENT VALUE OF THIS ALTERNATIVE							892,089

Table A.9. The Payback Analysis of Candidate 2 (Rounded to nearest 1), Baht.

Cash Flow description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development cost	(294,000)	-	-	-	-	-
Operations and maintenance cost	-	(24,600)	(25,600)	(26,600)	(27,600)	(28,600)
Discount factors for 12%	1.000	0.893	0.797	0.712	0.636	0.567
Time-adjusted cost (adjusted to PV)	(294,000)	(21,968)	(20,403)	(18,939)	(17,554)	(16,216)
Cumulative time-adjusted costs over lifetime	(294,000)	(315,968)	(336,371)	(355,310)	(372,864)	(389,080)
Benefits derived from operation of new system	0	352,800	354,200	355,660	357,182	358,772
Discount factors for 12%	1.000	0.893	0.797	0.712	0.636	0.567
Time-adjusted cost (adjusted to PV)	0	315,050	282,297	253,230	227,168	203,424
Cumulative time-adjusted costs over lifetime	0	315,050	597,348	850,578	1,077,745	1,281,169
Cumulative lifetime time-adjusted costs + benefits	(294,000)	(917)	260,977	495,268	704,882	892,089

For a candidate 3Estimated Costs for Client-Server System Alternative is shown in Tables A.10.

Table A.10. Development Cost of Candidate 3, Baht.

Cost Items	Description	Amount	Unit Price (/Hr.)	Price
1.Development Cost:	1.1 Personnel Cost			
	System Analysts (20 hrs. /ea.)	1	400	8,000
	Programmer/Analysts (90 hrs. /ea.)	2	250	45,000
	Database Specialist (12 hrs. /ea.)	1	500	6,000
	Network Specialist (18 hrs. /ea.)	1	500	9,000
	Subtotal 1:			68,000
	1.2 New Hardware and Software Cost			
	Development Server (Pentium III)	1	250,000	250,000
	MS SQL Client Access License	5	32,00	16,000
	MS SQL Server 7.0 Software	1	18,000	18.000
	Delphi	1	10,000	10,000
	Subtotal 2 :			294,000
	Total Development Cost			362,000
2.Operating Cost:	2.1 Personnel Cost			
	Programmer/Analysts (50 hrs. /ea.)	2	250	25,000
	Subtotal 1:			25,000
	2.2 Maintenance Cost			
	Maintenance Agreement for MS.SQL	1	9,000	9,000
	Preprinted Form (15,840 /yrs)	3	13,200	39,600
	Subtotal 2:			48,600
	Total Operating Cost			73,600
	Total Project Annual Cost			435,600

For the candidate 3, The net present value analysis is shown in Table A.11 and the payback analysis is shown in Table A.12.

Table A.11. Net Present Value Analysis of Candidate 3 (Rounded to nearest 1), Baht.

Cash Flow description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Development cost	(362,000)	-	-	-	-	-	
Operations and maintenance cost		(73,600)	(74,600)	(75,600)	(76,600)	(77,600)	
Discount factors for 12%	1.000	0.893	0.797	0.712	0.636	0.567	
Present value of annual costs	(362,000)	(65,725)	(59,456)	(53,827)	(48,718)	(43,999)	
Total present value of lifetime costs							(633,725)
Benefits derived from operation of new system	0	352,800	354,200	355,660	357,182	358,772	
Discount factors for 12%	1.000	0.893	0.797	0.712	0.636	0.567	
Present value of annual benefits	0	315,050	282,297	253,230	227,168	203,424	
Total present value of lifetime benefits							1,281,169
NET PRESENT VALUE OF THIS ALTERNATIVE							647,444

Table A.12. The Payback Analysis of Candidate 3 (Rounded to nearest 1), Baht.

Cash Flow description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development cost :	(362,000)	-	-	-	-	-
Operations and maintenance cost :	-	(73,600)	(74,600)	(75,600)	(76,600)	(77,600)
Discount factors for 12% :	1.000	0.893	0.797	0.712	0.636	0.567
Time-adjusted cost (adjusted to PV):	(362,000)	(65,725)	(59,456)	(53,827)	(48,718)	(43,999)
Cumulative time-adjusted costs over lifetime:	(362,000)	(427,725)	(487,181)	(541,008)	(589,726)	(633,725)
Benefits derived from operation of new system :	0	352,800	354,200	355,660	357,182	358,772
Discount factors for 12% :	1.000	0.893	0.797	0.712	0.636	0.567
Time-adjusted cost (adjusted to PV):	0	315,050	282,297	253,230	227,168	203,424
Cumulative time-adjusted costs over lifetime:	0	315,050	597,348	850,578	1,077,745	1,281,169
Cumulative lifetime time-adjusted costs + benefits:	(362,000)	(112,674)	110,167	309,570	488,020	647,444

APPENDIX B

INPUT AND OUTPUT DESIGN

Line graphs used to depict the payback period of each candidate are shown in Figures A.1, A.2, and A.3 respectively.

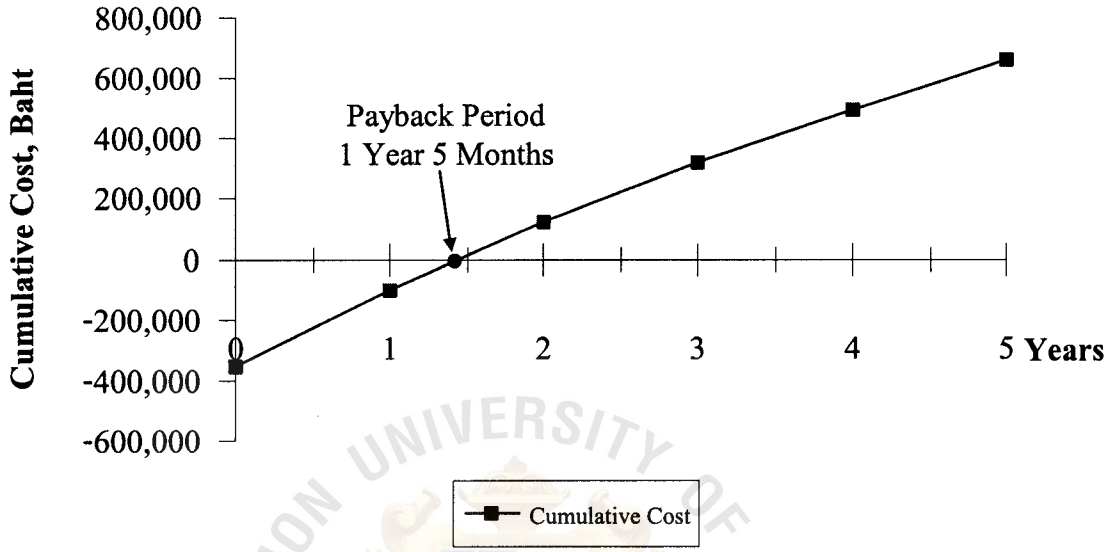

Figure A.1. Payback Period of Candidate 1.

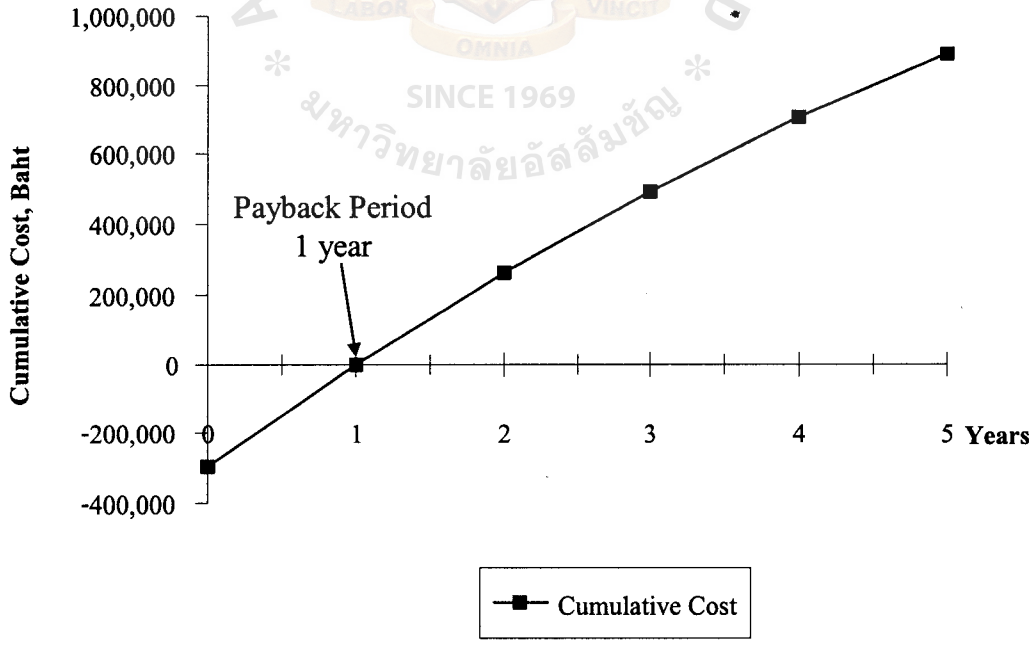

Figure A.2. Payback Period of Candidate 2.

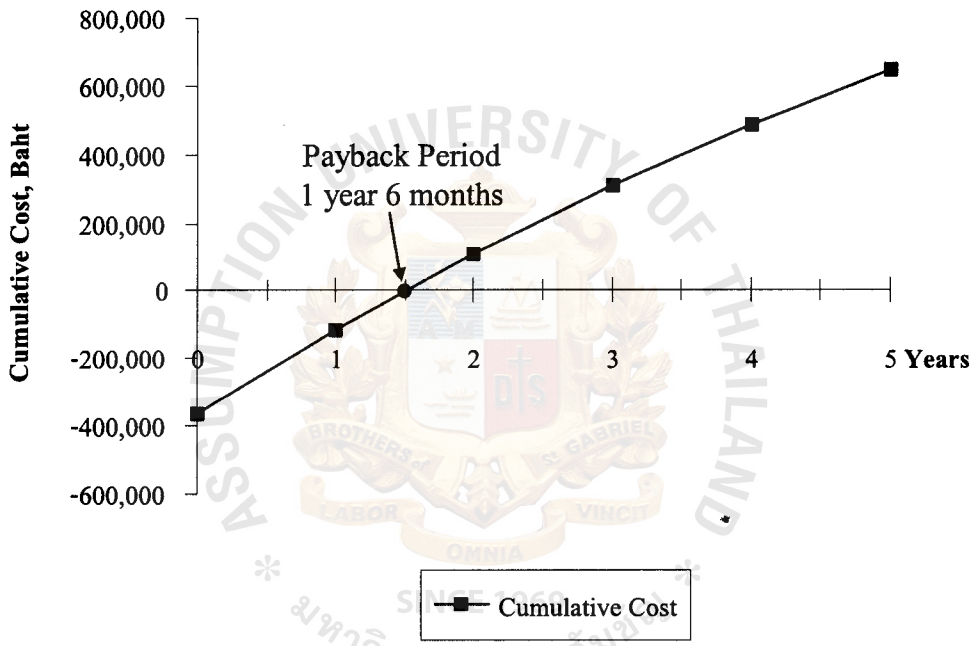

Figure A.3. Payback Period of Candidate 3.

INPUT AND OUTPUT DESIGN

B.1 Input Design

Input design serves as important goal to capture and get the data into a format suitable for the computer. Our Logistics Control System need input design that can increase fast performance of data input daily. We select Batch input method for this system. The source documents or forms are collected and then periodically forwarded to data entry operators, who key the data using a data entry device that translates the data into a machine-readable format.

Because inputs originate with system users, human factors play a significant role in input. Then, input should be as simple as possible and designed to reduce the possibility of incorrect data being entered. In our considerations to capture data, we follow these good principles below:

(1) Capture only variable data

(2) Do not capture data that can be calculated or stored in computer programs

(3) Use codes for appropriate attributes

Concerning to our requirement, we have designed five Graphic User Interfaces (GUIs) to make easy for data entry. The selected GUIs are depicted the lay out of input GUIs Form follows:-

(1) GUI of Service Call Receive Form is depicted in Figure B.1.

(2) GUI of Service Report Form is depicted in Figure B.2.

(3) GUI of Order Form is depicted in Figure B.3.

(4) GUI of Sparepart Form is depicted in Figure B.4.

(5) GUI of Request Form is depicted in Figure B.5.

(1) GUI of Service Call Receive Form: uses for input service information before engineer service customer.

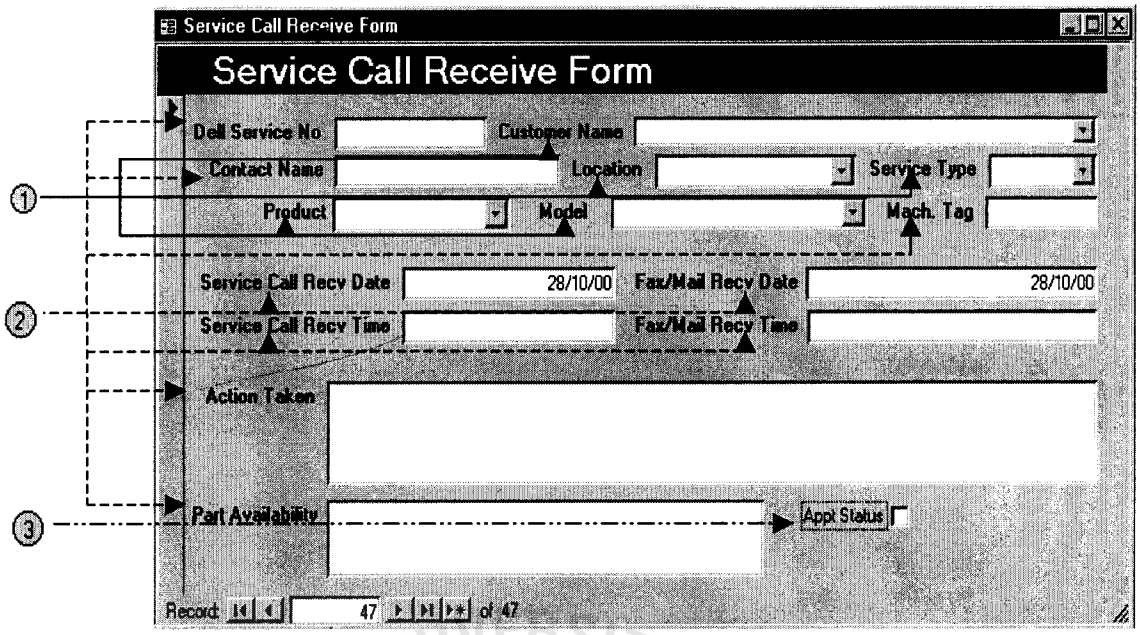

Figure B.1. Graphic User Interface of Service Call Receive Form.

Service call receive Form consist of:

(1) List Box

Attribute: Customer Name, Location, Service Type, Product, Model

require user to value from a list of possible choice.

(2) Text Box

Attribute: Dell Service Number, Contact Name, Mach. Tag, Service Call Receive Date, Service Call Receive Time, Fax/Mail Receive Date, Fax/Mail Receive Time, Action Taken, Part Availability.

require the user to type the data inside the box, it can around for single and multiple line of data character to be entered.

(3) Check Box

Attribute: Appointment Status

A square box by a textual description of the input field for which the user is to provide the Yes/No value.

A detail of each attribute, input control, and data validation technique, is described in Table B.1.

(2) GUI of Service report form: After service information.

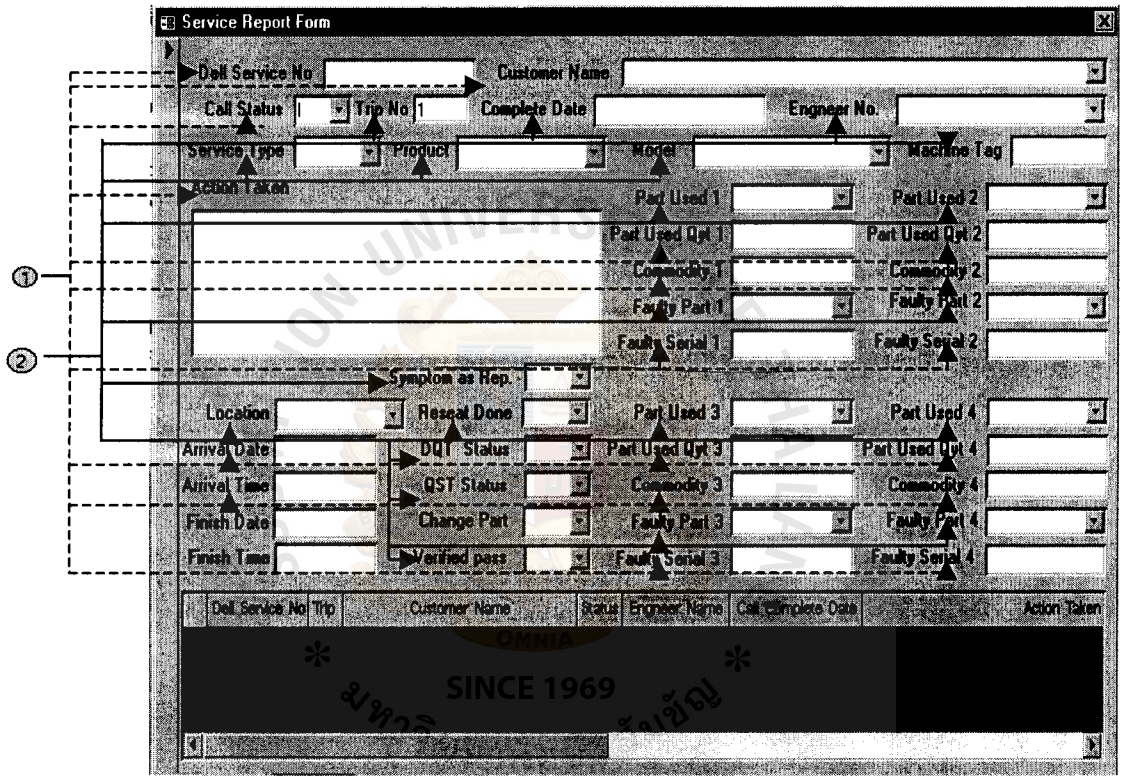

Figure B.2. Graphic User Interface of Service Report Form.

Service report form consist of:

(1) Text Box

Attribute: Request Number, Service Order Number, Faulty Serial Number, Requested Date, Requested Time, Returned Date

require the user to type the data inside the box, it can around for single and multiple line of data character to be entered.

(2) List Box

Attribute: Engineer Name, Engineer Number, Faulty Part Number, Dell Part Number

require user to select value from a list of possible choice.

A detail of each attribute, input control, and data validation technique, is described in Table B.2.

(3) Order Form: Input order information

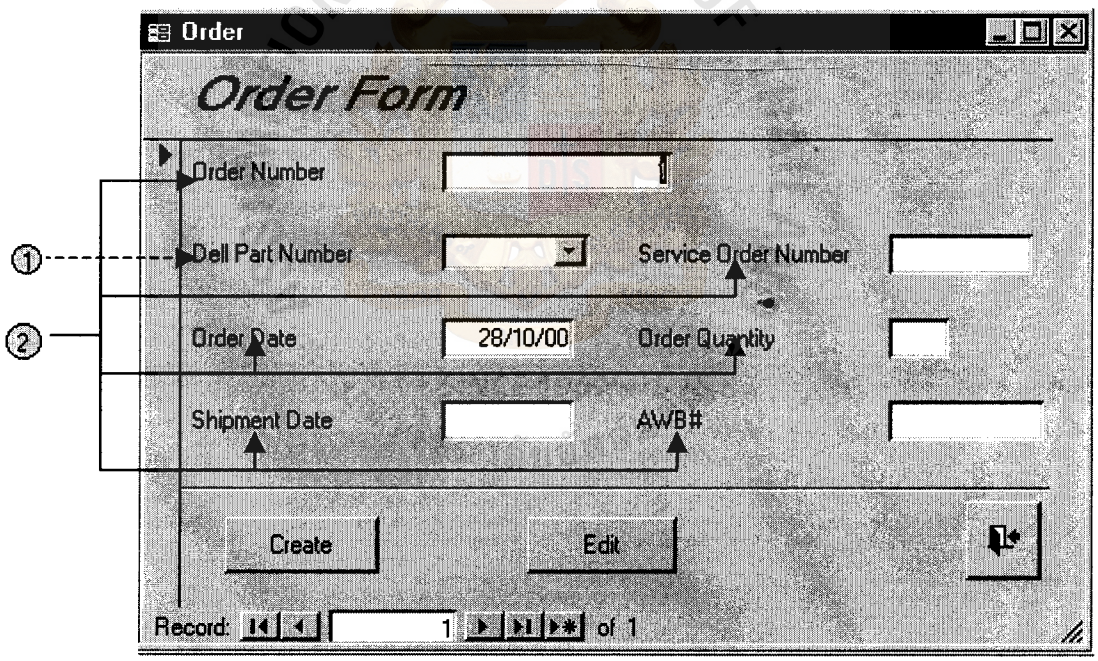

Figure B.3. Graphic User Interface of Order Form.

Order form consist of:

(1) List Box

Attribute: Dell Part Number

require user to select value from a list of possible choice.

(2) Text Box

Attribute: Order Number, Service Order Number, Order Date, Order Quantity, Shipment Date, AWB#

require the user to type the data inside the box, it can around for single and multiple line of data character to be entered.

A detail of each attribute, input control, and data validation technique, is described in Table B.3.

(4) Spare Part Form: For input spare part information.

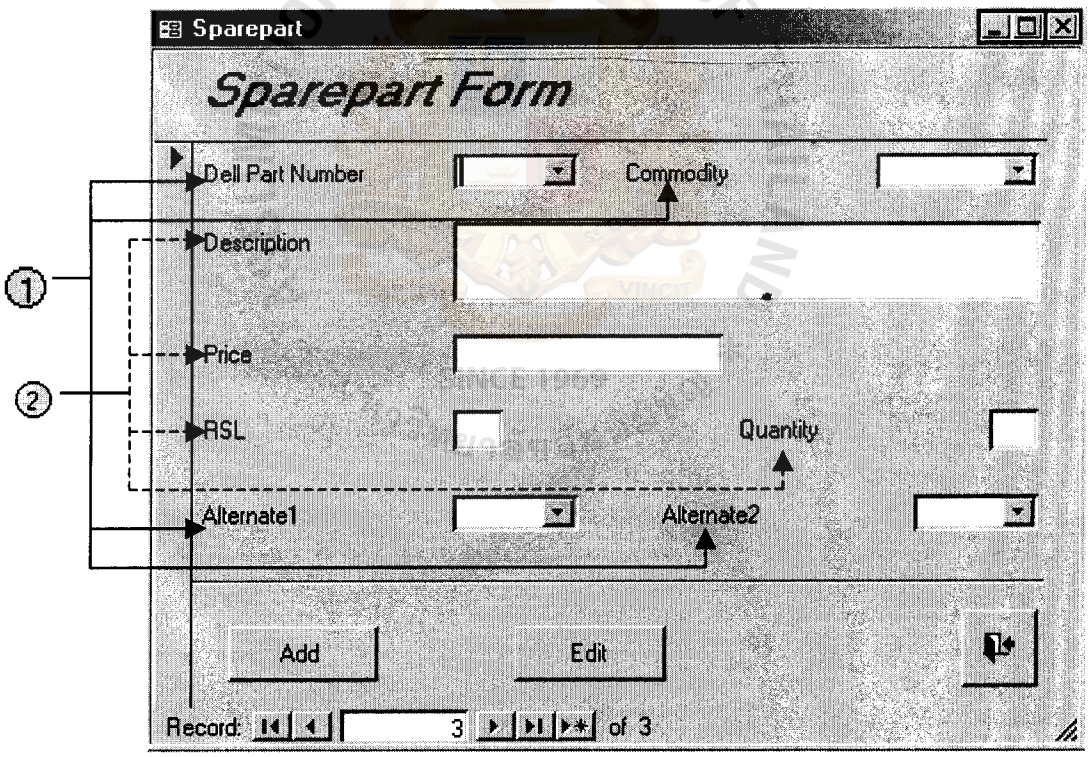

Figure B.4. Graphic User Interface of Spare Part Form.

Spare part Form consist of:

(1) List Box

Attribute: Dell Part Number, Commodity, Alternate1, Alternate2

require user to select value from a list of possible choice.

(2) Text Box

Attribute: Description, Price, RSL, Quantity.

require the user to type the data inside the box, it can around for single and multiple line of data character to be entered.

A detail of each attribute, input control, and data validation technique, is described in Table B.4.

(5) GUI: Request Form

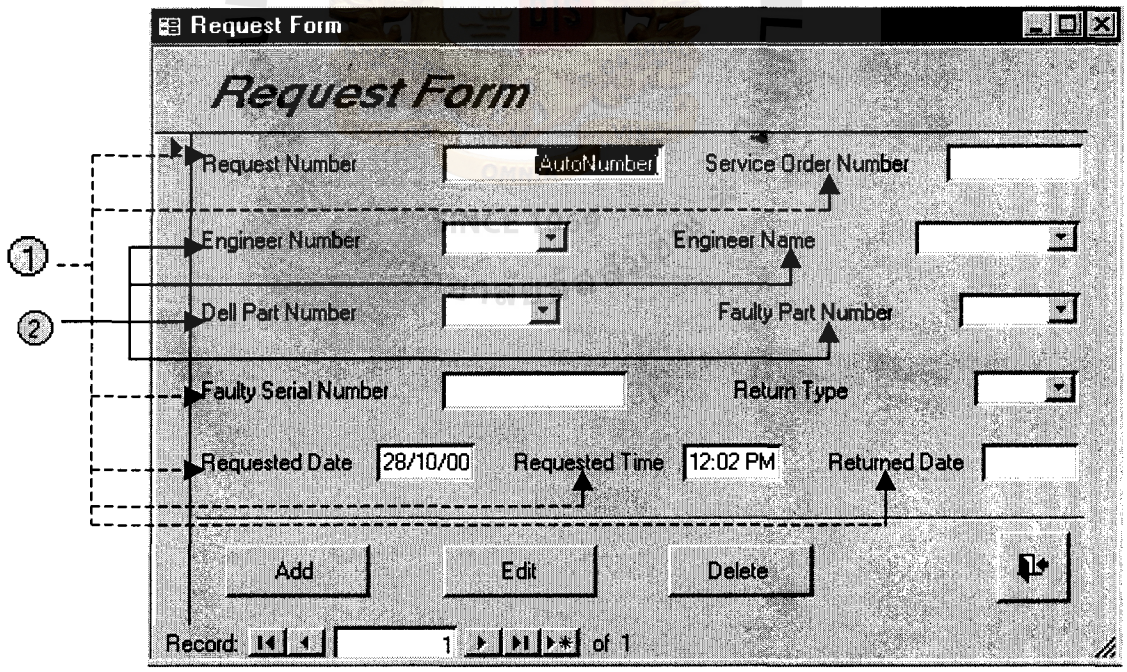

Figure B.5. Graphic User Interface of Request Form.

Request Input Form consist of:

(1) Text Box

Attribute: Request Number, Service Order Number, Faulty Serial Number, Requested Date, Requested Time, Returned Date

require the user to type the data inside the box, it can around for single and multiple line of data character to be entered.

(2) List Box

Attribute: Engineer Name, Engineer Number, Faulty Part Number, Dell Part Number

require user to select value from a list of possible choice.

A detail of each attribute, input control, and data validation technique, is described in Table B.5.

B.2 Graphical User Interface Controls for Input Design

Input validation is an important aspect of any successful business application. A program that simply accepts just any user input is condemned to waste a great deal of time dealing with bad information. And, as applications move away from the character-based and toward event-driven GUI design, input validation needs become even more complex. In traditional text-based, users were forced to key data in linear fashion, delete back to any mistakes they made, and then retype the section or line over again. This unproductive input method proved so frustrating that many developers designed their own input controls to more creatively handle the entry and editing of keyed data.

As GUI has emerged, the issue of sophisticated input control has resurfaced. Suddenly users are in charge of everything that happens on an application's interface. They are no longer content to enter multiple fields in a programmed order; they want to be able to cut, paste, insert, and remove characters from input fields at will. And input

validation is just as important for controls that conform to the Windows paradigm as it was in character-based systems.

GUI designs provide a more user friendly interface and so as for our Logistic Control System. GUI help guide the call planner through a set of function and avoid the need to display discouraging error data resulting from the use of inappropriate functionality. For easy understanding, we have divided all the data input attributes of LCS system in separate table according to our GUI control design.

I. ATTRIBUTES WITH TEXT BOX			
1	Service Order No.	12	Action Taken
2	Asset	13	Order Quantity
3	Mail Received Date	14	RSL
4	Mail Received Time	15	Quantity
5	Call Received Date	16	Description
6	Call Received Time	17	Price
7	Trip Date	18	Faulty Serial No.
8	Trip Time	19	Order No.
9	Call Close Date	20	Order Date
10	Call Close Time	21	Shipment Date
11	Reserved Part	22	Airway Bill No.

Figure B.6. List of Attributes with Text Box.

The TEXT control provides a box for the entry and display of text strings and has optional prefix and suffix labels. Displayed text will scroll if the string length is longer than the text entry box width. A text box is the most suitable used in this situations where in the input data values are unlimited in scope and we are not able to provide the call planner with a meaningful list from which they can select. For example, a single-line text box would be an appropriate control for engineer number since the possibilities for engineer number are virtually impossible to predetermine.

2. ATTRIBUTES WITH DROP- DOWN LIST			
1	Location	9	Symptom as report
2	Service Type	10	Receive done
3	Product Type	11	Dell DQT
4	Used Part No.	12	Dell DST
5	Faulty Part No.	13	Change Part
6	Return Type	14	Verify pass
7	Engineer No.	15	Dell Part No.
8	Service Status	16	Alternate No.

Figure B.7. List of Attributes with Drop Down List.

Drop-down list consists of a rectangular selection field with a small button connected to its side. The small button contains the image of a downward pointing arrow and bar. The reasons why the above attributes are suitable for drop-down list are because the input data item has a large number of predefined values and screen space availability prohibits the use of list box. Even though the drop-down requires extra steps for the call planner, the button is intended to suggest the user the existence of a hidden list of possible values for a date item and use minimal screen space.

3. ATTRIBUTE WITH COMBO	
1.	Customer

Figure B.8. List of Attributes with Combo Box.

Combination box combines the capabilities of a text box and list box. A combo box gives the user the flexibility of entering a date item's value (as with a text box) or selecting its value from a list (as with a list box). The reason why we will use combo for the service type is because the screen is limited. And it is desirable to provide the call

planner with option of selecting a value from a list or typing a value that may or may not appear as an option is the list.

4. ATTRIBUTE WITH CHECK BOX	
1.	Appointment Status

Figure B.9. List of Attributes with Check Box.

The check box consists of a square box followed by a textual description of the input field for which the call planner is to provide the C/I (complete / incomplete) valve. Check box is selected because it provides the call planner with the flexibility of selecting the value via the keyboard or mouse. Since the input in our case is the simple one (either complete or incomplete), the check box is the most appropriate it offers a visual and intuitive means for the user to input such data.

B.3 Data Validation Technique

(1) **Completeness checks** determine weather all requires fields on the input have actually been entered.

(2) **Limit and range** checks determine weather the input data for each field falls within the legitimate set or range of values define for that field. For instance, an upper-limit range may be put on pay rate to ensure that no employ is paid at higher rate.

(3) **Combination checks** determine weather a weather a known relationship between two fields is valid. For instance, if the vehicle is Pontiac, then the vehicle model must be one of a limited set of value that comprises cars

manufactured by Pontiac (Firebird, Grand Prix, and Bonneville to name a few).

(4) **Self-checking digits** determine data entry errors on Primary keys. A check digit is a number or character that is appended to a primary key field. The check digit is calculated by applying a formula. Such as Modulus 11, to the actual key. The check digit verifies correct data entry in one of two ways. Some data entry devices can automatically validate data by the data entry clerk. If the check digit entered doesn't match the check digit calculated, an error is displayed. Alternatively, computer programs can also validate check digits by using readily available subroutines.

(5) **Picture checks** compare data enters against the known COBOL picture or other language format defined for that data. For instance, the input field may have a picture clause XX999 AA (where X can be a later or number, 9 must be a number, and A must be a letter). The field "A4898 DH" would pass the picture check, but the field "A489 ID8" would not.

Data validation requirement requires that special edit programs be written to perform checks. However, the input validation requirements should be designed when the input themselves are designed.

B.4 Output Design

System users need output that can present accurate information and effectiveness. There are two types of computer outputs, which are internal outputs and external outputs. External outputs will leave the system to trigger actions on the part of their recipients or confirm actions to their recipients. Most external outputs are created as preprinted forms that are designed and duplicated by Forms Company for use on computer printers. Internal outputs will stay inside the system to support the system's

users and managers. These outputs can fulfill management reporting and decision support requirements. System users can generate report from this information directly, which save their time a lot.

LCS has two forms of turnaround outputs, which are Visited Report and Requested Form.

(1) Figure B.10 represents the layout of Visited Report Printed Form

(2) Figure B.11 represents the layout of Requested Printed Form

The other two forms of output are internal outputs.

(3) Figures B.12 to B.15 represent the layout of Daily Service Report

(4) Figure B.16 represents the layout of Order Shipment Report

Tables B.1 – B.9 describe attributes of each form depicted in Figures B.1 – B.5 and Figures B.10 – B.16.

ISET ENGINEERING ISET Engineering Co.,Ltd. Service Activity Report

Service Order No. : _____ Customer Name : _____

Contact Name : _____ Contact No. : _____ Engineer : _____

Service Type : _____ Model : _____ Model Type : _____ Machine Tag No. : _____

Action Taken : _____

Job Status ❑ : C ❑ : I

Arrival Date : _____

Arrival Time : _____

Finish time : _____

	Yes	No	N/A
Symptom as Report :	❑	❑	❑
Reseat done :	❑	❑	❑
DQT Status :	❑	❑	❑
DST Status :	❑	❑	❑
Change Part :	❑	❑	
Verified pass after fix :	❑	❑	❑

Part Used 1 : _____ ❑ : ORI ❑ : ALT

Commodity 1 : _____

Faulty Part 1 : _____

Serial 1 : _____

Part Used 2 : _____ ❑ : ORI ❑ : ALT

Commodity 2 : _____

Faulty Part 2 : _____

Serial 2 : _____

Part Used 3 : _____ ❑ : ORI ❑ : ALT

Commodity 3 : _____

Faulty Part 3 : _____

Serial 3 : _____

Part Used 4 : _____ ❑ : ORI ❑ : ALT

Commodity 4 : _____

Faulty Part 4 : _____

Serial 4 : _____

Customer Name : _____ Date : _____

Figure B.10. Visited Report.

Running No.....

ISSUE TO ENGINEER FORM

REQUESTED BY : ..... ENGINEER CODE : .....

DELL S/O NO. : ..... REQ. DATED : ..... TIME : .....

FROM STOCK LOCATION : 534.....

PART NO.	QTY.	SERVICE TYPE	WLP ENTRY DATED

( ) Manual Entry Dated : .....

PART ISSUED

ISSUED BY : ..... DATED.....

RECEIVED BY : ..... DATED.....

Figure B.11. Requested Form.

Service Order Number	Customer	Service Type	Call Received		Mail Received		Service Status	Call Close		Trip Date
			Date	Time	Date	Time		Date	Time	

Figure B.12. The Layout of Daily Service Report.

Trip Time	Used Part No.1	Commodity No.1	Faulty Part No.1	Faulty Serial No.1	Used Part No.2	Commodity No.2	Faulty Part No.2	Faulty Serial No.2	Used Part No.3

Figure B.13. The Layout of Daily Service Report (Continued).

Commodity No.3	Faulty Part No.3	Faulty Serial No.3	Used Part No.4	Commodity No.4	Faulty Part No.4	Faulty Serial No.4	Symtom as report	Receive Done	Dell DQT

Figure B.14. The Layout of Daily Service Report (Continued).

Dell DST	Change Part	Verify Pass	TPM Engineer Name	Type of Product	Location	Part Availability	Appointment Status

Figure B.15. The Layout of Daily Service Report (Continued).

COMPANY NAME:_____

Order Date	Service Order Number	TPM Ref Number	Quotation Date	Quotation Number	Part Number	Qty	Altenate/ Repl	Price	Lacation	SHIPMENT DETAIL		Status Of Part Availability
										Date	AWB#	

Figure B.16. The Layout of Order Shipment Report.

Table B.1. Service Call Receive Form (ACTOR: CALL PLANNER).

Attribute Name	Type	Length	Default	Data Validation Technique	Control for Input	Remark
Service Order No.	Numeric	11 digits	-	Limit and Length Check	Text Box	
Service Type	Alphanumeric	4 digits	-	-	Drop-Down List	NBD POW 4HR PO4 NBDO INST
Customer	String	50 digits	-	-	Combo Box	
Location	Alphabet	3 digits	BKK	-	Drop-Down List	
Product Type	String	15 digits	-	Combination Check	Drop-Down List	
Asset	Alphanumeric	6 digits	-	-	Text Box	
Appointment Status	Character	1 digit	Appoint	-	Drop-Down List	Appoint Unappoint
Mail Received Date	Date	8 digits	Current date	Picture Checks	Text Box	
Mail Received Time	Time	5 digits	-	-	Text Box	
Call Received Date	Date	8 digits	Current date	Picture Checks	-	
Call Received Time	Time	5 digits	-	-	-	
1{Dell Part No.}8	Alphanumeric (repeating group)	5 digits	-	Limit and Length Check	Text Box	
Action taken	String	200 digits	-	-	-	

Table B.2. Service Report Form.

Attribute Name	Type	Length	Default	Data Validation Technique	Control for Input	Remark
Service Order No.	Numeric	11 digits	-	Limit and Range Check	Text Box	
Used Part No. 1	Alphanumeric	5 digits	-	-	Drop-Down List	
Commodity 1	String	10 digits	-	-	Text Box	
Faulty Part No.1	Alphanumeric	5 digits	-	-	Drop-Down List	
Faulty Serial No.1	Alphanumeric	15 digits	-	-	Text Box	
Return Type 1	Alphabet	4 digits	Bad	-	Drop-Down List	Bad Good DOA IFIA
Used Part No. 2	Alphanumeric	5 digits	-	-	Drop-Down List	
Commodity 2	String	10 digits	-	-	Text Box	
Faulty Part No.2	Alphanumeric	5 digits	-	-	Drop-Down List	
Faulty Serial No.2	Alphanumeric	15 digits	-	-	Text Box	
Return Type 2	Alphabet	4 digits	Bad	-	Drop-Down List	Bad Good DOA IFIA
Used Part No. 3	Alphanumeric	5 digits	-	-	Drop-Down List	
Commodity 3	String	10 digits	-	-	Text Box	
Faulty Part No. 3	Alphanumeric	5 digits	-	-	Drop-Down List	
Faulty Serial No.3	Alphanumeric	15 digits	-	-	Text Box	

Table B.2. Service Report Form (Continued).

Attribute Name	Type	Length	Default	Data Validation Technique	Control for Input	Remark
						Good DOA IFIA
Used Part No. 4	Alphanumeric	5 digits	-	-	Drop-Down List	
Commodity 4	String	10 digits	-	-	Text Box	
Faulty Part No.4	Alphanumeric	5 digits	-	-	Drop-Down List	
Faulty Serial No.4	Alphanumeric	15 digits	-	-	Text Box	
Return Type 4	Alphabet	4 digits	Bad	-	Drop-Down List	Bad Good DOA IFIA
Engineer No.	Alphanumeric	7 digits	-	Limit and Range Check	Drop-Down List	
Service Status	Character	1 digit	C = complete	-	Drop-Down List	
Trip Date	Date	8 digits	-	Picture Check	Text Box	
Trip Time	Time	5 digits	-	-	Text Box	
Call Close Date	Date	8 digits	-	Picture Check	Text Box	
Call Close Time	Time	5 digits	-	-	Text Box	
Action taken	String	200 characters	-	-	Text Box	
Symptom as report	Numeric	1 digit	0 = Yes	-	Drop-Down List	0 = Yes 1 = No 2 = N/A
Receive done	Numeric	1 digit	0 = Yes	-	Drop-Down List	0 = Yes 1 = No 2 = N/A

Table B.2. Service Report Form (Continued).

Attribute Name	Type	Length	Default	Data Validation Technique	Control for Input	Remark
Dell DQT	Numeric	1 digit	0 = Yes	-	Drop-Down List	0 = Yes 1 = No 2 = N/A
Dell DST	Numeric	1 digit	0 = Yes	-	Drop-Down List	0 = Yes 1 = No 2 = N/A
Change Part	Numeric	1 digit	0 = Yes	-	Drop-Down List	0 = Yes 1 = No 2 = N/A
Verify pass	Numeric	1 digit	0 = Yes	-	Drop-Down List	0 = Yes 1 = No 2 = N/A

Table B.3. Order Form.

Attribute Name	Type	Length	Default	Data Validation Technique	Control for Input	Remark
Order No.	Numeric	5 digits	-	Auto Number	Text Box	
Dell Part No.	Alphanumeric	5 digits	-	Limit and Range Check	Drop-Down List	
Service Order No.	Numeric	11 digits	-	Limit and Range Check	Text Box	
Order Date	Date	8 digits	Current Date	Picture Check	Text Box	
Order Quantity	Numeric	1 digit	1	-	Text Box	
Shipment Date	Date	8 digits	-	Picture Check	Text Box	
Awb#	Alphanumeric	12 digits	-	-	Text Box	

Table B.4. Sparepart Form.

Attribute Name	Type	Length	Default	Data validation technique	Control for Input	Remark
Dell Part No.	Alphanumeric	5 digits	-	Limit and Range Check	Drop-Down List	
Description	String	30 digits	-	-	Text Box	
Price	Numeric	4 digits	-	-	Text Box	
RSL	Numeric	2 digits	-	-	Text Box	
Quantity	Numeric	2 digits	-	-	Text Box	
Alternate No.1	Alphanumeric	5 digits	-	Limit and Range Check	Drop-Down List	
Alternate No.2	Alphanumeric	5 digits	-	Limit and Range Check	Drop-Down List	
Commodity	String	10 digits	-	-	Text Box	

Table B.5. Request Form.

Attribute Name	Type	Length	Default	Data validation technique	Control for Input	Remark
Request No.	Numeric	7 digits	-	-	Drop-Down List	
Service Order No.	Numeric	11 digits	-	-	Text Box	
Engineer No.	Alphanumeric	7 digits	-	Limit and Range Check	Text Box	
Engineer Name	Alphabet	10 digits	-	-	Text Box	
Request Date	Date	8 digits	Current Date	-	Text Box	
Request Time	Time	5 digits	-	-	Text Box	
Return Date	Date	8 digits	-	-	Drop-Down List	
Dell Part No.	Alphanumeric	5 digits	-	Limit and Range Check	Drop-Down List	
Faulty Part No.	Alphanumeric	5 digits	-	-	Drop-Down List	
Faulty Serial No.	Alphanumeric	15 digits	-	-	Text Box	
Return Type	Alphabet	4 digits	Bad	-	Drop-Down List	Bad Good DOA IFIA

Table B.6. The Attribute Detail of Visited Report.

Attribute Name	Type	Length	Default	Remark
Service Order No.	Numeric	11 digits	-	
Engineer No.	Alphanumeric	7 digits	-	
Service Type	Alphanumeric	4 digits	NBD	
Customer	String	50 digits	-	
Product Type	String	15 digits	-	
Asset	Alphanumeric	6 digits	-	
Service Status	Character	1 digit	-	
Trip Date	Date	8 digits	-	
Trip Time	Time	5 digits	-	
Call Close	Time	5 digits	-	
Action taken	String	200 characters	-	
1{ Used Part No., Commodity, Faulty Part No., Faulty Serial No. }4	Alphanumeric String Alphanumeric Alphanumeric	5 digits 10 digits 5 digits 15 digits	- - - -	
Symptom as report	Numeric	1 digit	-	0 = Yes 1 = No 2 = N/A
Receive done	Numeric	1 digit	-	0 = Yes 1 = No 2 = N/A
Dell DQT	Numeric	1 digit	-	0 = Yes 1 = No 2 = N/A

Table B.6. The Attribute Detail of Visited Report (Continued).

Attribute Name	Type	Length	Default	Remark
Dell DST	Numeric	1 digit	-	0 = Yes 1 = No 2 = N/A
Change Part	Numeric	1 digit	-	0 = Yes 1 = No 2 = N/A
Verify pass	Numeric	1 digit	-	0 = Yes 1 = No 2 = N/A

Table B.7. The Attribute Detail of Request Form.

Attribute Name	Type	Length	Default	Remark
Request No.	Numeric	7 digits	-	
Service Order No.	Numeric	11 digits	-	
Engineer No.	Alphanumeric	7 digits	-	
Dell Part No.	Alphanumeric	5 digits	-	
Request Date	Date	8 digits	Current Date	
Request Time	Time	5 digits	-	
Return Date	Date	8 digits	-	
Service Type	Alphanumeric	4 digits	NBD	
Return Type	Alphabet	4 digits	Bad	

Table B.8. The Attribute Detail of Daily Service Report.

Attribute Name	Type	Length	Default	Remark
Service Order No.	Numeric	11 digits	-	
Customer	String	50 digits	-	
Service Type	Alphanumeric	4 digits	NBD	
Call Received Date	Date	8 digits	Current date	
Call Received Time	Time	5 digits	-	
Mail Received Date	Date	8 digits	Current date	
Mail Received Time	Time	5 digits	-	
Service Status	Character	1 digit	C = complete	Complete Incomplete
Call Close Date	Date	8 digits	-	
Call Close Time	Time	5 digits	-	
Trip Date	Date	8 digits	-	
Trip Time	Time	5 digits	-	
Used Part No 1.	Alphanumeric	5 digits	-	
Commodity 1.	String	10 digits	-	
Faulty Part No 1.	Alphanumeric	5 digits	-	
Faulty Serial No. 1.	Alphanumeric	15 digits	-	
Used Part No 2.	Alphanumeric	5 digits	-	
Commodity 2.	String	10 digits	-	
Faulty Part No 2.	Alphanumeric	5 digits	-	
Faulty Serial No. 2.	Alphanumeric	15 digits	-	
Used Part No 3.	Alphanumeric	5 digits	-	
Commodity 3.	String	10 digits	-	
Faulty Part No 3.	Alphanumeric	5 digits	-	

Table B.8. The Attribute Detail of Daily Service Report (Continued).

Attribute Name	Type	Length	Default	Remark
Used Part No 4.	Alphanumeric	5 digits	-	
Commodity 4.	String	10 digits	-	
Faulty Part No 4.	Alphanumeric	5 digits	-	
Faulty Serial No. 4.	Alphanumeric	15 digits	-	
Used Part No 5.	Alphanumeric	5 digits	-	
Commodity 5.	String	10 digits	-	
Faulty Part No 5.	Alphanumeric	5 digits	-	
Faulty Serial No. 5.	Alphanumeric	15 digits	-	
Used Part No 6.	Alphanumeric	5 digits	-	
Commodity 6.	String	10 digits	-	
Faulty Part No 6.	Alphanumeric	5 digits	-	
Faulty Serial No. 6.	Alphanumeric	15 digits	-	
Used Part No 7.	Alphanumeric	5 digits	-	
Commodity 7.	String	10 digits	-	
Faulty Part No 7.	Alphanumeric	5 digits	-	
Faulty Serial No. 7.	Alphanumeric	15 digits	-	
Used Part No 8.	Alphanumeric	5 digits	-	
Commodity 8.	String	10 digits	-	
Faulty Part No 8.	Alphanumeric	5 digits	-	
Faulty Serial No. 8.	Alphanumeric	15 digits	-	
Symptom as report	Numeric	1 digit	-	0 = Yes 1 = No 2 = N/A

Table B.8. The Attribute Detail of Daily Service Report (Continued).

Attribute Name	Type	Length	Default	Remark
Receive done	Numeric	1 digit	-	0 = Yes 1 = No 2 = N/A
Dell DQT	Numeric	1 digit	-	0 = Yes 1 = No 2 = N/A
Dell DST	Numeric	1 digit	-	0 = Yes 1 = No 2 = N/A
Change Part	Numeric	1 digit	-	0 = Yes 1 = No 2 = N/A
Verify pass	Numeric	1 digit	-	0 = Yes 1 = No 2 = N/A
Engineer No.	Alphanumeric	7 digits	-	
Location	Alphabet	3 digits	BKK	
Product Type	String	15 digits	-	

Table B.9. The Attribute Detail of Order Shipment Report.

Attribute Name	Type	Length	Default	Remark
Order Date	Date	8 digits	Current Date	
Service Order No.	Numeric	11 digits	-	
TPM Reference No.	Alphanumeric	10 digits	-	
Quotation Date	Date	8 digits	-	
Quotation No.	Alphanumeric	10 digits	-	
Dell Part No.	Alphanumeric	5 digits	-	
Quantity	Numeric	2 digits	-	
1{Alternate No.}3	Alphanumeric	5 digits	-	
Price	Numeric	4 digits	-	
Location	Alphabet	3 digits	BKK	
Shipment Date	Date	8 digits	-	
Awb#	Alphanumeric	12 digits	-	
Status of Part Availability	Character	1 digits	A = Available	Available Unavailable

APPENDIX C

SOFTWARE DESIGN

SOFTWARE DESIGN

The software design phase is to produce a detailed design of the desired software sometimes referred to as a software specification. The idea behind a software design or specification is that it is implementation "language independent". Again there are many approaches to design or specification. We will be using diagrammatic techniques, Nassi-Shneiderman charts, supported by data tables to design the software for LCS. Software design is consisting of two component – modular design and packaging. Modular design is the decomposition of a program into modules. A module is a group of executable instructions with a single point of entry and a single point of exit, which could be a subroutine or subprogram. Packaging is the assembly of data, process, interface, and geography for each module.

The most popular modular design techniques or strategy for determining an optimal modular design for program. The technique is called structured design. This technique deals with the size and complexity of program by breaking up the program into a hierarchy of modules (top-down) that result in a computer program that is easier to implement and maintain.

The primary tool used in structured design is the structure chart. Structure charts are used to graphically depict a modular design of a program. Specifically, they show how the program has been partitioned into smaller more manageable modules, the hierarchy and organization of those modules, and the communication interfaces between modules.

Structured design provides strategies for developing structure charts. Both strategies are based on the use of data flow diagram to derive the structure chart. In our LCS, the DFDs for order process, RMA, WLP, warehouse, call planner, and engineer

have been reconstructed or revised so that the process appearing on the DFDs should do only one function. The six software DFDs of LCS are presented as Figures C.1 – C3, C.5, C.7, C.8, C.10, C.12, C.13, C.15, C.17, C.19, and C.21.

Once the data flow diagram has been revised, a structure chart can be derived. There are two strategies for developing the structure charts from data flow diagrams. The strategies are transform analysis and transaction analysis.

C.1 Transformation Analysis

Transformation analysis is the strategy to derive a structure chart from the units defined in the transaction analysis. It falls apart into five steps:

(1) Drawing or selecting the DFD-part

Normally this step can be left out, because the DFD's are already drawn in the structured analysis phase. This step then only picks a part of the DFD's that is derived during the transaction analysis. If no DFD exists, then in this step one is constructed.

(2) Define central functions

This step concentrates on the central transformation of the DFD (that part of the DFD that contains the essential functions of the system and is independent of implementations of the input and output). In order to find the central process, start with the input to the system and follow the arrows until you think that the data has ceased to flow inwards and is not yet processed. Similarly, start at the output from the system and work backwards to find out where it starts and is not yet formatted.

(3) Transform into interim chart

The next step is to find the main process, representing the main module in the structure chart. Choose one of the central process and check

whether the process can be considered as main process. If not, choose another. If none of the central process can be considered as main process, then introduce a new process, which will be the main process.

Transform the process into boxes, and there's the structure chart. Note that all the data flows are now turned into calls, and the direction of the data flows is not necessarily the direction of the calls. The data that the flows transmitted are the parameters that the calls carry with them.

(4) Refinement of charts

The interim charts can be refined by some extra points:

(a) add read modules and write modules for access to sources, sinks and files;

(b) factorize and reorganize the supplying and the removing nodules, but keep the system balanced;

(c) if needed, factorize the central transformation using the DFD as a guide (the levels of the DFD are useful here);

(d) add modules for error handling;

(e) add details for initialization and termination;

(f) check if the modules have names that correspond with their hierarchical role;

(g) add flags that were not needed in the DFD, but are in the structure chart (for example the end of a data flow);

(h) check the cohesion of the modules and adjust it, if needed;

(i) check if the structure chart is in line with the data structures and adjust it, if needed.

(5) Check the chart

This final step checks if the design implements the specification correctly.

C.2 Transaction Analysis

Transaction analysis is the technique of pointing out the transaction types of a system and the usage of it as autonomous design unit or the examination of the DFD to identify process that represent transaction centers. A transaction center is a process that does not do actual transformation on the incoming data flow. Such processes are usually easy to recognize on a DFD, because they usually appear as a process containing a single incoming data flow to two or more other processes. The primary difference between transaction analysis and transform analysis is that transaction analysis recognizes that modules can be organized around the transaction center rather than a transform center. These units are then used in the transformation analysis.

C.3 Structure Charts

Structure charts are used to graphically depict a modular design of a program. A structure diagram is a hierarchical, modular breakdown of a program. Between levels on the tree, there are links, with symbols to indicate the sort of information that is being passed back and forth. These structures are represented either as trees or as directed acyclic graphs (DAGs). The structure chart is usually the end result of the activity known as structured analysis, in which the functions of a system are partitioned in a top-down manner

Specifically, they show how the program has been partitioned into smaller more manageable modules, the hierarchy and organization of those modules, and the communication interfaces between modules. Structure charts, however, do not show the internal procedures performed by the module or the internal data used by the

module. From above two approaches, the structure charts for our LCS are draw as below. Then follow by the 3 complicated module specification of our LCS or the detail description of each module in the LCS structure chart. The structure chart of LCS is depicted in Figures C.4, C.6, C.9, C.11, C.14, C.16, C.18, C.20, and C.22.

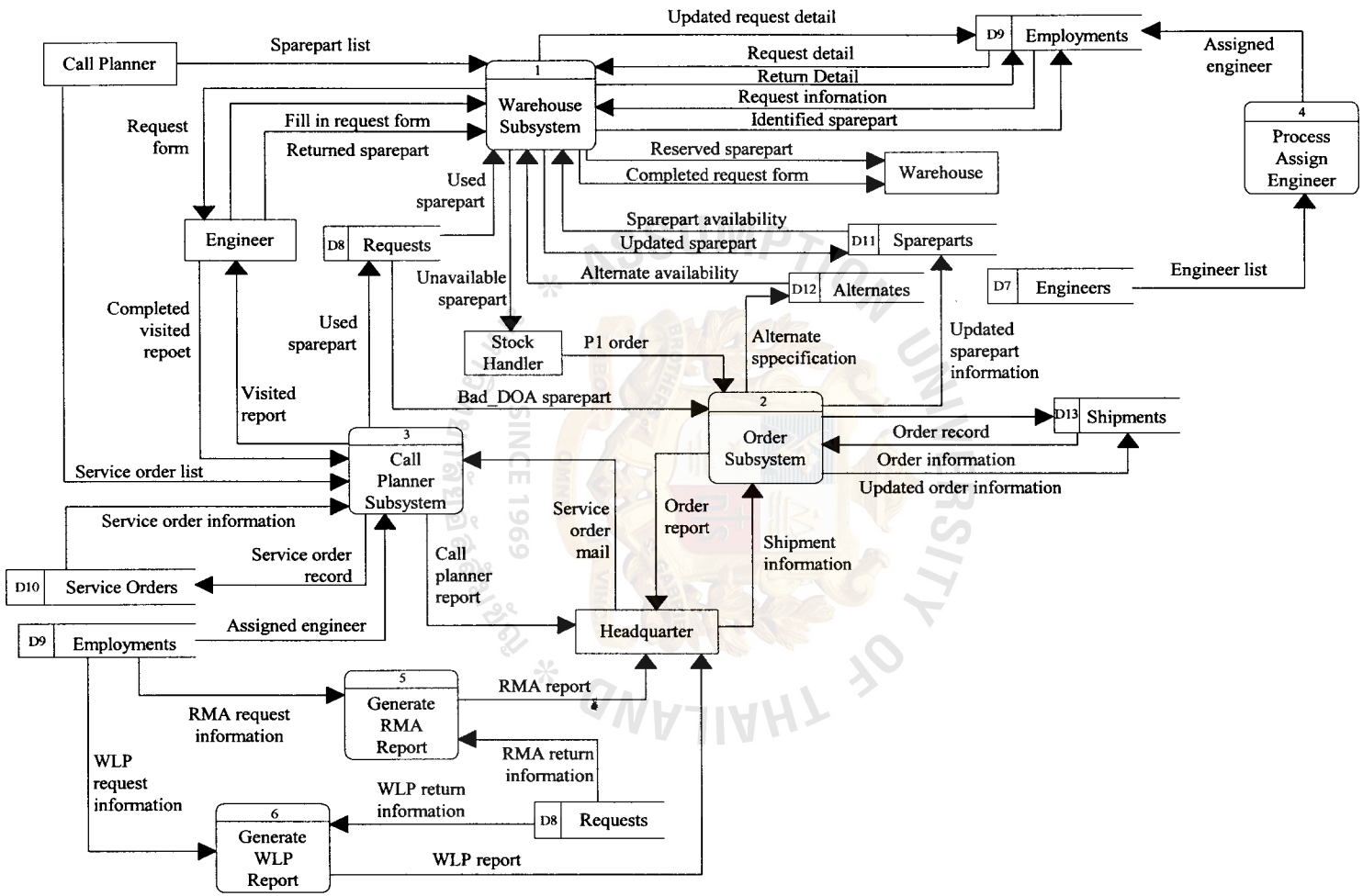

Figure C.1. First Level DFD of Logistic Control System.

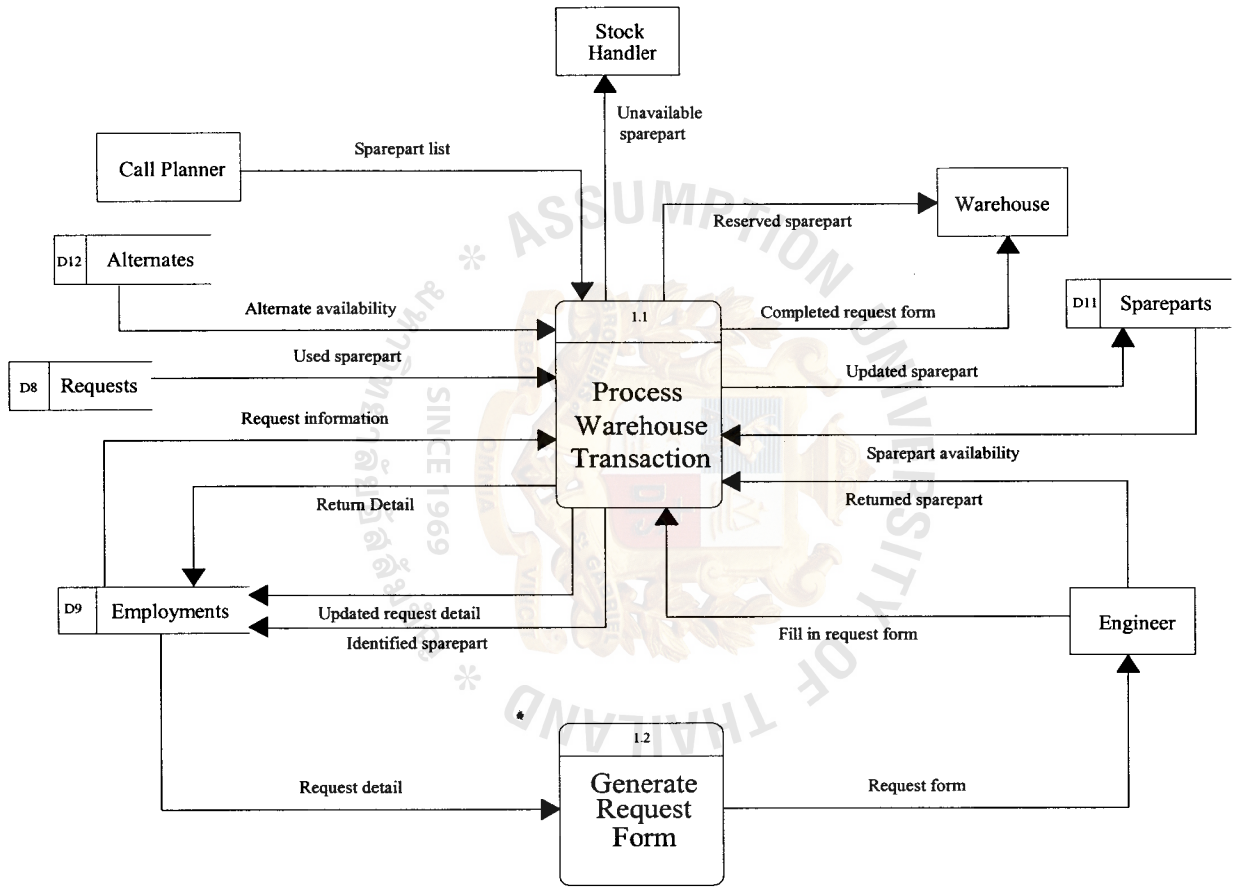

Figure C.2. Level 2 of Warehouse Subsystem.

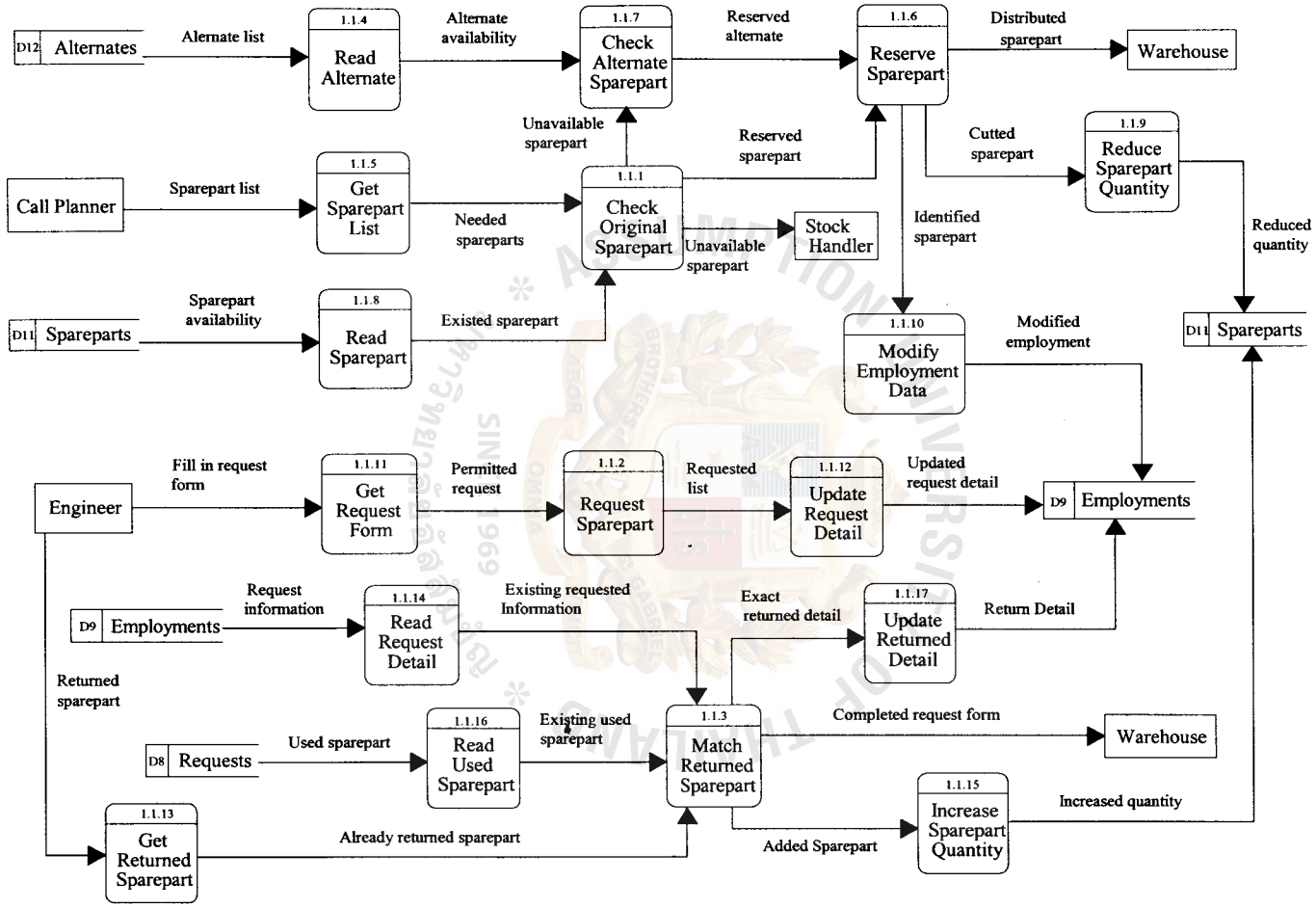

Figure C.3. Level 3 of Process Warehouse Transaction.

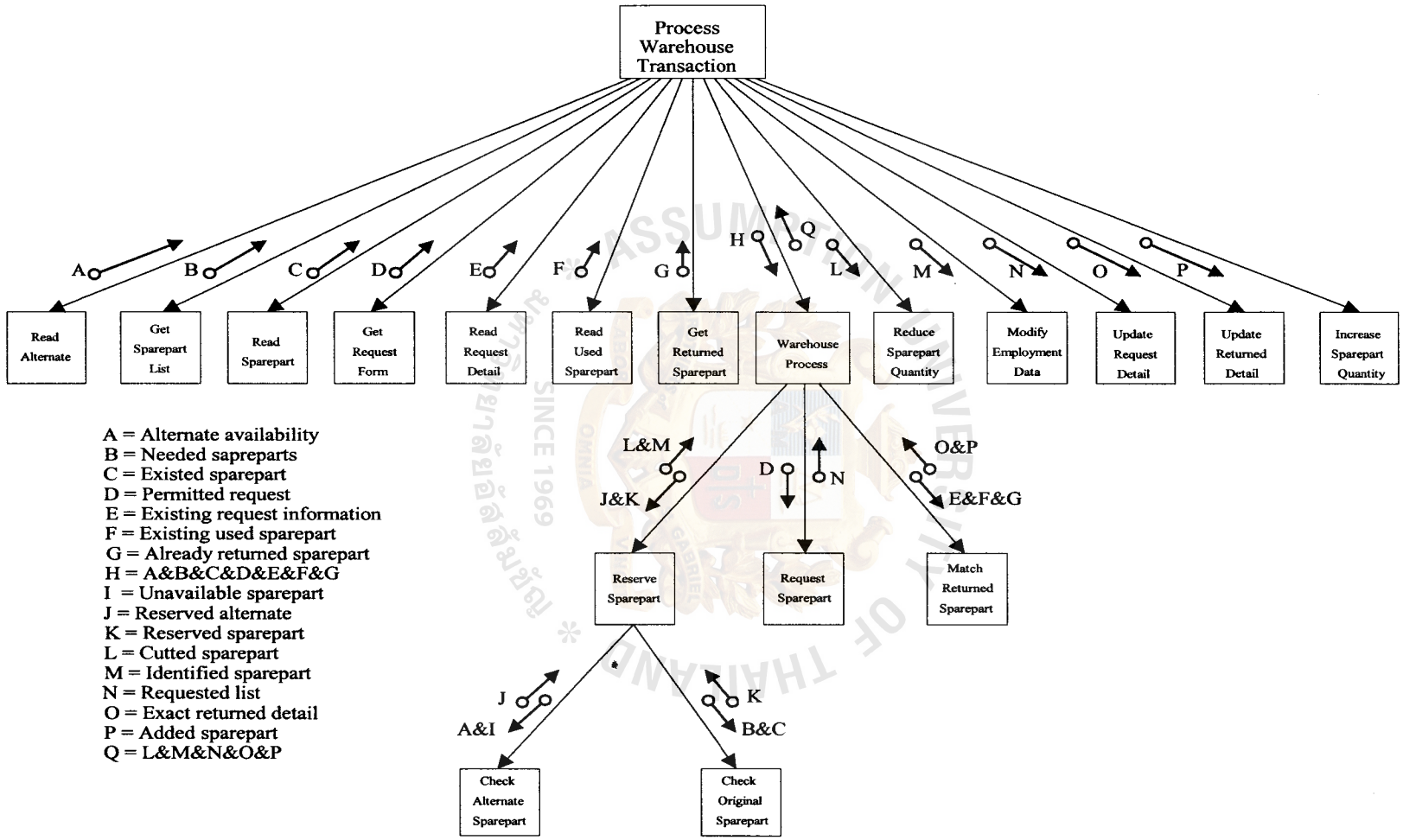

Figure C.4. Structure Chart of Process Warehouse Transaction.

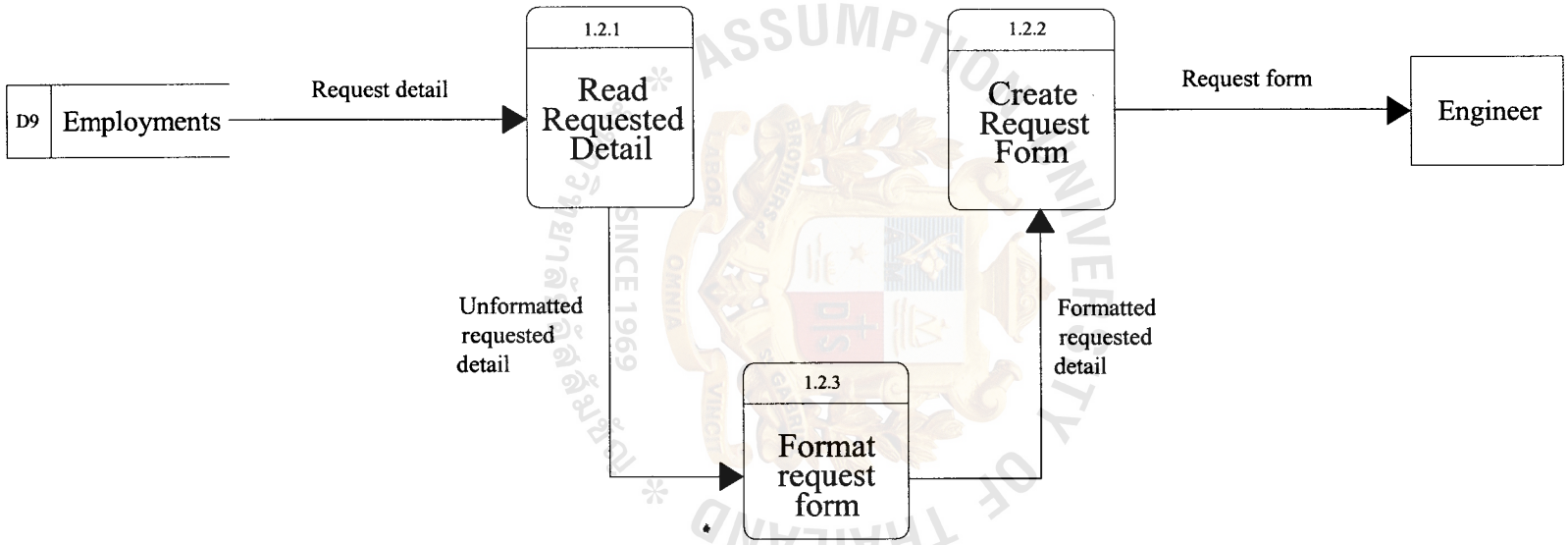

Figure C.5. Level 3 of Generate Request Form.

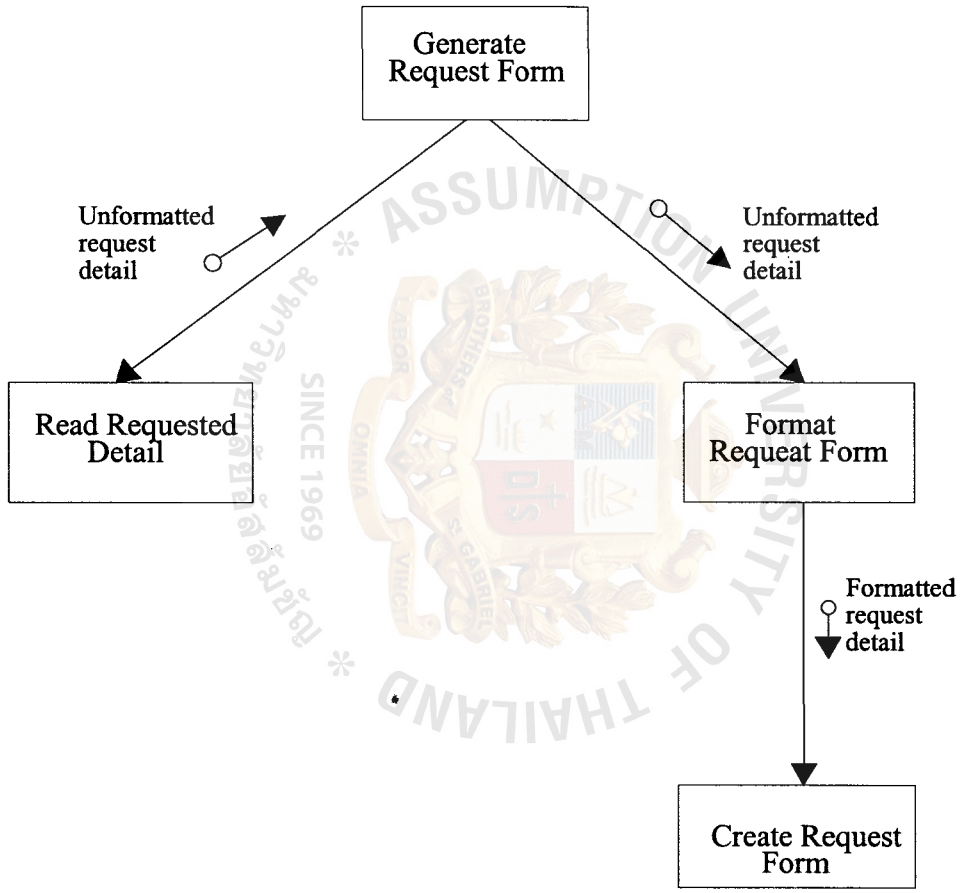

Figure C.6. Structure Chart of Generate Request Form.

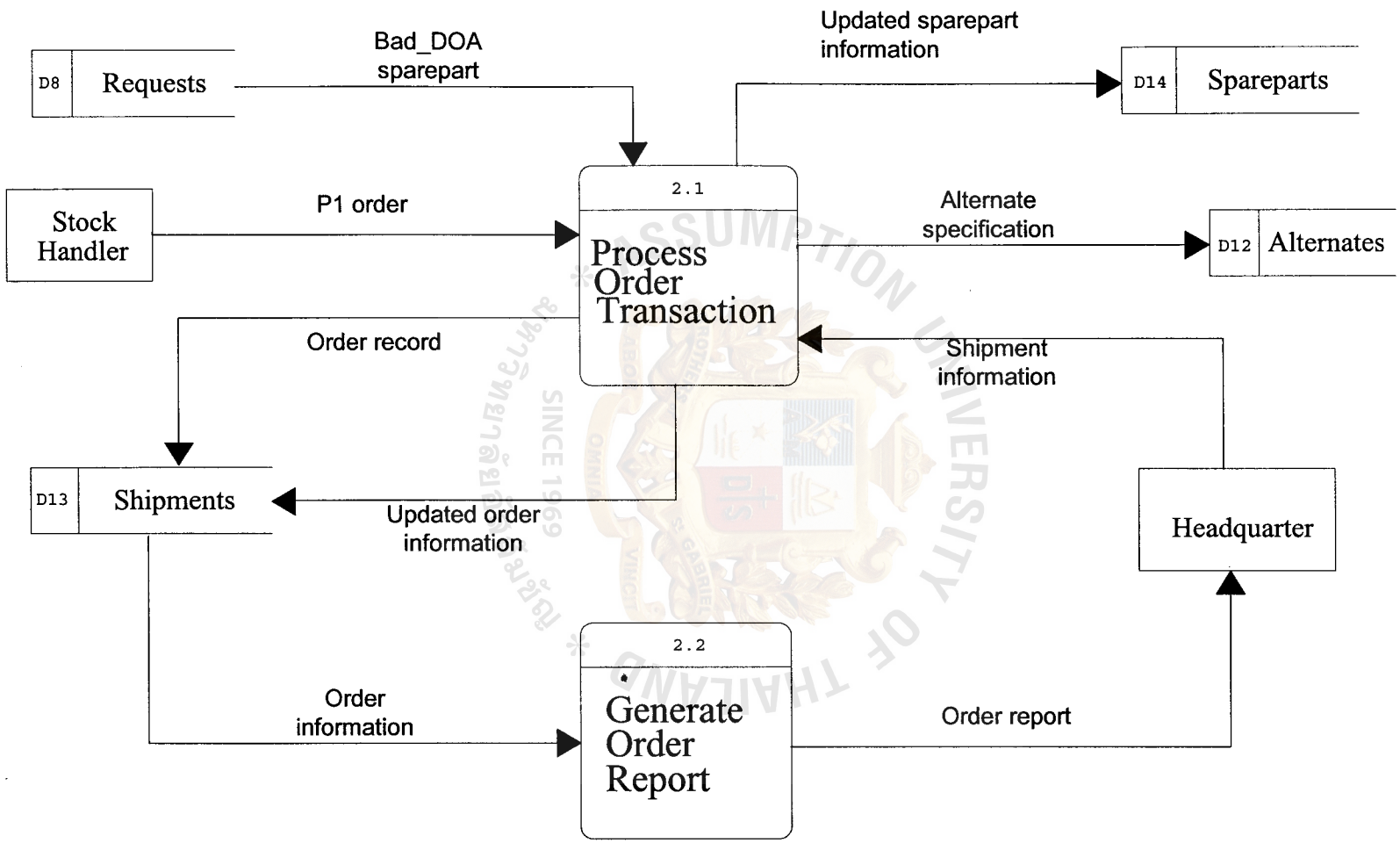

Figure C.7. Level 2 of Order Subsystem.

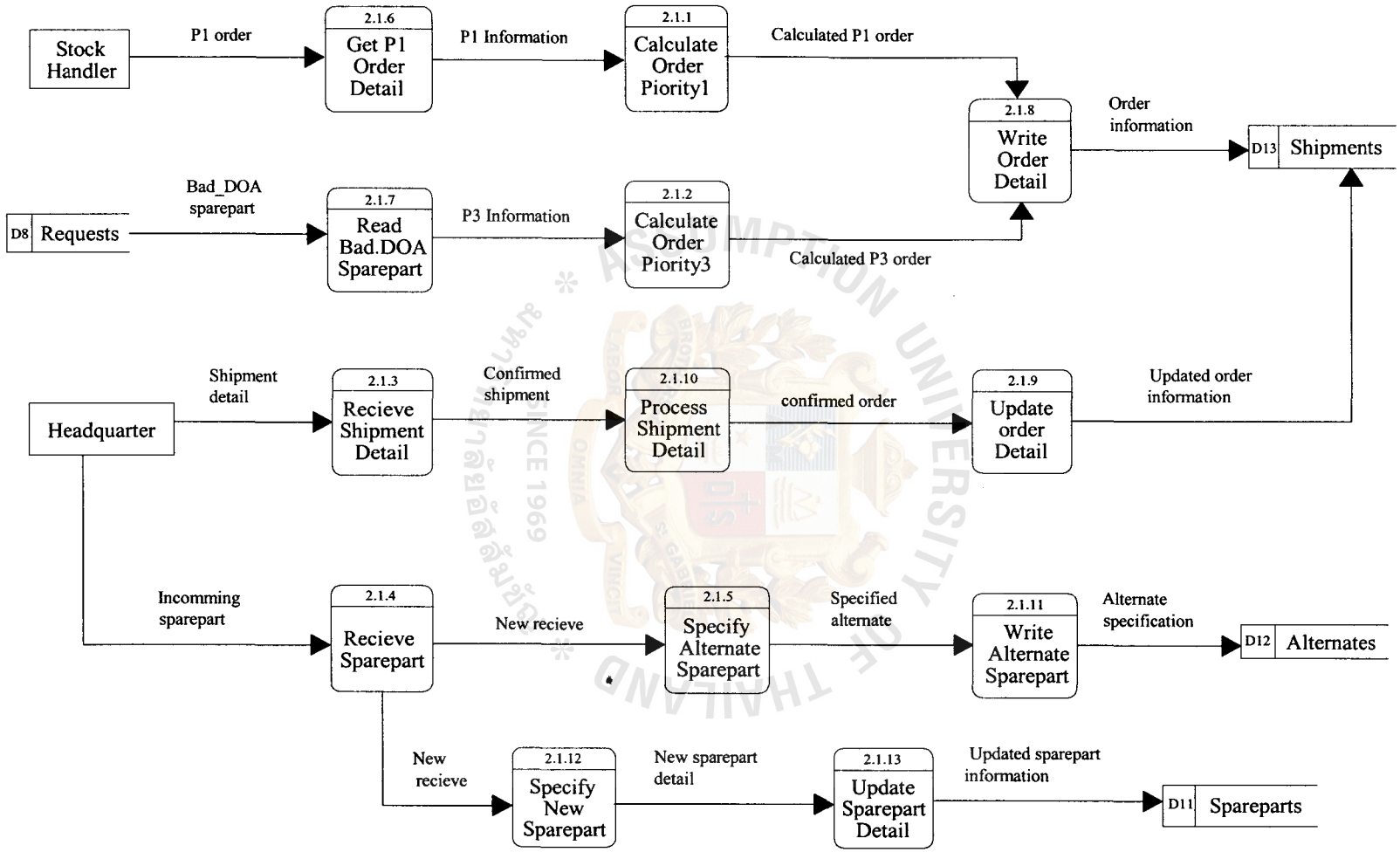

Figure C.8. Level 3 of Process Order Transaction.

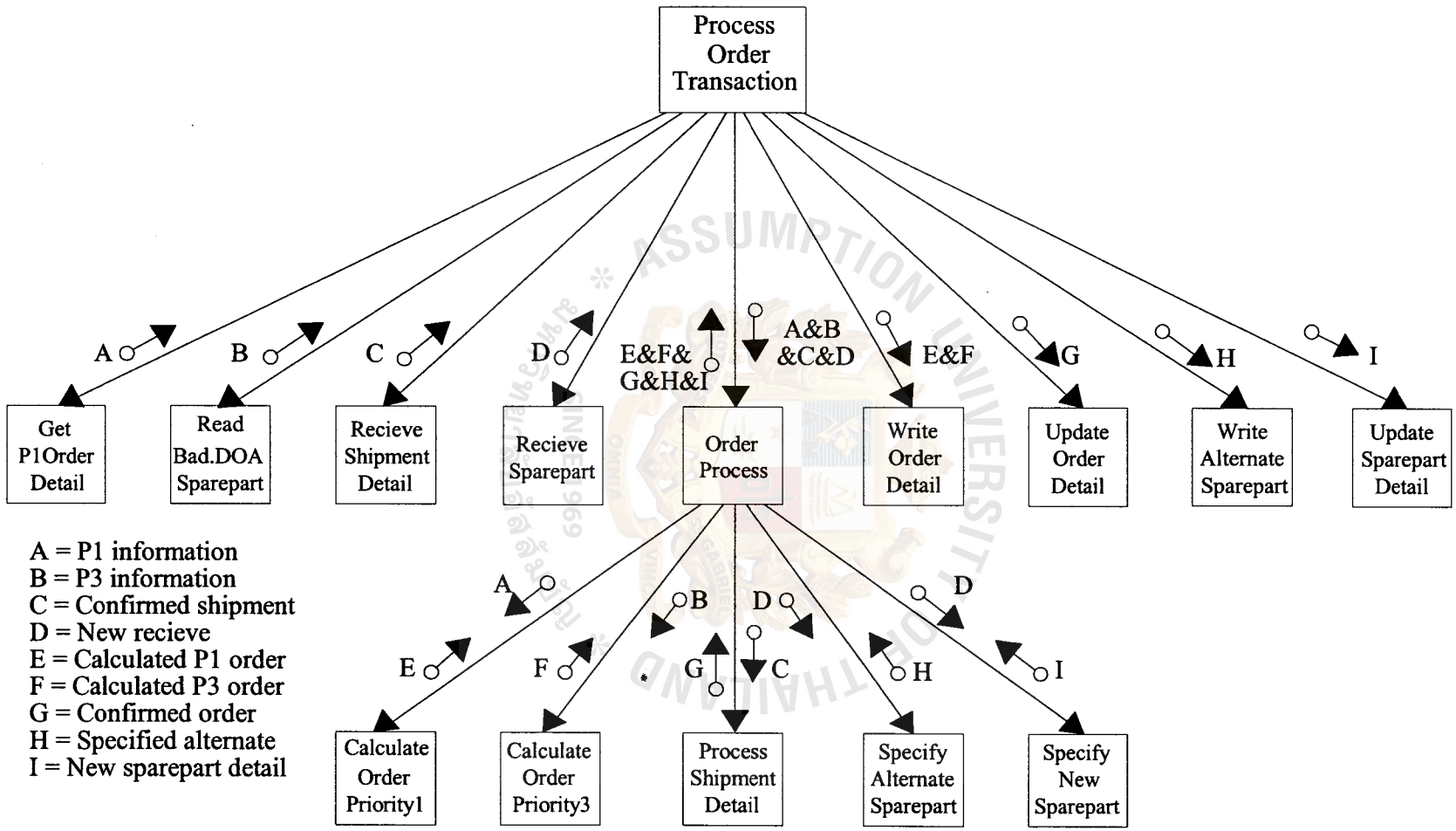

Figure C.9. Structure Chart of Process Order Transaction.

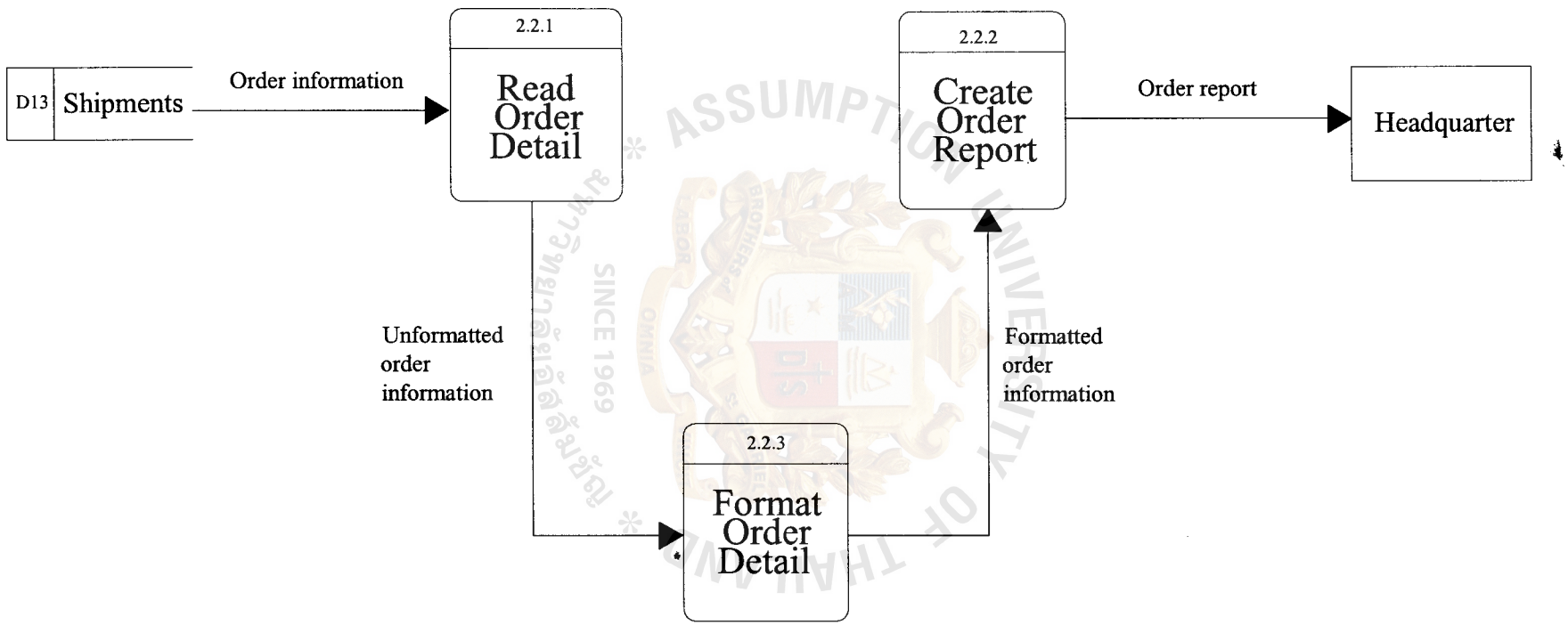

Figure C.10. Level 3 of Generate Order Report.

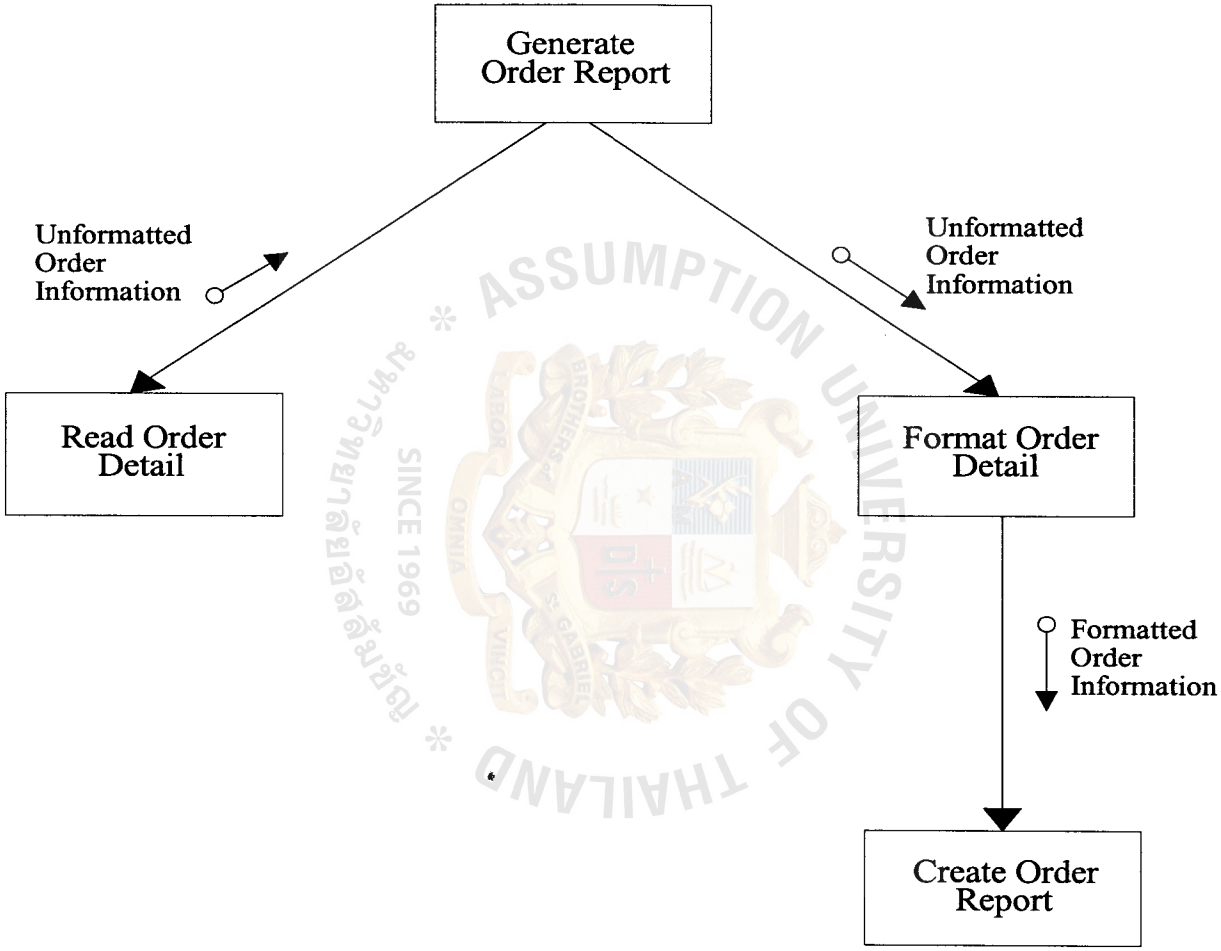

Figure C.11. Structure Chart of Generate Order Report.

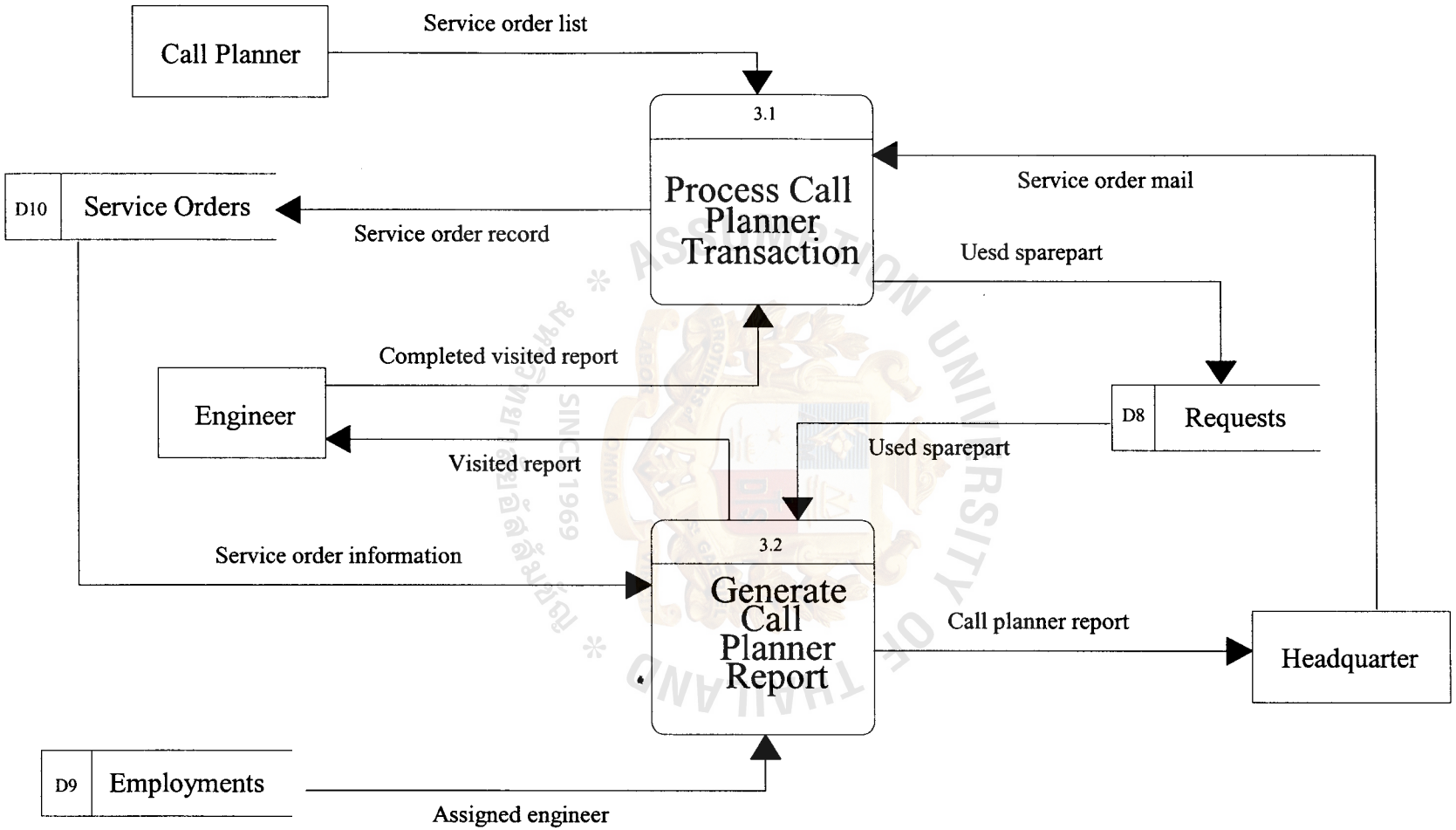

Figure C.12. Level 2 of Call Planner Subsystem.

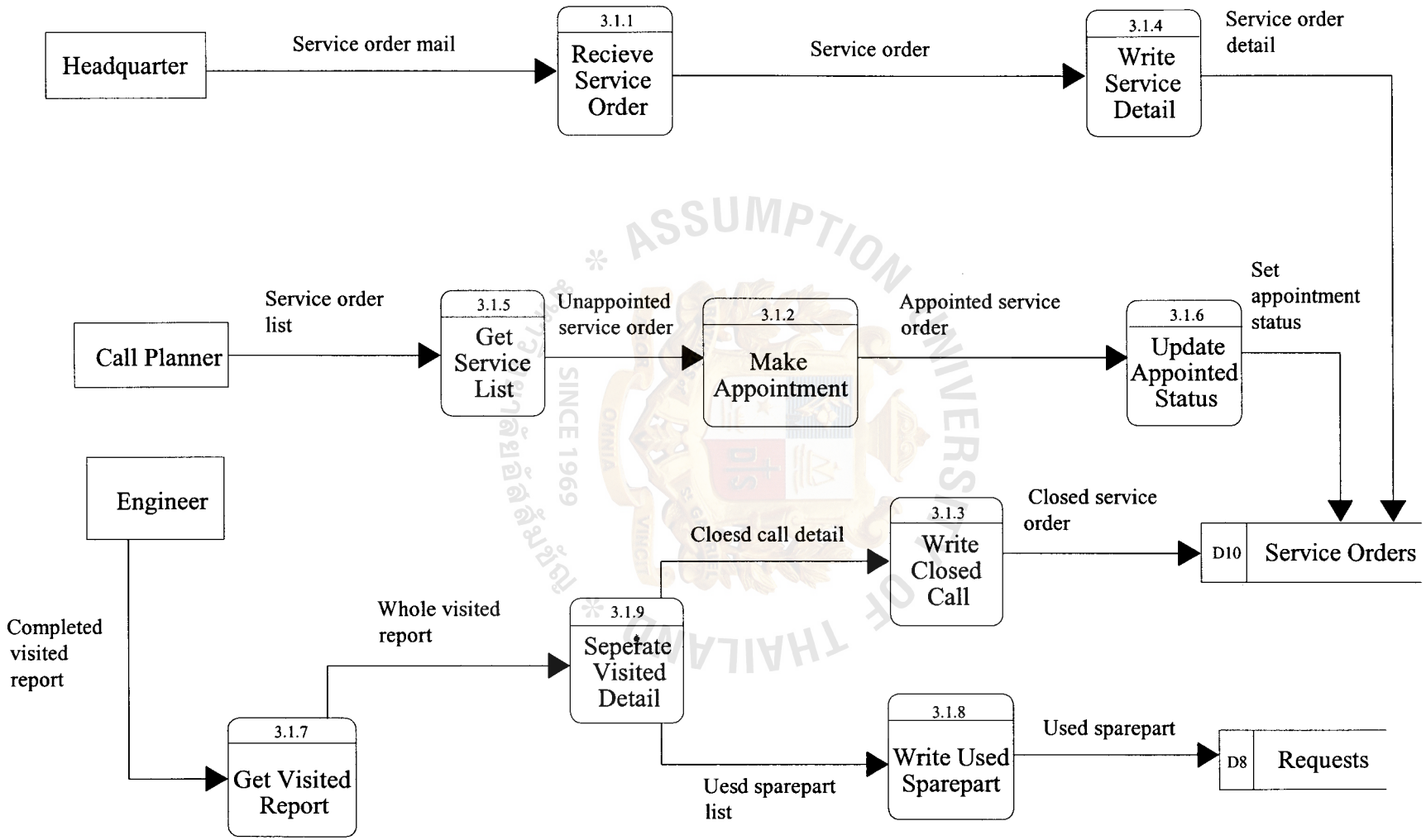

Figure C.13. Level 3 of Process Call Planner Transaction.

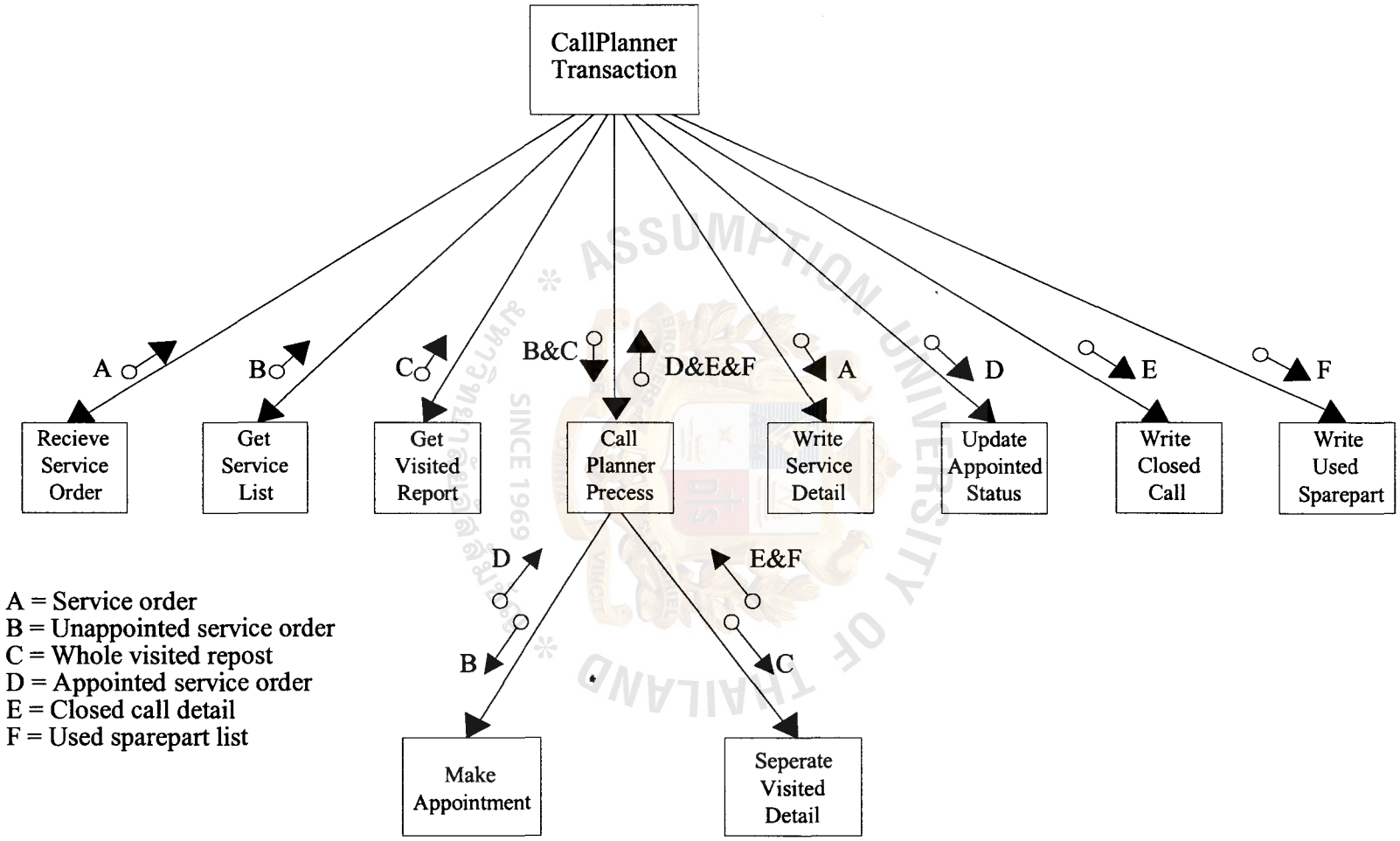

Figure C.14. Structure Chart Of Call Planner Transaction.

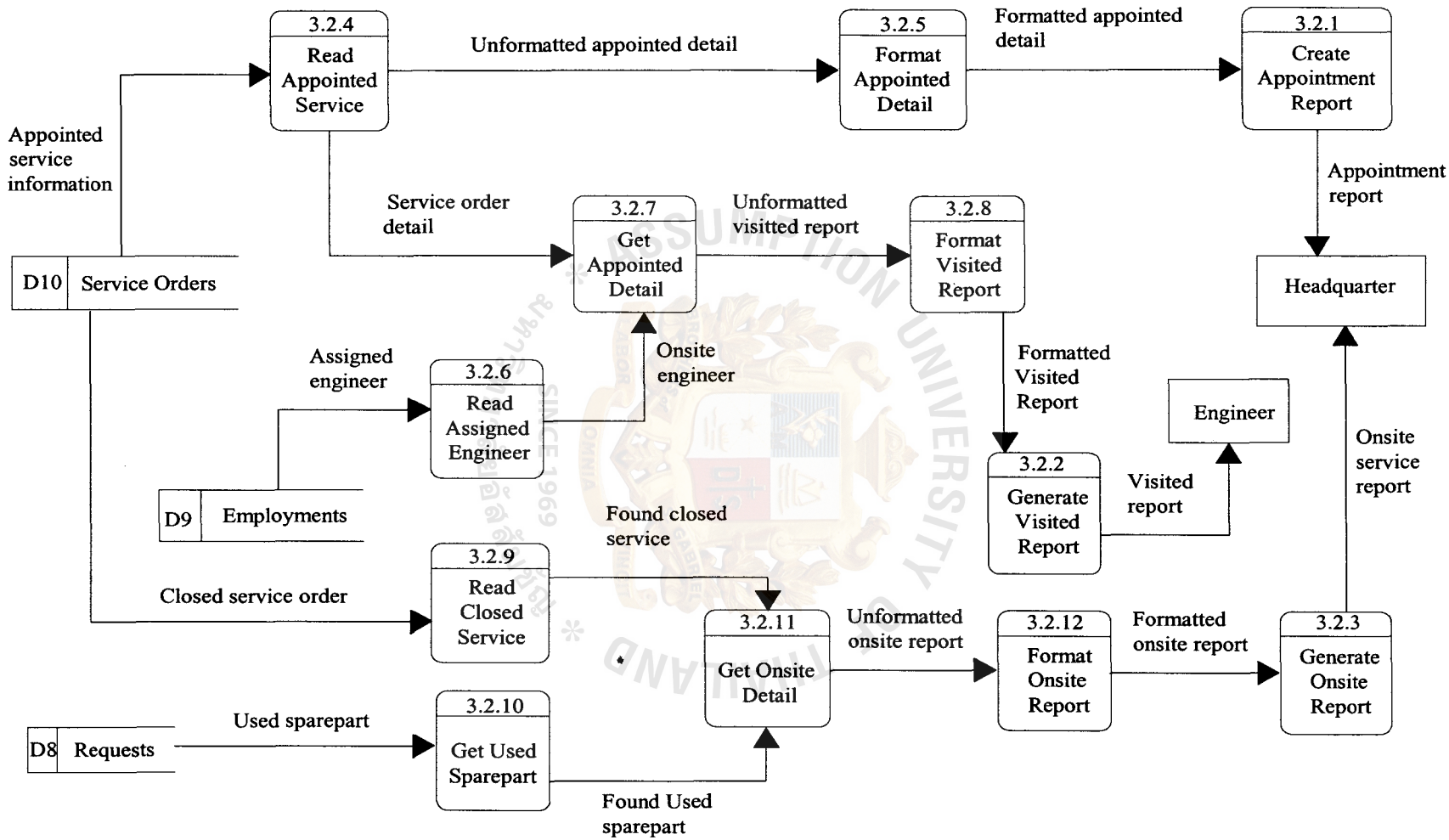

Figure C.15. Level 3 of Generate Call Planner Report.

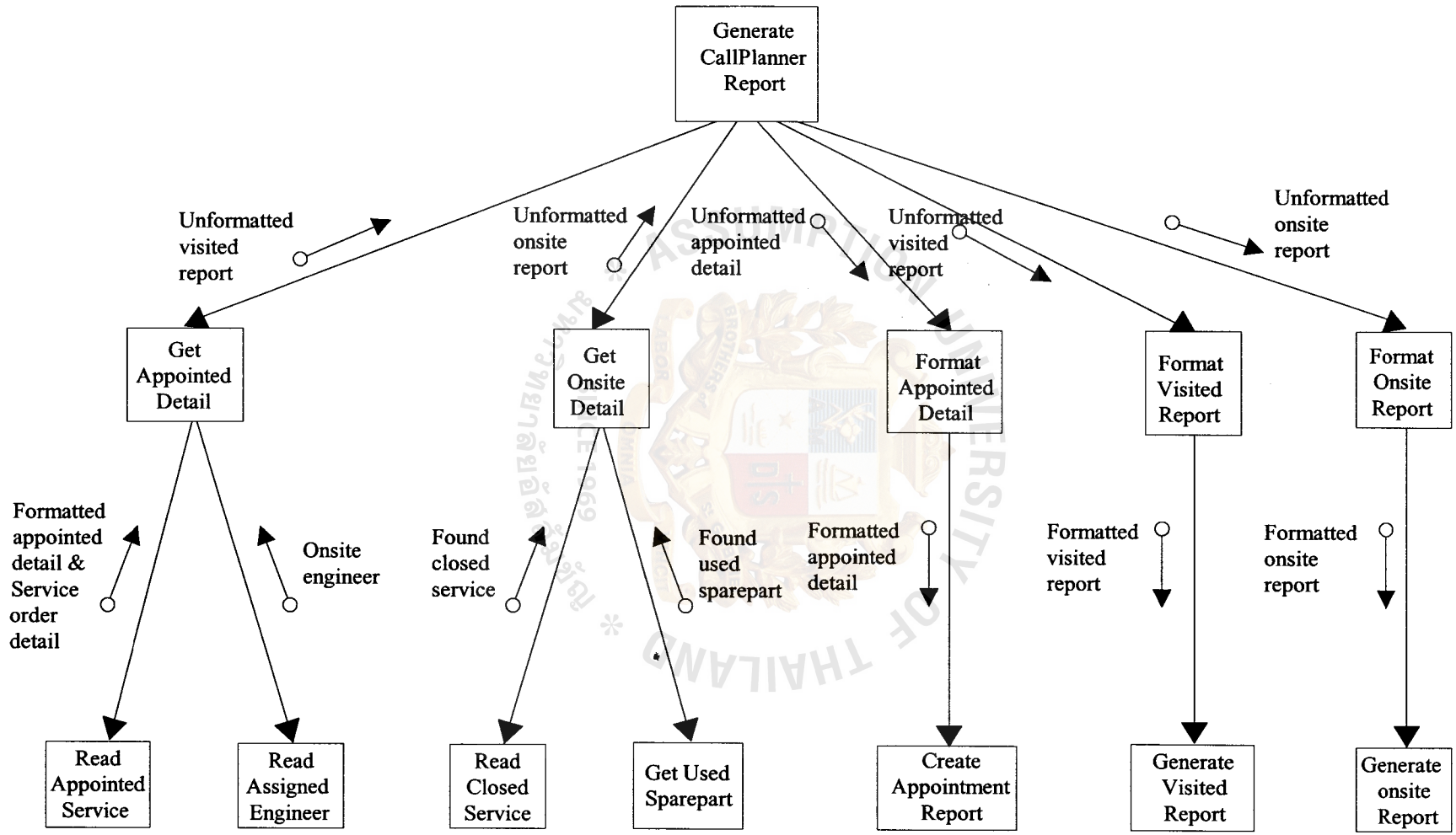

Figure C.16. Structure Chart of Generate Call Planner Report.

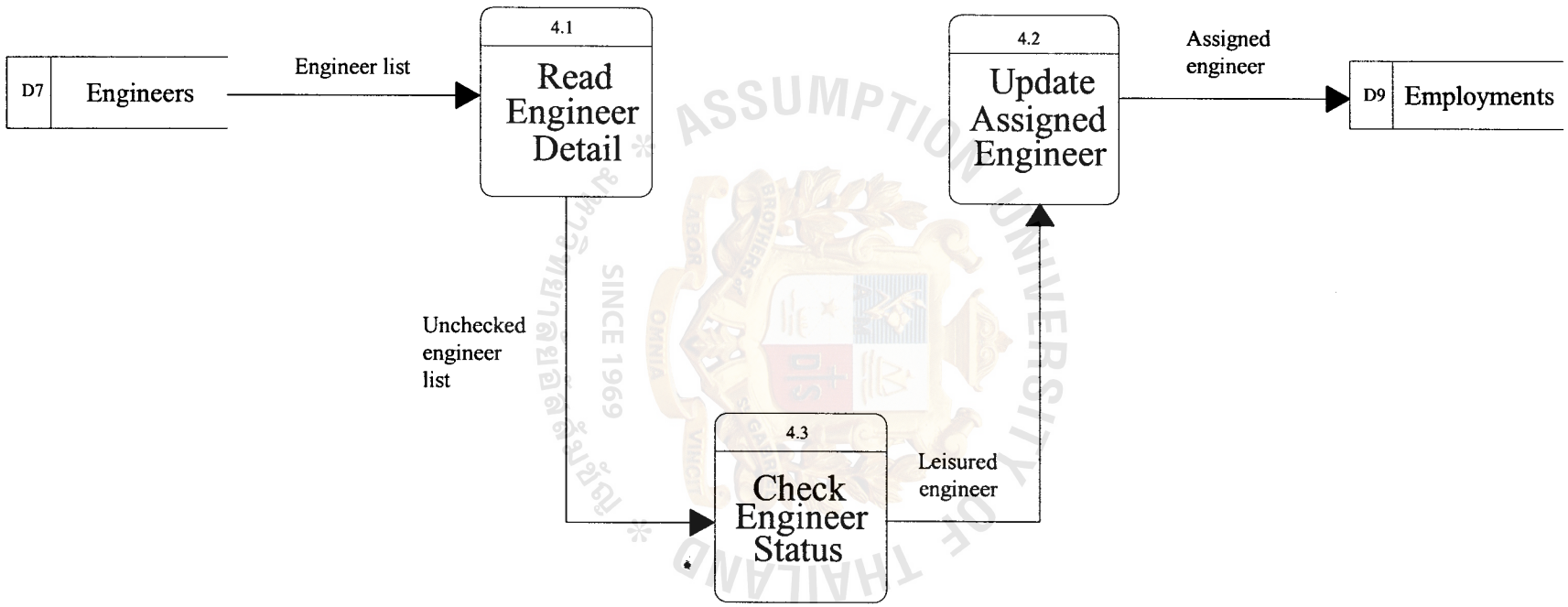

Figure C.17. Level 2 of Process Assign Engineer.

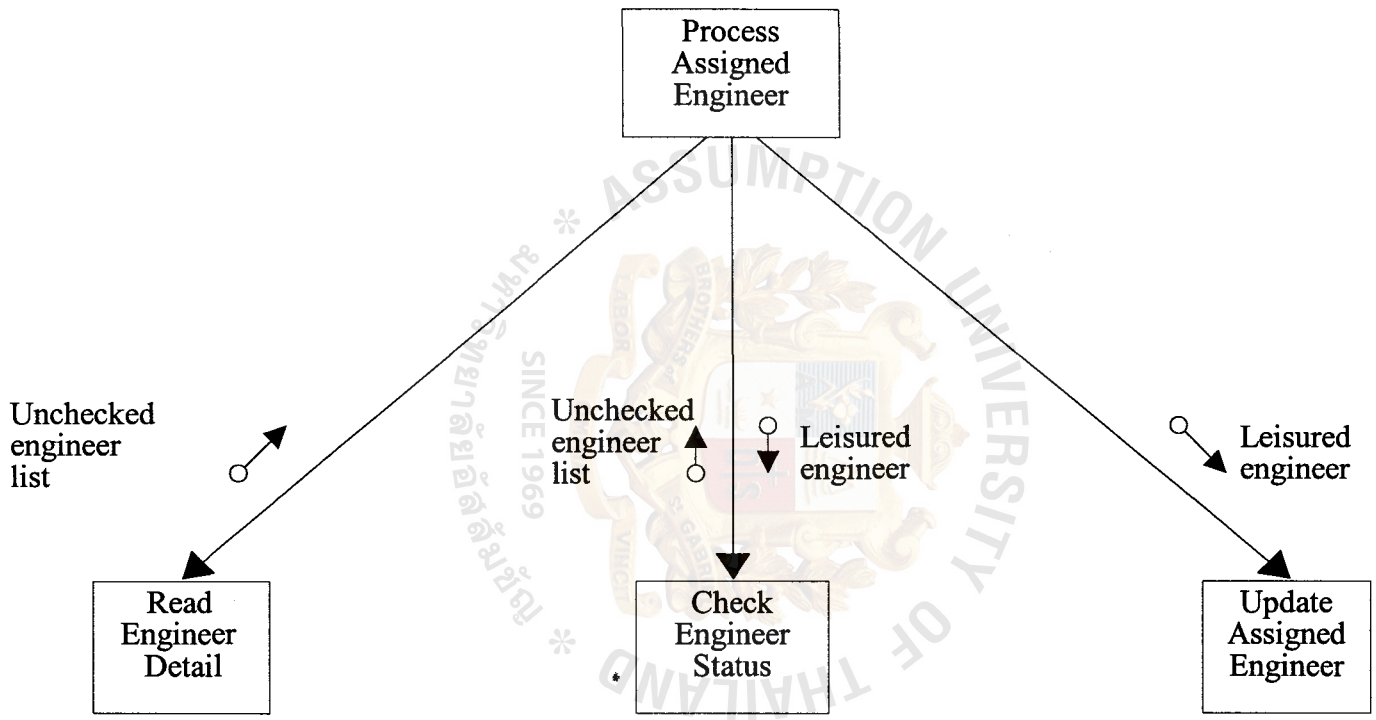

Figure C.18. Structure Chart of Process Assigned Engineer.

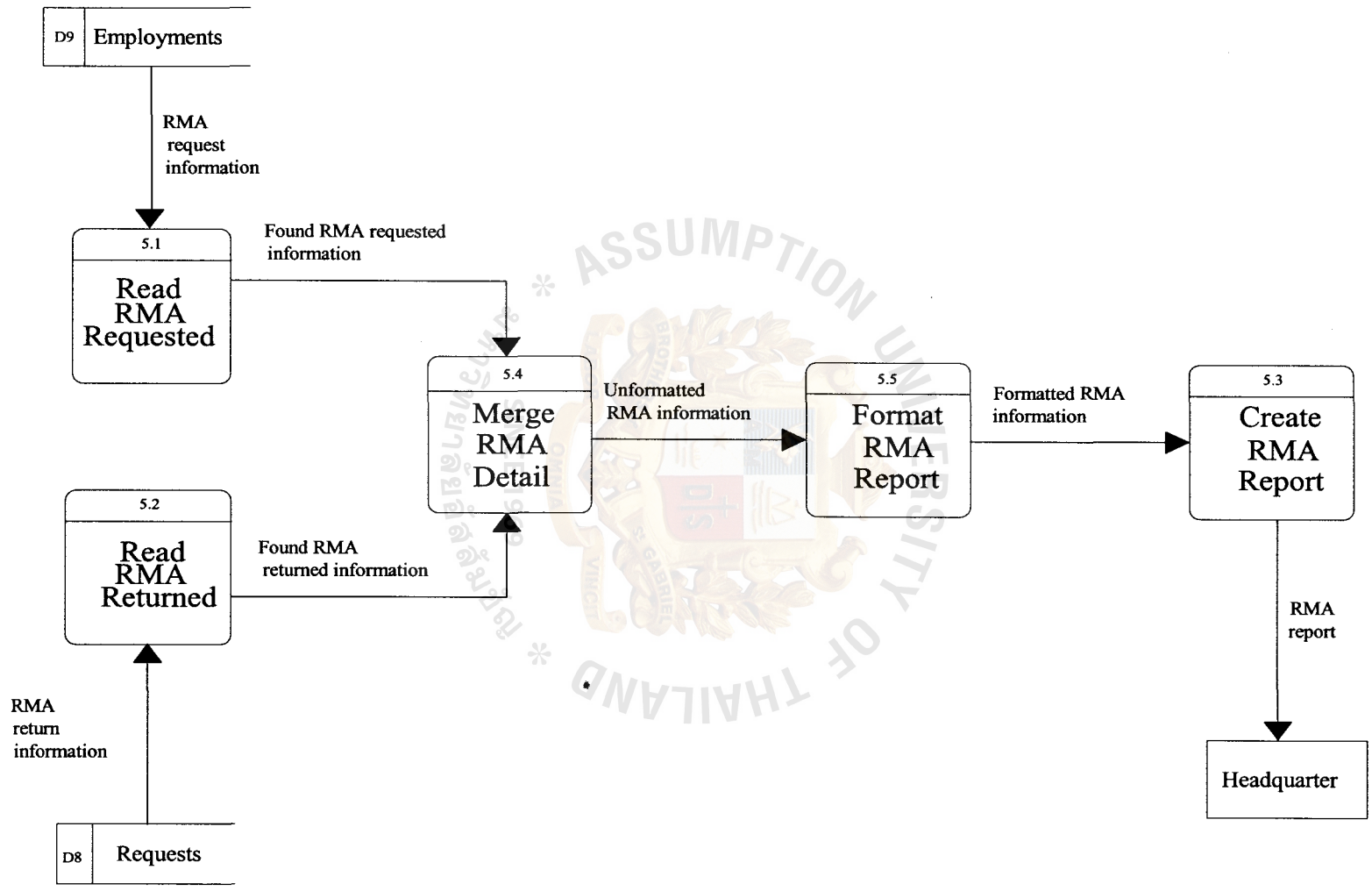

Figure C.19. Level 2 of Generate RMA Report.

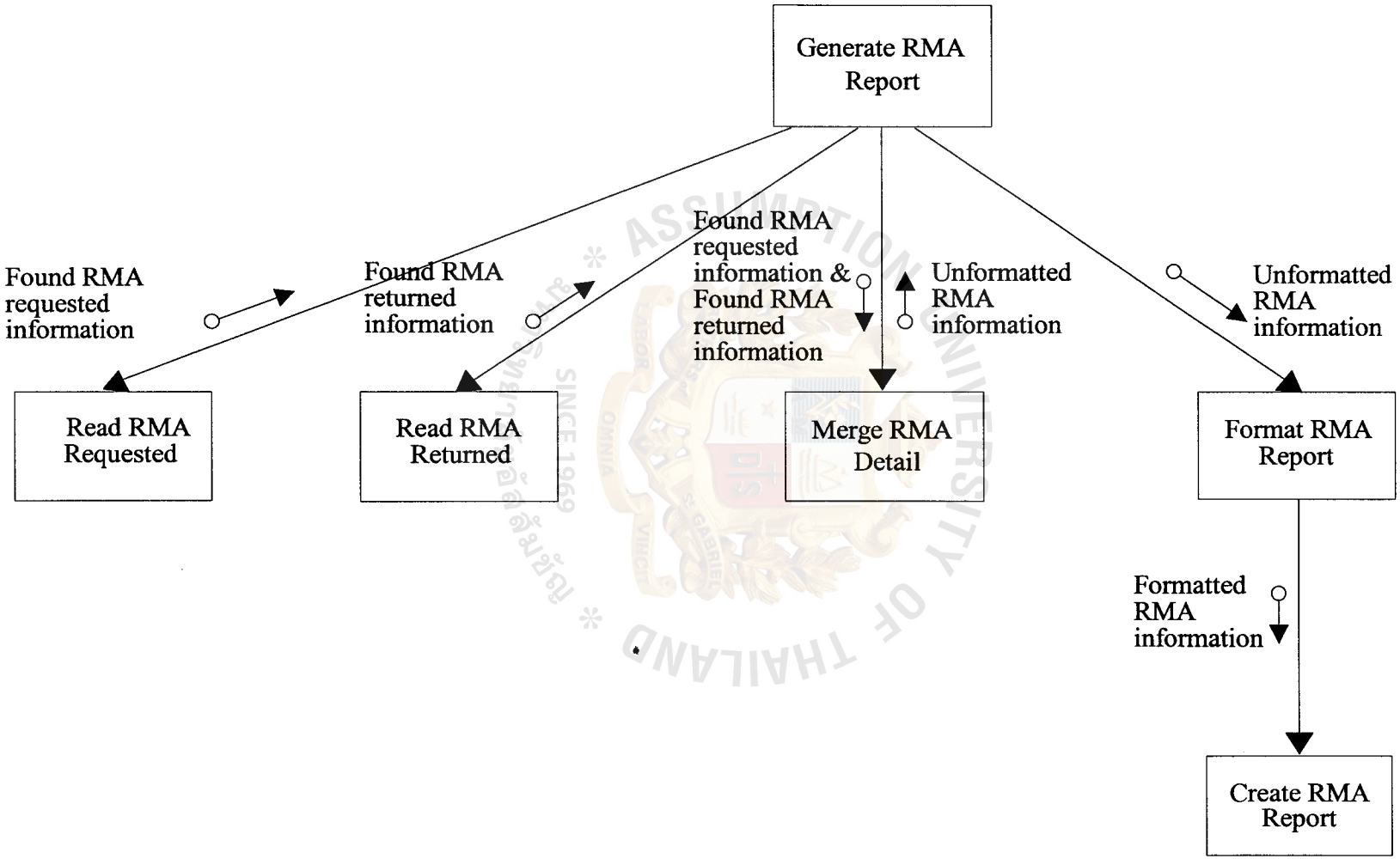

Figure C.20. Structure Chart of Generate RMA Report.

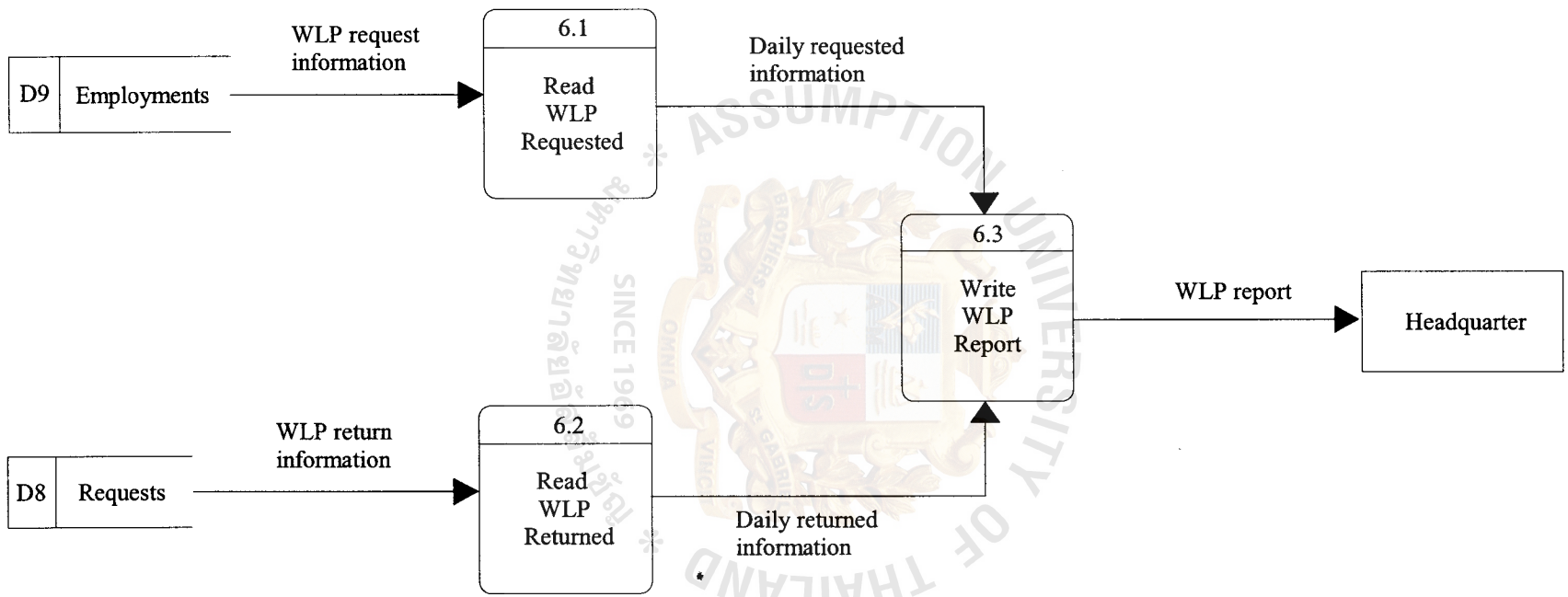

Figure C.21. Level 2 of Generate WLP Report.

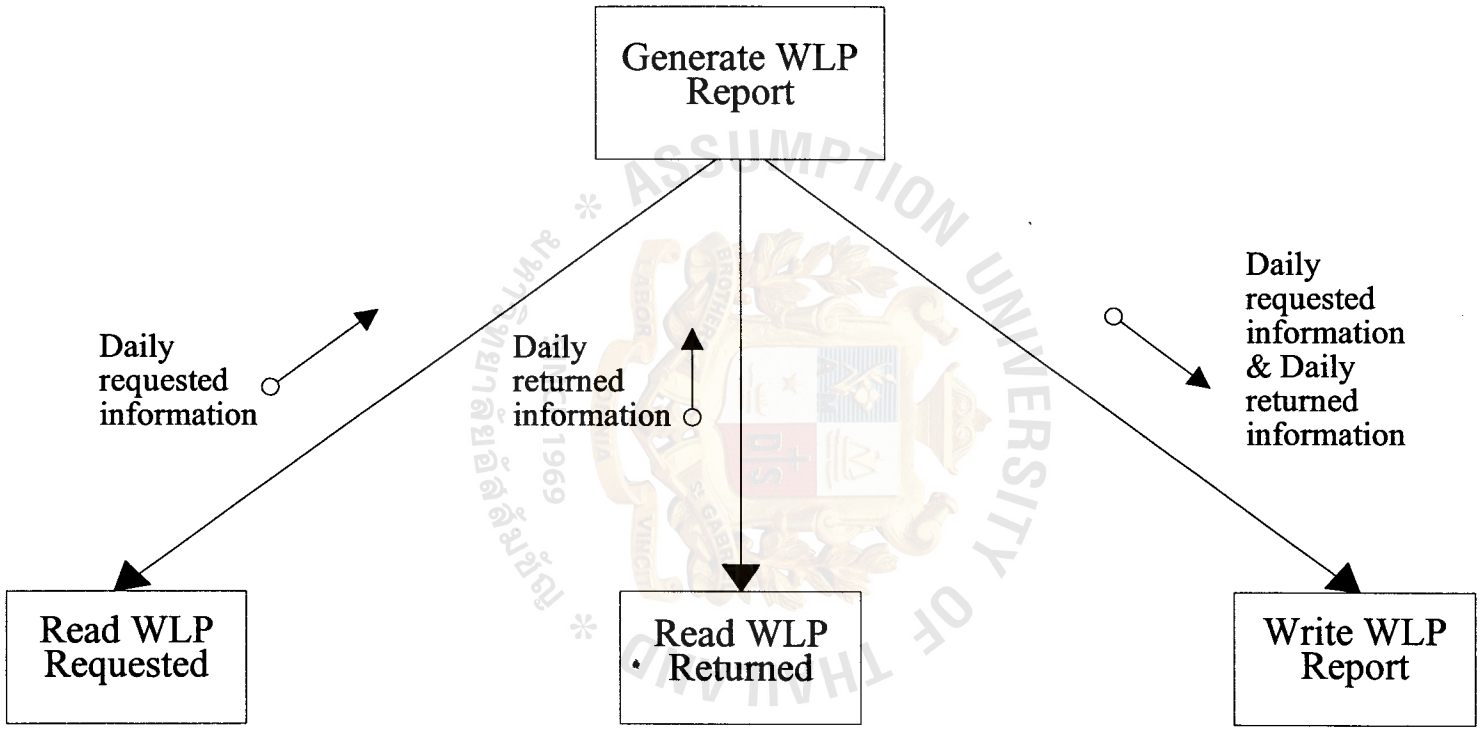

Figure C.22. Structure Chart of Generate WLP Report.

APPENDIX D

PROCESS SPECIFICATION

PROCESS SPECIFICATION

Action Taken Data Element
SERVICE ORDER::Action Taken
Description:
Everythings that engineer do to fix customer's problems
Data element attributes
Storage Type: Long VarChar
Length: 200
Null Type: Null
Location:
Entity --> SERVICE ORDER
Date Last Altered:12/9/00 Date Created:12/9/00

Added sparepart Data Flow
Location:
Level 3 of Process Warehouse Transaction (1.1)
Source: Return Sparepart (Process)
Dest: Spareparts (Data Store)
Date Last Altered:13/9/00 Date Created:13/9/00

Alternate Data Store
Data Store No.:D1
Location:
Modify Context DFD (0)
Output Flows:
Alternate availability
Date Last Altered:13/9/00 Date Created:13/9/00

Alternate availability Data Flow
Location:
Modify Context DFD (0)
Source: Alternate (Data Store)
Dest: Logistic Control System (Process)
Modify Level 1 of LCS (0)
Source: Alternates (Data Store)
Dest: Warehouse Subsystem (Process)
Level 2 of Warehouse Subsystem (1)
Source: Alternates (Data Store)
Dest: Process Warehouse Transaction (Process)
Level 3 of Process Warehouse Transaction (1.1)
Source: Alternates (Data Store)
Dest: Check Reserve Sparepart (Process)
Date Last Altered:13/9/00 Date Created:13/9/00

Alternate specification Data Flow
Location:
Modify Level 1 of LCS (0)
Source: Order Subsystem (Process)

Dest: Alternates (Data Store)
Level 2 of Order Subsystem (2)
Source: Process Order Transaction (Process)
Dest: Alternates (Data Store)
Level 3 of Process Order Transaction (2.1)
Source: Specify Alternate Sparepart (Process)
Dest: Alternates (Data Store)
Date Last Altered:13/9/00 Date Created:13/9/00

Alternates Data Store
Data Store No.:D12
Location:
Modify Level 1 of LCS (0)
Input Flows:
Alternate specification
Output Flows:
Alternate availability
Level 2 of Warehouse Subsystem (1)
Output Flows:
Alternate availability
Level 2 of Order Subsystem (2)
Input Flows:
Alternate specification
Level 3 of Process Warehouse Transaction (1.1)
Output Flows:
Alternate availability
Level 3 of Process Order Transaction (2.1)
Input Flows:
Alternate specification
Date Last Altered:13/9/00 Date Created:13/9/00

Appointed service information Data Flow
Location:
Level 3 of Generate Call Planner Report (3.2)
Source: Service Orders (Data Store)
Dest: Generate Appointment Report (Process)
Data Flow --> Service order information
Date Last Altered:13/9/00 Date Created:13/9/00

Appointment report Data Flow
Location:
Level 3 of Generate Call Planner Report (3.2)
Source: Generate Appointment Report (Process)
Dest: Headquarter (External Entity)
Data Flow --> Call planner report
Date Last Altered:13/9/00 Date Created:13/9/00
Appointment Status Data Element
SERVICE ORDER::Appointment Status
Description:

Show the status of service order that is appointed
Values & Meanings:
0 = can't contacted
1 = scheduled
3 = cancelled
Data element attributes
Storage Type: Integer 4
Length: 1
Default: 0
Null Type: Null
Location:
Entity --> SERVICE ORDER
Date Last Altered:14/9/00 Date Created:12/9/00

Asset Data Element
SERVICE ORDER::Asset
Description:
Machine serial number
Data element attributes
Storage Type: Unicode VarChar
Length: 6
Null Type: Null
Location:
Entity --> SERVICE ORDER
Date Last Altered:14/9/00 Date Created:12/9/00

Assigned engineer Data Flow
Location:
Modify Level 1 of LCS (0)
Source: Employments (Data Store)
Dest: Call Planner Subsystem (Process)
Source: Process Assign Engineer (Process)
Dest: Employments (Data Store)
Level 2 of Call Planner Subsystem (3)
Source: Emploiments (Data Store)
Dest: Generate Call Planner Report (Process)
Level 3 of Generate Call Planner Report (3.2)
Source: Employments (Data Store)
Dest: Generate Visited Report (Process)
Date Last Altered:13/9/00 Date Created:13/9/00

AWB No. Data Element
SHIPMENT::AWB No.
Description:
A shipment number that is issued by the headquarter to ensure an order of stock orderor
Data element attributes
Storage Type: Unicode VarChar
Length: 10

Null Type: Null
Location:
Associative Entity -->SHIPMENT
Date Last Altered:14/9/00 Date Created:12/9/00

Bad_DOA sparepart Data Flow
Location:
Modify Level 1 of LCS (0)
Source: Requests (Data Store)
Dest: Order Subsystem (Process)
Level 2 of Order Subsystem (2)
Source: Requests (Data Store)
Dest: Process Order Transaction (Process)
Level 3 of Process Order Transaction (2.1)
Source: Requests (Data Store)
Dest: Order_ Piority3 (Process)
Date Last Altered:13/9/00 Date Created:13/9/00

Call Closed Date Data Element
SERVICE ORDER::Call Closed Date
Description:
The date that a a service order is completed
Data element attributes
Storage Type: Date
Length: 8
Null Type: Null
Location:
Entity --> SERVICE ORDER
Date Last Altered:14/9/00 Date Created:12/9/00

Call Closed Time Data Element
SERVICE ORDER::Call Closed Time
Description:
Time that a service order is completed
Data element attributes
Storage Type: Time
Length: 5
Null Type: Null
Location:
Entity --> SERVICE ORDER
Date Last Altered:14/9/00 Date Created:12/9/00

Call Planner External Entity
Location:
Modify Context DFD (0)
Output Flows:
Service order list
Modify Level 1 of LCS (0)
Output Flows:

Service order list
Sparepart list
Level 2 of Warehouse Subsystem (1)
Output Flows:
Sparepart list
Level 2 of Call Planner Subsystem (3)
Output Flows:
Service order list
Level 3 of Process Warehouse Transaction (1.1)
Output Flows:
Sparepart list
Level 3 of Call Planner Transaction (3.1)
Output Flows:
Service order list
Date Last Altered:13/9/00 Date Created:13/9/00

Call planner report Data Flow
Composition:
Appointment report :
Onsite service report :
Location:
Modify Context DFD (0)
Source: Logistic Control System (Process)
Dest: Headquarter (External Entity)
Modify Level 1 of LCS (0)
Source: Call Planner Subsystem (Process)
Dest: Headquarter (External Entity)
Level 2 of Call Planner Subsystem (3)
Source: Generate Call Planner Report (Process)
Dest: Headquarter (External Entity)
Date Last Altered:13/9/00 Date Created:13/9/00

Call Planner Subsystem Process
Process No.: 3
Location:
Modify Level 1 of LCS (0)
Input Flows:
Service order list
Completed visited report
Service order mail
Service order information
Assigned engineer
Output Flows:
Call planner report
Visited report
Uesd sparepart
Service order record
Date Last Altered:13/9/00 Date Created:13/9/00

Call Recieved Date Data Element
SERVICE ORDER::Call Recieved Date
Description:
The date that a technical support at a headquarter recieves a call for a service from an user
Data element attributes
Storage Type: Date
Length: 8
Default: Current Date
Null Type: Null
Location:
Entity --> SERVICE ORDER
Date Last Altered:14/9/00 Date Created:12/9/00

Call Recieved Time Data Element
SERVICE ORDER::Call Recieved Time
Description:
Time that a technical support at a headquarter recieves a call for a service from an user
Data element attributes
Storage Type: Time
Length: 5
Null Type: Null
Location:
Entity --> SERVICE ORDER
Date Last Altered:14/9/00 Date Created:12/9/00

Change Part Data Element
SERVICE ORDER::Change Part
Description:
A status asked to define whether an engineer changes spareparts
Values & Meanings:
0 = N/A
1 = Yes
2 = No
Data element attributes
Storage Type: Integer 4
Length: 1
Default: 0
Null Type: Null
Location:
Entity --> SERVICE ORDER
Date Last Altered:14/9/00 Date Created:12/9/00

Check Reserve Sparepart Process
Process No.: 1.1.1
Location:
Level 3 of Process Warehouse Transaction (1.1)
Input Flows:

Alternate availability
Sparepart availability
Sparepart list
Output Flows:
Reserved sparepart
Unavailable sparepart
Identified sparepart
Cutted sparepart
Date Last Altered:13/9/00 Date Created:13/9/00

Closed Call Process
Process No.: 3.1.3
Location:
Level 3 of Call Planner Transaction (3.1)
Input Flows:
Completed visited report
Output Flows:
Uesd sparepart
Closed service order
Date Last Altered:13/9/00 Date Created:13/9/00

Closed service order Data Flow
Location:
Level 3 of Call Planner Transaction (3.1)
Source: Closed Call (Process)
Dest: Service Orders (Data Store)
Level 3 of Generate Call Planner Report (3.2)
Source: Service Orders (Data Store)
Dest: Generate Onsite Report (Process)
Data Flow --> Service order record
Data Flow --> Service order information
Date Last Altered:13/9/00 Date Created:13/9/00

Commodity Data Element
SPAREPART::Commodity
Description:
Type of sparepart such as HDD ,FDD , Moniter ect.
Data element attributes
Storage Type: Long VarChar
Length: 20
Null Type: Null
Location:
Entity --> SPAREPART
Date Last Altered:14/9/00 Date Created:12/9/00

Completed request form Data Flow
Location:
Modify Context DFD (0)
Source: Logistic Control System (Process)

Dest: Warehouse (External Entity)
Modify Level 1 of LCS (0)
Source: Warehouse Subsystem (Process)
Dest: Warehouse (External Entity)
Level 2 of Warehouse Subsystem (1)
Source: Process Warehouse Transaction (Process)
Dest: Warehouse (External Entity)
Level 3 of Process Warehouse Transaction (1.1)
Source: Return Sparepart (Process)
Dest: Warehouse (External Entity)
Date Last Altered:13/9/00 Date Created:13/9/00

Completed visited report Data Flow
Location:
Modify Context DFD (0)
Source: Engineer (External Entity)
Dest: Logistic Control System (Process)
Modify Level 1 of LCS (0)
Source: Engineer (External Entity)
Dest: Call Planner Subsystem (Process)
Level 2 of Call Planner Subsystem (3)
Source: Engineer (External Entity)
Dest: Process Call Planner Transaction (Process)
Level 3 of Call Planner Transaction (3.1)
Source: Engineer (External Entity)
Dest: Closed Call (Process)
Date Last Altered:13/9/00 Date Created:13/9/00

Customer Data Element
SERVICE ORDER::Customer
Description:
Customer address and contacted name of each service
Data element attributes
Storage Type: Long VarChar
Length: 60
Null Type: Null
Location:
Entity --> SERVICE ORDER
Date Last Altered:14/9/00 Date Created:12/9/00

Cutted sparepart Data Flow
Location:
Level 3 of Process Warehouse Transaction (1.1)
Source: Check Reserve Sparepart (Process)
Dest: Spareparts (Data Store)
Data Flow --> Updated sparepart
Date Last Altered:13/9/00 Date Created:13/9/00

Dell DQT Data Element

SERVICE ORDER::Dell DQT

Description:

A status asked to define whether the service get pass result from testing by dell diagnostic quick test before repair

Values & Meanings:

0 = N/A
1 = Yes
2 = No

Data element attributes

Storage Type: Integer 4
Length: 1
Default: 0
Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Dell DST Data Element

SERVICE ORDER::Dell DST

Description:

A status asked to define whether the service get pass result from testing by dell diagnostic specific test before repair

Values & Meanings:

0 = N/A
1 = Yes
2 = No

Data element attributes

Storage Type: Integer 4
Length: 1
Default: 0
Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Dell Part Number Data Element

EMPLOYMENT::Dell Part Number

Description:

A number of sparepart issued by DELL

Data element attributes

Storage Type: Unicode VarChar
Length: 5
Null Type: Null

Location:

Associative Entity -->EMPLOYMENT

Date Last Altered:14/9/00 Date Created:12/9/00

Dell Part Number Data Element

SHIPMENT::Dell Part Number

Description:
A number of sparepart issued by DELL
Data element attributes
Storage Type: Unicode VarChar
Length: 5
Null Type: Null
Location:
Associative Entity -->SHIPMENT
Date Last Altered:14/9/00 Date Created:12/9/00

Dell Part Number Data Element
SPAREPART::Dell Part Number
Description:
A number of sparepart issued by DELL
Data element attributes
Storage Type: Unicode VarChar
Length: 5
Null Type: Null
Location:
Entity --> SPAREPART
Date Last Altered:14/9/00 Date Created:12/9/00

Dell Part Number_1 Data Element
SPAREPART::Dell Part Number_1
Description:
A number of sparepart issued by DELL
Data element attributes
Storage Type: Unicode VarChar
Length: 5
Null Type: Null
Location:
Entity --> SPAREPART
Date Last Altered:14/9/00 Date Created:12/9/00

Description Data Element
SPAREPART::Description
Description:
A specific detail of each sparepart
Data element attributes
Storage Type: Long VarChar
Length: 40
Null Type: Null
Location:
Entity --> SPAREPART
Date Last Altered:14/9/00 Date Created:12/9/00

Emploiments Data Store
Data Store No.:D14
Location:

Level 2 of Call Planner Subsystem (3)
Output Flows:
Assigned engineer
Date Last Altered:13/9/00 Date Created:13/9/00

Employments Data Store
Data Store No.:D9
Location:
Modify Level 1 of LCS (0)
Output Flows:
Assigned engineer
RMA request information
WLP request information
Input Flows:
Updated request detail
Return Detail
Identified sparepart
Assigned engineer
Output Flows:
Request detail
Request information
Level 2 of Warehouse Subsystem (1)
Input Flows:
Updated request detail
Return Detail
Identified sparepart
Output Flows:
Request detail
Request information
Level 3 of Process Warehouse Transaction (1.1)
Input Flows:
Updated request detail
Return Detail
Identified sparepart
Output Flows:
Request information
Level 3 of Generate Call Planner Report (3.2)
Output Flows:
Assigned engineer
Date Last Altered:13/9/00 Date Created:13/9/00

Engineer External Entity
Location:
Modify Context DFD (0)
Input Flows:
Request form
Output Flows:
Completed visited report
Modify Level 1 of LCS (0)

Input Flows:
Request form
Visited report
Output Flows:
Completed visited report
Fill in request form
Returned sparepart
Level 2 of Warehouse Subsystem (1)
Input Flows:
Request form
Output Flows:
Fill in request form
Returned sparepart
Level 2 of Call Planner Subsystem (3)
Input Flows:
Visited report
Output Flows:
Completed visited report
Level 3 of Process Warehouse Transaction (1.1)
Output Flows:
Fill in request form
Returned sparepart
Level 3 of Call Planner Transaction (3.1)
Output Flows:
Completed visited report
Level 3 of Generate Call Planner Report (3.2)
Input Flows:
Visited report
Date Last Altered:13/9/00 Date Created:13/9/00

Engineer Address Data Element
ENGINEER::Engineer Address
Description:
A current address of an engineer
Data element attributes
Storage Type: Long VarChar
Length: 60
Null Type: Null
Location:
Entity --> ENGINEER
Date Last Altered:14/9/00 Date Created:12/9/00

Engineer list Data Flow
Location:
Modify Level 1 of LCS (0)
Source: Engineers (Data Store)
Dest: Process Assign Engineer (Process)
Date Last Altered:13/9/00 Date Created:13/9/00

Engineer Name Data Element
ENGINEER::Engineer Name
Description:
A name if an engineer
Data element attributes
Storage Type: Long VarChar
Length: 30
Null Type: Null
Location:
Entity --> ENGINEER
Date Last Altered:14/9/00 Date Created:12/9/00

Engineer Number Data Element
EMPLOYMENT::Engineer Number
Description:
An engineer code number specified by DELL
Data element attributes
Storage Type: Unicode VarChar
Length: 7
Null Type: Null
Location:
Associative Entity -->EMPLOYMENT
Date Last Altered:14/9/00 Date Created:12/9/00

Engineer Number Data Element
ENGINEER::Engineer Number
Description:
An engineer code number specified by DELL
Data element attributes
Storage Type: Unicode VarChar
Length: 7
Null Type: Null
Location:
Entity --> ENGINEER
Date Last Altered:14/9/00 Date Created:12/9/00

Engineer Phone Data Element
ENGINEER::Engineer Phone
Description:
A mobile phone or pager number of an engineer that can be used to contact to the engineer anytime
Data element attributes
Storage Type: Decimal
Length: 9
Null Type: Null
Location:
Entity --> ENGINEER
Date Last Altered:14/9/00 Date Created:12/9/00

Engineers Data Store
Data Store No.:D7
Location:
Modify Level 1 of LCS (0)
Output Flows:
Engineer list
Date Last Altered:13/9/00 Date Created:13/9/00

Faulty Part Number Data Element
REQUEST::Faulty Part Number
Description:
The DELL 's sparepart number of bad or DOA returned sparepart
Data element attributes
Storage Type: Unicode VarChar
Length: 5
Null Type: Null
Location:
Entity --> REQUEST
Date Last Altered:14/9/00 Date Created:12/9/00

Faulty Serial Number Data Element
REQUEST::Faulty Serial Number
Description:
The manufacturer 's sparepart number of bad or DOA returned sparepart
Data element attributes
Storage Type: Unicode VarChar
Length: 15
Null Type: Null
Location:
Entity --> REQUEST
Date Last Altered:14/9/00 Date Created:12/9/00

Fill in request form Data Flow
Location:
Modify Level 1 of LCS (0)
Source: Engineer (External Entity)
Dest: Warehouse Subsystem (Process)
Level 2 of Warehouse Subsystem (1)
Source: Engineer (External Entity)
Dest: Process Warehouse Transaction (Process)
Level 3 of Process Warehouse Transaction (1.1)
Source: Engineer (External Entity)
Dest: Request Sparepart (Process)
Date Last Altered:13/9/00 Date Created:13/9/00

Generate Appointment Report Process
Process No.: 3.2.1
Location:
Level 3 of Generate Call Planner Report (3.2)

Input Flows:
Appointed service information
Output Flows:
Appointment report
Date Last Altered:13/9/00 Date Created:13/9/00

Generate Call Planner Report Process
Process No.: 3.2
Location:
Level 2 of Call Planner Subsystem (3)
Input Flows:
Service order information
Assigned engineer
Used sparepart
Output Flows:
Call planner report
Visited report
Date Last Altered:13/9/00 Date Created:13/9/00

Generate Onsite Report Process
Process No.: 3.2.3
Location:
Level 3 of Generate Call Planner Report (3.2)
Input Flows:
Used sparepart
Closed service order
Output Flows:
Onsite service report
Date Last Altered:13/9/00 Date Created:13/9/00

Generate Order Report Process
Process No.: 2.2
Location:
Level 2 of Order Subsystem (2)
Input Flows:
Order information
Output Flows:
Order report
Date Last Altered:13/9/00 Date Created:13/9/00

Generate Request Form Process
Process No.: 1.2
Location:
Level 2 of Warehouse Subsystem (1)
Input Flows:
Request detail
Output Flows:
Request form
Date Last Altered:13/9/00 Date Created:13/9/00

Generate RMA Report Process

Process No.: 5

Location:

Modify Level 1 of LCS (0)

Input Flows:

RMA request information

RMA return information

Output Flows:

RMA report

Date Last Altered:13/9/00 Date Created:13/9/00

Generate Visited Report Process

Process No.: 3.2.2

Location:

Level 3 of Generate Call Planner Report (3.2)

Input Flows:

Assigned engineer

Service order detail

Output Flows:

Visited report

Date Last Altered:13/9/00 Date Created:13/9/00

Generate WLP Report Process

Process No.: 6

Location:

Modify Level 1 of LCS (0)

Input Flows:

WLP request information

WLP return information

Output Flows:

WLP report

Date Last Altered:13/9/00 Date Created:13/9/00

Headquarter External Entity

Location:

Modify Context DFD (0)

Input Flows:

RMA report

WLP report

Order report

Call planner report

Output Flows:

Shipment information

Service order mail

Modify Level 1 of LCS (0)

Input Flows:

RMA report

WLP report

Order report
Call planner report
Output Flows:
Shipment information
Service order mail
Level 2 of Order Subsystem (2)
Input Flows:
Order report
Output Flows:
Shipment information
Level 2 of Call Planner Subsystem (3)
Input Flows:
Call planner report
Output Flows:
Service order mail
Level 3 of Process Order Transaction (2.1)
Output Flows:
Shipment detail
Incomming sparepart
Level 3 of Call Planner Transaction (3.1)
Output Flows:
Service order mail
Level 3 of Generate Call Planner Report (3.2)
Input Flows:
Appointment report
Onsite service report
Date Last Altered:13/9/00 Date Created:13/9/00

Identified sparepart Data Flow
Location:
Modify Level 1 of LCS (0)
Source: Warehouse Subsystem (Process)
Dest: Employments (Data Store)
Level 2 of Warehouse Subsystem (1)
Source: Process Warehouse Transaction (Process)
Dest: Employments (Data Store)
Level 3 of Process Warehouse Transaction (1.1)
Source: Check Reserve Sparepart (Process)
Dest: Employments (Data Store)
Date Last Altered:13/9/00 Date Created:13/9/00

Incomming sparepart Data Flow
Location:
Level 3 of Process Order Transaction (2.1)
Source: Headquarter (External Entity)
Dest: Recieve Sparepart (Process)
Data Flow --> Shipment information
Date Last Altered:13/9/00 Date Created:13/9/00

Location Data Element
SERVICE ORDER::Location
Description:
Customer 's location specified into province
Data element attributes
Storage Type: Long VarChar
Length: 15
Null Type: Null
Location:
Entity --> SERVICE ORDER
Date Last Altered:14/9/00 Date Created:12/9/00

Logistic Control System Process
Process No.: 0
Location:
Modify Context DFD (0)
Input Flows:
Service order list
Completed visited report
Alternate availability
Sparepart availability
P1 order
Shipment information
Service order mail
Output Flows:
Request form
Completed request form
Reserved sparepart
Unavailable sparepart
RMA report
WLP report
Order report
Call planner report
Date Last Altered:13/9/00 Date Created:13/9/00

Mail Recieved Date Data Element
SERVICE ORDER::Mail Recieved Date
Description:
The date that call planner recieves a service order mailed by the headquarter
Data element attributes
Storage Type: Date
Length: 8
Default: Current Date
Null Type: Null
Location:
Entity --> SERVICE ORDER
Date Last Altered:14/9/00 Date Created:12/9/00

Mail Recieved Time Data Element

SERVICE ORDER::Mail Recieved Time
Description:
Time that call planner recieves a service order mailed by the headquarter
Data element attributes
Storage Type: Time
Length: 5
Null Type: Null
Location:
Entity --> SERVICE ORDER
Date Last Altered:14/9/00 Date Created:12/9/00
Make Appointment Process
Process No.: 3.1.2
Location:
Level 3 of Call Planner Transaction (3.1)
Input Flows:
Service order list
Output Flows:
Set appointment status
Date Last Altered:13/9/00 Date Created:13/9/00

New recieve Data Flow
Location:
Level 3 of Process Order Transaction (2.1)
Source: Recieve Sparepart (Process)
Dest: Specify Alternate Sparepart (Process)
Date Last Altered:13/9/00 Date Created:13/9/00

Onsite service report Data Flow
Location:
Level 3 of Generate Call Planner Report (3.2)
Source: Generate Onsite Report (Process)
Dest: Headquarter (External Entity)
Data Flow --> Call planner report
Date Last Altered:13/9/00 Date Created:13/9/00

Order Date Data Element
SHIPMENT::Order Date
Description:
The date that stock orderor launch an order to a headquarter
Data element attributes
Storage Type: Date
Length: 8
Null Type: Null
Location:
Associative Entity -->SHIPMENT
Date Last Altered:14/9/00 Date Created:12/9/00

Order information Data Flow
Location:

Modify Level 1 of LCS (0)
Source: Shipments (Data Store)
Dest: Order Subsystem (Process)
Level 2 of Order Subsystem (2)
Source: Shipments (Data Store)
Dest: Generate Order Report (Process)
Date Last Altered:13/9/00 Date Created:13/9/00

Order Number Data Element
ORDER::Order Number
Description:
Number of each order issued by stock orderor
Data element attributes
Storage Type: Decimal
Length: 8
Null Type: Null
Location:
Entity --> ORDER
Date Last Altered:14/9/00 Date Created:12/9/00

Order Number Data Element
SHIPMENT::Order Number
Description:
Number of each order issued by stock orderor
Data element attributes
Storage Type: Decimal
Length: 8
Null Type: Null
Location:
Associative Entity -->SHIPMENT
Date Last Altered:14/9/00 Date Created:12/9/00

Order Quantity Data Element
SHIPMENT::Order Quantity
Description:
A quantity of each sparepart to be orderor
Data element attributes
Storage Type: Decimal
Length: 2
Default: 1
Null Type: Null
Location:
Associative Entity -->SHIPMENT
Date Last Altered:14/9/00 Date Created:12/9/00

Order record Data Flow
Composition:
P1 Information :
P3 Information :

Location:
Modify Level 1 of LCS (0)
Source: Order Subsystem (Process)
Dest: Shipments (Data Store)
Level 2 of Order Subsystem (2)
Source: Process Order Transaction (Process)
Dest: Shipments (Data Store)
Date Last Altered:13/9/00 Date Created:13/9/00

Order report Data Flow
Location:
Modify Context DFD (0)
Source: Logistic Control System (Process)
Dest: Headquarter (External Entity)
Modify Level 1 of LCS (0)
Source: Order Subsystem (Process)
Dest: Headquarter (External Entity)
Level 2 of Order Subsystem (2)
Source: Generate Order Report (Process)
Dest: Headquarter (External Entity)
Date Last Altered:13/9/00 Date Created:13/9/00

Order Subsystem Process
Process No.: 2
Location:
Modify Level 1 of LCS (0)
Input Flows:
P1 order
Shipment information
Bad_DOA sparepart
Order information
Output Flows:
Order report
Alternate specification
Updated sparepart information
Order record
Updated order information
Date Last Altered:13/9/00 Date Created:13/9/00

Order_ Piority1 Process
Process No.: 2.1.1
Location:
Level 3 of Process Order Transaction (2.1)
Input Flows:
P1 order
Output Flows:
P1 Information
Date Last Altered:13/9/00 Date Created:13/9/00

Order_ Piority3 Process
Process No.: 2.1.2
Location:
Level 3 of Process Order Transaction (2.1)
Input Flows:
Bad_DOA sparepart
Output Flows:
P3 Information
Date Last Altered:13/9/00 Date Created:13/9/00

P1 Information Data Flow
Location:
Level 3 of Process Order Transaction (2.1)
Source: Order_ Piority1 (Process)
Dest: Shipments (Data Store)
Data Flow --> Order record
Date Last Altered:13/9/00 Date Created:13/9/00

P1 order Data Flow
Location:
Modify Context DFD (0)
Source: Stock Orderor (External Entity)
Dest: Logistic Control System (Process)
Modify Level 1 of LCS (0)
Source: Stock Orderor (External Entity)
Dest: Order Subsystem (Process)
Level 2 of Order Subsystem (2)
Source: Stock Orderor (External Entity)
Dest: Process Order Transaction (Process)
Level 3 of Process Order Transaction (2.1)
Source: Stock Orderor (External Entity)
Dest: Order_ Piority1 (Process)
Date Last Altered:13/9/00 Date Created:13/9/00

P3 Information Data Flow
Location:
Level 3 of Process Order Transaction (2.1)
Source: Order_ Piority3 (Process)
Dest: Shipments (Data Store)
Data Flow --> Order record
Date Last Altered:13/9/00 Date Created:13/9/00

Part Type Data Element
SPAREPART::Part Type
Description:
Used to identify that a sparepart belong to which type of service
Values & Meanings:
0 = Normal
1 = 4Hr

Data element attributes
Storage Type: Integer 4
Length: 1
Default: 0
Null Type: Null
Location:
Entity --> SPAREPART
Date Last Altered:14/9/00 Date Created:12/9/00

Price Data Element
SPAREPART::Price
Description:
Net price of a sparepart
Data element attributes
Storage Type: Decimal
Length: 4
Null Type: Null
Location:
Entity --> SPAREPART
Date Last Altered:14/9/00 Date Created:12/9/00

Process Assign Engineer Process
Process No.: 4
Location:
Modify Level 1 of LCS (0)
Input Flows:
Engineer list
Output Flows:
Assigned engineer
Date Last Altered:13/9/00 Date Created:13/9/00

Process Call Planner Transaction Process
Process No.: 3.1
Location:
Level 2 of Call Planner Subsystem (3)
Input Flows:
Service order list
Completed visited report
Service order mail
Output Flows:
Uesd sparepart
Service order record
Date Last Altered:13/9/00 Date Created:13/9/00

Process Order Transaction Process
Process No.: 2.1
Location:
Level 2 of Order Subsystem (2)
Input Flows:

P1 order
Shipment information
Bad_DOA sparepart
Output Flows:
Alternate specification
Updated sparepart information
Order record
Updated order information
Date Last Altered:13/9/00 Date Created:13/9/00

Process Warehouse Transaction Process
Process No.: 1.1
Location:
Level 2 of Warehouse Subsystem (1)
Input Flows:
Alternate availability
Sparepart availability
Sparepart list
Fill in request form
Returned sparepart
Request information
Used sparepart
Output Flows:
Completed request form
Reserved sparepart
Unavailable sparepart
Updated request detail
Return Detail
Identified sparepart
Updated sparepart
Date Last Altered:13/9/00 Date Created:13/9/00

Product Type Data Element
SERVICE ORDER::Product Type
Description:
Dell 's mechine type such as optiplex desktop , lattitude notebook ,ect.
Values & Meanings:
0 = Optiplex
1 = Latitude
2 = Workstation
3 = Poweredge
Data element attributes
Storage Type: Integer 4
Length: 1
Null Type: Null
Location:
Entity --> SERVICE ORDER
Date Last Altered:14/9/00 Date Created:12/9/00

Quantity Data Element
SPAREPART::Quantity
Description:
Amount of sparepart that remain in the store
Data element attributes
Storage Type: Decimal
Length: 2
Null Type: Null
Location:
Entity --> SPAREPART
Date Last Altered:14/9/00 Date Created:12/9/00

Recieve Shipment Detail Process
Process No.: 2.1.3
Location:
Level 3 of Process Order Transaction (2.1)
Input Flows:
Shipment detail
Output Flows:
Updated order information
Date Last Altered:13/9/00 Date Created:13/9/00

Recieve Sparepart Process
Process No.: 2.1.4
Location:
Level 3 of Process Order Transaction (2.1)
Input Flows:
Incomming sparepart
Output Flows:

...

APPENDIX E

DATA DICTIONARY

DATA DICTIONARY

Action Taken Data Element

SERVICE ORDER::Action Taken

Description:

Everythings that engineer do to fix customer's problems

Data element attributes

Storage Type: Long VarChar

Length: 200

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:12/9/00 Date Created:12/9/00

Appointment Status Data Element

SERVICE ORDER::Appointment Status

Description:

Show the status of service order that is appointed

Values & Meanings:

0 = can't contacted

1 = scheduled

3 = cancelled

Data element attributes

Storage Type: Integer 4

Length: 1

Default: 0

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Asset Data Element

SERVICE ORDER::Asset

Description:

Machine serial number

Data element attributes

Storage Type: Unicode VarChar

Length: 6

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

---

assign to Relationship

Attached Entities:

ENGINEER

assign to MIN: 0 MAX: many

EMPLOYMENT

[assign to] MIN: 1 MAX: 1

Location:

ModifyERD

Date Last Altered:12/9/00 Date Created:12/9/00

AWB No. Data Element

SHIPMENT::AWB No.

Description:

A shipment number that is issued by the headquarter to ensure an order of stock orderor

Data element attributes

Storage Type: Unicode VarChar

Length: 10

Null Type: Null

Location:

Associative Entity -->SHIPMENT

Date Last Altered:14/9/00 Date Created:12/9/00

Call Closed Date Data Element

SERVICE ORDER::Call Closed Date

Description:

The date that a a service order is completed

Data element attributes

Storage Type: Date

Length: 8

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Call Closed Time Data Element

SERVICE ORDER::Call Closed Time

Description:

Time that a service order is completed

Data element attributes

Storage Type: Time

Length: 5

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Call Recieved Date Data Element

SERVICE ORDER::Call Recieved Date

Description:

The date that a technical support at a headquarter recieves a call for a service from an user

Data element attributes

Storage Type: Date

Length: 8

Default: Current Date

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Call Recieved Time Data Element

SERVICE ORDER::Call Recieved Time

Description:

Time that a technical support at a headquarter recieves a call for a service from an user

Data element attributes

Storage Type: Time

Length: 5

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Change Part Data Element

SERVICE ORDER::Change Part

Description:

A status asked to define whether an engineer changes spareparts

Values & Meanings:

0 = N/A

1 = Yes

2 = No

Data element attributes

Storage Type: Integer 4

Length: 1

Default: 0

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Commodity Data Element

SPAREPART::Commodity

Description:

Type of sparepart such as HDD ,FDD , Moniter ect.

Data element attributes

Storage Type: Long VarChar

Length: 20

Null Type: Null

Location:

Entity --> SPAREPART

Date Last Altered:14/9/00 Date Created:12/9/00

Customer Data Element

SERVICE ORDER::Customer

Description:

Customer address and contacted name of each service

Data element attributes

Storage Type: Long VarChar

Length: 60

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Dell DQT Data Element

SERVICE ORDER::Dell DQT

Description:

A status asked to define whether the service get pass result from testing by dell diagnostic quick test before repair

Values & Meanings:

0 = N/A

1 = Yes

2 = No

Data element attributes

Storage Type: Integer 4

Length: 1

Default: 0

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Dell DST Data Element

SERVICE ORDER::Dell DST

Description:

A status asked to define whether the service get pass result from testing by dell diagnostic specific test before repair

Values & Meanings:

0 = N/A

1 = Yes

2 = No

Data element attributes

Storage Type: Integer 4

Length: 1

Default: 0

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Dell Part Number Data Element

EMPLOYMENT::Dell Part Number

Description:

A number of sparepart issued by DELL

Data element attributes

Storage Type: Unicode VarChar

Length: 5

Null Type: Null

Location:

Associative Entity -->EMPLOYMENT

Date Last Altered:14/9/00 Date Created:12/9/00

Dell Part Number Data Element

SHIPMENT::Dell Part Number

Description:

A number of sparepart issued by DELL

Data element attributes

Storage Type: Unicode VarChar

Length: 5

Null Type: Null

Location:

Associative Entity -->SHIPMENT

Date Last Altered:14/9/00 Date Created:12/9/00

Dell Part Number Data Element

SPAREPART::Dell Part Number

Description:

A number of sparepart issued by DELL

Data element attributes

Storage Type: Unicode VarChar

Length: 5

Null Type: Null

Location:

Entity --> SPAREPART

Date Last Altered:14/9/00 Date Created:12/9/00

Dell Part Number_1 Data Element

SPAREPART::Dell Part Number_1

Description:

A number of sparepart issued by DELL

Data element attributes

Storage Type: Unicode VarChar

Length: 5

Null Type: Null

Location:

Entity --> SPAREPART

Date Last Altered:14/9/00 Date Created:12/9/00

Description Data Element

SPAREPART::Description

Description:

A specific detail of each sparepart

Data element attributes

Storage Type: Long VarChar

Length: 40

Null Type: Null

Location:

Entity --> SPAREPART

Date Last Altered:14/9/00 Date Created:12/9/00

---

emploied Relationship

Attached Entities:

SPAREPART

emploied MIN: 0 MAX: many

EMPLOYMENT

[emploied] MIN: 1 MAX: 1

Location:

ModifyERD

Date Last Altered:12/9/00 Date Created:12/9/00

EMPLOYMENT Associative Entity

Composition:

Request NumberDecimal(10) NotNull [FK]

Service Order NumberDecimal(12) NotNull [PK][FK]

Engineer NumberUnicode VarChar(7) NotNull [FK]

Dell Part NumberUnicode VarChar(5) NotNull [PK][FK]

Requested DateDate(8) Null

Requested TimeTime(5) Null

Returned Date Date(8) Null

Primary Key:

Index Name: Generated by VAW

Column(s): Dell Part Number [ASC]

Service Order Number [ASC]

Foreign Key(s):

REQUEST 'sponsors'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

ENGINEER 'assign to'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

SPAREPART 'emploied'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

SERVICE ORDER 'generates'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

ModifyERD

Attached relationships on ModifyERD:

[generates] MIN: 1 MAX: 1

SERVICE ORDER

[emploied] MIN: 1 MAX: 1

SPAREPART

[assign to] MIN: 1 MAX: 1

ENGINEER

[sponsors] MIN: 1 MAX: 1

REQUEST

Date Last Altered:14/9/00 Date Created:12/9/00

ENGINEER Entity

Description:

An onsite service engineer

Composition:

Engineer NumberUnicode VarChar(7) Null [PK]

Engineer NameLong VarChar(30) Null

Engineer AddressLong VarChar(60) Null

Engineer PhoneDecimal(9) Null

Primary Key:

Index Name: Generated by VAW

Column(s): Engineer Number [ASC]

Location:

ModifyERD

Attached relationships on ModifyERD:

assign to MIN: 0 MAX: many

EMPLOYMENT

Date Last Altered:12/9/00 Date Created:12/9/00

Engineer Address Data Element

ENGINEER::Engineer Address

Description:

A current address of an engineer

Data element attributes

Storage Type: Long VarChar

Length: 60

Null Type: Null

Location:

Entity --> ENGINEER

Date Last Altered:14/9/00 Date Created:12/9/00

Engineer Name Data Element

ENGINEER::Engineer Name

Description:

A name if an engineer

Data element attributes

Storage Type: Long VarChar

Length: 30

Null Type: Null

Location:

Entity --> ENGINEER

Date Last Altered:14/9/00 Date Created:12/9/00

Engineer Number Data Element

EMPLOYMENT::Engineer Number

Description:

An engineer code number specified by DELL

Data element attributes

Storage Type: Unicode VarChar

Length: 7

Null Type: Null

Location:

Associative Entity -->EMPLOYMENT

Date Last Altered:14/9/00 Date Created:12/9/00

Engineer Number Data Element

ENGINEER::Engineer Number

Description:

An engineer code number specified by DELL

Data element attributes

Storage Type: Unicode VarChar

Length: 7

Null Type: Null

Location:

Entity --> ENGINEER

Date Last Altered:14/9/00 Date Created:12/9/00

Engineer Phone Data Element

ENGINEER::Engineer Phone

Description:

A mobile phone or pager number of an engineer that can be used to contact to the engineer anytime

Data element attributes

Storage Type: Decimal

Length: 9

Null Type: Null

Location:

Entity --> ENGINEER

Date Last Altered:14/9/00 Date Created:12/9/00

Faulty Part Number Data Element

REQUEST::Faulty Part Number

Description:

The DELL 's sparepart number of bad or DOA returned sparepart

Data element attributes

Storage Type: Unicode VarChar

Length: 5

Null Type: Null

Location:

Entity --> REQUEST

Date Last Altered:14/9/00 Date Created:12/9/00

Faulty Serial Number Data Element

REQUEST::Faulty Serial Number

Description:

The manufacturer 's sparepart number of bad or DOA returned sparepart

Data element attributes

Storage Type: Unicode VarChar

Length: 15

Null Type: Null

Location:

Entity --> REQUEST

Date Last Altered:14/9/00 Date Created:12/9/00

---

generates Relationship

Attached Entities:

SERVICE ORDER

generates MIN: 0 MAX: many

EMPLOYMENT

[generates] MIN: 1 MAX: 1

Location:

ModifyERD

Date Last Altered:12/9/00 Date Created:12/9/00

---

has an alternate Relationship

Attached Entities:

SPAREPART

has an alternate MIN: 0 MAX: many

SPAREPART

[has an alternate] MIN: 0 MAX: many

Location:

ModifyERD

Date Last Altered:12/9/00 Date Created:12/9/00

Location Data Element

SERVICE ORDER::Location

Description:

Customer 's location specified into province

Data element attributes

Storage Type: Long VarChar

Length: 15

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Mail Recieved Date Data Element

SERVICE ORDER::Mail Recieved Date

Description:

The date that call planner recieves a service order mailed by the headquarter

Data element attributes

Storage Type: Date

Length: 8

Default: Current Date

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Mail Recieved Time Data Element

SERVICE ORDER::Mail Recieved Time

Description:

Time that call planner recieves a service order mailed by the headquarter

Data element attributes

Storage Type: Time

Length: 5

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

---

needed Relationship

Attached Entities:

SPAREPART

needed MIN: 0 MAX: many

SHIPMENT

[needed] MIN: 1 MAX: 1

Location:

ModifyERD

Date Last Altered:12/9/00 Date Created:12/9/00

ORDER Entity

Description:

A daily event whereby bad or DOA spareparts are returned or shortaged spareparts are needed

Composition:

Order NumberDecimal(8) Null [PK]

Primary Key:

Index Name: Generated by VAW

Column(s): Order Number [ASC]

Location:

ModifyERD

Attached relationships on ModifyERD:

placed MIN: 0 MAX: many

SHIPMENT

Date Last Altered:12/9/00 Date Created:12/9/00

Order Date Data Element

SHIPMENT::Order Date

Description:

The date that stock orderor launch an order to a headquarter

Data element attributes

Storage Type: Date

Length: 8

Null Type: Null

Location:

Associative Entity -->SHIPMENT

Date Last Altered:14/9/00 Date Created:12/9/00

Order Number Data Element

ORDER::Order Number

Description:

Number of each order issued by stock orderor

Data element attributes

Storage Type: Decimal

Length: 8

Null Type: Null

Location:

Entity --> ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Order Number Data Element

SHIPMENT::Order Number

Description:

Number of each order issued by stock orderor

Data element attributes

Storage Type: Decimal

Length: 8

Null Type: Null

Location:

Associative Entity -->SHIPMENT

Date Last Altered:14/9/00 Date Created:12/9/00

Order Quantity Data Element

SHIPMENT::Order Quantity

Description:

A quantity of each sparepart to be orderor

Data element attributes

Storage Type: Decimal

Length: 2

Default: 1

Null Type: Null

Location:

Associative Entity -->SHIPMENT

Date Last Altered:14/9/00 Date Created:12/9/00

Part Type Data Element

SPAREPART::Part Type

Description:

Used to identify that a sparepart belong to which type of service

Values & Meanings:

0 = Normal

1 = 4Hr

Data element attributes

Storage Type: Integer 4

Length: 1

Default: 0

Null Type: Null

Location:

Entity --> SPAREPART

Date Last Altered:14/9/00 Date Created:12/9/00

---

placed Relationship

Attached Entities:

ORDER

placed MIN: 0 MAX: many

SHIPMENT

[placed] MIN: 1 MAX: 1

Location:

ModifyERD

Date Last Altered:12/9/00 Date Created:12/9/00

Price Data Element

SPAREPART::Price

Description:

Net price of a sparepart

Data element attributes

Storage Type: Decimal

Length: 4

Null Type: Null

Location:

Entity --> SPAREPART

Date Last Altered:14/9/00 Date Created:12/9/00

Product Type Data Element

SERVICE ORDER::Product Type

Description:

Dell 's mechine type such as optiplex desktop , lattitude notebook ,ect.

Values & Meanings:

0 = Optiplex

1 = Latitude

2 = Workstation

3 = Poweredge

Data element attributes

Storage Type: Integer 4

Length: 1

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Quantity Data Element

SPAREPART::Quantity

Description:

Amount of sparepart that remain in the store

Data element attributes

Storage Type: Decimal

Length: 2

Null Type: Null

Location:

Entity --> SPAREPART

Date Last Altered:14/9/00 Date Created:12/9/00

REQUEST Entity

Description:

A request generated whereby an engineer requests spareparts to go onsite service

Composition:

Request NumberDecimal(10) Null [PK]

Faulty Part NumberUnicode VarChar(5) Null

Faulty Serial NumberUnicode VarChar(15) Null

Return Type Integer 4(1) Null

Primary Key:

Index Name: Generated by VAW

Column(s): Request Number [ASC]

Location:

ModifyERD

Attached relationships on ModifyERD:

sponsors MIN: 0 MAX: many

EMPLOYMENT

Date Last Altered:12/9/00 Date Created:12/9/00

Request Number Data Element

EMPLOYMENT::Request Number

Description:

Number of sparepart request form

Data element attributes

Storage Type: Decimal

Length: 10

Null Type: Null

Location:

Associative Entity -->EMPLOYMENT

Date Last Altered:14/9/00 Date Created:12/9/00

Request Number Data Element

REQUEST::Request Number

Description:

Number of sparepart request form

Data element attributes

Storage Type: Decimal

Length: 10

Null Type: Null

Location:

Entity --> REQUEST

Date Last Altered:14/9/00 Date Created:12/9/00

Requested Date Data Element

EMPLOYMENT::Requested Date

Description:

Date that an engineer requests each sparepart

Data element attributes

Storage Type: Date

Length: 8

Default: Current Date

Null Type: Null

Location:

Associative Entity -->EMPLOYMENT

Date Last Altered:14/9/00 Date Created:12/9/00

Requested Time Data Element

EMPLOYMENT::Requested Time

Description:

Time that an engineer requests each sparepart

Data element attributes

Storage Type: Time

Length: 5

Default: Current Time

Null Type: Null

Location:

Associative Entity -->EMPLOYMENT

Date Last Altered:14/9/00 Date Created:12/9/00

Reseat Done Data Element

SERVICE ORDER::Reseat Done

Description:

A status asked to define whether the peoblem is gone after reseat spareparts

Values & Meanings:

0 = N/A

1 = Yes

2 = No

Data element attributes

Storage Type: Integer 4

Length: 1

Default: 0

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Return Type Data Element

REQUEST::Return Type

Description:

Type of a returned sparepart

Values & Meanings:

0 = Bad

1 = Good

2 = DOA

3 = IFIR

Data element attributes

Storage Type: Integer 4

Length: 1

Default: 0

Null Type: Null

Location:

Entity --> REQUEST

Date Last Altered:14/9/00 Date Created:12/9/00

Returned Date Data Element

EMPLOYMENT::Returned Date

Description:

Date that an engineer returns a sparepart

Data element attributes

Storage Type: Date

Length: 8

Default: Current Date

Null Type: Null

Location:

Associative Entity -->EMPLOYMENT

Date Last Altered:14/9/00 Date Created:12/9/00

RSL Data Element

SPAREPART::RSL

Description:

Quantity of each sparepart that shoud be remained in a stock

Data element attributes

Storage Type: Decimal

Length: 2

Null Type: Null

Location:

Entity --> SPAREPART

Date Last Altered:14/9/00 Date Created:12/9/00

SERVICE ORDER Entity

Description:

A requested call for onsite service that is sent after customer informed problems to technical support at a headquarter

Composition:

Service Order NumberDecimal(12) Null [PK]

Service Type Integer 4(1) Null

Customer Long VarChar(60) Null

Location Long VarChar(15) Null

Product Type Integer 4(1) Null

Asset Unicode VarChar(6) Null

Appointment StatusInteger 4(1) Null

Mail Recieved DateDate(8) Null

Mail Recieved TimeTime(5) Null

Call Recieved DateDate(8) Null

Call Recieved TimeTime(5) Null

Service StatusInteger 4(1) Null

Trip Date Date(8) Null

Trip Time Time(5) Null

Call Closed DateDate(8) Null

Call Closed TimeTime(5) Null

Action Taken Long VarChar(200) Null

Symtom as ReportInteger 4(1) Null

Reseat Done Integer 4(1) Null

Dell DQT Integer 4(1) Null

Dell DST Integer 4(1) Null

Change Part Integer 4(1) Null

Verified Pass Integer 4(1) Null

Primary Key:

Index Name: Generated by VAW

Column(s): Service Order Number [ASC]

Location:

ModifyERD

Attached relationships on ModifyERD:

generates MIN: 0 MAX: many

EMPLOYMENT

specified MIN: 0 MAX: many

SHIPMENT

Date Last Altered:12/9/00 Date Created:12/9/00

Service Order Number Data Element

EMPLOYMENT::Service Order Number

Description:

Number of service order issued by a headquarter

Data element attributes

Storage Type: Decimal

Length: 12

Null Type: Null

Location:

Associative Entity -->EMPLOYMENT

Date Last Altered:14/9/00 Date Created:12/9/00

Service Order Number Data Element

SERVICE ORDER::Service Order Number

Description:

Number of service order issued by a headquarter

Data element attributes

Storage Type: Decimal

Length: 12

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Service Order Number Data Element

SHIPMENT::Service Order Number

Description:

Number of service order issued by a headquarter

Data element attributes

Storage Type: Decimal

Length: 12

Null Type: Null

Location:

Associative Entity -->SHIPMENT

Date Last Altered:14/9/00 Date Created:12/9/00

Service Status Data Element

SERVICE ORDER::Service Status

Description:

A status used to identify whether a sevice is completed

Values & Meanings:

0 = Completed

1 = Incompleted

Data element attributes

Storage Type: Integer 4

Length: 1

Default: 0

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Service Type Data Element

SERVICE ORDER::Service Type

Description:

Type of each service such as NBD (Next Business Day) , 4HR (Complete within 4 hours) ,ect.

Values & Meanings:

0 = NBD

1 = POW

2 = 4HR

3 = NBDO

Data element attributes

Storage Type: Integer 4

Length: 1

Default: 0

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

SHIPMENT Associative Entity

Composition:

Order Number Decimal(8) NotNull [PK][FK]

Dell Part NumberUnicode VarChar(5) NotNull [PK][FK]

Service Order NumberDecimal(12) NotNull [FK]

Order Date Date(8) Null

Shipment Date DateTime Null

AWB No. Unicode VarChar(10) Null

Order QuantityDecimal(2) Null

Primary Key:

Index Name: Generated by VAW

Column(s): Order Number [ASC]

Dell Part Number [ASC]

Foreign Key(s):

SPAREPART 'needed'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

ORDER 'placed'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

SERVICE ORDER 'specified'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

ModifyERD

Attached relationships on ModifyERD:

[needed] MIN: 1 MAX: 1

SPAREPART

[placed] MIN: 1 MAX: 1

ORDER

[specified] MIN: 1 MAX: 1

SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Shipment Date Data Element

SHIPMENT::Shipment Date

Description:

Date that spareparts should be reached to warehouse

Data element attributes

Storage Type: DateTime

Null Type: Null

Location:

Associative Entity -->SHIPMENT

Date Last Altered:14/9/00 Date Created:12/9/00

SPAREPART Entity

Description:

Inventoried spareparts available for engineer to employ with service orders

Composition:

Dell Part NumberUnicode VarChar(5) Null [PK]

Commodity Long VarChar(20) Null

Description Long VarChar(40) Null

Price Decimal(4) Null

RSL Decimal(2) Null

Quantity Decimal(2) Null

Part Type Integer 4(1) Null

Dell Part Number_1Unicode VarChar(5) Null [FK]

Primary Key:

Index Name: Generated by VAW

Column(s): Dell Part Number [ASC]

Foreign Key(s):

SPAREPART 'has an alternate'

On Delete Restrict

On Update Restrict

On Insert of Child Row Restrict

Location:

ModifyERD

Attached relationships on ModifyERD:

emploied MIN: 0 MAX: many

EMPLOYMENT

needed MIN: 0 MAX: many

SHIPMENT

has an alternate MIN: 0 MAX: many

SPAREPART

has an alternate MIN: 0 MAX: many

SPAREPART

Date Last Altered:12/9/00 Date Created:12/9/00

---

specified Relationship

Attached Entities:

SERVICE ORDER

specified MIN: 0 MAX: many

SHIPMENT

[specified] MIN: 1 MAX: 1

Location:

ModifyERD

Date Last Altered:13/9/00 Date Created:13/9/00

---

sponsors Relationship

Attached Entities:

REQUEST

sponsors MIN: 0 MAX: many

EMPLOYMENT

[sponsors] MIN: 1 MAX: 1

Location:

ModifyERD

Date Last Altered:12/9/00 Date Created:12/9/00

Symtom as Report Data Element

SERVICE ORDER::Symtom as Report

Description:

A status asked to define whether problems are same as define in a service order

Values & Meanings:

0 = N/A

1 = Yes

2 = No

Data element attributes

Storage Type: Integer 4

Length: 1

Default: 1

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Trip Date Data Element

SERVICE ORDER::Trip Date

Description:

Date that an engineer goes onsite

Data element attributes

Storage Type: Date

Length: 8

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Trip Time Data Element

SERVICE ORDER::Trip Time

Description:

Time that an engineer goes onsite

Data element attributes

Storage Type: Time

Length: 5

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

Verified Pass Data Element

SERVICE ORDER::Verified Pass

Description:

A status asked to define whether all problems are gone after repair

Values & Meanings:

0 = N/A

1 = Yes

2 = No

Data element attributes

Storage Type: Integer 4

Length: 1

Default: 1

Null Type: Null

Location:

Entity --> SERVICE ORDER

Date Last Altered:14/9/00 Date Created:12/9/00

BIBLIOGRAPHY

1. Ackoff, Russell L. Creating the Corporate Future. NY: John Wiley and Sons, 1981.

2. Alter, S. L. Decision Support Systems: Current Practice and Continuing Challenges. Philippines: Addison-Wesley, 1980.

3. Argyris, C. Knowledge for Action. San Francisco: Jossey-Bass, 1993.

4. Armour, G. C. and E. S. Buffa. "A Heuristic Algorithm and Simulation Approach to Relative Location of Facilities." Management Science 9, no. 6 (1986): 16-23.

5. Benjamin, C. O. and C. Jungthirapanich. "An Intelligent Decision Support System for Facility Location," Proceedings of the International Industrial Engineering Conference, Detroit, Michigan, May 19-22, 1991.

6. Berry, H. P. "Applications of Linear Programming and Electronic Computers to the Planning of Expansion of Plant Facilities," Proceedings of the Conference of Electronics in Action, American Management Association, 1957.

7. Boose, J. H. Expertise Transfer for Expert System Design. New York: Elsevier Science, 1986.

8. Buffa, E. S. Basic Production Management. New York: John Wiley & Sons, 1971.

9. Clark, K. B. and S. C. Wheelwright. Leading Product Development: The Senior Managers Guide to Creating and Shaping the Enterprise. New York: The Free Press, 1995.

10. Csikszentmhalyi, M. Flow: The Psychology of Optional Experience. New York: Harper-Collins Publishers, 1990.

11. Davis, S. and J. Botkin. The Monster Under the Bed: How Business Is Mastering the Opportunity of Knowledge for Profit. New York: Simom and Schuster, 1994.

12. FitzGerald, J. and Ardre F. FitzGerald. Fundamentals of System Analysis. NY: John Wiley & Sons, 1987.

13. Hamel, G. and C. K. Prahalad. Competing for the Future: Breakthrough Strategies for Seizing Control of Your Industry and Creating the Markets of Tomorrow, 1993.

14. Imparato, N. and O. Harari. Jumping the Curve: Innovation and Strategic Choice in an Age of Transition. San Francisco: Jossey-Bass, 1994.

15. Katzenbach, J. R. and D. K. Smith. The Wisdom of Teams: Creating the High Performance Organization. 1993.

16. Korth, F. Henry and Abraham Slberschatz. Database System Concepts. NY: McGraw-Hill International, 1991.

17. Leonard-Barton, D. Wellsprings of Knowledge. Boston: Harvard Business School Press, 1995.

18. Lipnack, J. and J. Stamps. The Age of the Network: Organizing Principles for the 21st Century, 1995.

19. McGill, Michael and John W. Stocum, Jr. The Smarter Organization: How to Build a Business that Learns and Adapts to Marketplace Needs. NY: John Wiley and Sons, 1994.

20. Nonaka, I. and H. Takeuchi. The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation. London: Oxford University Press, 1995.

21. Page-Jones, Meilir. The Practical Guide to Structured System Design. NJ: Prentice-Hall International Company, 1988.

22. Schrage, M. No More Teams! Mastering the Dynamics of Creative Collaboration, 1994.

23. Senge, P. M. The Fifth Discipline: The Art and Practice of the Learning Organization. New York: Doubleday, 1990.

24. Senge, P. M., Roberts C., Ross R., Smith B., and A. Kleiner. The Fifth Discipline Fieldbook. New York: Currency Doubleday, 1994.

25. Senn, James A. Analysis & Design of Information Systems, 2nd Edition. NY: McGraw-Hill Publishing Company, 1989.

26. Wheatley, M. J. Leadership and the New Science. San Francisco: Berrett-Koehler Publishers, Inc., 1992.