Industrial Maintenance Information System for KM Precision Co., Ltd.

by

Mr. Somsak Dekhajondach

A Final Report of the Six-Credit Course
CS 6998 - CS 6999 System Development Project

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

March 2003

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Project Title	Industrial Maintenance Information System for KM Precision Co., Ltd.
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Academic Year	March 16, 2003

The Graduate School of Assumption University has approved this final report of the six-credit course, CS 6998 – CS 6999 System Development Project, submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer Information Systems.

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ABSTRACT

KM Precision Co., Ltd. is a middle size manufacturing company in Thailand, located in Teparuk Rd, Samutprakarn. The number of employees is now about 500 people and there are 2 plants in Production. The type of business of company is Flex Circuit for component of Hard Disk Drive.

The current existing Corporate Information System is based on the manual system solely. All of the data are stored on paper. Many staff members who require any information needed, face the general problems of a manual system, which is error-prone and has a high maintenance cost.

The new proposed Information System will be developed to replace the manual Maintenance system. All data are kept in the database server which will be accessed by Microsoft SQL Server 7.0 from clients, then accessed through the server. The operating system and network management would be Microsoft Windows 98 Professional Edition. The user interface is implemented on Microsoft Visual Basic 6.0. It will reduce the number of administrative staff, the time used to check routine maintenance schedule, to prepare reports, to solve the problem of the manual system, and it also used to decrease 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.

He would like to thank Air Marshal Dr. Chulit Meesajjee, project advisor, for his valuable suggestions and advice given in preparation of this project.

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TABLE OF CONTENTS

Chapter	Page
ABSTRACT	i
ACKNOWLEDGEMENTS	ii
LIST OF FIGURES	v
LIST OF TABLES	viii
I. INTRODUCTION	1
1.1 Background of the Project	1
1.2 Objectives of the Project	1
1.3 Scope of the Project	2
1.4 Deliverables	2
1.5 Project Plan	3
II. THE EXISTING SYSTEM	5
2.1 Background of the Company	5
2.2 Existing Business System	7
2.3 Current Problems and Areas for Improvement	10
2.4 Existing Computer System	11
III. THE PROPOSED SYSTEM	12
3.1 User's Requirement	13
3.2 System Design	13
3.3 Hardware and Software Requirements	18
3.4 Security and Control	21
3.5 System Cost Evaluation and Comparison	23

Chapter		Page
IV.	PROJECT IMPLEMENTATION	36
	4.1 Overview of Project Implementation	36
	4.2 Test Plan	36
	4.3 Training	37
V.	CONCLUSIONS AND RECOMMENDATIONS	38
	5.1 Conclusions	38
	5.2 Recommendations	39
APPENDIX A	DATA FLOW DIAGRAM OF THE EXISTING SYSTEM	41
APPENDIX B	DATA FLOW DIAGRAM OF THE PROPOSED SYSTEM	43
APPENDIX C	INPUT SCREEN DESIGN	50
APPENDIX D	REPORT DESIGN	58
APPENDIX E	DATABASE DESIGN	61
APPENDIX F	PROCESS SPECIFICATION	72
APPENDIX G	DATA DICTIONARY	83
APPENDIX H	STRUCTURE CHART	90
BIBLIOGRAPHY		95

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LIST OF FIGURES

Figure		Page
1.1	Project Plan of Maintenance Information System	4
2.1	Organization Chart of Krungthep Transportation Co., Ltd.	6
2.2	Context Diagram of the Existing System	8
2.3	Data Flow Diagram of the Existing System	9
2.4	Stan-alone Computer of the existing System	10
3.1	Context Diagram of the Proposed System	16
3.2	Data Flow Diagram of the Proposed System	17
3.3	The Network of the Proposed System	20
3.4	Operating Cost Breakeven Analysis	33
3.5	Payback Period Analysis of Proposed System	34
A.1	Context Diagram (Existing System)	41
A.2	Data Flow Diagram (Existing System)	42
B.1	Context Diagram (Proposed System)	43
B.2	Data Flow Diagram (Proposed System)	44
B.3	Process 1 Data Flow Diagram (Proposed System)	45
B.4	Process 2 Data Flow Diagram (Proposed System)	46
B.5	Process 3 Data Flow Diagram (Proposed System)	47
B.6	Process 4 Data Flow Diagram (Proposed System)	48
B.7	Process 5 Data Flow Diagram (Proposed System)	49

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Figure		Page
C.1	Login Interface	50
C.2	Main Menu Interface	51
C.3	Work Order Form	52
C.4	Work Plan Form	53
C.5	Job Order Form	54
C.6	Request Spare Part Form	55
C.7	Summary Monthly Report	56
C.8	Employee Form	57
D.1	Maintenance Report	58
D.2	Monthly Maintenance Report	59
D.3	Employee Report	60
E.1	Full Attributed Data Model	61
H.1	Structure Chart	90

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LIST OF TABLES

Table		Page
3.1	Hardware Requirement	19
3.2	Software Requirement	21
3.3	Manual System Cost Analysis	23
3.4	Five Year Accumulated Manual System Cost	24
3.5	Candidate Matrix	25
3.6	Feasible Analysis Matrix	26
3.7	Computerized System Cost Analysis, Baht	27
3.8	Five Years Accumulated Computerized Cost, Baht	28
3.9	Comparison of the System Cost, Baht	29
3.10	Estimate Annual Tangible Benafit, Baht	30
3.11	Payback Period Analysis	32
3.12	Net Present Value	33
5.1	Degree of Achievement	39
E.1	Order Table	64
E.2	Job Table	65
E.3	Equipment _Inventory Table	66
E.4	Work_Plan Table	67
E.5	Employee Table	68
E.6	Machine Table	69
E.7	Emp_Job Table	70
E.8	Department Table	71

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Table		Page
F.1	Process Specification of Process 1.1	72
F.2	Process Specification of Process 1.2	73
F.3	Process Specification of Process 1.3	74
F.4	Process Specification of Process 1.4	75
F.5	Process Specification of Process 2.1	76
F.6	Process Specification of Process 3.1	77
F.7	Process Specification of Process 3.2	78
F.8	Process Specification of Process 4.1	79
F.9	Process Specification of Process 4.2	80
F.10	Process Specification of Process 4.3	81
F.11	Process Specification of Process 5.1	82
G.1	Data Dictionary of Maintenance Information System	83

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I. INTRODUCTION

1.1 Background of the Project

The purpose of this system development project is to improve the existing maintenance of ordering manually done to become the computerized ordering system.

Nowadays, equipment, machine and tools in production business employ more advanced technology than in the past, most machines are automated, and complex. Moreover, manufacturing processes are changed from man-made to machine made.

The main problem occurred which the company faces is a delay in maintenance service and mistake maintenance service according to it being run with a manual ordering system. the volume of output depends so much on effectiveness of machine. So, the computer has become one of the needed factors. It is widely used all around the world with a very low cost, compared to its efficiency. The idea of bringing this kind of technology to help improve our performance had emerged and built up more competitive advantages for our company.

1.2 Objectives of the Project

The objectives of this project are focused on Ordering System, which can be described as follows:

(1) To analyze the existing manual system.

(2) To provide the accuracy of the information in the form of on-line information system as proposed.

(3) To serve customer satisfaction.

(4) To reduce a tedious routine job.

(5) To design a new computerized system, focused on a maintenance ordering system.

(6) To create a document to report all levels of management.

(7) To conduct the analysis result of the new system.

(8) To help maintenance section in planning, proactive working

1.3 Scope of the Project

The project will cover the basic requirements, including the following:

(1) To analyze the whole existing manual system.

(2) To design the proposed online maintenance ordering system.

(3) To create new daily and monthly reports.

(4) To identify the quantities of the ordered items.

(5) To be aware of the most frequently ordered items.

(6) To maintain adequate inventory.

(7) To monitor actual maintenance cost.

1.4 Deliverables

(1) Project Introduction

(a) Background of the project

(b) Objectives

(c) Scope

(2) Description of the existing system

(a) Background and organization functions

(b) Existing business functions

(c) Current incurred problems and area for improvements

(d) Existing manual system

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(3) Description of the proposed new system

(a) System specification

(b) System design

(c) Hardware and software requirement

(d) Security and controls

(e) Cost and benefit analysis

(4) Project Implementation

(a) Overview of project implementation

(b) Test plan and results

(5) Conclusion and Recommendations

(6) Data Dictionary

1.5 Project Plan

This project is planned timeframe, its activities and duration of each activity is presented in Figure 1.1.

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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	Report Design
9	Database Design
10	Network Design
11	Program Design
	III. Implementation of the Proposed System
12	Coding
13	Testing
14	Hardware Installation
15	Software Installation
16	Conversion

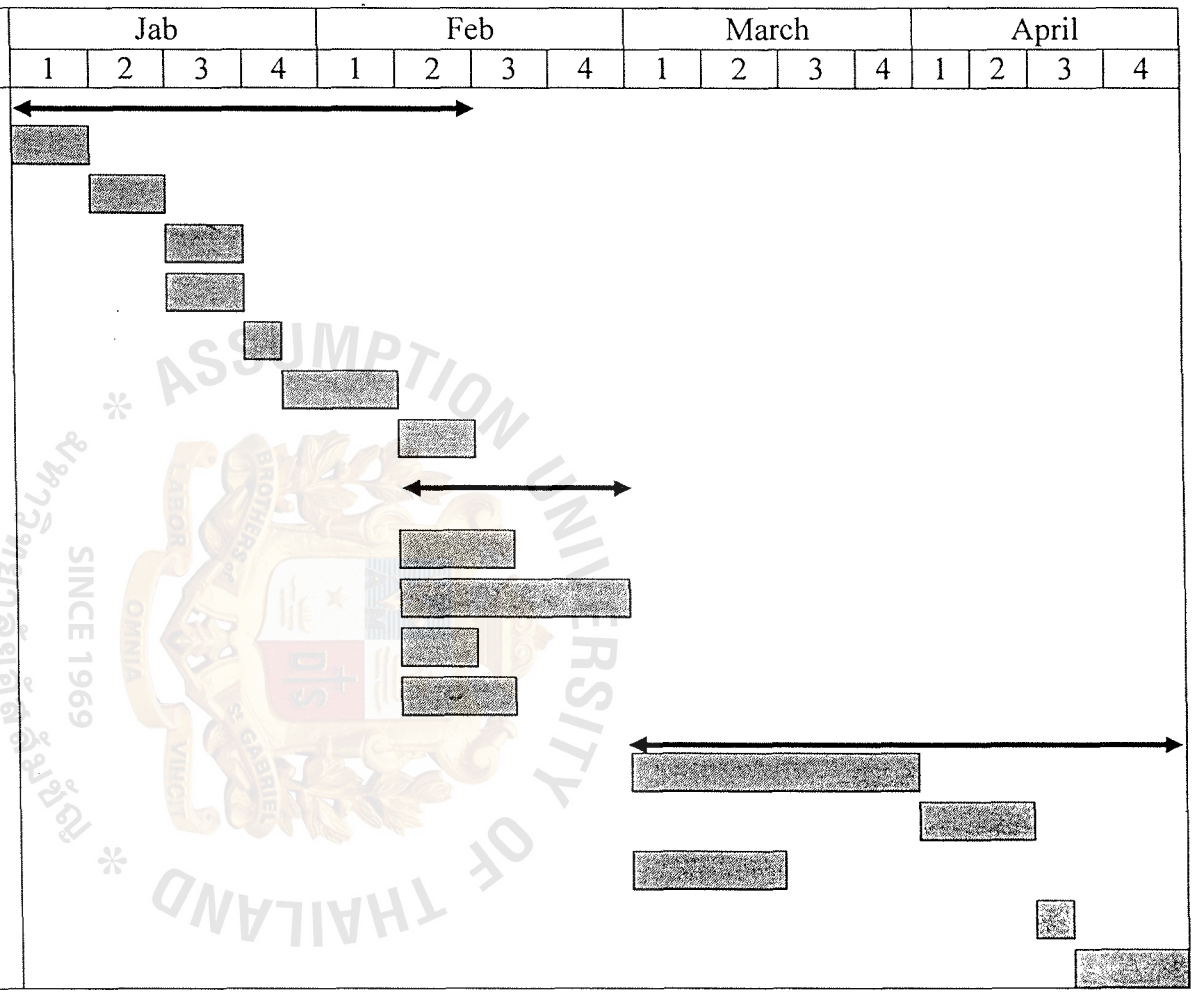

Figure 1.1. Plan of Maintenance Information System.

II. THE EXISTING SYSTEM

2.1 Background of the Organization

KM company is a middle size manufacturing company in Thailand, located in Teparuk Rd, Samutprakarn. The number of employees is now about 500 and there are 2 plants in production. The type of business of the company is Flex circuit for the component of Hard Disk Drive. There are 4 main departments, which are Financial Department, Operating Department, General Affairs Department, and Maintenance Department that is separated into electrical section and mechanic section. The organization chart is shown in Figure 2.1.

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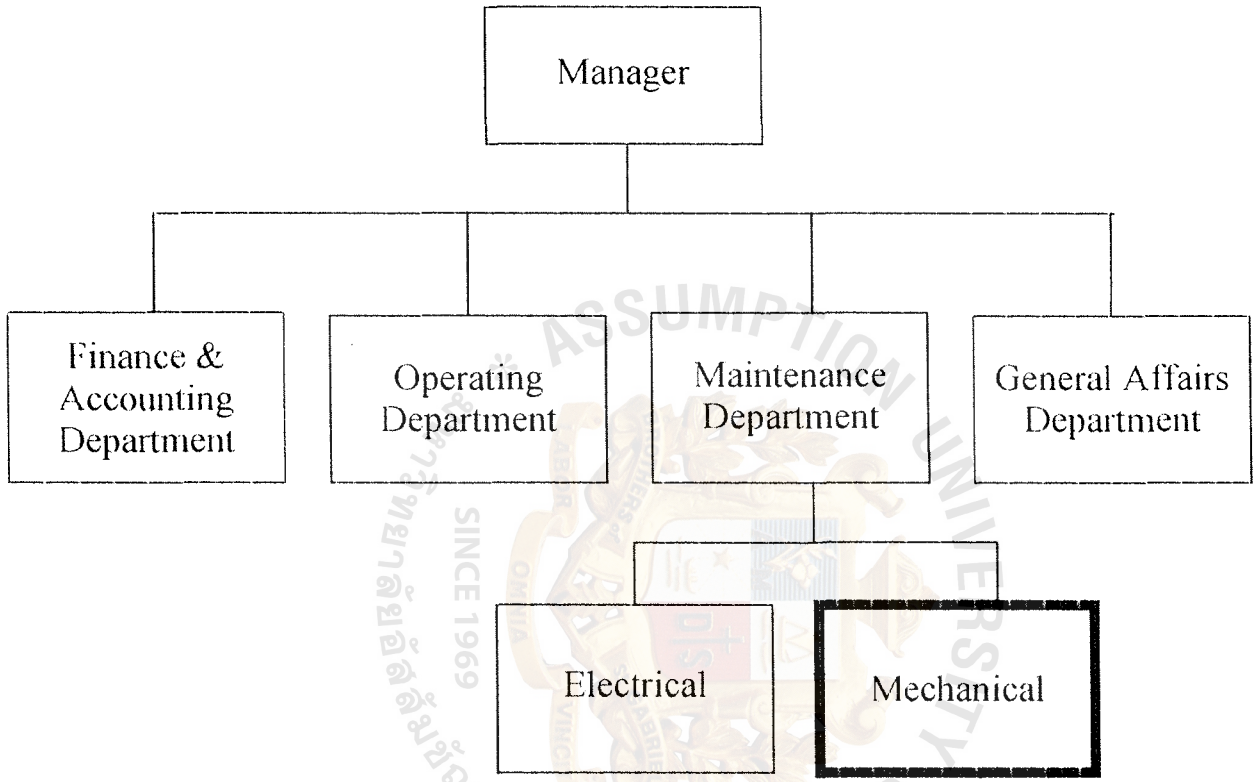

Figure 2.1. Organization Chart of KM Precision Co., Ltd.

2.2 Existing Business Functions

The system under study is a function maintenance section. It is concerned with all equipment. The major responsibility of the maintenance department is to ensure that all equipment in the plant run smoothly.

Maintenance tasks can be classified into 2 types:

(1) Preventive Maintenance is periodic maintenance schedule according to machine reference operation.

(2) Corrective Maintenance, this maintenance occurs when machine has broken down.

As the existing system is done on a manual basis, human errors would be absolutely unavoidable. Time consuming and tedious works are also burdens for the company.

The context diagram for existing ordering system and data flow diagram are shown in the Figure 2.2 and Figure 2.3.

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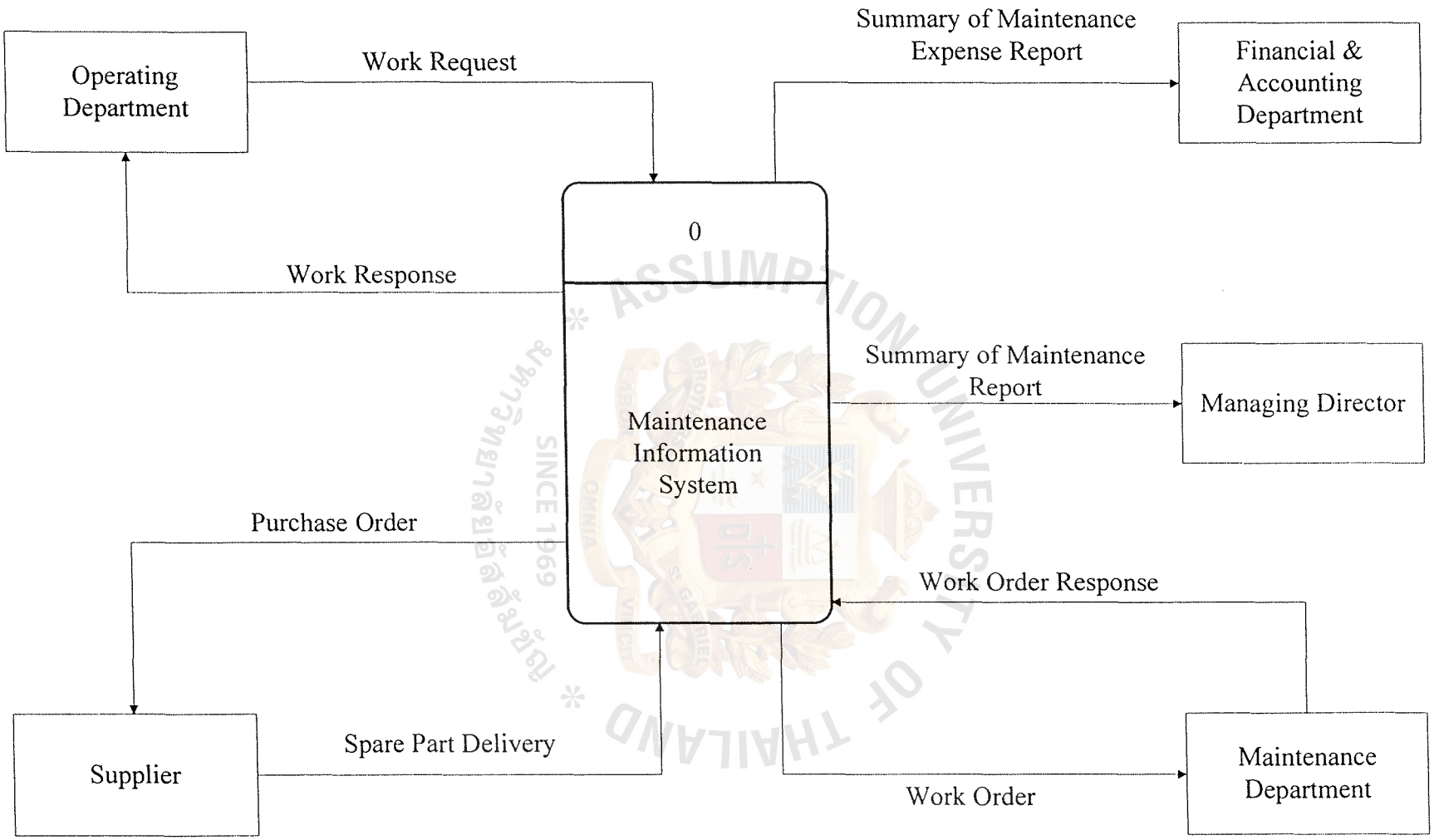

Figure 2.2. Context Diagram of the Existing System.

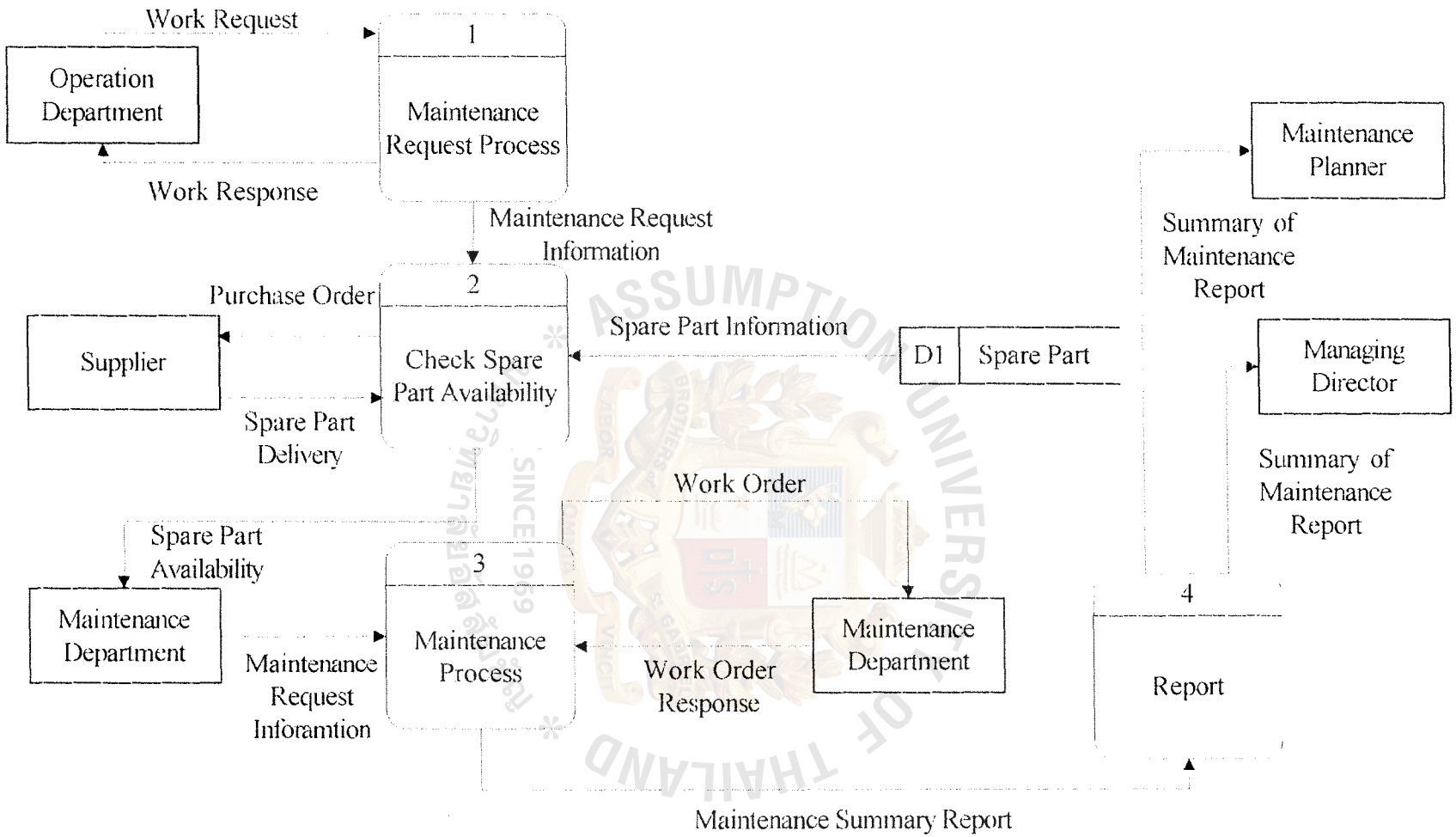

Figure 2.3. Data Flow Diagram of the Existing System.

2.3 Current Problems and Areas for Improvement

The current problems of the Maintenance System are the basic problems, occurred in most companies. The problems can be defined in details as follows:

(1) Since serving, a consequence of work request is a kind of work, which needs speed and accuracy, load of requesting can make a delayed serving.

(2) Human error is also one of the main problems, for speed and accuracy and the existing system was run on a manual basis, where human error cannot be avoided.

(3) Insufficient inventory control of spare parts cause the planning to be inefficient.

(4) Indirect consequence, mainly on collecting data for daily or monthly report to control every transaction in the company is difficult in many aspects:

   (a) Difficult to retrieve data to generate a report.

   (b) Difficult to search data for requested information.

   (c) Difficult to compare cost, expense, revenue, etc. of each period of time.

   (e) Data is not up to date.

(5) Manual collecting data is also time-consuming and in significant error, done by humans, can reflect the result as whole.

(6) Maintenance information does not flow through the company.

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2.4 Existing Computer System

There is only one stand-alone computer, located at Maintenance Center. Purpose is only to help user for ordinary application such as Microsoft Word, Microsoft Excel to generate a report from manual record. System is shown in Figure 2.4.

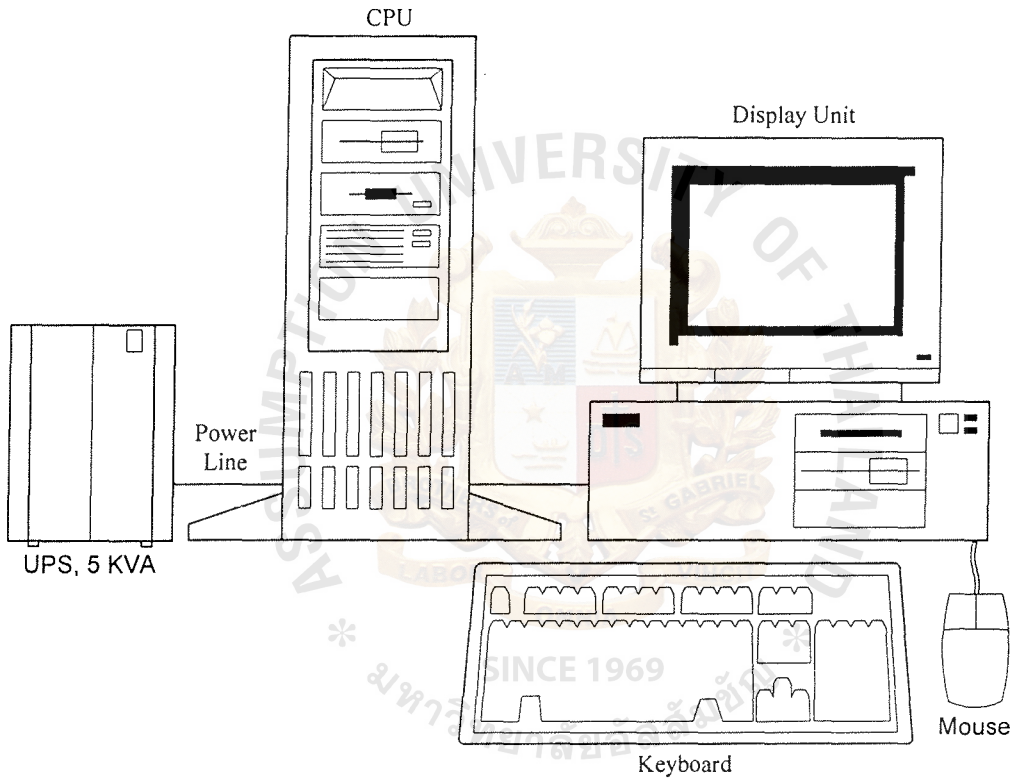

Figure 2.4. Stand-alone Computer of the Existing System.

III. THE PROPOSED SYSTEM

3.1 User's Requirement

Nowadays computer is accepted as one of the needed factors in our life. Management of the company has a thought that technology can solve the problems that occurred. After a few months of exploring all users' requirement, we can come up with this following specifications for a new computerized system.

(1) New system must focus on supporting the work order system, the main problem of company. The input requirements for the system are as follows:

   (a) Spare part request.

   (b) Work order request.

   (c) Employee request data

(2) Inquiry current maintenance information can be done by other departments;

   (a) Spare parts available.

   (b) Maintenance cost.

   (c) Maintenance detail.

(3) Security for each user level must be provided.

(4) Every order must be recorded into the database.

(5) The system automatically records the quantities of work order into the database.

(6) The system can easily create, update, and delete information regarding our work order.

(7) The system also can create the summary report of each period of time such as daily, monthly, etc.

(8) The system must support multi-user environment.

(9) The system should be run on Client-Server architecture.

3.2 System Design

The system design categories are divided into the following sections:

3.2.1 Design of Input Screen

The input screen provides the convenience for user to key in the data to the form. The input should be simple, easy to key in and ensure that forms meet the purpose and design forms to assure accurate completion. The input screen is shown in Appendix C.

3.2.2 Design of Output Screen

The output screen will display the data for reference of printing reports. The output screen should be a simple screen simple and the information must be useful and support user requirements and management decision making. The output screen is shown in Appendix D.

3.2.3 Database Design

This method shall be designed to increase working process' efficiency, that can also reduce human mistakes and redundant information. The database design is shown in Appendix E.

3.2.4 Design of Context Diagram and Data Flow Diagram

The context diagram of the proposed system represents an overview of the Maintenance Information System. It depicts the relationship between Maintenance Department and each Department. The Context Diagram of the Proposed Maintenance system is shown in Figure 3.1.

Process 1.0 Trouble Machine

Firstly, Operating Department inputs information of the troubled machine into work order form and sent to Maintenance Information system, hence all relating information will be kept in order database.

Process 2.0 Plan Job

After Maintenance Department receives work order form, it has to compare the priority of job and sorting all jobs consequently, identify the responsible persons and inspect the symptom that occurred. Maintenance Department is also responsible in deciding whether the machine should be repaired or not. If yes, it has to issue the job order form; on the other hand inform operating department about this machines conditions.

Process 3.0 Repairing Machine

Receive job order forms. Maintenance Department interpret the spare part and the required tools, then send order to Inventory Department.

Process 4.0 Finished Repairing

Notify the operating department to verify and approve for repairing, and update information into database.

Process 5.0 Approved Repairing

After that Operating Department recognizes in making decision for repairing, and keep information into the database.

Process 6.0 Summary Monthly Report

After all troubles in machine have been rectified, then summarizing the Repair attached in Monthly Report for submitting to the Board of Directors. Calculate cost of repairing and submit to financial department.

Process 7.0 Register Employee

Input the information about employee data into employee's database for reference to employee of the company.

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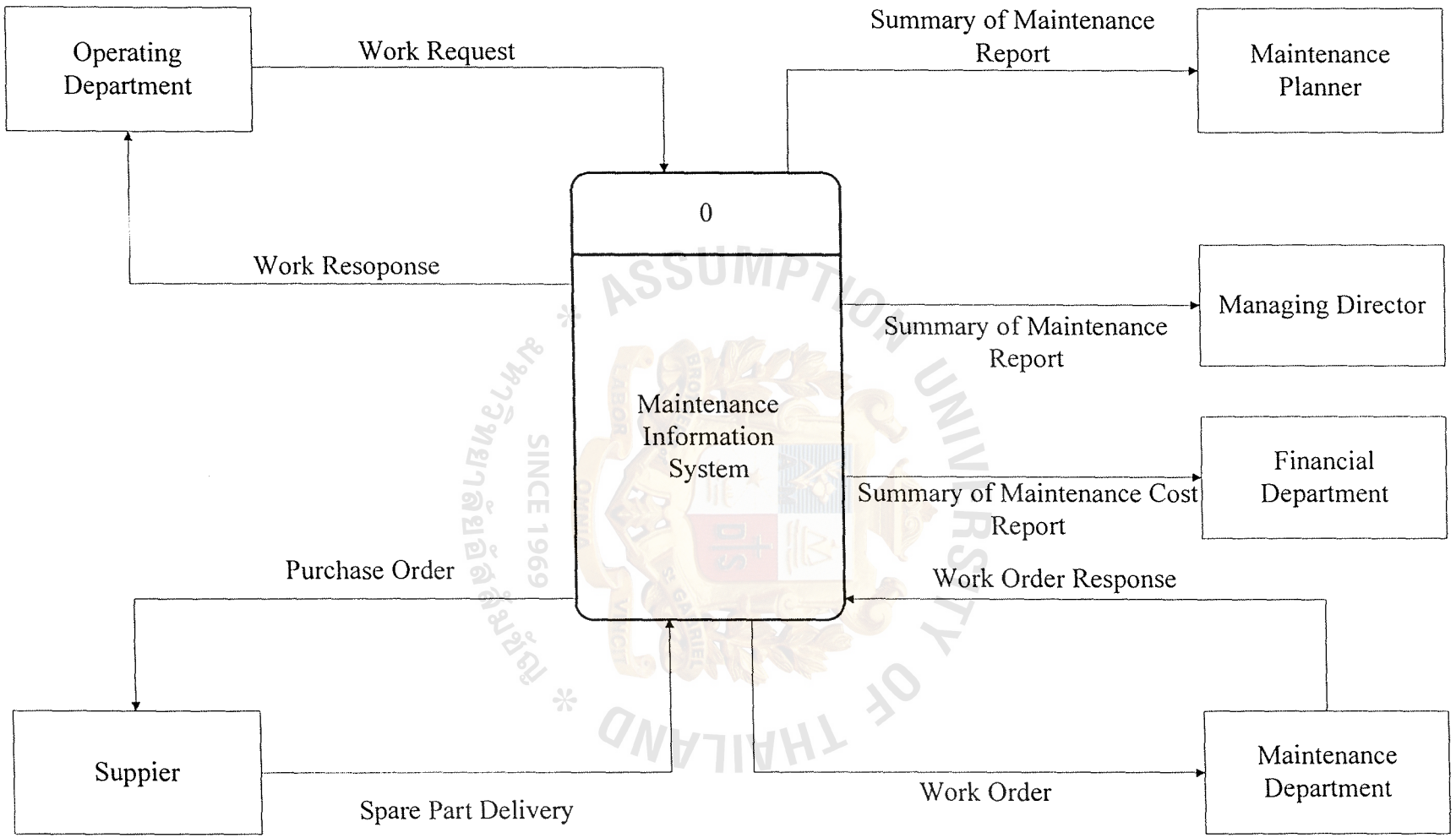

Figure 3.1. Context Diagram of the Proposed Ordering System.

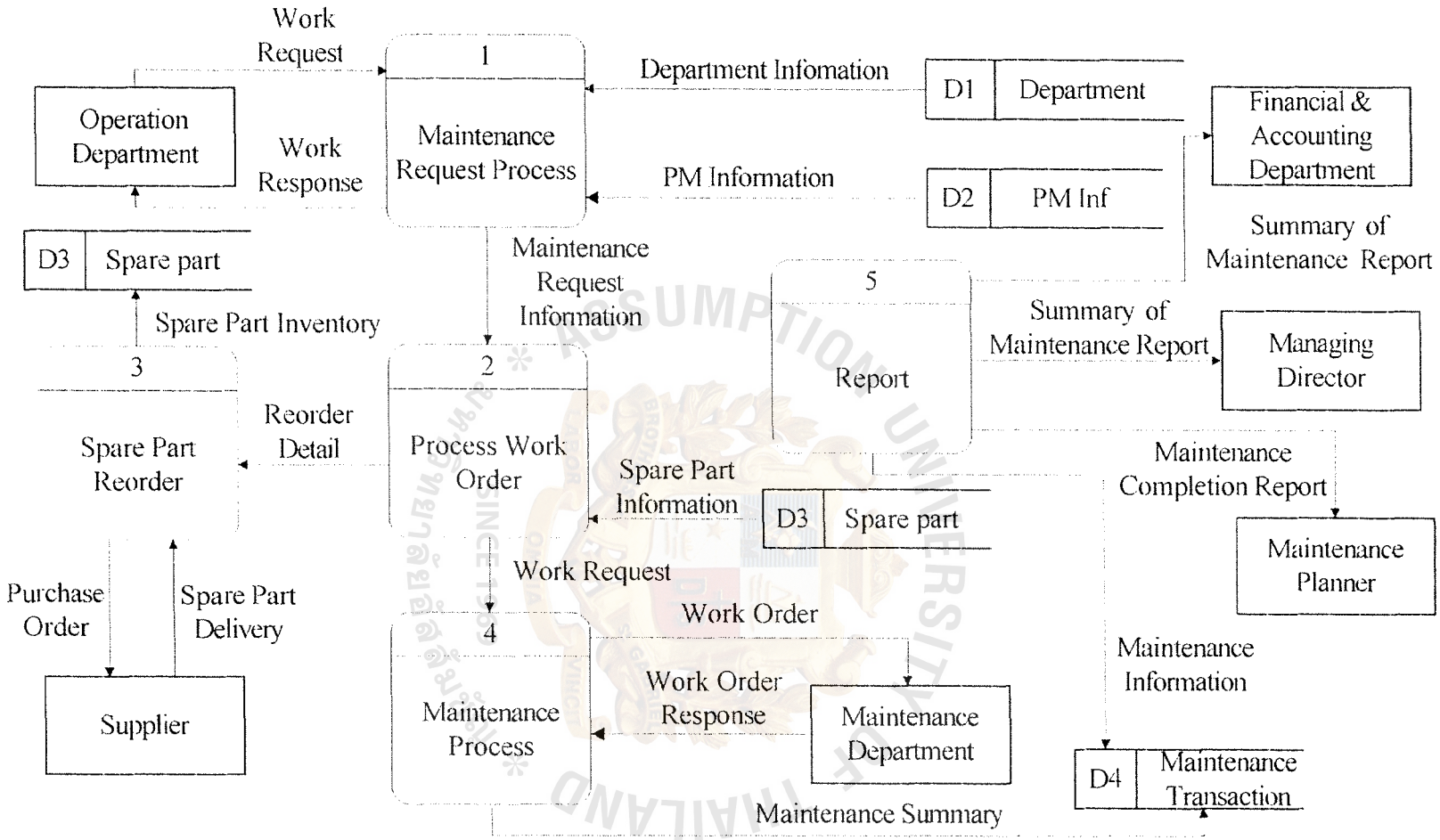

Figure 3.2. Data Flow Diagram Level 0 of the Proposed System.

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3.3 Hardware and Software Requirement

3.3.1 Hardware Requirement

To serve a new Maintenance System using Client-Server architecture, personal computers are the main communication device for man-machine interface. At least five computers are required and one of them will be a server. They will be installed to use a Local Area Network (LAN). The file server is responsible for serving the database and allows file sharing among computers. The personal computers will be connected from each department, which is anticipated at 4 areas. Table 3.1 will show the description of hardware requirements.

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Table 3.1. Hardware Requirements.

Hardware and Specification	Objective	Quantities
File Server 1. CPU Pentium III 800 MHz. 2. RAM 128 megabytes. 3. Hard disk Interface SCSI-2, capacity 20GB. 4. Floppy Disk Drive 3.5" capacity 1.44 M. 5. CD-ROM Drive 6. Ethernet Interface Card 10/100BaseT 7. 14" SVGA Monitor, Non-Interface 8. PS/2 Mouse	Database Server File Sharing Primary Domain Controller.	1
PC Work Station 1. CPU Pentium III 650 MHz. 2. RAM 64 megabytes. 3. Hard disk capacity 10.3 GB 4. Floppy Disk Dive 3.5" capacity 1.44 M. 5. CD-ROM Drive 6. Ethernet Interface Card 10/100BaseT 7. 14" SVGA Monitor, Non-Interface 8. PS/2 Mouse	Data Entry Word Processing	3
Laser Printer HP Laser Jet 2001	Print Server	1
HUB 8 Ports 10/100Base T	Concentrator	1
UPS Capacity 5 KVA Backup (Server) Power Supply Less 15 minutes	Backup Power Supply for File Server	1
UTP Cable Unshielded Twisted Pair, Category 5	Cable	1 Box
RJ-45	Connector	10

Hardware configuration will be shown as Figure 3.3 below. As it can be seen in the pictures there is one server and three workstations, installed in the new system. The server with one printer will be located at the central server to control all the database and only are authorized person is allowed to make any updated transactions. All computer machines are interconnected as LAN Network. Each device is directly connected to the central server. Server will install MS Window 2000 and MS Server and each station will install MS Window 98 and MS Office 2000.

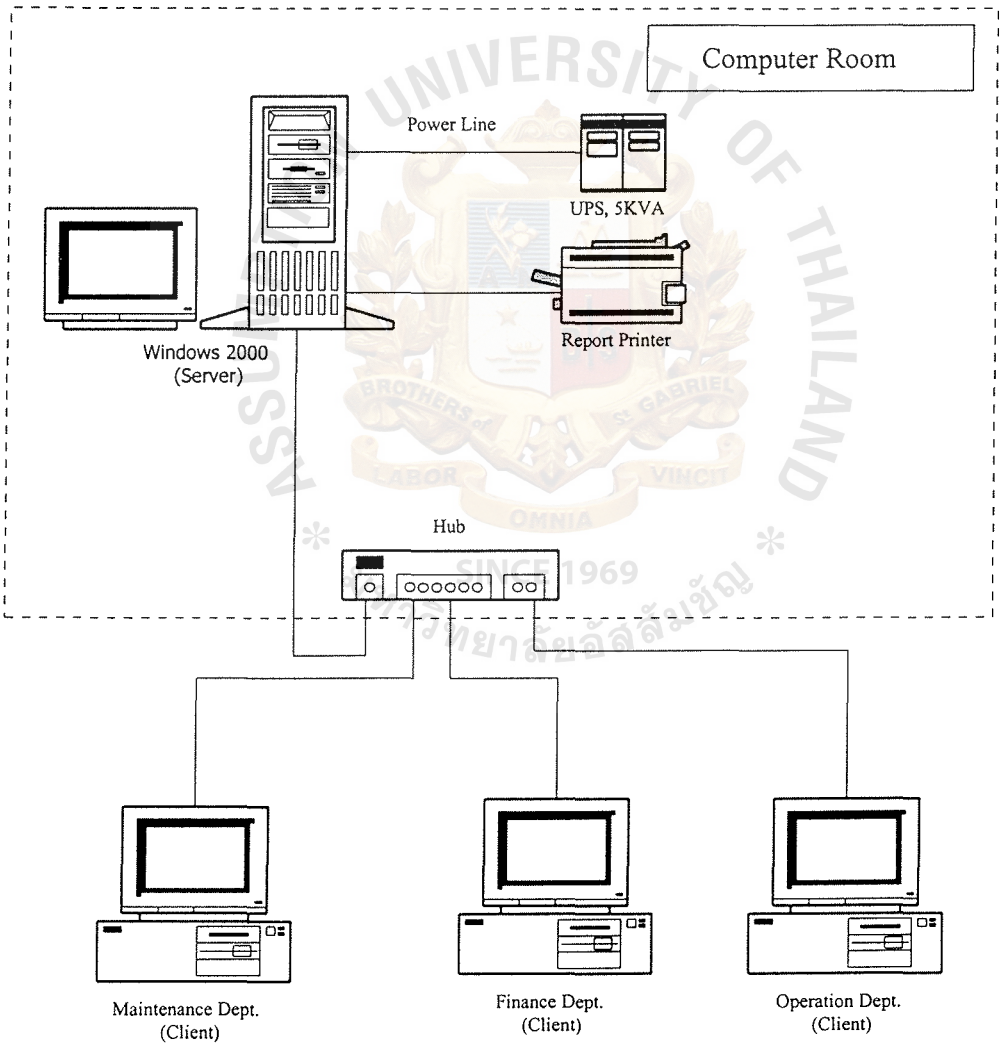

Figure 3.3. The Network of the Proposed System.

3.3.2 Software Requirements

The new system will be implemented by using Graphical User Interface (GUI) environment. This is achievable by using Window 2000 as the GUI software for the system. And SQL Server 7.0 as database management system as shown in the table below.

Table 3.2. Software Requirements.

Software and Specification	Objective	Quantities
Opearting System for server - MS Window 2000 (Server)	Network Operating System for File Server	1
Microsoft Windows 98	Operating System for Work Station	3
SQL Server 7.0	Database Management System	1
Microsoft Office 2000	Operating System for Work Station	5

3.4 Security and Control

Security and control plan is one of most important controls a company can implement. A good way to develop a plan is to determine who needs access to what information, when they need it, and on which systems the information resides. This information can be used to determine information treats, risk, and exposure and to select the most cost-effectiveness security measures.

Both the physical ability to use the computer equipment referred to as physical access the ability to gain access to company data, call logical access controls, should be restricted.

Physical access security can be achieved by the following controls:

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(1) Installing all computer equipment in the locked rooms and restricting access to authorized personnel.

(2) Using a security alarm system to detect unauthorized access during off-hours.

(3) Restricting access to private, secured telephone lines or to authorized terminals or PCs.

(4) Use UPS (Uninterruptible Power supply) to supply instead of the main electricity supply. To protect any damage occurred to whole computer equipment.

(5) Installing locks on PCs and other computer devices.

(6) A virus checking program will be installed for scanning virus.

Logical Access Control

Users should be allowed access only to the data that is permitted for them to use and then only to perform specific, authorized functions such as reading, copying, and adding to and deleting data. It is also important to protect data from outside the organization.

(1) Password; a series of characters that uniquely identified the user and is known only to the user and the system. If the user-entered ID and password that match those in the computer, the system assumes it is an authorized user. The downside of passwords is that they can be guessed, lost, written down, or given away, creating the potential for unauthorized, and in some cases, dangerous persons to gain system access.

(2) Data Storage Controls a properly supervised file library is one essential means of preventing loss of data. The file storage area should also be

protected against fire, dust, excess heat or humidity, and conditions that could harm stored data.

(3) Back Up

A staff member has to back up the important information to prevent damaging of files in the hard disk and use recovery of any destroyed or error on the files.

(4) Document

The source document will be stored in a secure cabinet located outside the company in order to prevent unauthorized changes and to prevent loss of source documents due to a natural disaster such as a fire or flood.

3.5 System Cost Evaluation and Comparison

3.5.1 Cost of the Manual System

Table 3.3. Manual System Cost Analysis, Baht.

Cost items	Years				
	1	2	3	4	5
Fixed Cost					
Computer 1 units @ 25,000	25,000.00	0	0	0	0
Total Fixed Cost	25,000.00	0	0	0	0
Operating Cost					
Officer	100,000	400,000	700,000	1,000,000	1,500,000
Staff	76,000	200,000	300,000	500,000	600,000
Overtime	55,000	128,000	123,000	165,022	58,488
Total Annual Salary Cost	231,000	728,000	1123000	1,665,022	2,158,498
Office Supplies & Miscellaneous Cost					
Stationary Per Annual	41,000	80,000	88,000	37,800	248,000
Paper Per Annual	50,000	58,000	78,000	28,000	18,000
Utility Per Annual	62,000	42,000	88,000	38,000	38,000
Miscellaneous Per Annual	67,000	80,000	39,000	38,000	20,000
Total Annual Office Supplies & Miscellaneous Cost	220,000	260,000	293,000	141,800	324,000
Total Manual System Cost	476,000	988,000	1,416,000	1,806,822	2,482,498

Table 3.4. Five Years Accumulated Manual System Cost, Baht.

Year	Total Manual Cost	Accumulated Cost
1	476,000	476,000
2	988,000	1,464,000
3	1,416,000	2,404,000
4	1,806,822	3,222,822
5	2,482,498	4,289,320
Total	7,169,320	-

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3.5.2 Alternative Candidate for the Proposed System

Table 3.5. Candidate Matrix.

Characteristics	Candidate 1	Candidate 2	Candidate 3
Portion of System Computerized: A description of the portion of the computerized system.	COTS software package would be purchased and customized.	Same as Candidate 1	Same as Candidate 1
Benefit: The benefit of each alternative that the company should consider in order to make decision.	This solution is very cheap, can support user requirement	Same as Candidate 1.	Fully supports user requirements.
Servers and Workstations: The needs of server and workstation to support alternatives.	Client/Server	Same as Candidate 1	Same as Candidate 1
Software Tools Needed: Tools needed for facilitating each candidate such as computer programming languages.	Microsoft Access 2000	MS Visual C++ and MS SQL Server 7.0 for customization of package.	MS Visual Basic and MS SQL Server 7.0
Method of Data Processing: An alternative solution to data processing.	Client/Server	Same as Candidate 1	Same as Candidate 1
Output Devices and Implications: The devices that will be used to show, present as well as document information.	Laser Printer	Same as Candidate 1	Same as Candidate 1
Input Devices with Implications: A device that will be used to enter data into the system in order to store or process.	Keyboard and mouse.	Same as Candidate 1	Same as Candidate 1
Storage Devices and Implications: A description of the storage device that will allow information to be retrieved from databases.	MS SQL Server with 60 GB capacity	Same as Candidate 1	Same as Candidate 1
Training: A description of the alternative way of training and preparing user to the new system.	Train new employees who have some knowledge.	Same as Candidate 1	Train current employees in the company for all process.
Technical Staff: A description of the alternative way for the company to hire technical people about the new system.	Hire new employees who have knowledge.	Same as Candidate 1	Current employees in the company.

Table 3.6. Feasibility Analysis Matrix.

Feasibility Criteria	Weight	Candidate1	Candidate 2	Candidate 3
Operational Feasibility Functionality	30%	Only support the maintenance department and current business processes would have to modify to take advantage of software functionality. Score: 80	Fully support user required functionary. Score: 100	Same as candidate 2 Score: 100
Technical Feasibility Technology: Expertise:	30%	The database implementation by using MS Access will be simple and finding MS Access expertise will be easy and cheap. Required to hire or train C++ expertise to perform modification for integration requirements. Score: 85	Transition by using MS SQL Server 7.0 will be simple. MS SQL Server can support larger amount of record when compare to MS Access. Required to hiring a computer company to construct all the system, and recruit one system engineer to take care of system Score: 95	By using MS Visual Basic as a development tool, the transition will be simple and finding Experience VB Programmer will be easy and cheap. MS Visual Basic 6.0 and LAN architecture is mature technology base on version number. Score: 90
Economic Feasibility Cost to develop: Payback period (discounted): Net present value: (Detail calculation are shown in next section)	30%	Approximately □ 1,900,000 Approximately 2 Years 5 Months Approximately 1,900,150 Score: 95	Approximately □ 3,012,000 Approximately 3 Years 5 Months Approximately 1,201,000 Score: 75	Approximately □ 2,090,200 Approximately 3 Years 4 Months Approximately 1,403,670 Score: 85
Schedule Feasibility	10%	Less than 2 months Score: 95	3 - 4 months Score: 80	5 - 6 months Score: 90
Ranking	100%	87.50%	89%	91.50%

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3.5.3 Cost of the Computerized System

As shown in feasibility matrix table, candidate 3 should be selected as the proposed system. The cost of the proposed system is shown below:

Table 3.7. Computerized System Cost Analysis, Baht.

Cost items	Years				
	1	2	3	4	5
Fixed Cost					
Hardware Cost:					
Computer Server Cost	100,000	150,000	300,000	400,000	500,000
Workstation Cost 3 Units@28,000	84,000	84,000	84,000	84,000	84,000
Total Hardware Cost	184,000	234,000	384,000	484,000	584,000
Maintenance Cost:					
Total Maintenance Cost	0	0	0	10,000	10,000
Software Cost:					
Total Software Cost	70,500	95,774	153,488	150,412	87,630
Implementation Cost:					
Training Cost	30,000	30,000	30,000	30,000	0
Set up Cost	50,000	30,000	30,000	20,000	0
Total Implementation Cost	80,000	60,000	60,000	50,000	0
Total Fixed cost	334,500	389,774	597,488	694,412	681,630
Operating Cost					
System Analysis	30,000	50,000	60,000	60,000	60,000
IT Specialist 2 persons	100,000	110,000	150,000	200,000	300,000
Programmer 2 persons	100,000	110,000	150,000	200,000	300,000
Staff 2 persons	20,000	30,000	40,000	40,000	40,000
Total Annual Salary Cost	250,000	300,000	400,000	500,000	700,000
Office Supplies & Miscellaneous Cost:					
Stationary Per Annual	33,000	64,000	74,000	46,560	74,560
Paper Per Annual	50,000	26,000	50,000	58,840	54,840
Utility Per Annual	48,000	56,300	70,000	61,600	81,600
Miscellaneous Per Annual	55,000	50,000	68,000	87,000	85,000
Total Annual Office Supplies & Utility & Miscellaneous Cost	186,000	196,300	262,000	254,000	296,000
Total Computerized System Cost	770,500	886,074	1,259,488	1,448,412	1,677,630

Table 3.8. Five Years Accumulated Computerized Cost, Baht:

Year	Total Computerized Cost	Accumulated Cost
1	770,500	770,500
2	886,074	1,656,574
3	1,259,488	2,145,562
4	1,448,412	2,707,900
5	1,677,630	3,126,042
Total	6,042,104	

3.5.4 Comparison between Cost of the Manual System and Cost of the Computerized System

From the comparison of the two systems, the manual one will be absolutely lower. However, insisting on using computerized system is because of the opportunity cost, which unavoidably occurred. The more turnover of the table, the more sales revenue we have got. Computerized system definitely can cure the problem that occurred.

Comparison in manpower cost will not change very much at this point. But to expand our business, only computerized system can support the additional orders with some limited staffs required. Manual needs more assistance by people to handle the task.

Table 3.9. The Comparison of the System Costs, Baht.

Year	Accumulated Manual Cost	Accumulated Computerized Cost
1	476,000	770,500
2	1,464,000	1,656,574
3	2,404,000	2,145,562
4	3,222,822	2,707,900
5	4,289,320	3,126,042

As shown in the above table, it can obviously be seen that the cost difference between the manual system and the computerized system is only in the first year of the implementation of new system, which arises mostly from the Hardware and Software installation.

However, in this case, we can not measure the cost and benefit from the Mathematical figure, since the increasing cost came from only the computerized installation while the benefit came from the re-entry of the lost customer, as it is called the opportunity.

3.5.5 Benefit

Two types of benefits need to be considered in developing the system.

(1) Tangible benefits are the benefits that can be determined. Implementing the proposed system causes the costs of the current system to be eliminated as follows:

Table 3.10. Estimated Annual Tangible Benefit, Baht.

Items	Amount
Saving on Human Resources	200,000
Saving on Paper Work	100,000
Saving on Human Errors	80,000
Saving on Inventory Overload Cost	300,000
Saving on Customer Dissatisfaction	300,000
Total	980,000

(2) Intangible benefits are benefits that cannot be determined. Implementing the proposed system has the following benefits:

(a) Time spent on entering generating report, query data is faster.

(b) Product should have better quality because the equipment work more effectively.

(c) Maintenance costs are reduced because the equipment works more smoothly.

(d) Equipment works more smoothly because all equipment is under close monitoring and controlling.

(e) Manufacturing should gain more productivity because scrapped products are reduced.

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3.5.6 Payback Period Analysis

According to Table 3.11, the proposed system has the net present value of 378,542 baht with 8 percent as a discount factor. It could payback after 3 years 4 months, so it is considered acceptable.

Incorporated with the Operating Cost Breakeven Analysis in Figure 3.5 the proposed system could outperform the existing system in terms of finance after 3 years after operation form the financial perspective, it is proposed that the management should develop the project and put it in to implementation.

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Table 3.11. Payback Period Analysis, Baht.

Cash flow description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development Cost	-2,090,200					
Operation and maintenance cost		-75,000	-80,000	-85,000	-90,000	-95,000
Discount factors furs for 8%	1.000	0.893	0.797	0.712	0.636	0.567
The adjusted cost (adjusted to present value)	-2,090,200	-66,975	-63,760	-60,520	-57,240	-53,865
Cumulative time-adjusted costs over lifetime	-2,090,200	-2,157,175	-2,220,935	-2,281,455	-2,338,695	-2,392,560
Benefit derived from operation of new system	0	750,000	850,000	950,000	1,050,000	1,150,000
Discount factor for 8%	1.000	0.893	0.797	0.712	0.636	0.567
Time adjusted benefits (current of present value)	0	669,750	677,450	676,400	667,800	652,050
Cumulative time-adjusted benefits over lifetime	0	669,750	1,347,200	2,023,600	2,691,400	3,343,450
Cumulative lifetime-adjusted costs benefits	-2,090,200	-1,487,425	-873,735	-257,855	352,705	950,890

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Table 3.12. Net Present Value Analysis, Baht.

Cash flow description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Development Cost	-2,090,200						
Operation and maintenance cost		-75,000	-80,000	-85,000	-90,000	-95,000	
Discount factors furs for 8%	1.000	0.935	0.873	0.816	0.763	0.713	
The adjusted cost (adjusted to present value)	-2,090,200	-70,125	-69,840	-69,360	-68,670	-67,735	
Total present value of lifetime costs:							-2,435,930

Benefit derived from operation of new system	0	750,000	850,000	950,000	1,050,000	1,150,000	
Discount factor for 8%	1.000	0.935	0.873	0.816	0.763	0.713	
Time adjusted benefits (current of present value)	0	701,250	742,050	775,200	801,150	819,950	
Total present value of lifetime costs:							3,839,600

NET PRESENT VALUE OF THIS ALTERNATIVE:							1,403,670

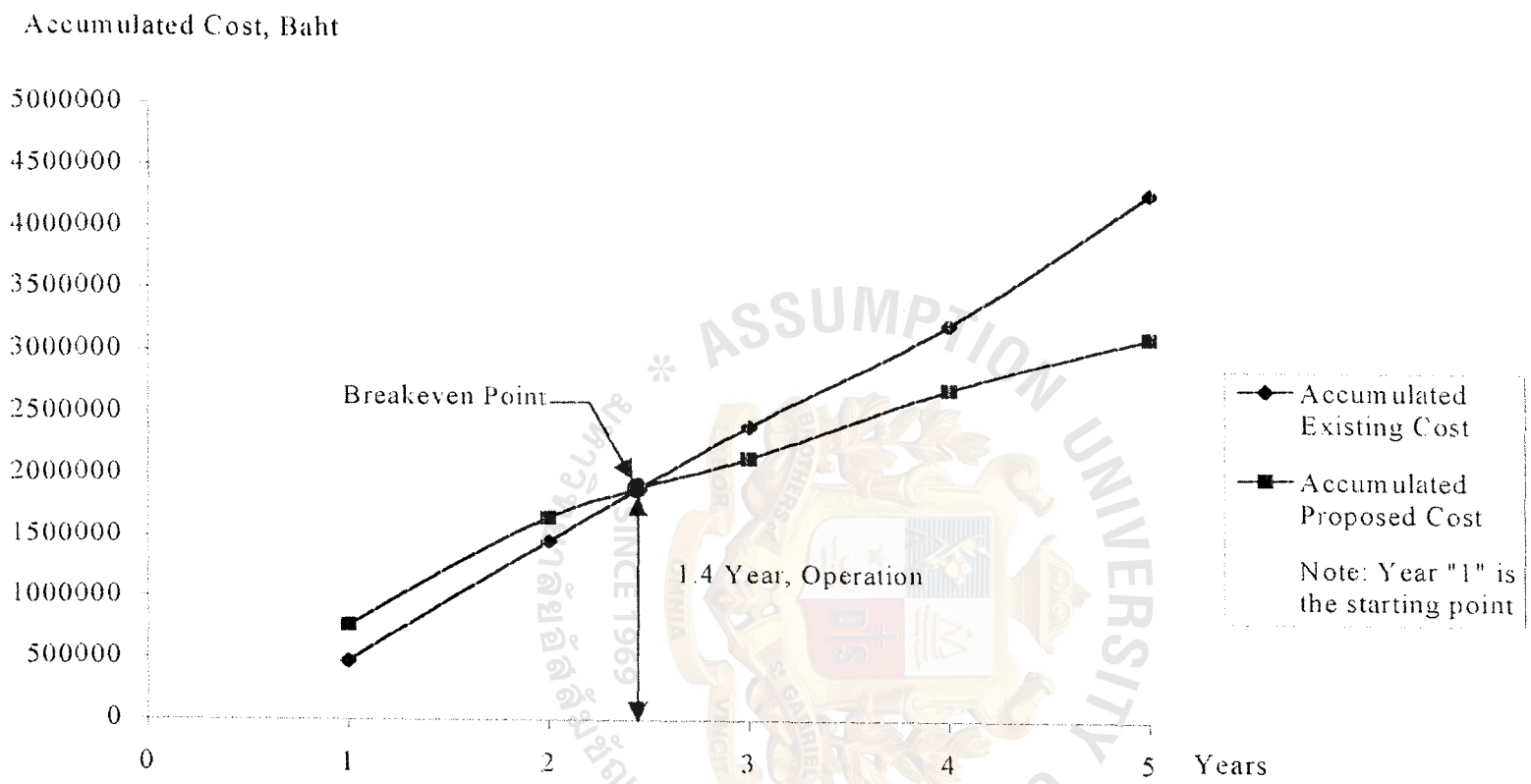

Figure 3.4. Operating Cost Breakeven Analysis.

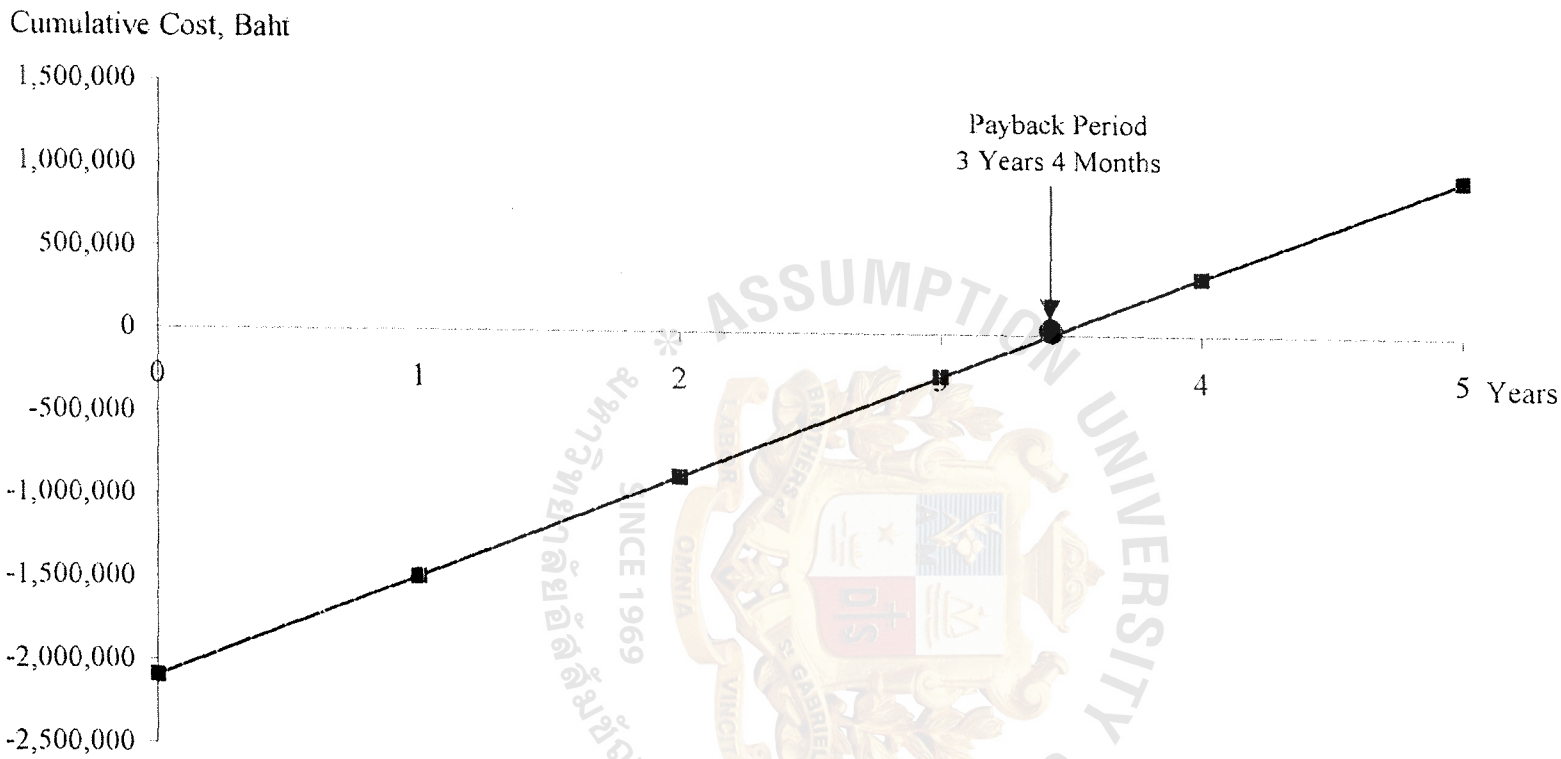

Figure 3.5. Payback Period Analysis of Propose System.

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IV. PROJECT IMPLEMENTATION

4.1 Overview of Project Implementation Schedule

The system plan will focus on the following topics:

4.1.1 Installation

The installation of the proposed system is to combine 2 major processes;

(1) Software Installation

The proposed system has to install new software, which is designed for solving the current problems and increasing the ability of the system. The program will use Visual Basic 6.0 to write the proposed system and will be inspected to guarantee the efficiency of the application before installation.

(2) Hardware Installation

The proposed system has to install some new hardware that is not in the existing system. The existing system is a manual system, which is different from the proposed system which is a computerized system. The hardware installation has to be concerned for many reasons, such as compatibility between each hardware component reasons, suitable location of the hardware component reason and security of the hardware component reason.

4.2 Test Plan

The testing system is the final step before the new system will be on production. There are many topics of testing as follows;

4.2.1 Network Testing

(1) Review the network design outline.

(2) Construction and then test new network.

(3) Revise network specification for future reference.

4.2.2 Database Testing

(1) SQL testing for database server testing.

4.2.3 Program Testing

(1) Conduct system testing to make sure that all programs work properly. If the program does not work correctly or the procedure is not the needed output, the programmer must debug or rewrite the program and continue testing until they operate correctly and properly

(2) Update the project repository with revised program documentation and future reference.

(3) Place the new program and reusable components on the software library.

4.2.4 Security and Control Testing

(1) User log in and system authentication.

(2) Access level testing.

4.3 Training

Training the staff is an important step in implementing the computerized system because the user would function system correctly when understanding it well. The user must be instructed on how to operate the equipment and be instructed in troubleshooting the system. The training topic would enable officer's duty and department.

V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Our company is under expansion since there is increasing demand. Nowadays the manual existing system can not serve adequately due to the growth of business. The proposed, computerized system can replace the existing system to work with high performance, reduce any faults occurred during manufacturing processes, enhance the effectiveness of the Company to reduce the redundant work in daily operation and the number of unnecessary work force.

After studying the existing system of Company, it has encountered many problems; improper data recording caused by manual operation; time processing, inaccurate and redundant data; keep the data in unsecured place; and unable to manage the information flow at the right time.

Passing through the analysis and the design phase, a computerized system is recommended to our company to solve all the problems. The Maintenance information system is developed by the programmers, using Visual Basic 6.0. and the security and control includes data accuracy control, authorized personnel allowance and installation of hardware and software concerned. The use of password can protect access of the system from unauthorized persons and the source documents are able to pass the correct interrelated section

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

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

Process	Existing System	Proposed System
Inquiry process	10 mins	3 mins
Work Plan Process	30 mins	10 mins
Maintenance Process	2 days	1 day
Inventory Control Process	15 mins	5 mins
Generate Report Process	10 mins	3 mins

From Table 5.1, the proposed system can save time more than existing system. Inquiry process in computerized time use less than existing system because all information kept in database and each table have relationship. Furthermore benefit of kept information in database is a work plan processed in computerized faster than existing system. Inventory control process of the proposed system can save time because it is easy to add or update inventory by computerized system. Moreover it is easy to mange inventory database. Finally generated report can save time by 70 percent of existing system because it can query information from database and send to board director on an executive to make a decision.

5.2 Recommendations

Since this system is an urgent assignment to solve the immediate problem, there are a lot of aspects, which, should be developed. Not only the maintenance system but also other systems should be considered to be a computerized system for reasons of completing the whole picture of the system.

This maintenance system should have other supporting systems, which are at least two; the inventory system and the accounting system.

These will make the whole system run perfectly and fulfill all the users' entire requirements.

Maintenance system will be working better with the support of the inventory system since inventory system can at least alert the out of Spare Part and also make a perfect preparation by alerting the lead time of the inventory.

Accounting system is also recommended to develop in order to control the revenue since ordering data can be used as the preliminary data for accounting system.

In conclusion, the system should develop a link with other systems in order to share information with each other and also bring in new technology to be applied to the system in order to get higher performance in the near future.

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APPENDIX A

DATA FLOW DIAGRAM OF THE EXISTING SYSTEM

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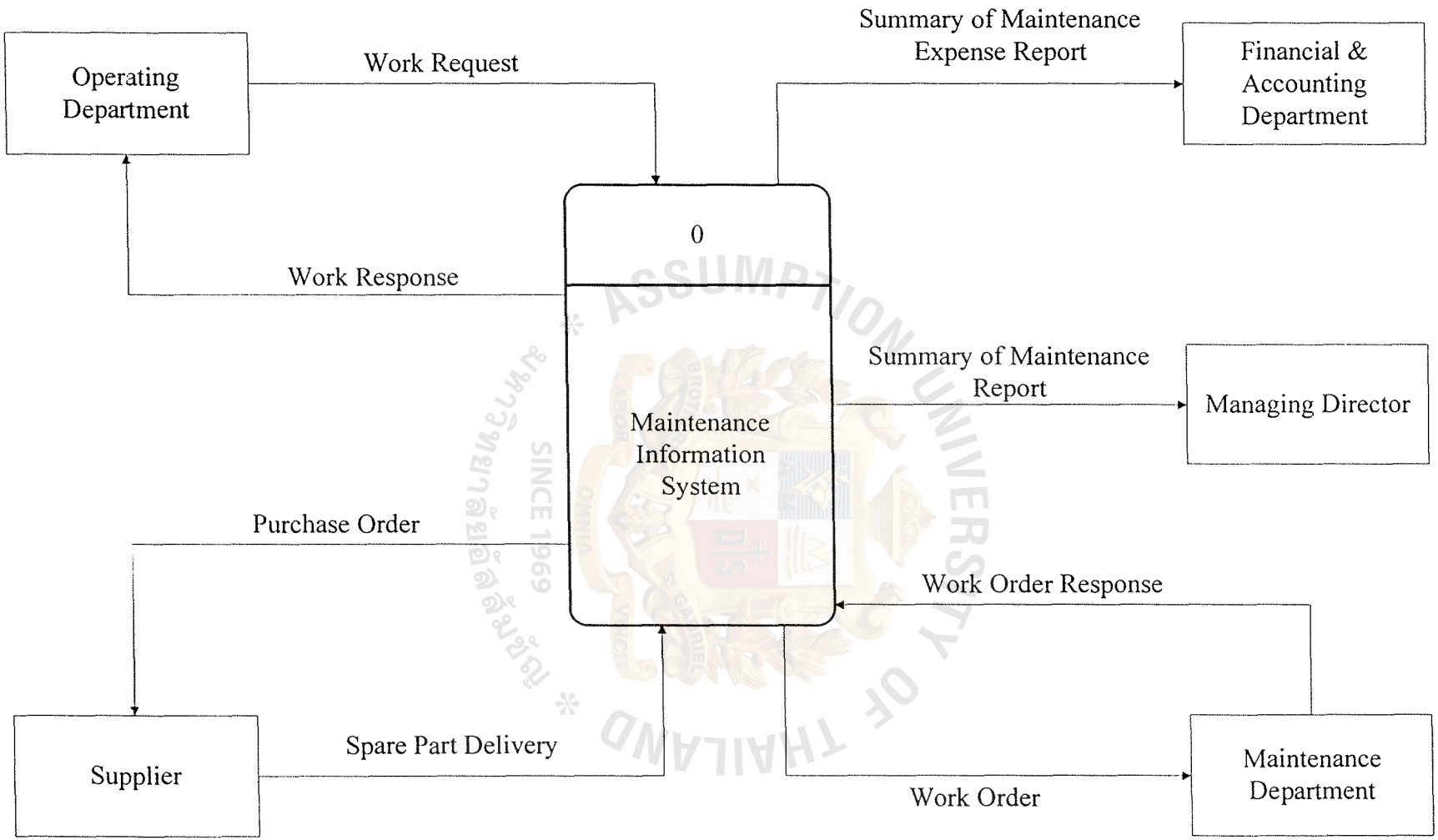

Figure A.1. Context Diagram of the Existing System.

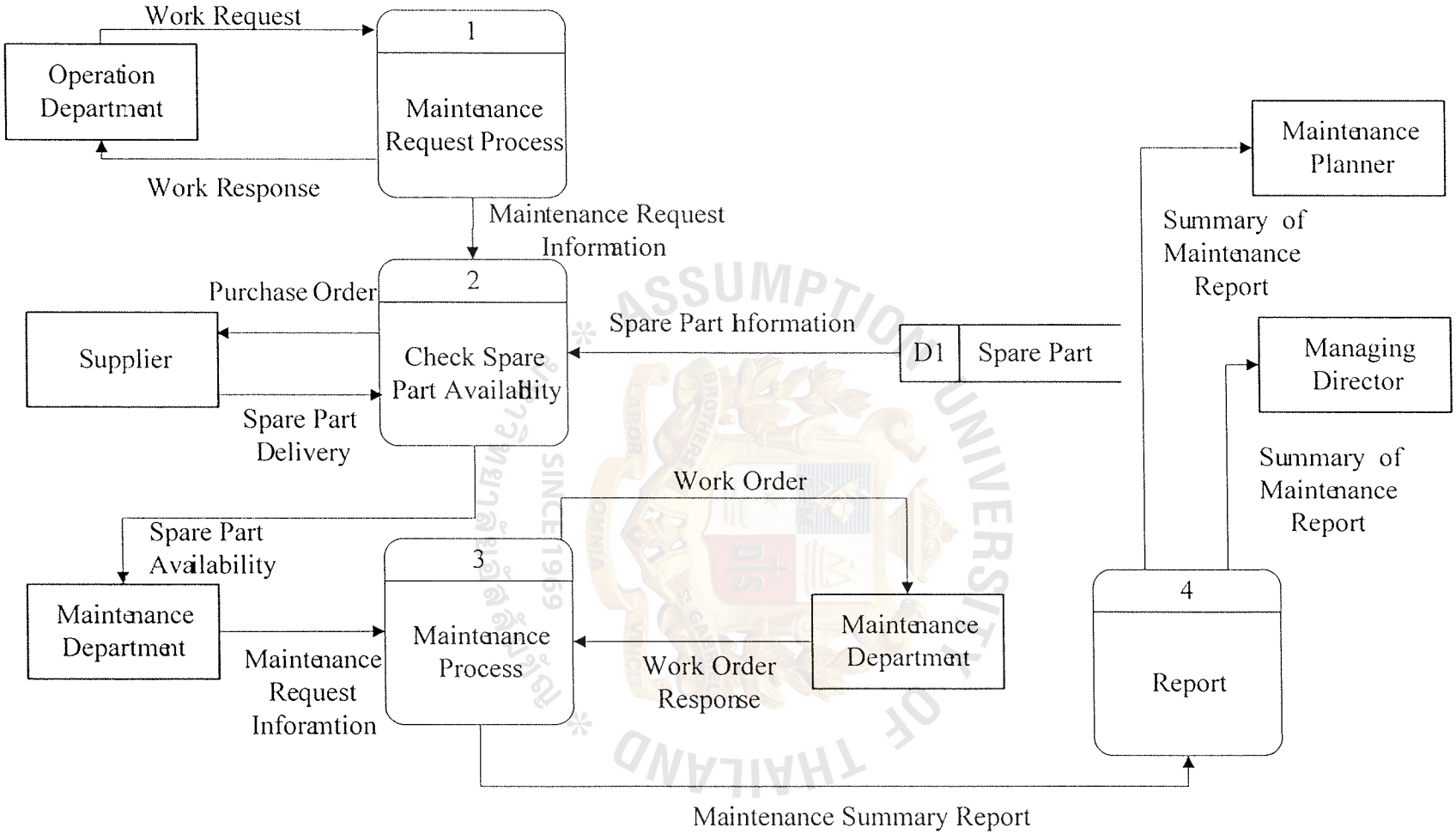

Figure A.2. Data Flow Diagram of the Existing System.

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APPENDIX B

DATA FLOW DIAGRAM OF THE PROPOSED SYSTEM

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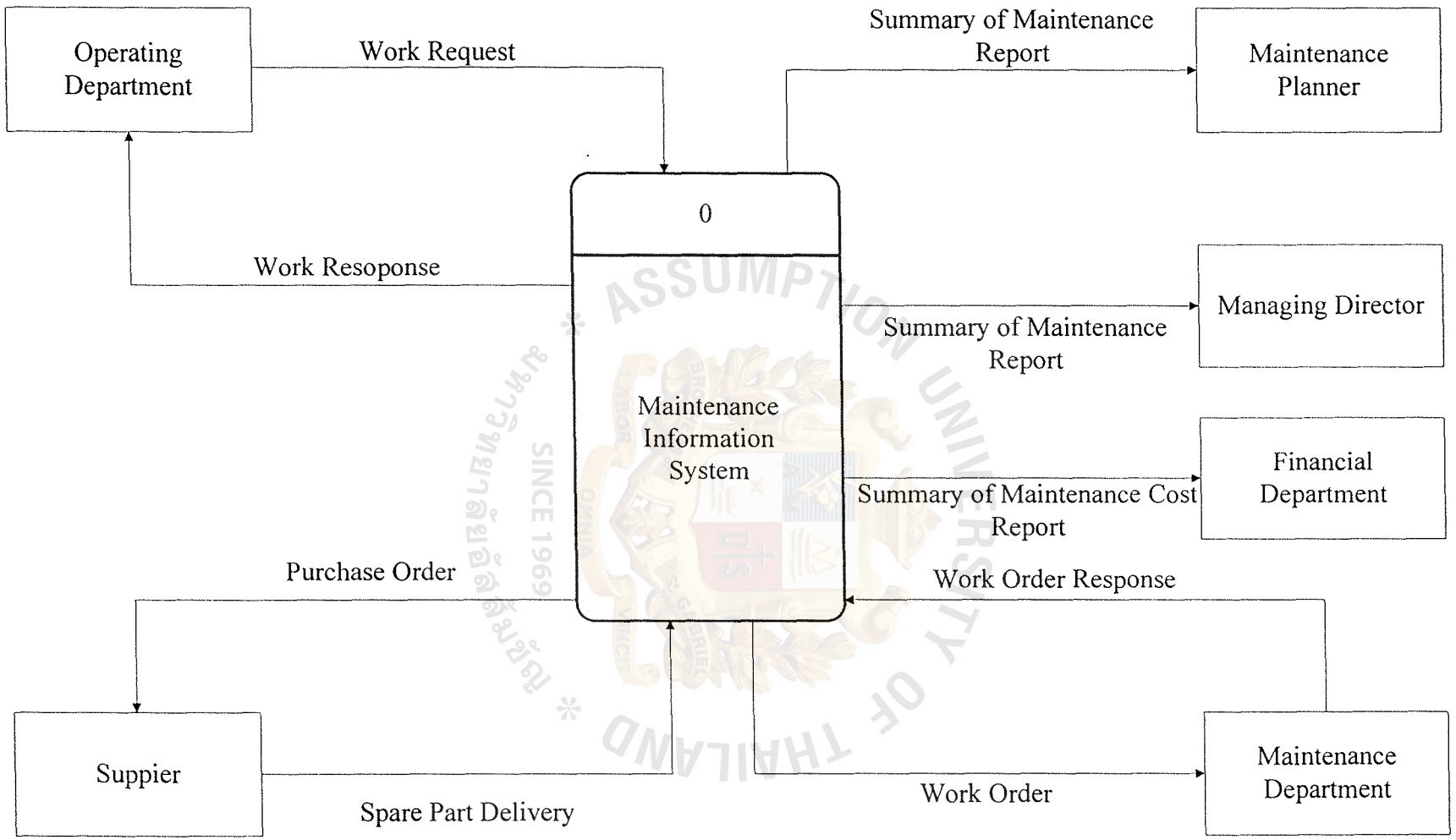

Figure B.1. Context Diagram of the Proposed Ordering System.

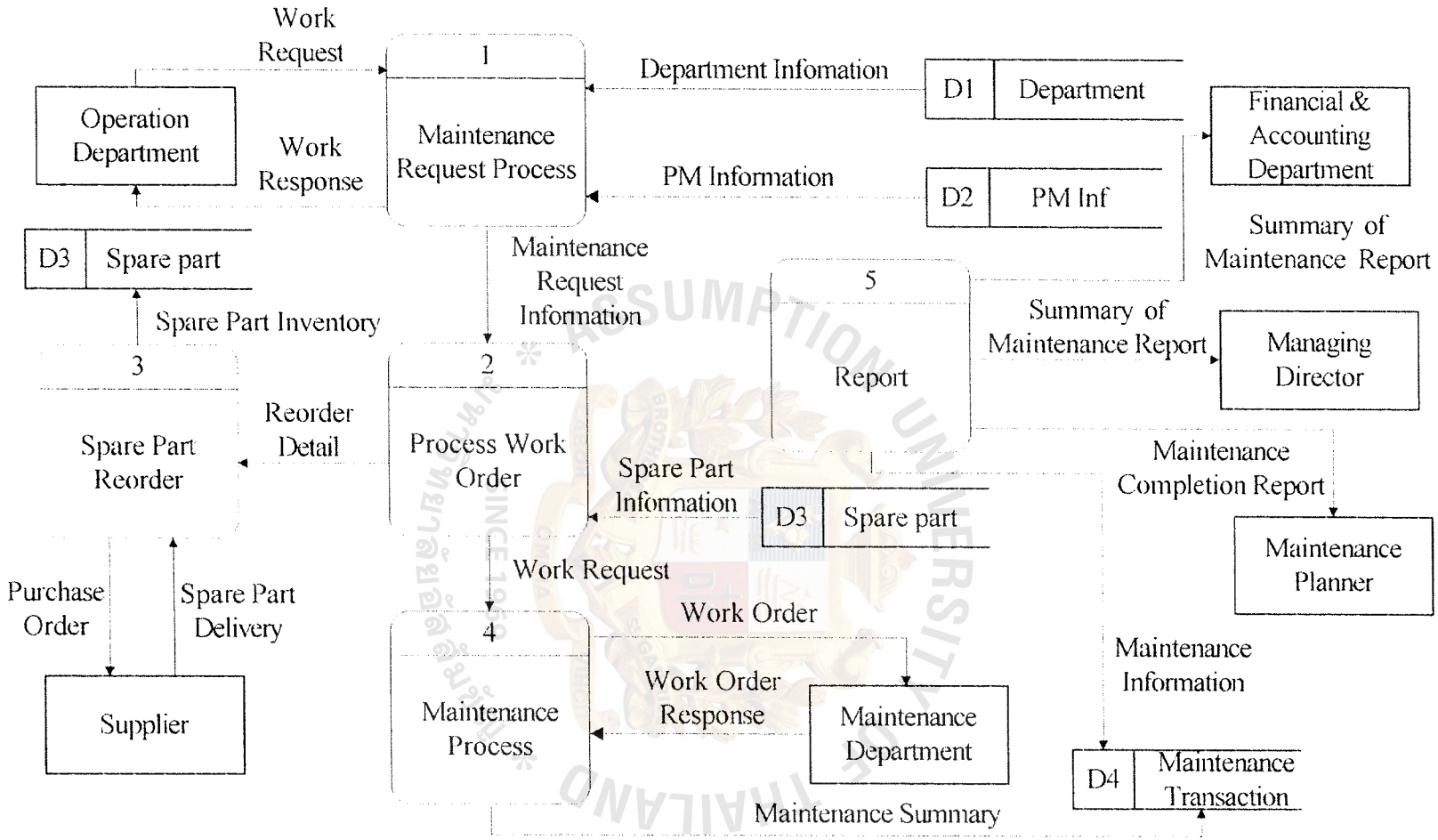

Figure B.2. Data Flow Diagram Level 0 of the Proposed System.

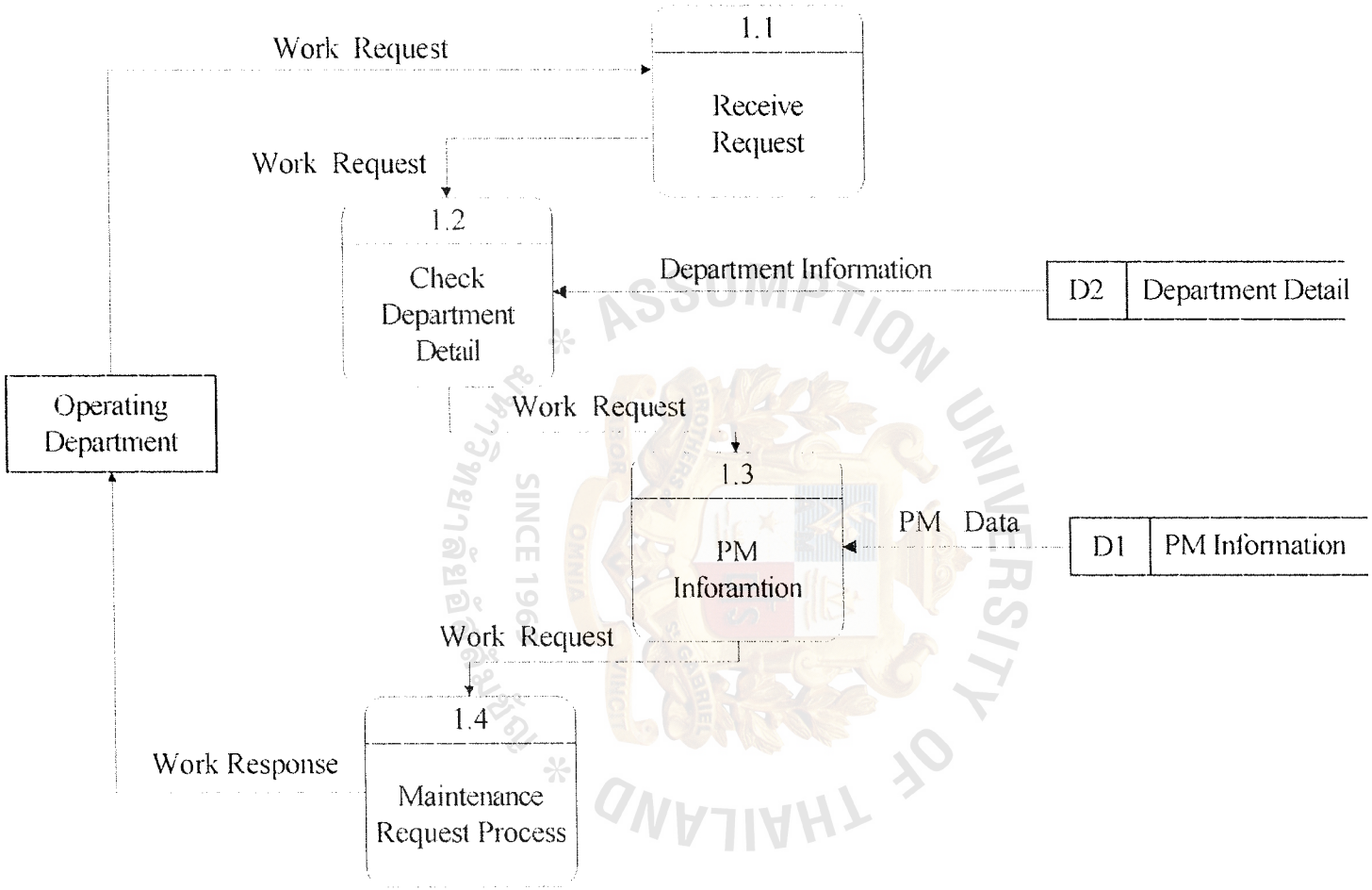

Figure B.3. Process 1 Data Flow Diagram (Proposed System).

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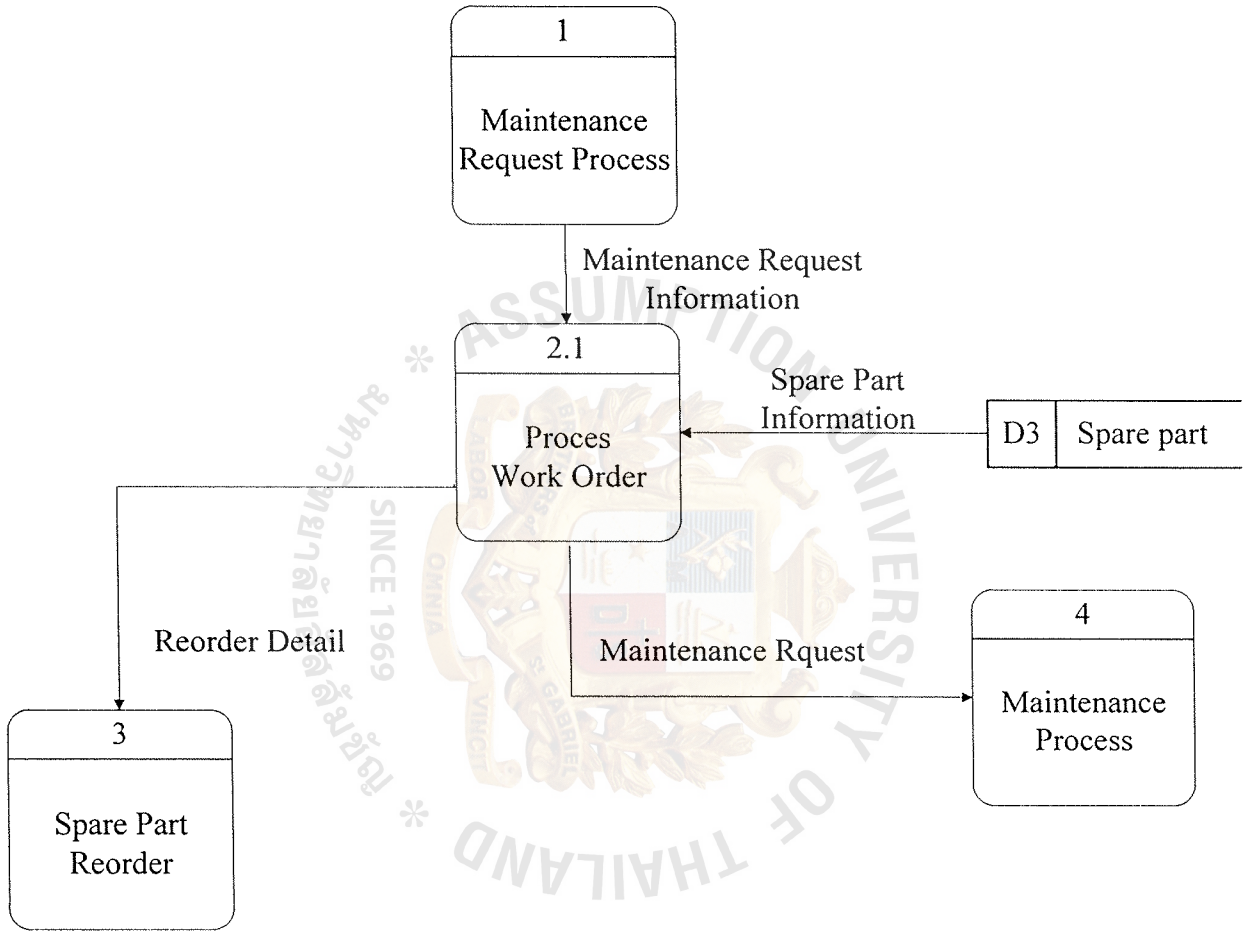

Figure B.4. Process 2 Data Flow Diagram (Proposed System).

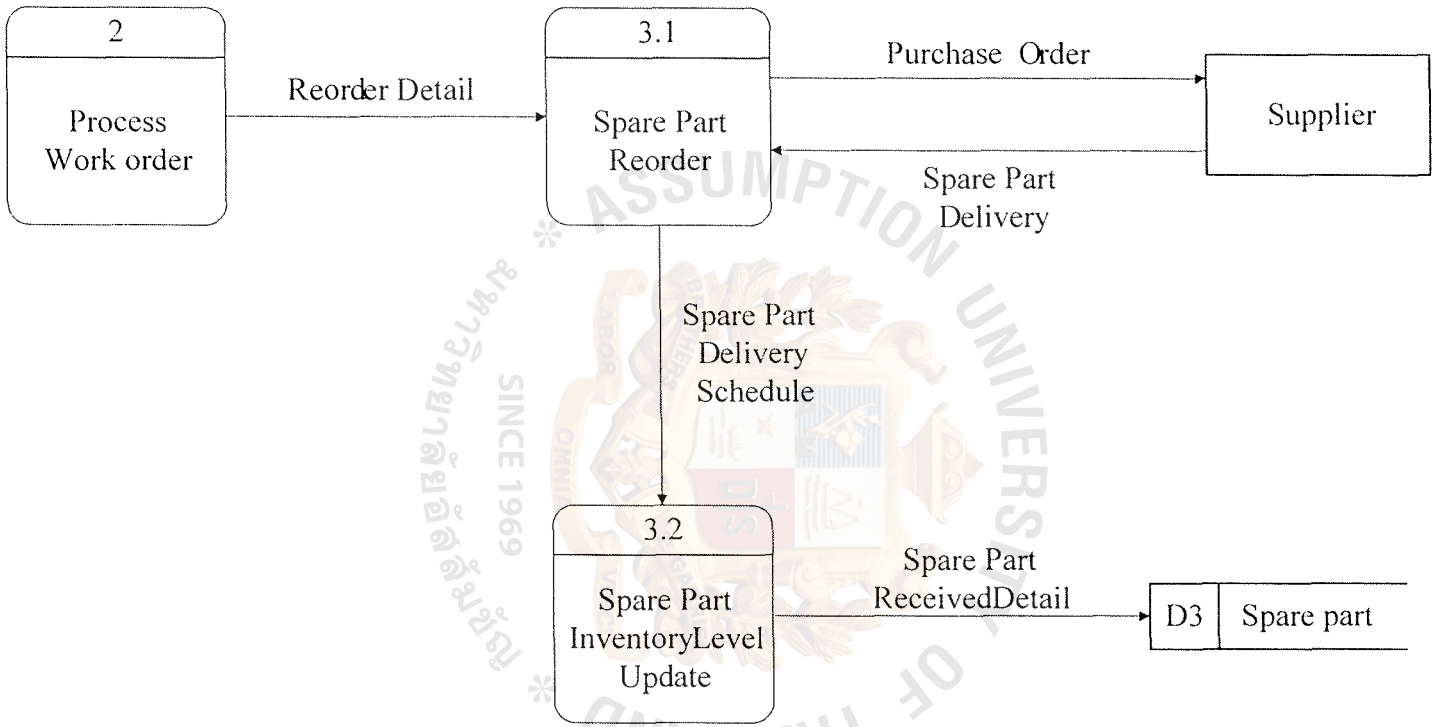

Figure B.5. Process 3 Data Flow Diagram (Proposed System).

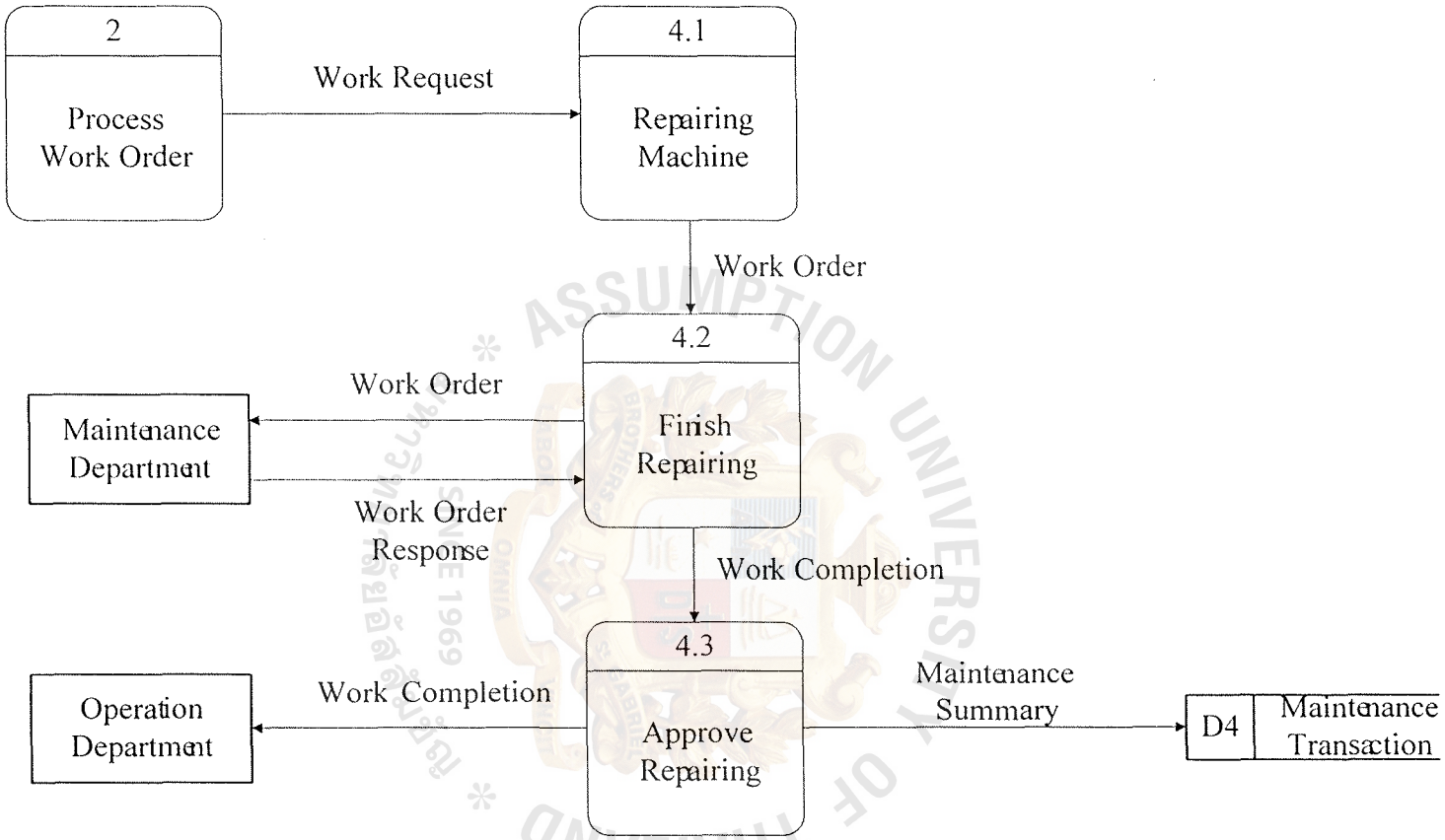

Figure B.6. Process 4 Data Flow Diagram (Proposed System).

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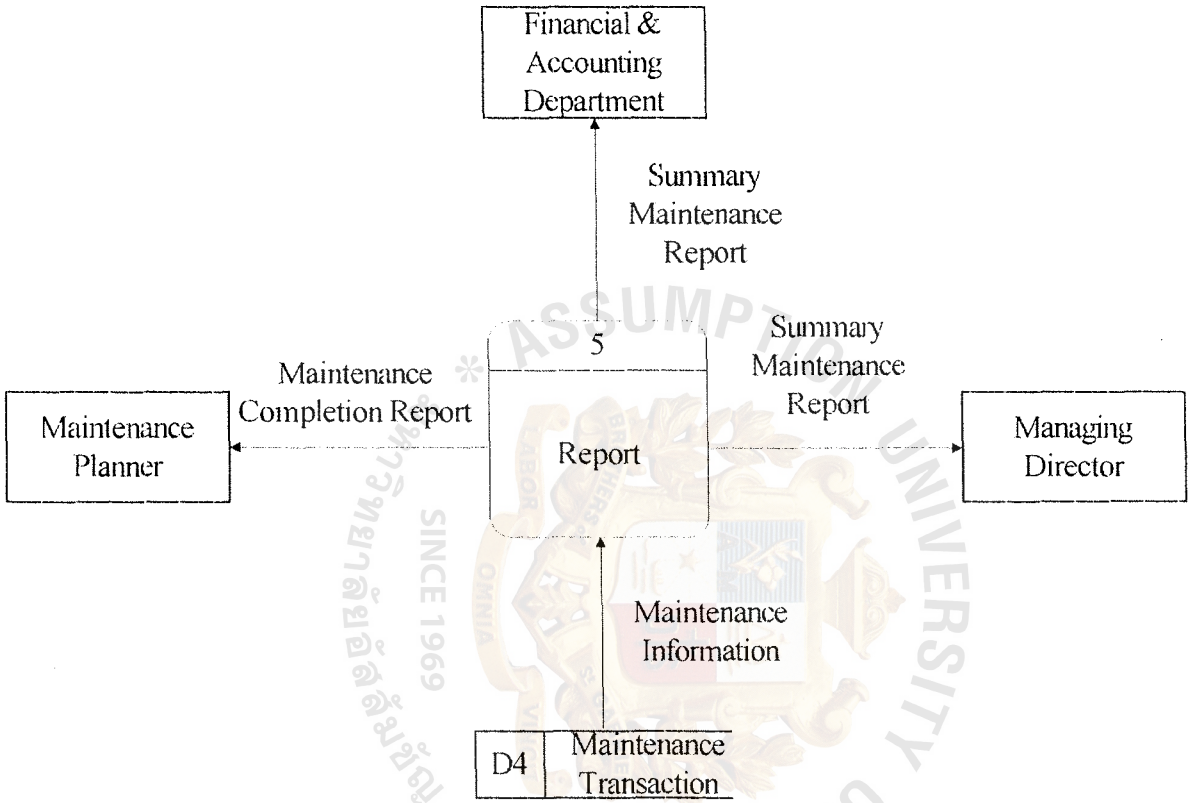

Figure B.7. Process 5 Data Flow Diagram (Proposed System).

APPENDIX C

INPUT SCREEN DESIGN

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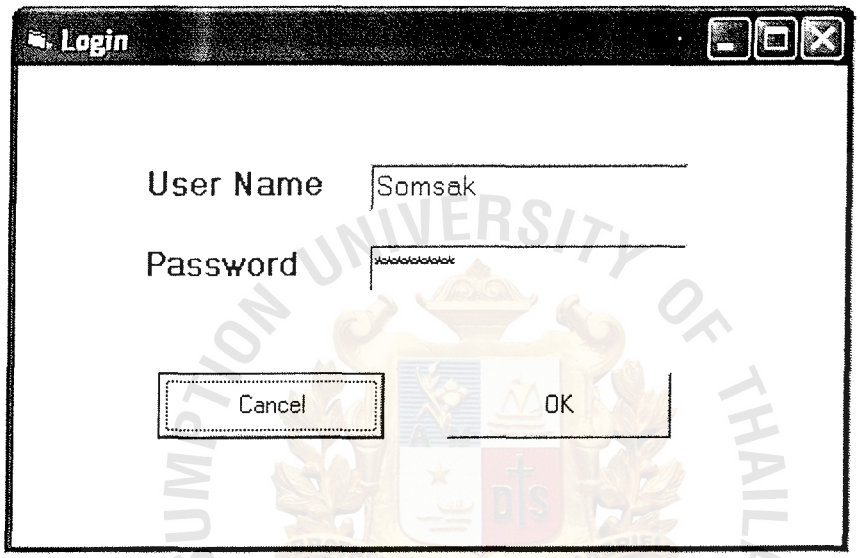

Figure C.1. Login Interface.

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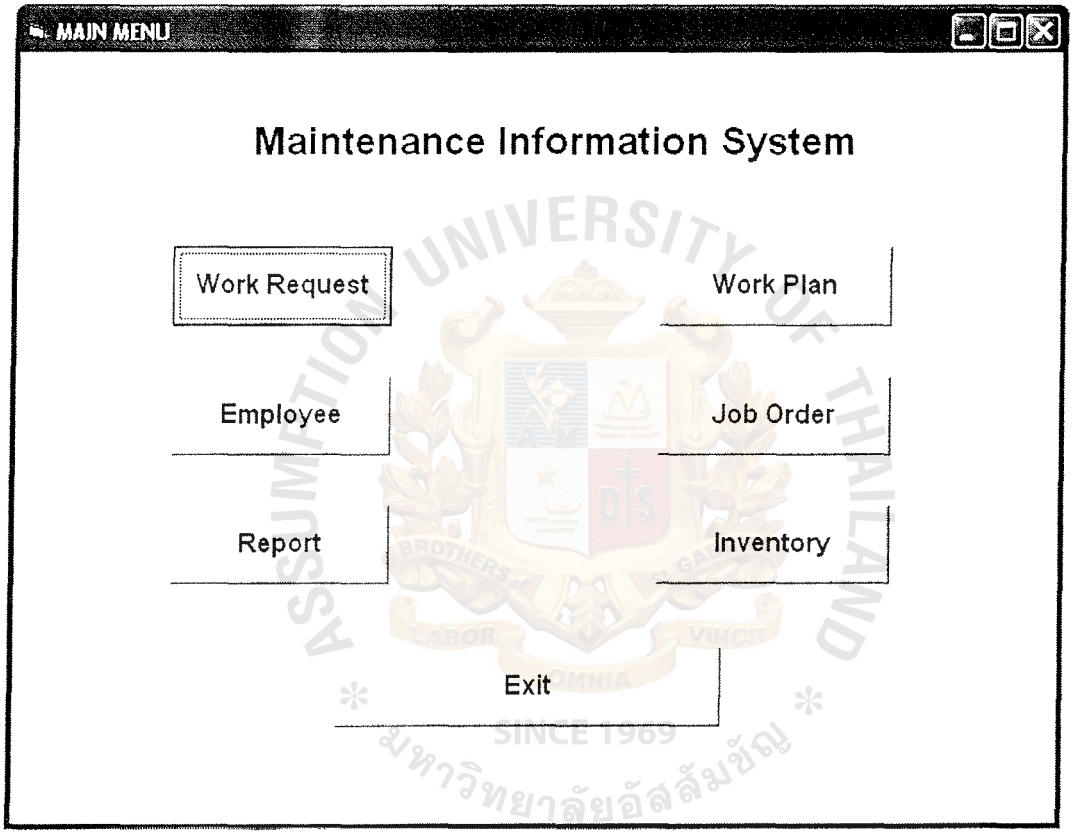

Figure C.2. Main Menu Interface.

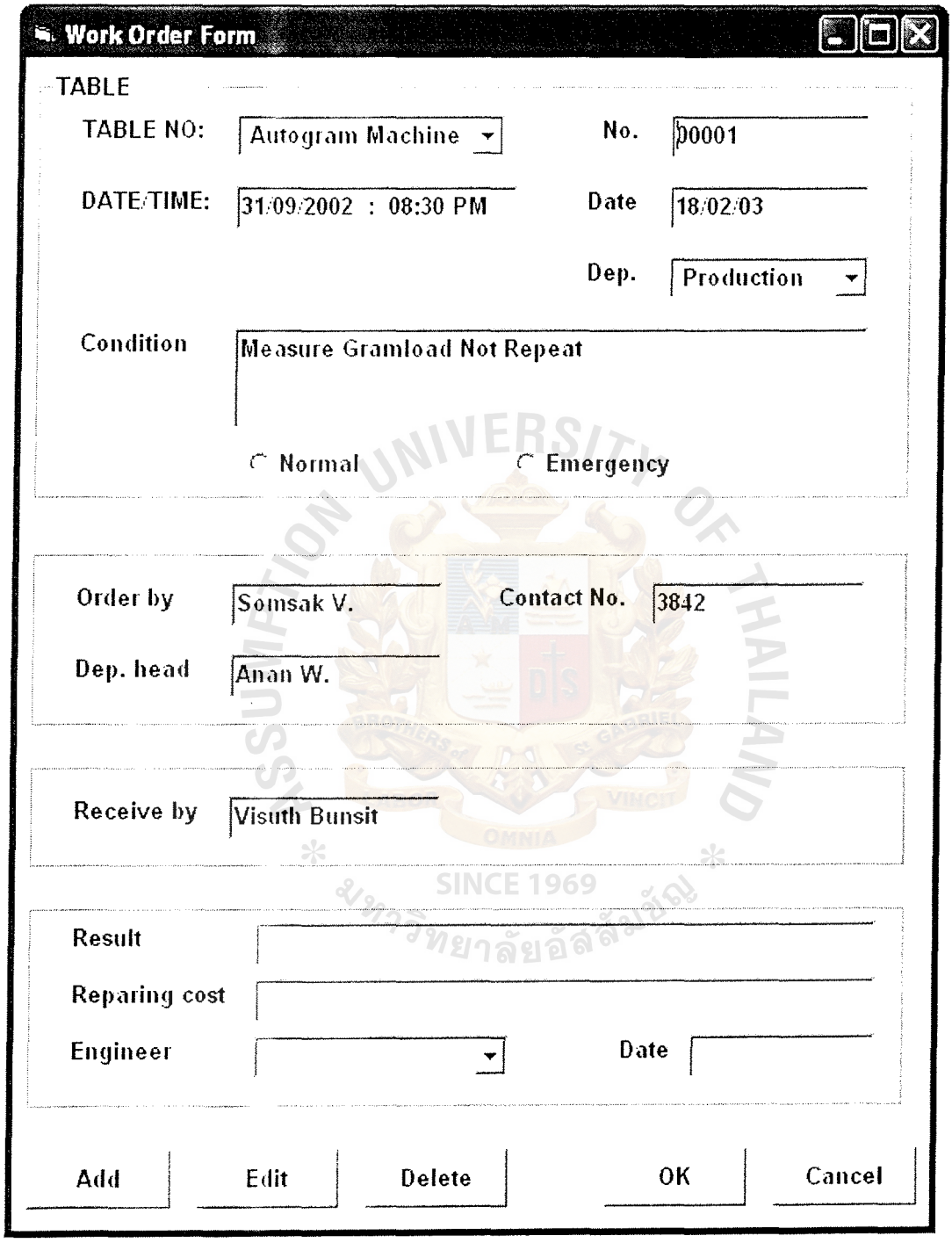

Figure C.3. Work Order Form.

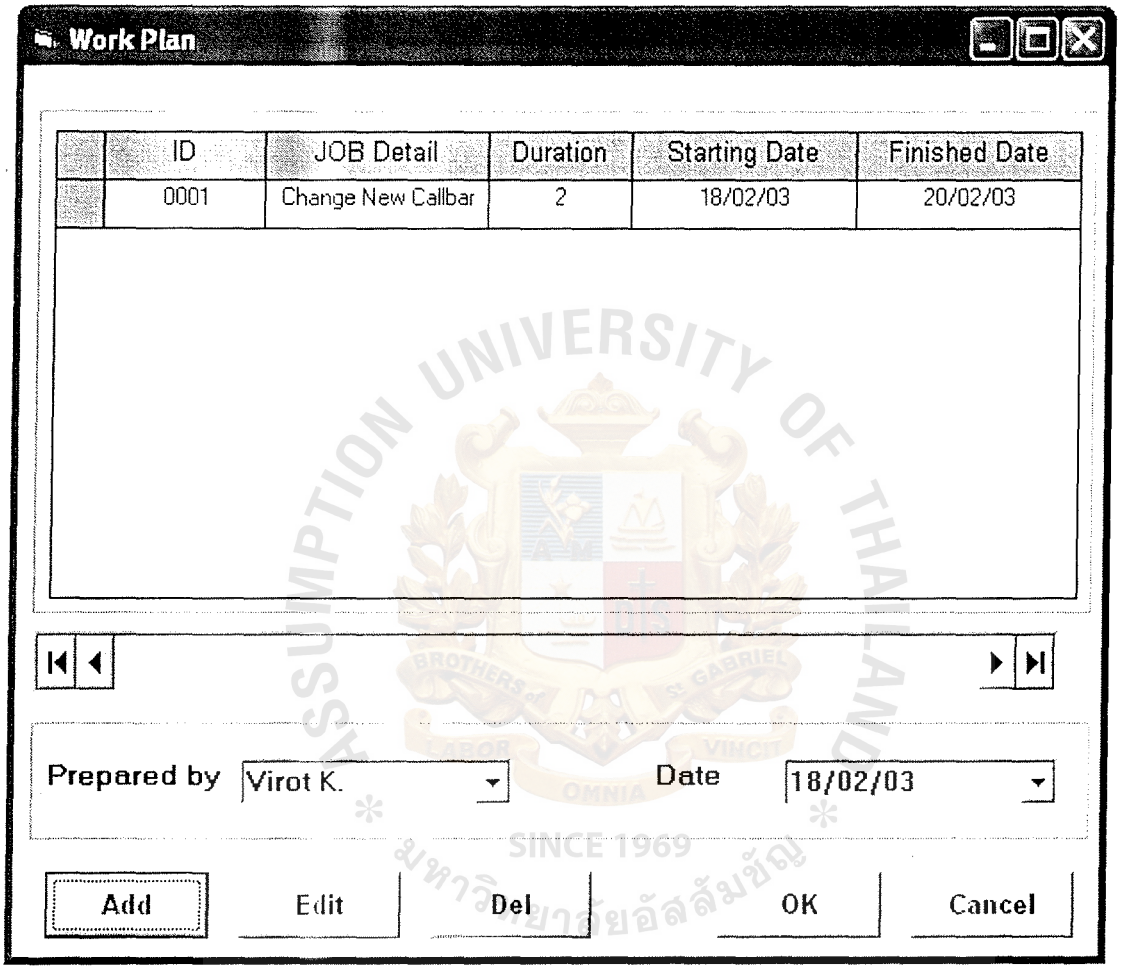

Figure C.4. Work Plan Form.

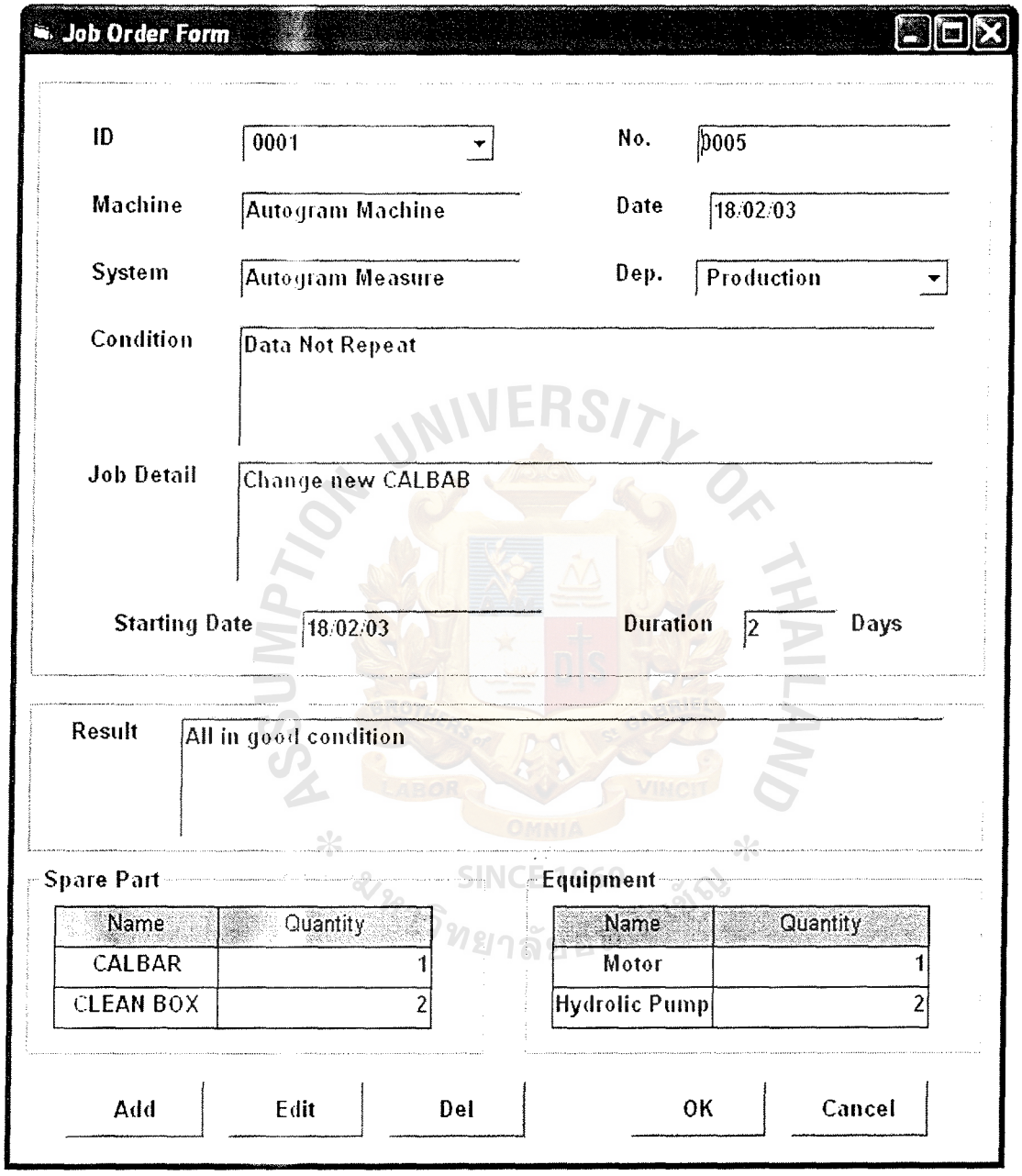

Figure C.5. Job Order Form.

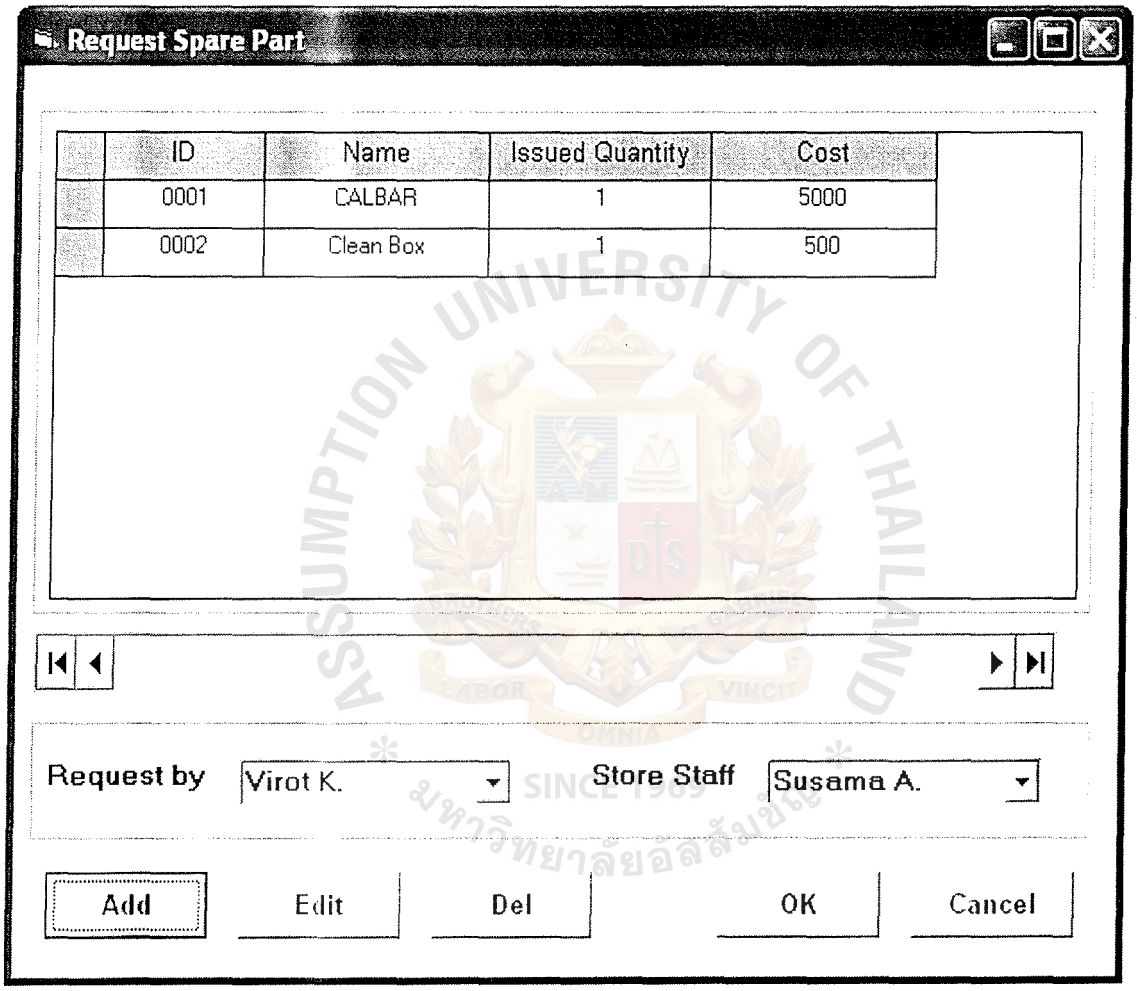

Figure C.6. Request Spare Part Form.

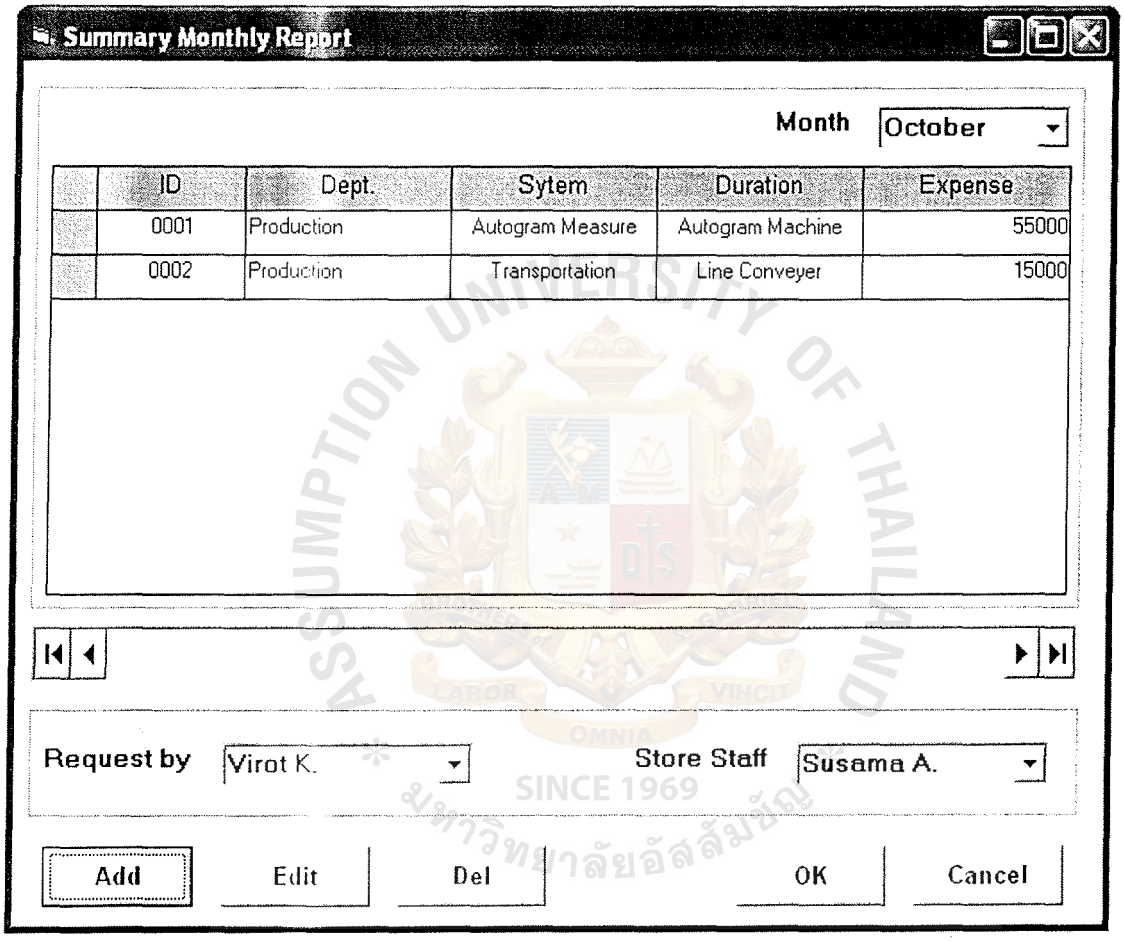

Figure C.7. Summary Monthly Report.

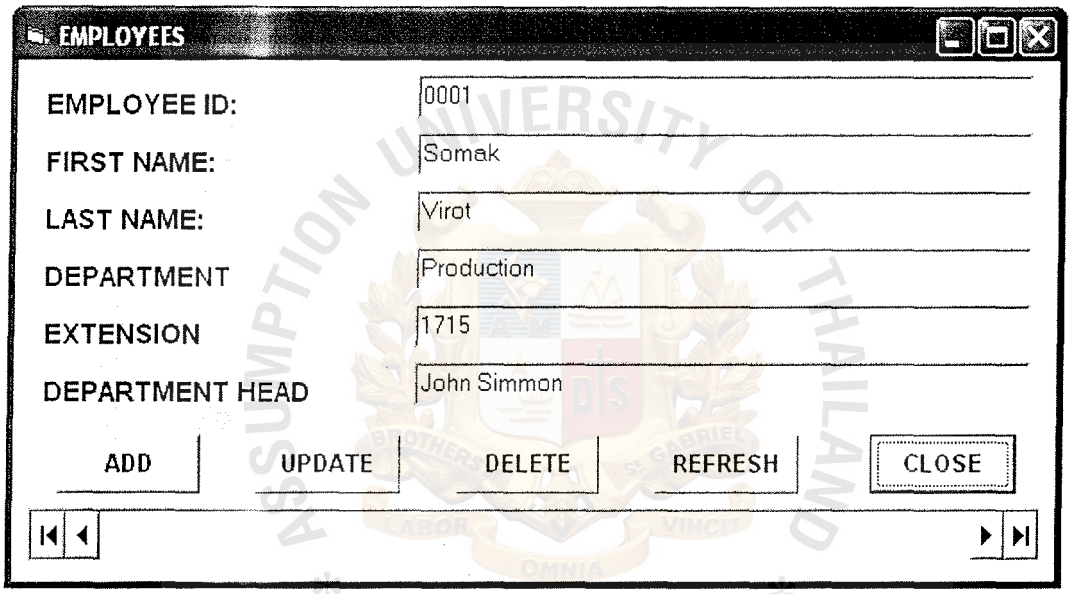

Figure C.8. Employee Form.

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APPENDIX D

REPORT DESIGN

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KM Precision Co.,Ltd.
Maintenance Report
Date 18/02/03

Page 1

Systems	Machine	Date	Number	Period of Fixing (Days)	Expenses (Baht)
1. Autogram Measure.	Autogram Machine	18/02/03	0001	2	55,000.00
			*** total machine fixed 2		55,000.00
2. Transportation.	Line Conveyer	20/02/03	0002	1	15,000.00
			*** total machine fixed 1		15,000.00

Prepared by: Somsak Virot

Figure D.1. Maintenance Report.

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KM Precision Co.,Ltd.
Monthly Maintenance Report
Date 28/02/03

Machine	Date	Condition	Job Detail	Total Date
Autogram Machine	18/02/03	Data Not Repeat	Change new Cal Bar.	2
Line Conveyer	20/02/03	Motor out of order	Change motor's control circuit	1

**** Total machine broken 2 *** Total Date 3

Prepared by: Somsak Virot

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Figure D.2. Monthly Maintenance Report.

Report Name: Employee Report

User ID: 0007

Print Date: 31/01/2003

Emp. ID	First Name	Last Name	Department	Extension	Department Head
1	Somsak	Virot	Production.	1715	Sompog S.
2	Virot	Demak.	Finance.	3254	Ratana T.
3	Pongpun	Punpur.	Engineer.	1544	Pattana K.
xxxx	xx(25)xx	xx(25)xx	xx(25)xx	xx(12)xx	xx(25)xx
xxxx	xx(25)xx	xx(25)xx	xx(25)xx	xx(12)xx	xx(25)xx
xxxx	xx(25)xx	xx(25)xx	xx(25)xx	xx(12)xx	xx(25)xx
xxxx	xx(25)xx	xx(25)xx	xx(25)xx	xx(12)xx	xx(25)xx
xxxx	xx(25)xx	xx(25)xx	xx(25)xx	xx(12)xx	xx(25)xx

** End of Report ***

Figure D.3. Employee Report.

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APPENDIX E

DATABASE DESIGN

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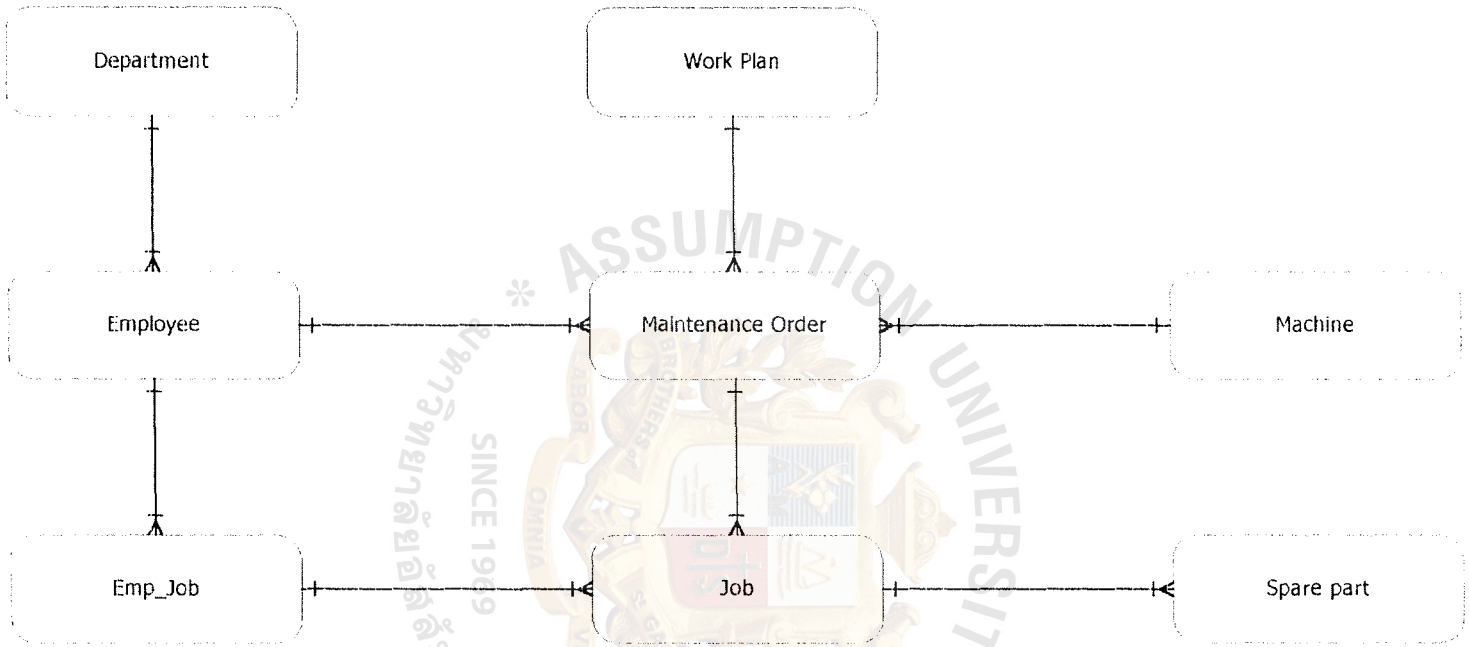

Figure E.1. Context Data Model.

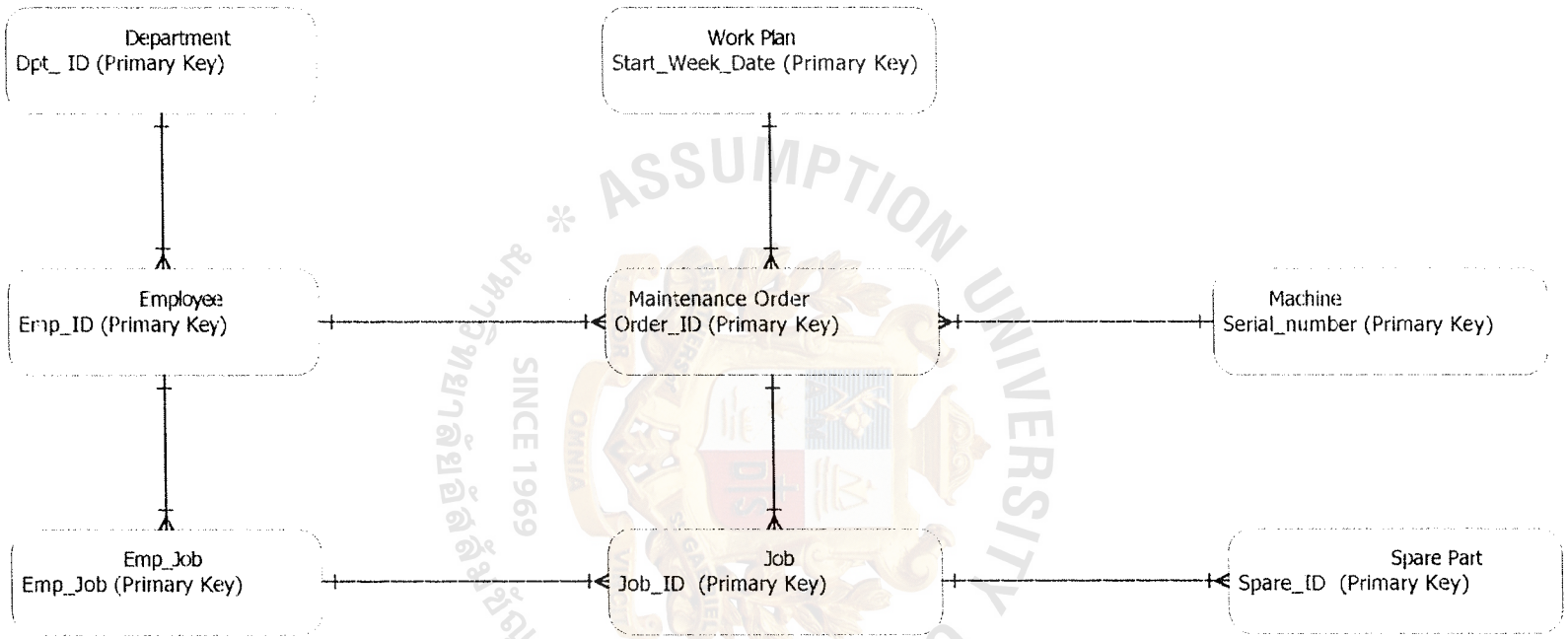

Figure E.2. Key-Based Data Model.

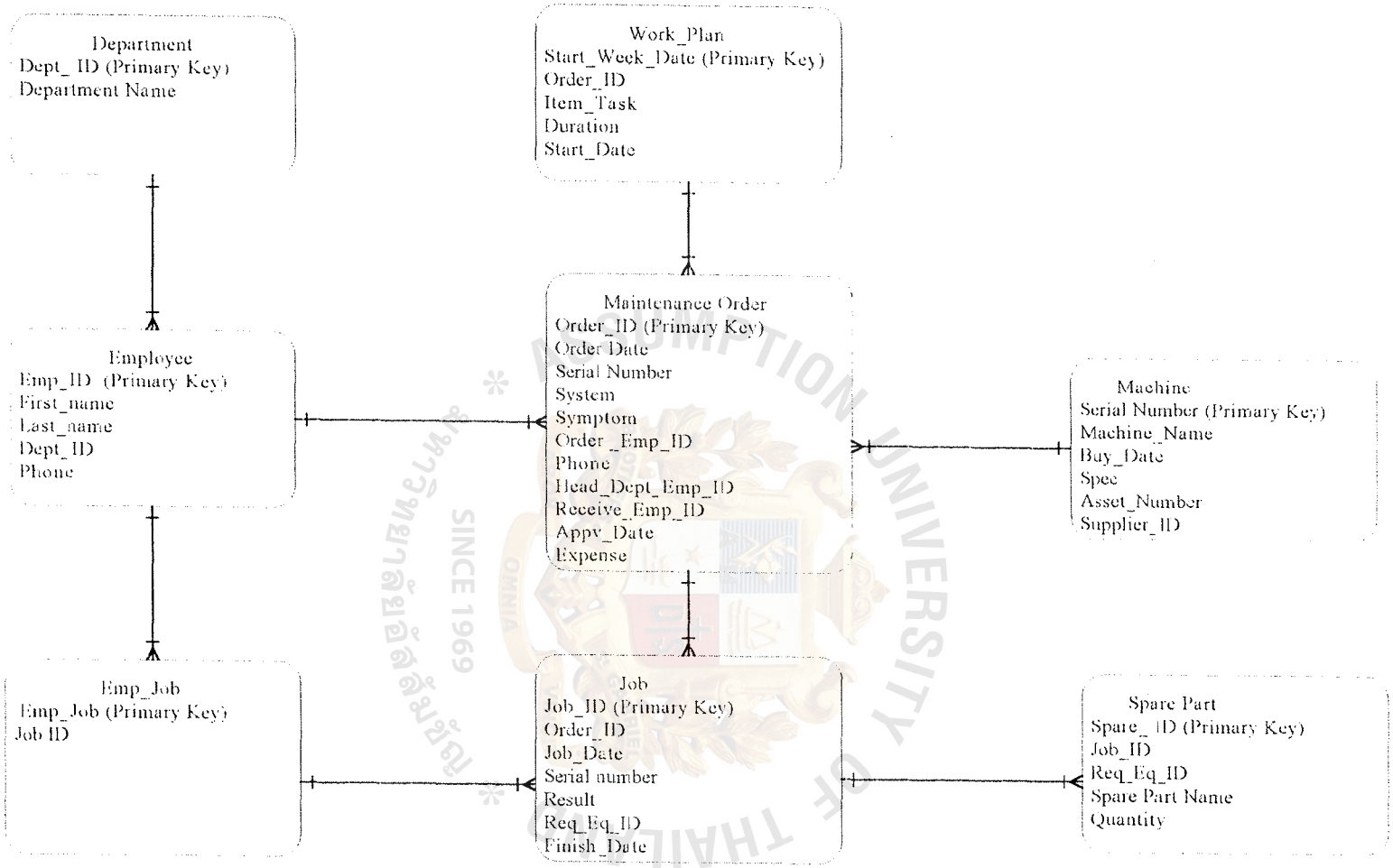

Figure E.3. Fully Attributed Data Model.

Table E.1. Order Table.

Database Name: Machine

Table Name: Order

System Name: Machine Maintenance Information System

Field Name	Description	Data type
Order_ID	No of work order form	INT (6)
Order_Date	Date of sent order	DATE
S/N	Serial Number	INT(5/20)
System	System of machine	CHAR(20)
Symptom	Symptom out of order	MEMO
Priority	Level of order	CHAR(10)
Order_Emp_ID	ID of employee who sent order	INT(6)
Head_Dept_Emp_ID	ID of department head	INT(6)
Receive_Emp_ID	ID of employee who receive order	INT(6)
Appv_Date	Date of approve order	DATE
Expense	Cost of repairing	DECIMAL(10)
Resp_Emp_ID	ID of employee who receive order	INT(6)
Resp_Date	Date of receive order	DATE

Primary Key (Order_ID)

Foreign Key (S/N) Reference Machine

Foreign Key (Order_Emp_ID) Reference Employee

Foreign Key (Head_Dept_Emp_ID) Reference Employee

Foreign Key (Receive_Emp_ID) Reference Employee

Foreign Key (Resp_Emp_ID) Reference Employee

Table E.2. Job Table.

Database Name: Machine

Table Name: Job

System Name: Machine Maintenance Information System

Field Name	Description	Data type
Job_ID	Number of repairing order form	INT(6)
Order_ID	Number of work order form	INT(6)
Job_Date	Date of repairing	DATE
S/N	Serial Number	INT(20)
Result	Result of repairing	MEMO
Req_Eq_ID	Number of equipment requisition forms	INT(6)
Finished_Date	Date of completed repairing	DATE
Tech_Emp_ID	ID of employee, who undertake repairing	INT(6)

Primary Key (Job_ID)

Foreign Key (Order_ID) Reference Order

Foreign Key (S/N) Reference Machine

Foreign Key (Req_Eq_ID) Reference Equipment Inventory

Foreign Key (Tech_Emp_ID) Reference Employee

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Table E.3. Equipment_Inventory Table.

Database Name: Machine		
Table Name: Equipment _Inventory		
System Name: Machine Maintenance Information System		
Field Name	Description	Data type
Spare_ID	Number of equipment order form	INT(6)
Job_ID	ID of repairing order order	INT(6)
Req_Eq_Date	Date of request equipment order	DATE
Spare Part Name	Name of spare part	INT(6)
Quantity	Amount of equipment order	INT(2)
Req_Emp_ID	ID of employee who request equipment order	INT(6)
Issue_Emp_ID	ID of employee who receive equipment order	INT(6)
Primary Key (Spare_ID) Foreign Key (Job_ID) Reference Job Foreign Key (Req_Emp_ID) Reference Employee Foreign Key (Issue_Emp_ID) Reference Employee		

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Table E.4. Work_Plan Table.

Database Name: Machine		
Table Name: Work_Plan		
System Name: Machine Maintenance Information System		
Field Name	Description	Data type
Start_Week_Date	Date of week strating	DATE
Order_ID	ID of work order form	INT(6)
Item_Task	Task of activity	CHAR(40)
Duration	Period of process conducting	INT(3)
Start_Date	Date of work plan starting	DATE
Remark	Remarks	MEMO
Plan_Emp_ID	ID of employee who plan the work plan	INT(6)
Primary Key (Start_Week_Date) Foreign Key (Order_Id) Reference Order Foreign Key (Plan_Emp_ID) Reference Employee		

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Table E.5. Employee Table.

Database Name: Machine

Table Name: Employee

System Name: Machine Maintenance Information System

Field Name	Description	Data type
Emp_ID	ID of employee	INT(6)
First_Name	Employee name	CHAR(20)
Last_Name	Employee surname	CHAR(20)
Dept_ID	Department ID	INT(6)
Phone	Contact number	INT(10)

Primary Key (Emp_ID)

Foreign Key (Dept_ID) Reference Departmet

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Table E.6. Machine Table.

Database Name: Machine		
Table Name: Machine System Name: Machine Maintenance Information System		
Field Name	Description	Data type
S/N	Serial Number	INT(20)
Machine_Name	Machine name	CHAR(20)
Buy_Date	Date of machine purchase	DATE
Spec	Detail of machine	MEMO
Asset_Number	Registration number	INT(6)
Supplier_ID	Supplier ID	INT(6)
Brand	Brand of machine	CHAR(20)
Primary Key (Serial Number)		

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Table E.7. Emp_Job Table.

Database Name: Machine		
Table Name: Emp_Job		
System Name: Machine Maintenance Information System		
Field Name	Description	Data type
Emp_ID	Employee ID	INT(6)
Job_ID	Repairing order ID	INT(6)
Primary Key (Emp_ID, Job_ID) Foreign Key (Emp_ID) Reference Employee Foreign Key (Job_ID) Reference Job		

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Table E.8. Department Table.

Database Name: Machine		
Table Name: Department		
System Name: Machine Maintenance Information System		
Field Name	Description	Data type
Dept_ID	Department ID	INT(6)
Department	Department	CHAR(20)
Primary Key (Serial Number)		

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APPENDIX F

PROCESS SPECIFICATION

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Table F.1. Process Specification of Process 1.1.

Items	Descriptions
Process Name:	Receive Request
Data In:	Work Request
Data Out:	Work Request Information
Process:	(1) Put information in work order work. (2) Sent work order form to Maintenance Department. (3) Keep information in order database.
Attachment:	Operation Department Maintenance Department Data Store Order Data Store Employee Data Store Machine

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Table F.2. Process Specification of Process 1.2.

Items	Descriptions
Process Name:	Check Department Detail
Data In:	Work Request
Data Out:	Work Request Form
Process:	(1) Sent work order form to Department Information. (2) Keep information in order database.
Attachment:	Operation Department Maintenance Department Data Store Order Data Store Employee

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Table F.3. Process Specification of Process 1.3.

Items	Descriptions
Process Name:	PM Information
Data In:	Work Request
Data Out:	Work Request Information
Process:	(1) Sent work order form to PM Inforamtion. (2) Keep information in order database
Attachment:	Operation Department Maintenance Department Data Store Machine

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Table F.4. Process Specification of Process 1.4.

Items	Descriptions
Process Name:	Maintenance Request Process
Data In:	Work Request Information
Data Out:	Work Response
Process:	(1) Get necessary information. (2) Put information in work order work. (3) Sent work order form to Maintenance Department (4) Keep information in order database
Attachment:	Production Department Engineer Department Data Store Order Data Store Employee Data Store Machine

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Table F.5. Process Specification of Process 2.

Items	Descriptions
Process Name:	Process Work Order
Data In:	Work Order Information Spare Part Information
Data Out:	Maintenance Request Reorder Data
Process:	(1) Receive work order form. (2) Sent Reorder detail to supplier in the case of Spare Part lacking. (3) Identify the responsible persons. (4) Deciding the machine should be repaired or not (4.1) If yes , make the job order form. (4.2) If no , inform to Production Department. (5) Keep information in each database.
Attachment:	Data Store Job Data Store Emp_job Data Store Work Plan Data Store Employee Data Store Order

Table F.6. Process Specification of Process 3.1.

Items	Descriptions
Process Name:	Spare Part Reorder
Data In:	Process Work Order
Data Out:	Spare Part Delivery Schdule
Process:	(1) Keep information about machine, spare part, and supplier. (2) Sent purchase order to supplier in the case of spar part lacking.
Attachment:	Supplier Data Store Spare Part Data Store Machine Data Store Supplier

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Table F.7. Process Specification of Process 3.2.

Items	Descriptions
Process Name:	Spare Part Inventory Level Update
Data In:	Spare Part Delivery Schedule
Data Out:	Spare Part Inventory
Process:	Update information of Spare Part into Database
Attachment:	Supplier Data Store Spare Part Data Store Machine Data Store Supplier

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Table F.8. Process Specification of Process 4.1.

Items	Descriptions
Process Name:	Repairing Machine
Data In:	Job Order Form
Data Out:	Job Order Form
Process:	(1) Receive job order form (2) Request spare part that send order to Inventory Department and supplier via Finance and Accounting Department (3) Rectify the trouble machine regarding the instructions assigned (4) Keep and update all information in each database
Attachment:	Inventory Department Supplier Data Store Spare Part_Inventory Data Store Spare Part Data Store Job Data Store Supplier

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Table F.9. Process Specification of Process 4.2.

Items	Descriptions
Process Name:	Finish Repairing
Data In:	Job Order Form
Data Out:	Job Order Form
Process:	(1) Notify the production department to verify and approval for repairing (2) Return exceed spare part to inventory department. (3) Update information in each database
Attachment:	Production Department Data Store Spare Part_Inventory Data Store Job

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Table F.10. Process Specification of Process 4.3.

Items	Descriptions
Process Name:	Approved Repairing
Data In:	Job Order form
Data Out:	Work Order Form
Process:	(1) Making a decision for repairing (1.1) If approved, sign approved and keep information in database (1.2) If no, inform Engineer Department to recheck and update information in database
Attachment:	Data Store Order Maintenance Department Operation Department

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Table F.11. Process Specification of Process 5.

Items	Descriptions
Process Name:	Summary Monthly Report
Data In:	Maintenance Transaction
Data Out:	Monthly Report
Process:	(1) Request all information from database (2) Summarizing the repairing report attached in monthly report (3) Sent to board of Director for submitting (4) Calculate cost of repairing and submitting to Financial and Accounting Department
Attachment:	Financial and Accounting Department Board of Director Maintenance Planner Data Store Employee

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APPENDIX G

DATA DICATIONARY

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DATA DICTIONARY

Remarks

T1 = Order Table

T2 = Job Table

T3 = Equipment_Inventory Table

T4 = Work Plan Table

T5 = Employee Table

T6 = Machine Table

T7 = Emp_Job Table

T8 = Department Table

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Table G.1. Data Dictionary of Maintenance Information System.

Field Name	Type	Length	Format	Description	Table
Order_ID	Integer	6	x(6)	No of work order form	T1
Order_Date	Date	-	dd/mm/yy	Date of sent order	T1
S/N	Integer	20	x(20)	Serial Number	T1
System	Character	20	-	System of Machine	T1
Symptom	Memo	-	-	Symptom out of order	T1
Priority	Character	10	x(10)	Level of order	T1
Order_Emp_ID	Integer	6	x(6)	ID of employee who sent order	T1
Phone	Integer	10	x(10)	Contact number	T1
Head_Dept_Emp	Integer	6	x(6)	ID of Department Head	T1
Receive_Emp_ID	Integer	6	x(6)	Contact number	T1
Appv_Date	Date	-	dd/mm/yy	Date of approved order	T1
Expense	Decimal	10	x(10)	Cost of repairing	T1
Resp_Emp_ID	Integer	6	x(6)	ID of employee who receive order	T1
Resp_Date	Date	-	dd/mm/yy	Date of receive order	T1
Job_ID	Integer	6	x(6)	Number of repairing order	T1

Table G.1. Data Dictionary of Maintenance Information System (Continued).

Field Name	Type	Length	Format	Description	Table
Order_ID	Integer	6	x(6)	Number of work order	T2
Job_Date	Date	-	-	Date of repairing	T2
S/N	Integer	20	x(20)	Serial number	T2
Result	Memo	-	-	Result of repairing	T2
Req_Eq_ID	Integer	6	x(6)	Number of equipment requisition form	T2
Req_Tool_ID	Integer	6	x(6)	Number of tool requisition forms	T2
Finish_Date	Date	-	dd/mm/yy	Date of complete repairing	T2
Tech_Emp_ID	Integer	6	x(6)	ID of employee, who undertake repairing	T2
Req_Tool_ID	Integer	6	x(6)	Number of tool borring form	T2
Job_ID	Integer	6	x(6)	Number of repairing order form	T2
Req_Tool_Date	Date	-	dd/mm/yy	Date of tool borrowing	T2
Tool_ID	Integer	6	x(6)	ID of tool, equipment	T2
Quantity	Integer	6	x(6)	Quantity of tool borrowing	T2

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Table G.1. Data Dictionary of Maintenance Information System (Continued).

Field Name	Type	Length	Format	Description	Table
Req_Eq_ID	Integer	6	x(6)	Number of equipment order form	T3
Job_ID	Integer	6	x(6)	ID of repairing order form	T3
Req_Eq_Date	Date	-	dd/mm/yy	Date of request equipment order	T3
Equipment_ID	Integer	6	x(6)	ID of equipment	T3
Quantity	Integer	2	x(2)	Amount of equipment order	T3
Return	Integer	2	x(2)	Amount of return equipment	T3
Req_Emp_ID	Integer	6	x(6)	ID of employee who receive	T3
Issue_Emp_ID	Integer	6	x(6)	ID of employee who request	T3

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Table G.1. Data Dictionary of Maintenance Information System (Continued).

Field Name	Type	Length	Format	Description	Table
Start_Week_Date	Date	-	dd/mm/yy	Date of week starting	T4
Order_ID	Integer	6	x(6)	ID of work order form	T4
Item_Task	Character	40	x(40)	Task of activity	T4
Duration	Integer	3	x(3)	Period of process conducting	T4
Start_Date	Date	-	dd/mm/yy	Date of work plan start	T4
Remark	Memo	-	-	Remark	T4
Plan_Emp_ID	Integer	6	x(6)	ID of employee who plan	T4

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Table G.1. Data Dictionary of Maintenance Information System (Continued).

Field Name	Type	Length	Format	Description	Table
Emp_ID	Integer	6	x(6)	ID of employee	T5
Frist_Name	Character	20	x(20)	Employee name	T5
Last_Name	Character	20	x(20)	Employee surname	T5
Dept_ID	Integer	6	x(6)	Department ID	T5
Phone	Integer	10	x(10)	Contact number	T5
Supplier_ID	Integer	6	x(6)	Supplier ID	T5
Supplier_Name	Character	20	x(20)	Supplier Name	T5
Supplier_Address	Memo	-	-	Supplier Address	T5
Tool_Name	Memo	-	-	Tool name	T5
Brand	Character	20	x(20)	Brand of tool	T5
Equipment_ID	Integer	6	x(6)	Equipment ID	T5
Equipment_Name	Character	20	x(20)	Equipment Name	T5
Buy_Date	Date	-	dd/mm/yy	Equipment purchase date	T5
Asset_Number	Integer	6	x(6)	Registration number	T5
Supplier_ID	Integer	6	x(6)	Supplier_ID	T5
Brand	Character	20	x(20)	Brand of equipment	T5

Table G.1. Data Dictionary of Maintenance Information System (Continued).

Field Name	Type	Length	Format	Description	Table
S/N	Integer	20	x(20)	Serial Number	T6
Machine_Name	Character	20	x(20)	Machine name	T6
Buy_Date	Date	-	dd/mm/yy	Date of machine purchase	T6
Spec	Memo	-	-	Detail of machine	T6
Asset_Number	Integer	6	x(6)	Registration number	T6
Supplier_ID	Integer	6	x(6)	Supplier ID	T6
Brand	Character	20	x(20)	Brand of machine	T6
Emp_ID	Integer	6	x(6)	Employee ID	T7
Job_ID	Integer	6	x(6)	Repairing order ID	T7
Dept_ID	Integer	6	x(6)	Department ID	T8
Department	Character	20	x(20)	Department	T8

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APPENDIX H

STRUCTURE CHART

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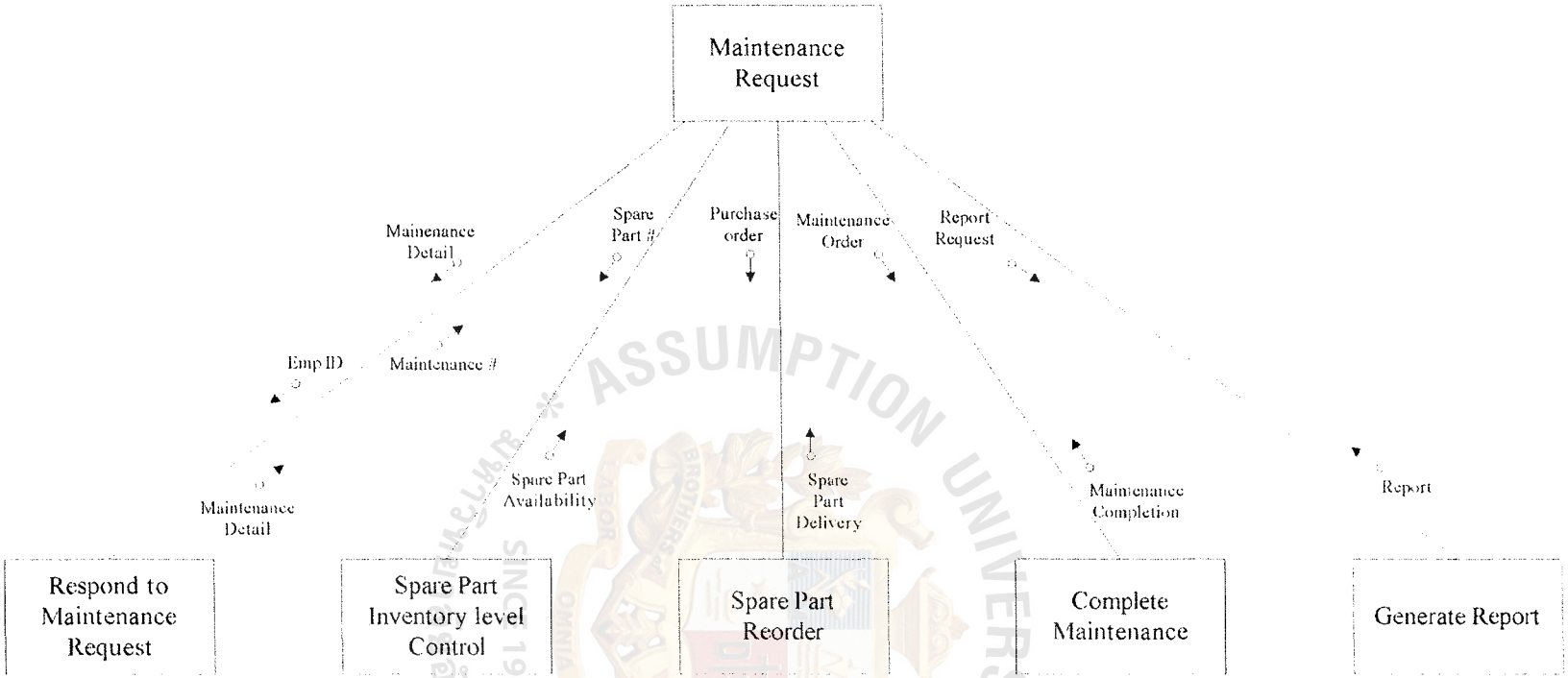

Figure H.1. System Structure (Maintenance Information System).

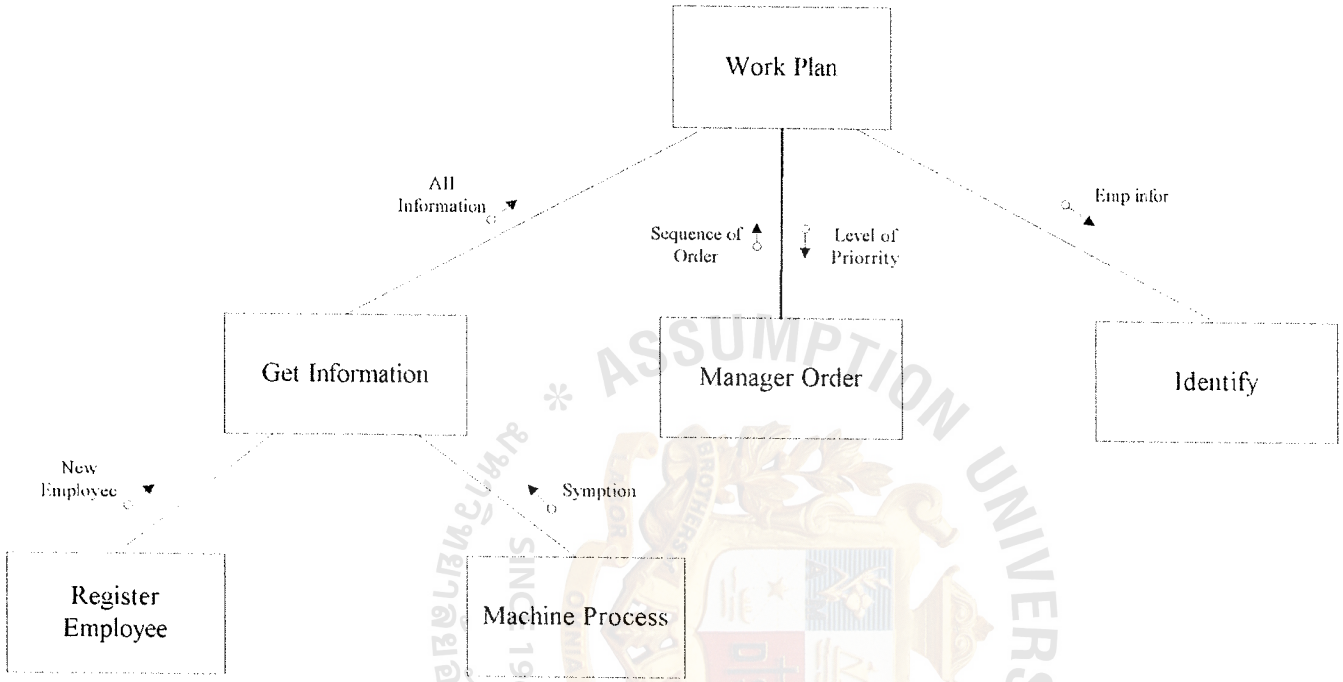

Figure H.2. Structure Chart of Work Plan.

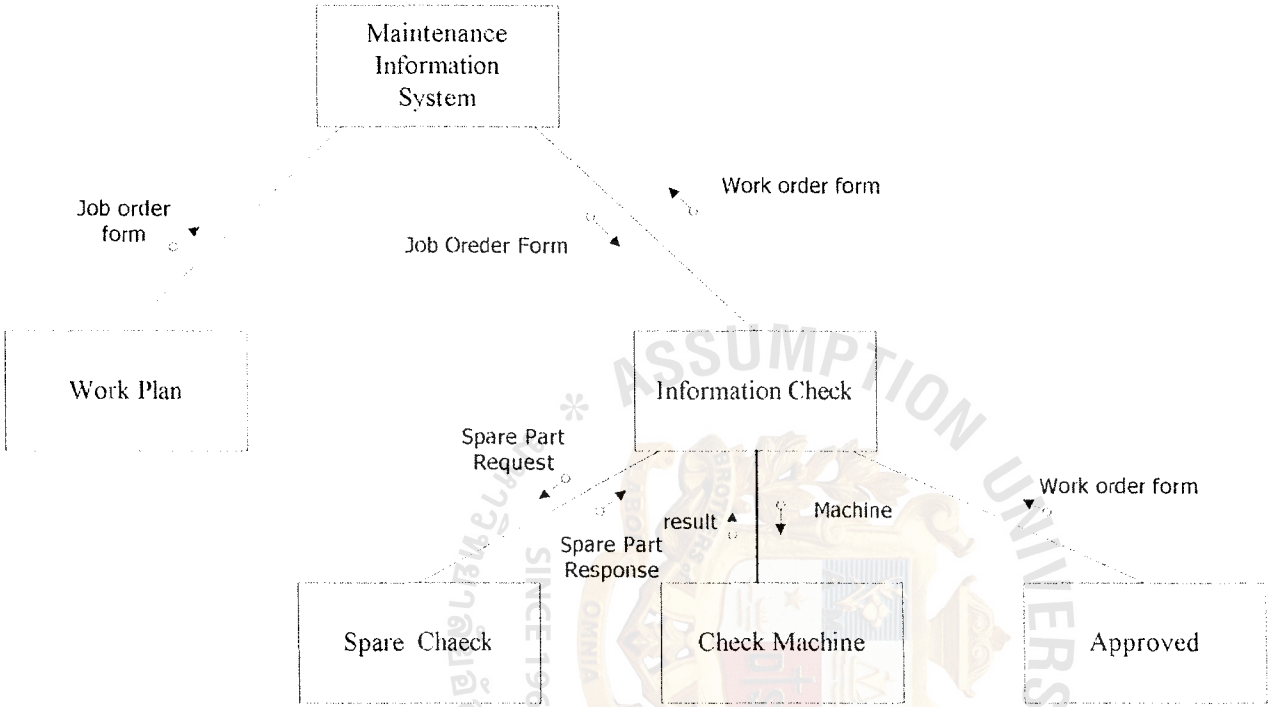

Figure H.3. Structure Chart of Maintenance Process.

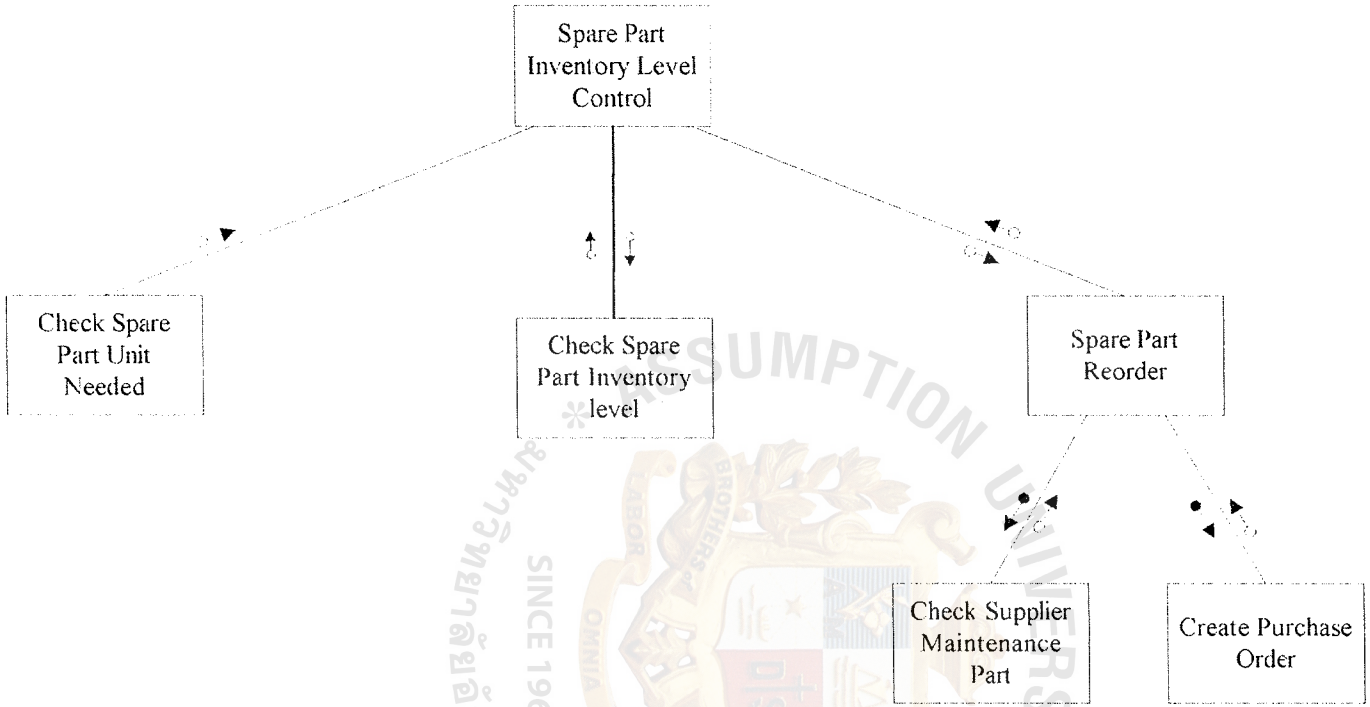

Figure H.4. Structure Chart of Spare Part Inventory level Control.

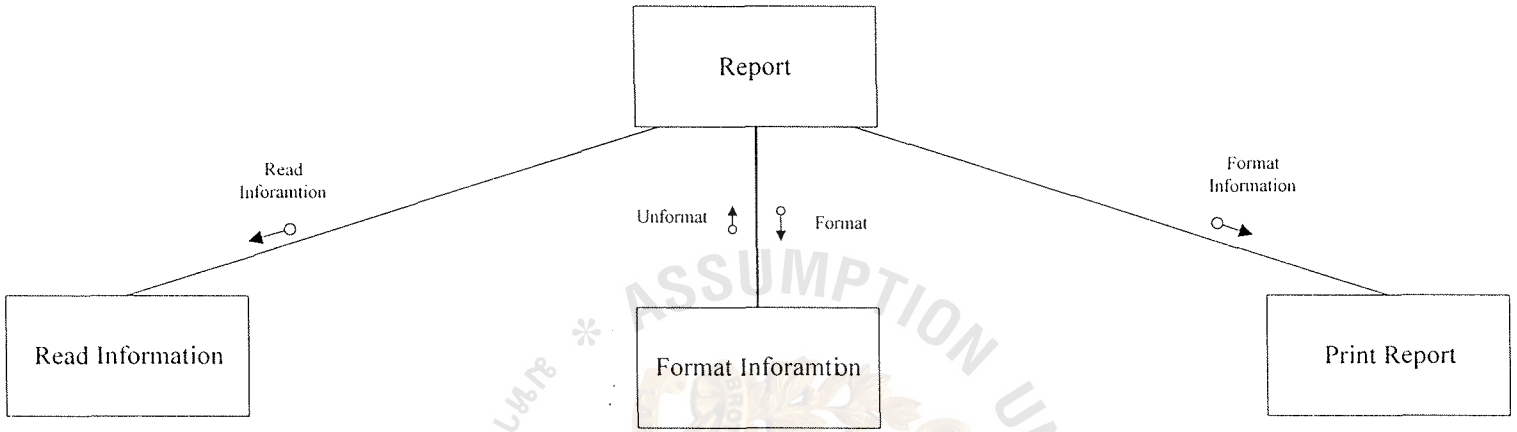

Figure H.5. Structure Chart of Report.

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