Training Information System
for MMC Sittipol Co., Ltd.

by
Ms. Kanidtha Kornsurat

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
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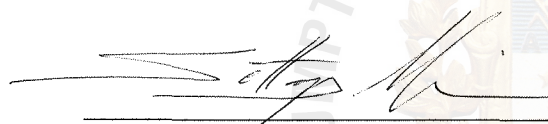Project Title   Training Information System for MMC Sittipol Co., Ltd.

Name   Ms. Kanidtha Kornsurat

Project Advisor   Dr. Settapong Malisuwan

Academic Year   March 2004

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.

Approval Committee:

(Dr. Settapong Malisuwan) 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)
CHE Representative

March 2004

ABSTRACT

Due to the growing competition of global automotive market, automotive manufactures are under immense pressure to produce higher competitive product. And to enable the manufactures to compete in today's global competition, it is necessary to develop their employees' knowledge, skills and competency. MMC Sittipol Co., Ltd. has risen to the challenge by the establishment of Employee Education and Training (EET) Division which is under General Administration (GA) Department. EET Division has responsibility of organizing in-house and outside training programs to fulfill employees' training needs. Consequently, the powerful training management system is needed to optimize the training information and to provide communication and analytical power that the company needs for conducting the training.

The current existing Training Information System is based on the manual and some computerized systems. Most of data are stored on paper while some data are stored in the Microsoft Access which is unable to store high volume of data and provide analytical information. Several mistakes are made and have recurred. Information is redundant, inconsistent and it is unable to access required data.

The new proposed Information System will be developed to replace the manual and some computerized information system with Intranet System. All data are kept in the database server, Microsoft SQL Server 2000, and are accessed through the web server. The user can use the system via a web browser such as Internet Explorer.

The proposed system is found to help improve the current training operation and solve the problems occurring in the manual system. The operating cost is also reduced because less operation time is required.
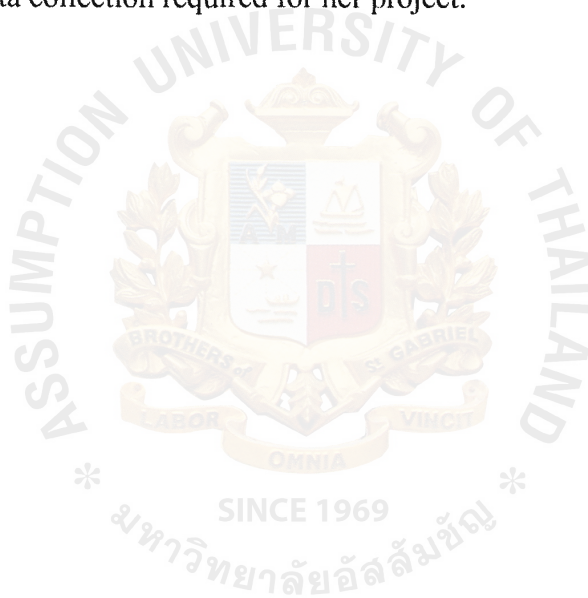
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I. INTRODUCTION

1.1 Background of the Project

The purpose of this system development project is to improve the existing manual and some computerized systems of Employee Education and Training (EET) division to become an effective computerized Training Information System.

Currently, the training program has increased in terms of number of courses and frequency. Different position ranks and responsibilities of employees from several departments must be well selected to participate in the courses to fulfill their training needs.

The main problems occurred are that the training officer faces a mistake of issuing quota for expected training participants and the division managers are not able to check the training status of his employees. These problems lead to poor and ineffective training programs provided for the employees. For instance, the management people get unreliable training evaluation reports that make wrong analysis for training development.

Consequently, computer-based information system is proposed to the company and now a training management tool is needed for helping the training officers to focus on their core areas of organizing training programs to fulfill the employees' training needs for training efficiency, effectiveness and strategic advantage.

1.2 Objective of the Project

The objectives of this project is focused on Training Information System, which can be described as follows:

(1) To study the current data and work flow of EET Division.

(2) To analyze the problem of the existing system and propose a solution to resolve the problem for consistent and accurate data and responsive, sharable and analyzable information.

(3) To design and implement a new system in order to incorporate the above solutions.

(4) To provide the management people for effective training summary report for training planning strategy to fulfill employee career path development.

(5) To reduce time and cost of operation and increase service to relevant divisions.

(6) To improve the training efficiency and effectiveness.

1.3 Scope of the Project

The project will cover the following parts of the training information system.

(1) The system can retrieve the updated employee records from the existing human resource information system which can be grouped or classified.

(2) The system can store high volume of information or training courses, participants and evaluation result.

(3) The history of participants and expected participants can be queried and classified or grouped by position rank, job title, work year and division.

(4) The system can support relevant division manager to check the history of participant record and expected participants, including online quota response.

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(5) The system can provide useful training information for management level for analyzing the training plan and actual participants, instructors, evaluation, cost and other relevant information in order to make a decision for effective training plans.

1.4 Deliverables

The deliverables of the project on Training Information System are as follows:

(1) Data Modeling (ERD)

(2) Process Modeling (Context Diagram, Data Flow Diagram)

(3) System Specification (Hardware and software specification)

(4) Cost Benefit Analysis (Payback Period, Net Present Value, ROI)

(5) Input Design (Input screen of proposed system)

(6) Output Design (Report from proposed system)

(7) Structure Design (Structured chart)

(8) Process Specification (Detail of each process of proposed system)

1.5 Project plan

After the approval of project proposal from the management, the development team has prepared the project plan, as shown in Figure 1.1, which composes three phases with the details as follows:

(1) Analysis of the existing system phase, which is the survey and planning of the system, the study and analysis of the existing business and information system and the definition of business requirements and priorities for a new improved system. The result of this phase is to model business requirement for a proposed system in the form of an Entity Relationship Diagram (ERD) and Data Flow Diagram (DFD).

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(2) Analysis and design of the proposed system phase, which is the evaluation of the alternative solution and the specification of a detailed computer-based solution. In this phase, it describes the specification with feasibility analysis of each solution. It mainly focuses on technical specification and implementation of the proposed system rather than the logical modeling in system analysis phase. The main activity is to design all system components including web interface, reports, database, network and program.

(3) Implementation of the proposed system phase, which is the construction of the new system and delivery of the new system into day-to-day operation. Besides construction and delivery activities that are the typical phases of system implementation, the user training and testing of developed program before implementation should not be neglected. The training course for users is provided to illustrate the clear picture of the new system, and the system testing is performed to guarantee that the new system operates in accordance with the requirements.

The Training Information System takes about four months to implement. Each system development phase takes approximately one-third of the total time frame.

No.	Task Name	October 2003				November 2003				December 2004				January 2004			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
I.	Analysis of the Existing System																
1	Define the Objective and Scope																
2	Study the Existing System																
3	Identify the Existing Problems																
4	Develop Data Flow Diagram																
5	Cost and Benefit Analysis																
II.	Analysis and Design of the Proposed System																
6	Web Interface Design																
7	Report Design																
8	Database Design																
9	Network Design																
10	Program Design																
III.	Implementation of the Proposed System																
11	Coding																
12	Testing																
13	Hardware Installation																
14	Software Installation																
15	Conversion																

Figure 1.1. Project Plan of Training Information System.

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II. THE EXISTING SYSTEM

2.1 Background of the Organization

Employee Education & Training Division is newly established and organized and is separated from Human Resource Department in the year of 2000 and subordinated under the department of General Administration Department.

The Training's quality objectives include:

(1) To survey yearly employees' training needs.

(2) To plan yearly company training plan according to employees' training needs.

(3) To evaluate training effectiveness.

(4) To provide online individual training record search and expected participants' information.

(5) To summary related training information for training planning strategy to correspond with employee career path development.

Figure 2.1.   Organization Chart of General Administration

Figure 2.1 illustrates the organizational chart of the General Administration

Department. It is separated into 4 divisions of Legal Division, Human Resource

Division, General Affair Division and Employee Education & Training Division.

However, the project will be focused on Employee Education & Training

Division. The main role of Employee Education & Training Division is to manage

overall training for the employees which is correspond to the career path system of the

company.

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instructor outside the organization) is evaluated and selected to satisfied the course, then the training course can be operated.

(6)   For training course, pre-test, post-test and evaluation must be done by the participants sequentially.

(7)   Monthly training evaluation and summary must be issued at the end of each month and reported to the relevant division manager which takes many days of operation.

Human error and data inconsistency would be absolutely unavoidable. Time consuming and tedious works are also burdens for EET division and the relevant divisions.

In analyzing the existing system, the context diagram shows the scope and boundaries of the system. This context diagram shows the total picture of information flow among system support department and other related divisions as illustrated in Figure 2.2.
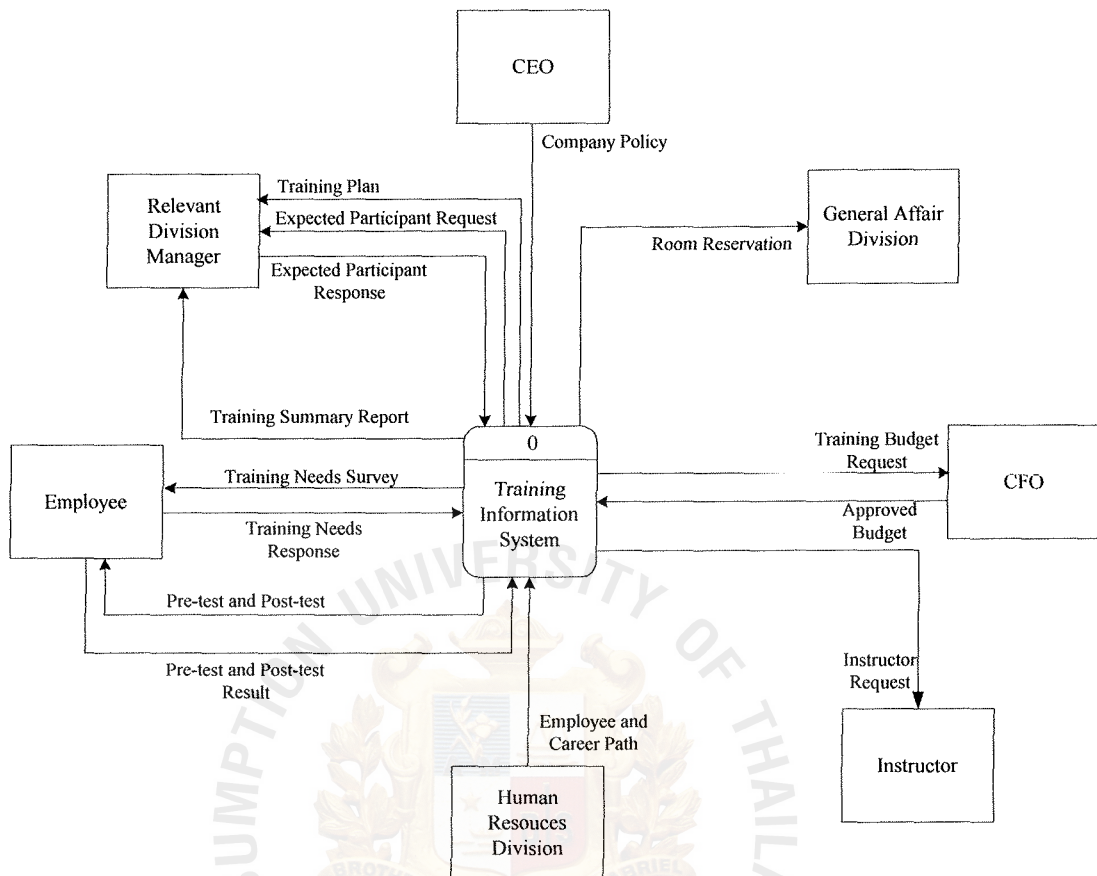
Figure 2.2.   The Context Diagram of the Existing System.

The external agents of training system are Chief of Executive Officer (CEO), relevant division manager, employees, general affair division, Instructor, human resources division and Chief Financial Officer (CFO). The data flow diagram in Figure 2.3 shows the external components and all data transferred to and from each agent.

2.3   Current Problems and Areas for Improvement

The current problems of the Training Information System can be defined to existing manual information system and computerized information system in detail as follows:

The current problems of existing manual information system.

(1)   Request for expected participant confirmation is not responsive. Relevant Division Managers manually check and ask their subordinates whether they have participated in the course.

(2)   It is difficult to keep track of available seats after expected participant cancels his/her quota for class attendance.

(3)   Related training documents is not completely collected but lost due to the use of filing paper documents.

The current problems of existing computer information system.

(1)   Monthly expected participant quota for different position ranks of each division lead to numerous mistakes because the database doesn't support for searching, retrieving and classifying.

(2)   The participant record is overwhelmed and redundant information is stored in many files.

The training information is not sharable among relevant divisions and employees.
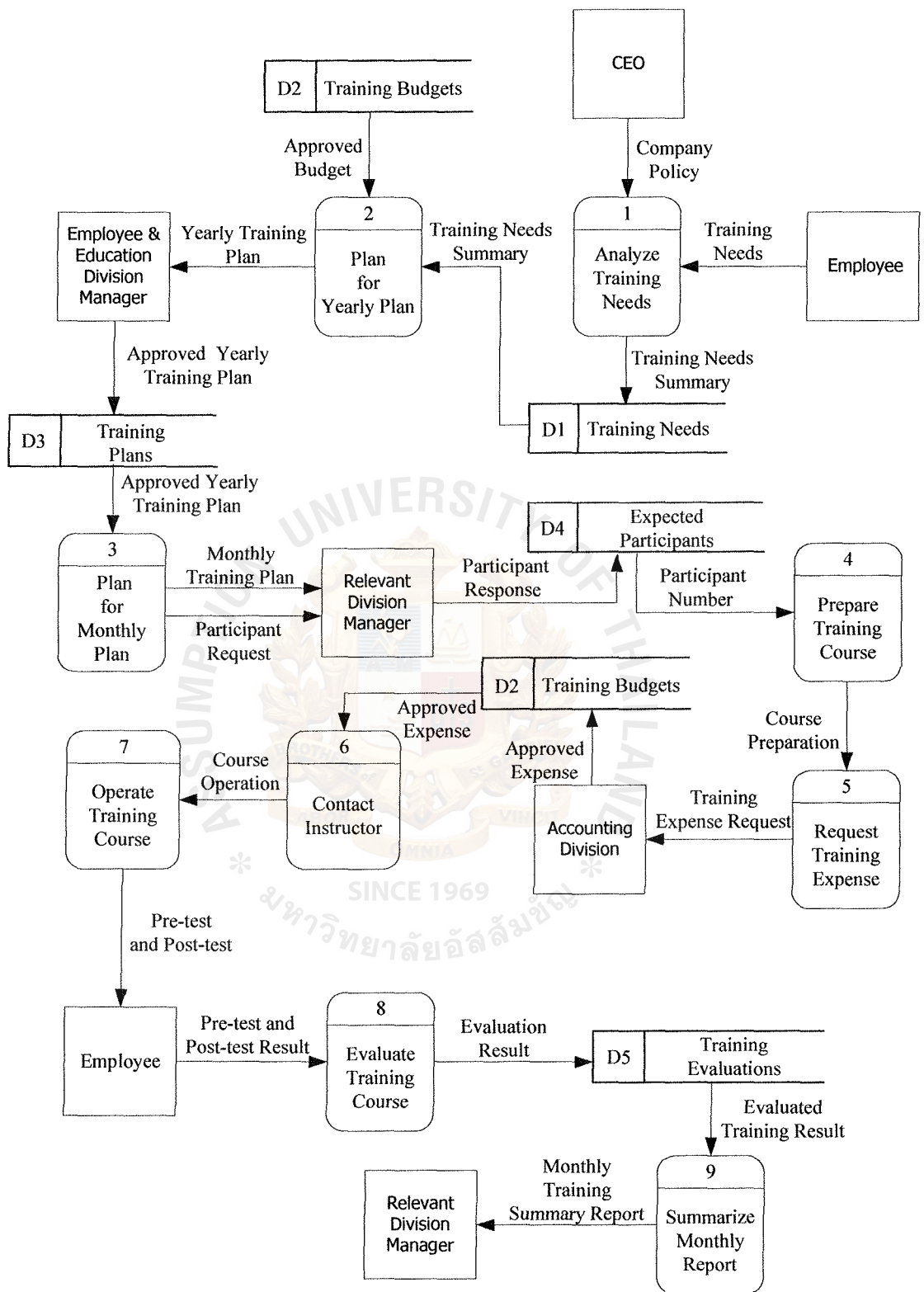
Figure 2.3.   Data Flow Diagram of the Existing System.

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2.4 The Existing Computer System

In the current working environment, Employee Education and Training (EET) Division is based on manual and some computerized systems such as spread sheet and Microsoft Access that does not implement effective database application. All PCs (Personal Computers) are connected through LAN (Local Area Network) via cable. The computer resources such as printers and files are shared through LAN, which is star topology.

The developed application applied the concept of Client/Server technology that distributes application and database to a separate server. The existing server is located at Information Technology department which is responsible for managing and maintaining the servers for all users.

The existing computer hardware and software specification of Employee Education and Training Division are as follows:

(1) Two Intel Pentium III processors 600 MHz with 128 MB SDRAM and 4.3 GB Hard Disk, which runs on Microsoft Windows 98 Second Edition platform with Microsoft Office 97 as a standard application program.

(2) One laser printer

Referring to the current Training Information System (the manual system with partial computerization), the existing personal computers (PCs) use Microsoft Excel and Microsoft Access to process and store the transaction in each day. It does not connect to any centralized server; therefore, it didn't take the advantage of Client/Server technology.

III. THE PROPOSED SYSTEM

3.1 System Specification

Based on the information in the previous chapter, the training officer requires an effective information system, which can accommodate the various processes of the training information management, and solve the problems from the existing manual system with an ineffective partially computerized system.

To achieve the specified objectives, the proposed Training Information System should have the following components:

(1) Database server serving as a web server using the Client/Server model and the World Wide Web technology to send files in the form of web pages to users, and apply intranet concept with the existing LAN to share information and computer resources among division.

(2) Training Information System database redesigned, developed and converted to the high performance database server, available for all relevant persons and departments.

(3) Training Information System converted from unstructured spreadsheet application and Microsoft Access to effective database format designed and developed on database server, and have been integrated to Employee Record and Career Path (Human Resources Division) database and training budget (Accounting Division) database.

(4) All training information system database replacing the existing manual system and some computerized systems to facilitate the current process, to provide on-line training information, history of participants and online participant quota response.

3.2 Requirement Analysis

The study of the existing system reveals many problems such as data inconsistency, human errors, time consuming and tedious works which make the users require a new computerized system to support their work to be more efficiently and realizable. After all problems are indentified and evaluated, the business requirement for the new system can be summarized as follows:

(1) The proposed system should facilitate the training officer in retrieving, searching and classifing the employee of different division, position and ranks to be able to issue the expected participants for each training course.

(3) The new system should provide online query history of participants or expected participants which can be classified or grouped by position ranks, job titles, work year and division to relevant division managers.

(4) The developed system should support relevant division manager to response quota online.

(5) The new system should facilitate and provide useful information for management level for analyzing the training result and follow up result to evaluate and make a decision for effective training plans.

(6) To encourage the paperless office, the proposed system should provide the request report or document to the user by introducing the on-line information display screen.

(7) To support training following up system.

To gain a better understanding of the new system requirement, the logical model is drawn to depict the system independent of any technical implementation. In this project, data modeling and process modeling techniques are used to document business

requirement, and serves as the logical design of the proposed system. The detail of each

technique can be explained as follows:

Table 3.1.   Problems, Opportunities, Objectives and Constraints.

Cause and Effect Analysis		System Improvement Objectives	
Problems	Causes and Effects	System Objective	System Constraints
1. Data inaccuracy and inconsistency	1. Multiple storage of same data create unreliable results 2. Human errors occur during data entry process	1. Eliminate data error entry	1. Data verification with source of information is impractical
2. Redundant data in many units	1. A lot of resources (people, office supplies and costs) are required to collect plenty of information 2. It lacks coordination in updating the same and related information in different units 3. Information stored in other units is difficult to access and inconsistent	1. Replace existing filing system with a computerized system to reduce paper work 2. Increase work collaboration through computerized system	1. Reduction of operating cost
3. Unshared data	1. It lacks coordination for cross checking on related information	1. Eliminate cross checking or cross approval in significant process 2. Accessibility by computerized system help management distributes process function to proper entity	1. New personnel employment is canceled
4. Response time on transaction processing is untimely	1. Information is mainly stored in hard copy and various source, so it is hard to process transaction	1. Reduce the transaction processing time by 75%	1. Hardware and software used in proposed system determine processing time

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3.3 System Analysis

To develop the new system, the proposed system was decomposed into its component pieces for studying. Model-driven analysis was a technique used to analyze this new system. It emphasized the drawing of pictorial system models to document and validate both existing and/or proposed systems.

Since system development constantly deals with unstructured problems, drawing models is one way to structure such problems. Models can be built for the existing system as a way to better understand requirements and also document business requirements or technical designs for the proposed system.

Concerning the problems identified in Chapter II, the analysis of Training Information System is based on 2 techniques as follows:

(1) Data-Centered technique: Data modeling is a technique for organizing and documenting a system's data. Data model is eventually implemented as a database, so Entity Relationship Diagram (ERD) will be a tool that depicts data in terms of the entities and relationship described by the data.

(2) Process-Centered technique: The models are pictures that illustrate the system's component pieces, processes and their associated inputs, outputs, and files. Data Flow Diagram (DFD) will be a tool that depicts the flow of data through a system and the work or processing performed by the new system.

Because data is a corporate resource that should be planned and managed, ERD was utilized to model the system raw data before drawing the DFD that illustrates how that data will be captured, stored, used and maintained.

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Data Modeling

It is a technique for organizing and documenting a system's data. The complete data model is usually implemented as a database. Typically, The data model is called an Entity Relationship Diagram (ERD). There are three levels of entity relationship diagram: Context Data Model, Key-Based Data Model and Fully Attributed Data Model.

The context data model represents only the entity and relationship between each entity. There are eight entities that are discovered in the system: Training Plan, Employee, Instructor, Training Evaluation, Follow Up, Training Needs, Training Room, Training Budget. Each entity has the relationship, when combined with the entity name, in form of simple business sentences or assertions.

In key-based data model, the primary and foreign keys are added to each entity to exhibit the unique characteristic of each entity. Employee has a single attribute primary key, whereas Training Evaluation, Follow Up, Instructor, Training Needs, Training Room, Training Plan, Training Budget have two or more attributes that are uniquely identified as an instance of the entity. The relationships that contribute foreign key from parent (Employee, Instructor, Training Budget and Training Room) to child (Training Needs, Training Evaluation and Follow Up) are defined an instance of the child entity.

The final data model, fully attributed data model, shows all attributes of each entity. To identify all attributes, it requires the understanding of the data attributes for the system. These facts can be discovered through the study of the existing reports and documents to be the naming standard for attribution.

The complete entity relationship diagram of the proposed system is shown in Appendix A.

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Process Modeling

Compared with data modeling, process modeling is a technique for organizing and documenting the structure and flow of data through a system's process and/or the logic, policies and procedures to be implemented by a system's process.

To construct the process model, the context diagram is firstly drawn to establish the initial project scope, which defines how the developed system interacts with other systems and the business as a whole. Figure 3.1 illustrates the context diagram of the proposed system. Four external entities, which are CEO, Employee, Relevant Division Manager and General Affair Division, interact with the developed system.
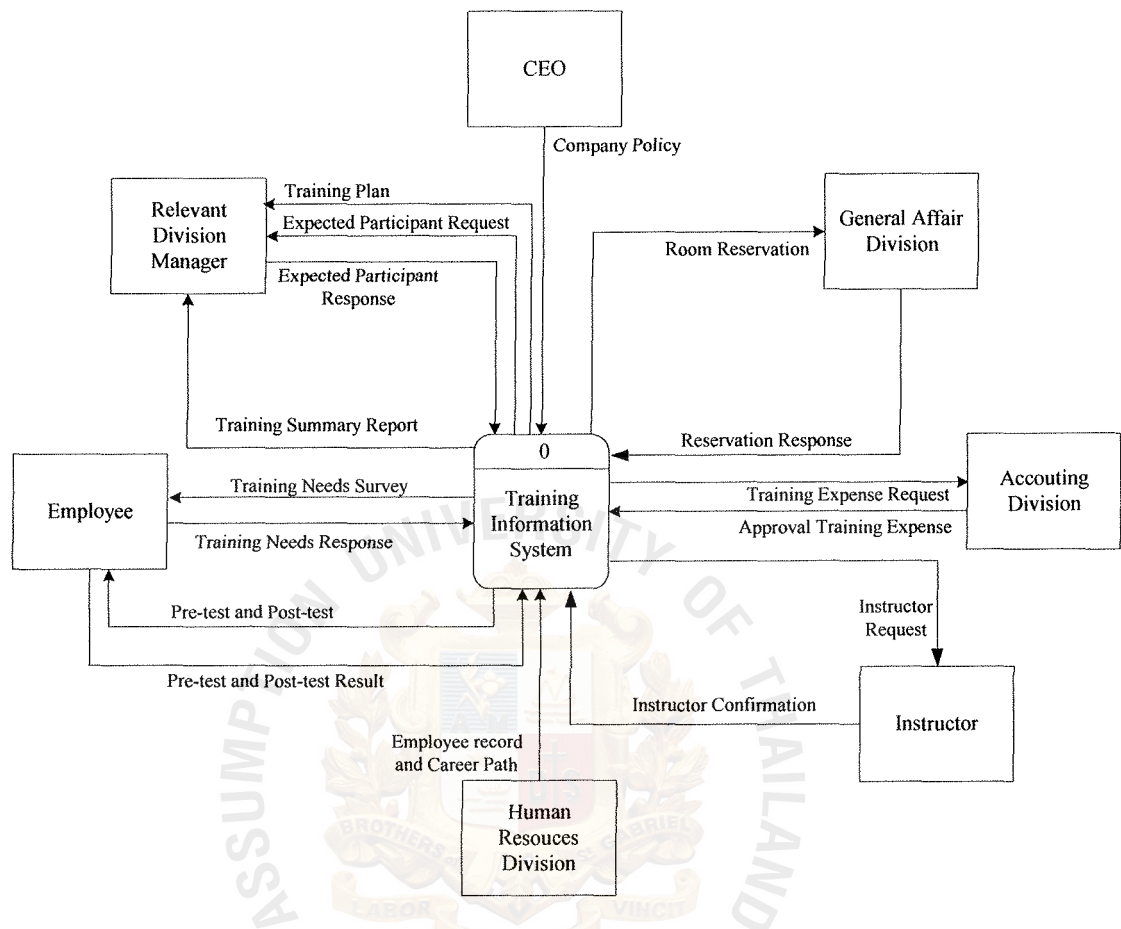
Figure 3.1.   Context Diagram of the Proposed System.

Next, the functional decomposition diagram is created to show the top-down structure of a system. This diagram also serves as an outline for drawing the data flow diagram. The functional decomposition diagram of proposed system is shown in Figure 3.2, which consists of five main subsystems.
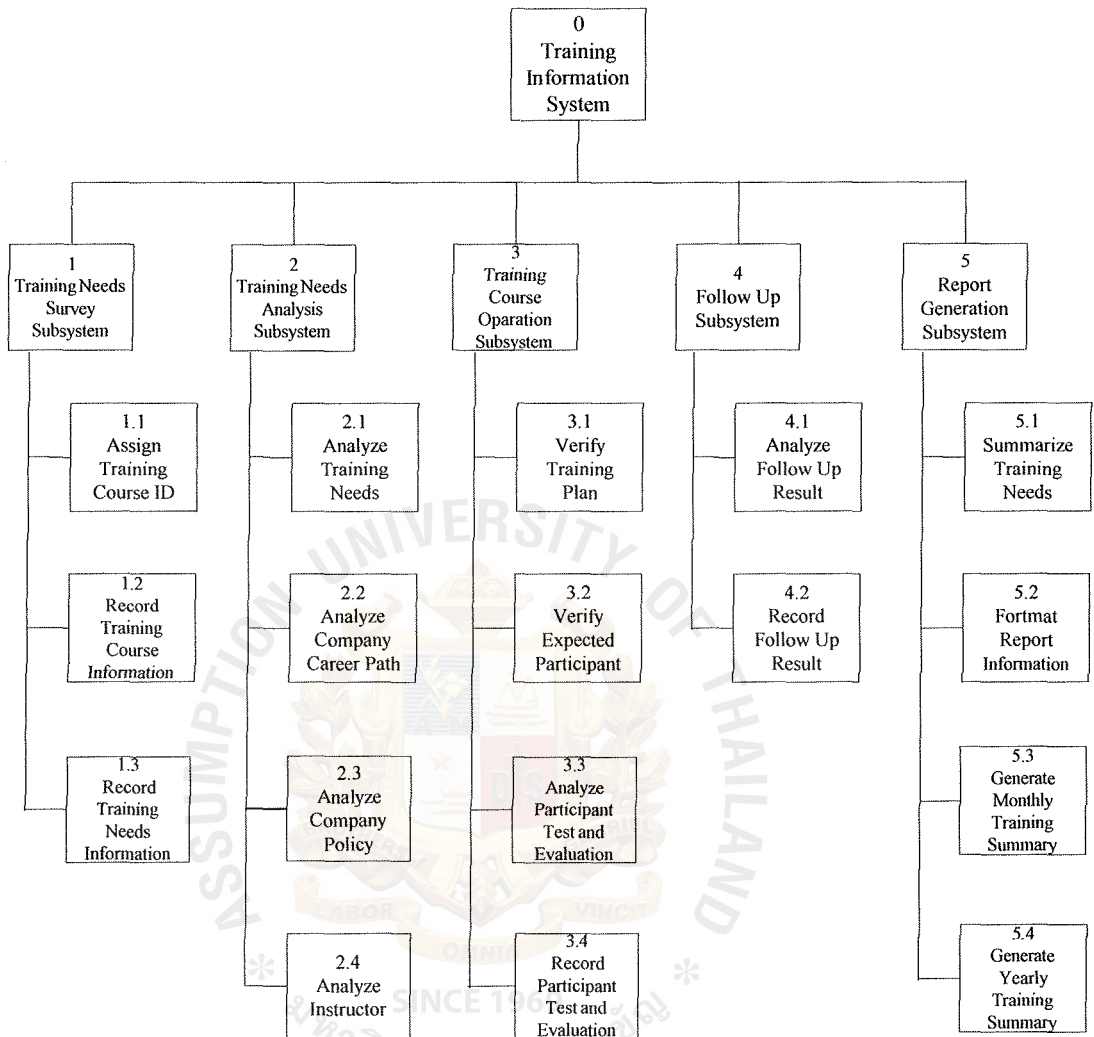
Figure 3.2. Functional Decomposition of the Proposed System.

After finishing the previous two diagrams, a data flow diagram (DFD) can be drawn to depict the flow of data to, from, and within the system. A data flow diagram has many levels of details. The lower the level of data flow diagram shows more details of the processes within the system. The details of each main process can be explained as follows:

(1)   Training Needs Survey

First of all, the training officer designs the training course ID and name. Next, the training officer assigns training course ID to the training needs survey form. Afterwards, the company employees select the training needs course ID and input more training needs information through electronic form of training needs survey form, which is a web interface system screen. The entry information is then stored on Training Needs database.

(2)   Training Needs Analysis

The training officer verifies the training transaction, which comes from Training Needs database for training needs analysis. Career path information from Career Path database, training budget information from Training Budget database and instructor information from instructor database are also used to analyze training needs for working a training plan and expected participants. Training plans and expected participants information are then stored in Training Plan database.

(3)   Training Course Operation

Relevant Division Manager reads training plans and expected participants from Training Plan database and responds to expected participants who are their subordinates into Training plan database. Training officer reads expected participants' response from Training plan database to prepare for a training course operation. Before the actual training date, the expected participants must confirm the attendance by registering online and the data is stored in training plan database. General Affair Division reads training plan from training plan database for training room reservation.

Before and after the training, the participants must do pre-test, post-test and evaluate the training course and the results will be stored in Training Evaluation database.

(4) Follow-up

Test and course evaluation result are used as a reference information for training follow-up. Relevant division managers respond to the follow up system by answering training follow-up questions online after they observe the performance of their subordinates after training within the predefined period.

The attended participants also answer the follow-up questions online to see how much their knowledge after training can be adapted to improve the work performance.

(5) Report Generation

The training information (Training Budget, Training Evaluation, Follow Up) are read to summarize, format and generate a report distributed to relevant parties. Monthly Training Report is sent to participants and relevant division manager. Follow-up Report is sent to participants and relevant division manager. Training Analysis Report is sent to relevant Division Manager and CEO.

Figure 3.3 illustrates Data Flow Diagram of the proposed system. The lower levels of Data Flow Diagram are shown in Appendix B.
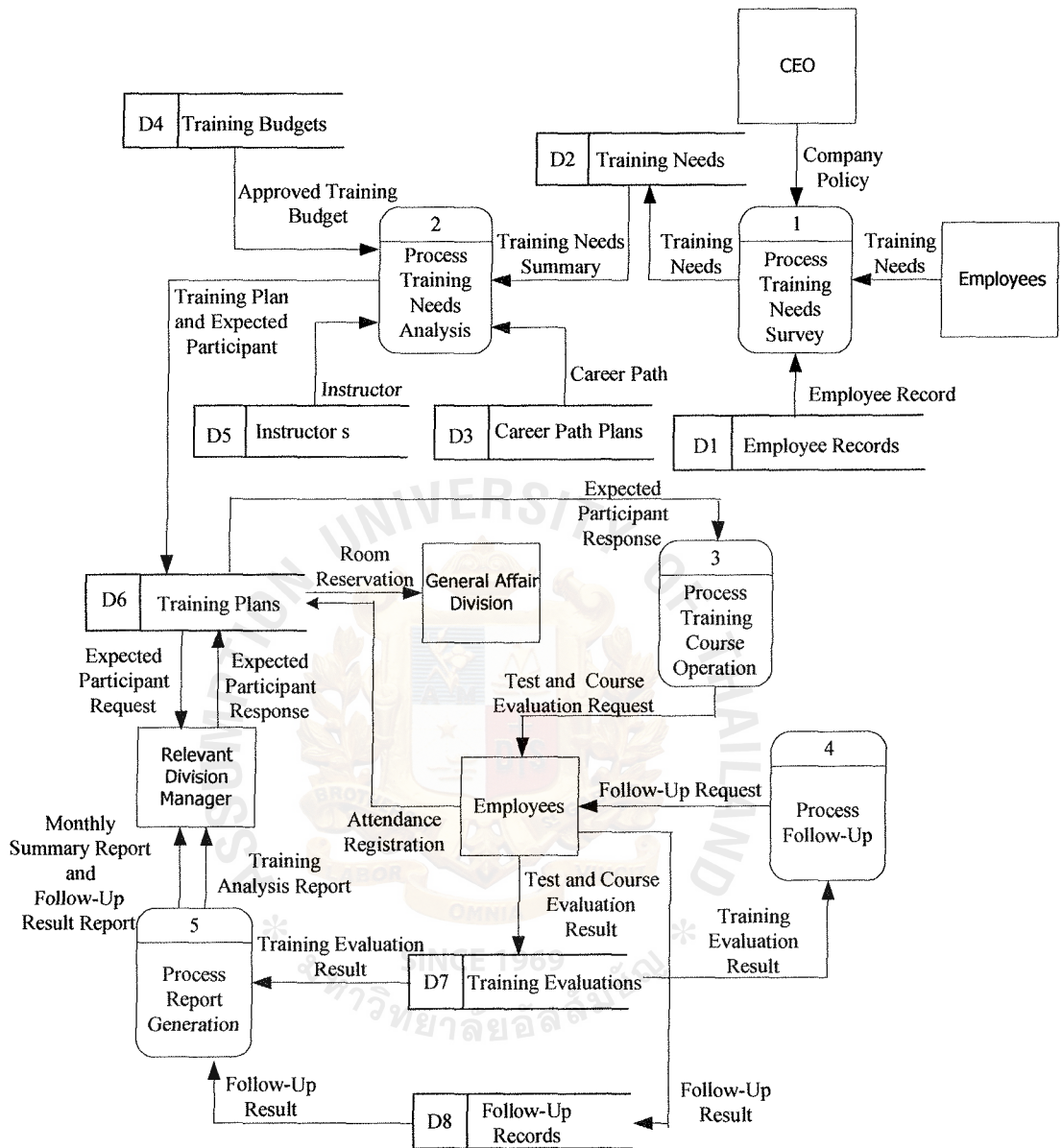
Figure 3.3.   Data Flow Diagram of the Proposed System.

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3.4   System Design

The previous requirement analysis section primarily focuses on the logical aspects of a system, whereas the system design deals with the physical implementation aspects of a system. Various design techniques are applied to construct the system to accomplish the objectives of the project. The details of each design technique can be explained as follows:

Candidate Solutions

Given the business requirement established in the previous section, the alternative candidate solutions can be identified from the idea and opinion of the development team and users. Along with reviewing the system specification, the three candidate solutions can be defined for the proposed system.

(1)   Candidate 1: Two Tier Client/Server – Web Database

Microsoft ASP.Net and Microsoft SQL Server 2000 are used in this candidate to develop web-based application, because Microsoft.Net technology is the trend for the future development and .NET technology still supports the variety database and languages. The network architecture for this solution is Two Tier Client/Server Computing. The database server serves not only as the system database, but also as the web server for the developed program. Thus, this kind of architecture is called Corporate Intranet.

This candidate can be implemented very quickly because it requires only a web browser to run the developed application. No additional software is installed in the client PCs. ASP.Net is the best solution in developing application, and Internet Information System (IIS) 6.0 serves as a web server to respond to any requests from client PCs.

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(2)   Candidate 2: Resource Sharing LAN – File Server

Microsoft Visual Basic 6.0 is a very popular development tool, because of its Rapid Application Development (RAD) environment. The existing programmer can use it without any technical assistance. As a visual style of Microsoft product, it facilitates the programmer to develop the new application quickly. For network architecture, the file server is used in this candidate to store the database, and the client PCs executes all database instructions. This means that the entire database and tables may have to be transported to and from the client across the network. The database software, Microsoft Access 97, is used to manage data in the system.

This candidate is easy to implement because Microsoft Visual Basic 6.0 is available for the programmer to use, and the current network architecture, Local Area Network (LAN), also supports this kind of configuration. Thus, it takes less time to design and implement this candidate in the current environment.

(3)   Candidate 3: Two Tier Client/Server Computing – Database Server

Develop 2000 and Personal Oracle 8 are used as Development Tool and Database Software respectively. This solution supports the multi-user environment and relational database technology. Database Server is used to follow the concept of two-tier Client/Server Computing.

Because the existing programmers have a little experience about oracle product, the training course is required to guide them in developing the new application with a powerful database server. However, this candidate provides the best way of developing the new system by introducing the effective development tool and database software.

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Table 3.2 illustrates the candidate system matrix of the proposed system, which explores the characteristics of each candidate in more details.

Table 3.2. Candidate Systems Matrix.

Characteristics	Candidate 1	Candidate 2	Candidate 3
Portion of System Computerized Brief description of the portions of the system that would be computerized in this candidate.	Support training information system processes	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 processes. Plus more efficient interaction with training system.	Easy to develop with the existing tool.	Powerful DBMS and application enable user performing their tasks more efficiently and effectively.
Servers and Workstations A description of the servers and workstations needed to support this candidate.	Pentium 4 2.8 GHz. MS Windows 2000 servers	Same as candidate 1.	Same as candidate 1.
Software Tools Needed Software tools needed to design and build the candidate (e.g., database management system, emulators, operating system, languages etc.) Not generally applicable if applications software package are to be purchased.	MS ASP.Net MS Internet Information System 6.0 MS.NET Framework MS SQL Server 2000	MS Visual Basic 6.0 MS Access 97	Developer 2000 Personal Oracle 8.0
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 and real-time.	Client/Server	Same as candidate 1.	Oracle uses a two-tier Client/Server architecture with a powerful database server.
Output Devices and Implications A description of output devices that would be used, special output requirements (e.g. network, preprinted form, etc.) and output considerations (e.g., timing constraints).	Display Monitor HP Laser Printer 3300	Same as candidate 1.	Same as candidate 1.
Input Devices and Implications A description of input devices 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.	Same as candidate 1.	Same as candidate 1.
Storage Devices and Implications Brief description of what data would be stored, what data would be accessed from existing stored, what storage media would be used, how much storage capacity would be needed, and how data would be organized.	MS SQL Server DBMS with 80 GB storage capacity.	File Server with 40 GB storage capacity.	Oracle SQL Server DBMS with 50 GB storage capacity.

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Feasibility Analysis

      After the candidate solutions are identified, the feasibility analysis can be done for each candidate. The following feasibility criteria should be taken into consideration when the development team wants to select the best solution to implement the production environment.

    (1)   Operational feasibility

        It is a measure of how well the solution of problems or a specific solution will work in the organization. It is also a measure of how people feel about the system/project. All candidates are fully supporting the current business process but candidate 1 and 2 are the most feasible because they can be implemented very quickly and they can support the full functional user requirements.

    (2)   Technical feasibility

        It is a measure of the practicality of a specific technical solution and the availability of technical resources and expertise. Candidate 3 is the most difficult to implement because the current traders have no experience about the trading solution package. Whereas candidate 1 and 2 are easy to design and implement because the current programmers have a similar experience with Microsoft product tools.

    (3)   Economics feasibility

        It is a measure of the cost-effectiveness of a project or solution. Candidate 3 is the most expensive solution because it is a solution package from the famous vendor. In contrast, candidate 1 and 2 require only a standard hardware for implementation, and to operate the developed system requires only a database administrator.

(4)   Schedule feasibility

It is a measurement of how reasonable the project timetable is. Candidate 3 takes the least time to implement because it is a purchased solution package. The package has the template that can continue to be developed in the short time to fulfill the user requirements. Conversely, candidate 1 and 2 consume the most time to design and implement the proposed system because the development processes started at survey of the existing system, then collected the user requirements and wrote the proposal for the proposed system to meet the business requirements. And in the design process, despite of the development tool, MS Visual Basic 6.0 or ASP.Net, are the standard tools to develop application in today's business. But they need time to develop and test the application to correct the error before implementing the system.

Up to this point, all four feasibility criteria assessments are provided for each candidate solutions. The score is then assigned to each feasibility criteria for each candidate, and multiplied by the weight, which is expressed in percentage, distributed from the total 100% to all four feasibility criteria according to their degree of importance. The weight scores of each feasibility criteria are summed up for each candidate to rank the candidate solution of the proposed system.

The feasibility analysis result reveals that Candidate 1 has the highest scores in terms of operational, technical and economic feasibility except in schedule feasibility, which is the highest score by Candidate 3. Thus, Candidate 1 has the highest total score, and ranks as the best solution for the proposed system.

Table 3.3 shows the completed feasibility analysis matrix for each candidate. In addition, the full details of cost-benefit calculations (Economic Feasibility) are shown in

Appendix C, which are all candidates' Cost table, Payback table and Graph, and Net Present Value (NPV) table.

Table 3.3. Feasibility Analysis Matrix.

Feasibility Criteria	Wt.	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. Practical. A description of how well received this solution would be by user management, user, and organization perspective.	30%	Fully supports the user requirements in terms of functionality and business process. Score: 95	Same as candidate 1. Score: 90	Same as Candidate 1. Score: 90
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.	25%	MS SQL Server is the simplest way to develop database, and Internet Explorer is available in all PCs. ASP.Net is a newest technology in developing Intranet application with Microsoft product. Score: 90	Current technical staff has MS Visual Basic experience, and the development process can be done easily and smoothly. MS Visual Basic is a mature technology based on version number. Score : 75	Although current technical staff has a little experience with oracle product, the management fully supports training and using oracle product. Oracle is a company standard and requires the continuous training course for operating and maintaining the system. Score: 75
Economic Feasibility Cost to develop: Payback period: Net Present Value: Detailed calculations:	35%	Approximately 886,500 Baht. Approximately 2.7 Years Approximately 851,183 Baht See Appendix C Score: 90	Approximately 916,500 Baht Approximately 3.5 Years Approximately 525,028 Baht See Appendix C Score: 80	Approximately 1,161,500 Baht Approximately 3.3 Years Approximately 566,478 Baht See Appendix C Score: 65
Schedule Feasibility An assessment of how long the solution will take to design and implement.	10%	Approximately 4 months Score: 95	Approximately 4 months Score: 95	Approximately 3 months Score: 95
Ranking	100%	92	81	78

Structure Design

To facilitate the development of the computerized system, structure design technique is used to break up the program into a hierarchy of modules that results in a program that is easier to implement and maintain.

Data Flow Diagram (DFD) from requirement analysis section is used as input of structure design. The logical DFD, which depicts the business requirement of the proposed system, is converted to Program DFD, which illustrates the technical aspects of the proposed system. The output of structure design is partitioned data flow diagram and structure chart, which is illustrated in Appendix D.

Process Specification

The objective of a process specification is to define what the system does to transform inputs into outputs. It provides the details of system processes in table format, which is easier to look at the related input, output, and relevant process than in a diagram. All specified tables, which are the process from the logical data flow diagram, are shown in Appendix E.

Data Dictionary

To support system design, data dictionary provides a list of terms and definition for all data items and data stores within the developed system. The data dictionary for both entity relationship diagram and data flow diagram is shown in Appendix F.

Database Design

Referring to the data model (ERD) in the previous section, it requires some additional processes called data analysis to convert the designed logical data model into an implemented database. In data analysis, a normalization technique is used to transform all data in ERD into an applicable database. The result of database design is database structure in table format, which is shown in Appendix G.

Input Design

To design system input, it requires the information from data flow diagram. These system inputs are represented as the data flows that connect external entities to process, and process to process. The selected attributes are reviewed to define the appropriate caption or label that clearly identifies these attributes appearing on the input screen. Input control is applied to ensure that the data input to the computer is accurate and that the system is protected against accidental and intentional errors and abuse, including fraud.

After reviewing input requirement, the training needs form screen is designed to accept the training needs data entry from the employee. The other input screens, which are expected participant response, attendance registration, follow-up are also designed to serve the training tasks for the training officer and relevant divisions.

The input screens of the proposed system are shown in the Appendix H.

Output Design

Like system input, output requirements also come from data flow diagram. These system outputs are easily identified and examined through the data flows that are connected to external entities. More details of output design can be gathered from interviewing the system users about their output requirements.

As shown on data flow diagram of the proposed system, there are three reports that are designed to support participants, relevant division managers and CEO. Those reports are Monthly Training Report, Follow-Up Report, Training Analysis Report. The example of report design is shown in the Appendix I.

3.5 Hardware and Software Requirement

Referring to the current operation, the training team has two stand-alone PCs, which do not connect to any server. To implement the purposed system, it requires the new hardware to be the database server and one more backup server that can use the existing server located at the Information Technology Department. The new server should have hardware specification, which can run Microsoft SQL Server 2000 and Microsoft Internet Information System 6.0 because it can be easy to install. The hardware and software specifications for database server are shown in Tables 3.4 and 3.5 respectively.

Table 3.4. Database Server Specification.

Device	Specification
Processor Type and Speed	Intel Pentium 4 2.8 GHz or higher
Primary Memory	256 MB DDR PC3200
Hard Drive Capacity	100 GB SCSI Interface
DVD-ROM Drive	16x
Floppy Drive	3.5" 1.44 MB
Display Graphic Card	32 MB DDR SDRAM AGP 4x
Display Monitor	0.25 dot pitch CRT 17"
Network Interface Card	10/100 Mbps
UPS	500 VA Power Line

Table 3.5. Server Software Specification.

Software	Specification
Operating System	Microsoft Windows 2000 Server (Service Pack 2)
Web Server	Microsoft Internet Information System 6.0
Application Server	Microsoft Active Server Pages
Database Server	Microsoft SQL Server 2000

With Intranet technology, the existing two personal computers(PCs) can be used as client machine without upgrading hardware capacity and two more PCs are added. The client machine requires only a web browser, such as Microsoft Internet Explorer, to run the developed application and some application programs, such as word processing and spreadsheet, to perform the general function. The hardware and software specifications for each client machine are shown in the Table 3.6 and 3.7 respectively.

Table 3.6. Client Machine Specification.

Device	Specification
Processor Type and Speed	Intel Pentium 4 2.4 GHz or higher
Primary Memory	128 MB DDR PC2700
Hard Drive Capacity	60 GB ATA 133
CD-ROM Drive	52x
Floppy Drive	3.5" 1.44 MB
Display Graphic Card	32 MB DDR SDRAM AGP 4x
Display Monitor	0.25 dot pitch SVGA 15"
Network Interface Card	10/100 Mbps

Table 3.7. Client Software Specification.

Software	Specification
Operating System	Microsoft Windows 2000
Web Browser	Microsoft Internet Explorer 6.0
Application Software	Microsoft Office 2000 Professional Edition

In addition, the connection between database server and client machine can be established through the existing LAN with some little configurations. Thus, there are no more investments in network peripheral. The network peripheral specification of the proposed system is shown in Table 3.8.

Table 3.8. Network Peripheral Specification.

Network Peripheral	Specification
Network Topology	Star topology
Switch	100BaseT Switch 8 ports
Network Interface Card	10/100 Mbps
Wiring and Cable	UTP 4 pairs CAT 5

Moreover, the network configuration of the proposed system is the Intranet technology. The user can use a common interface to access application and information. Intranet application can be easily developed with the widely used development tool. The users do not need to install the developed software on client because they can use the web browser software to execute the developed application stored on the database server. The network architecture of the proposed system is shown in Figure 3.4.
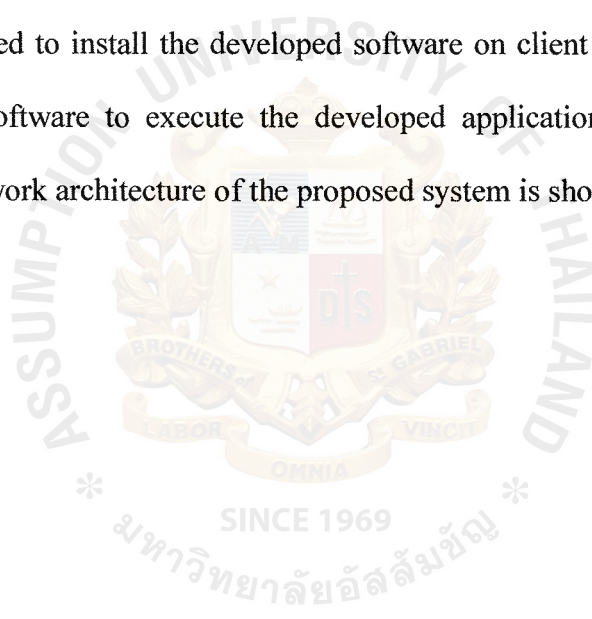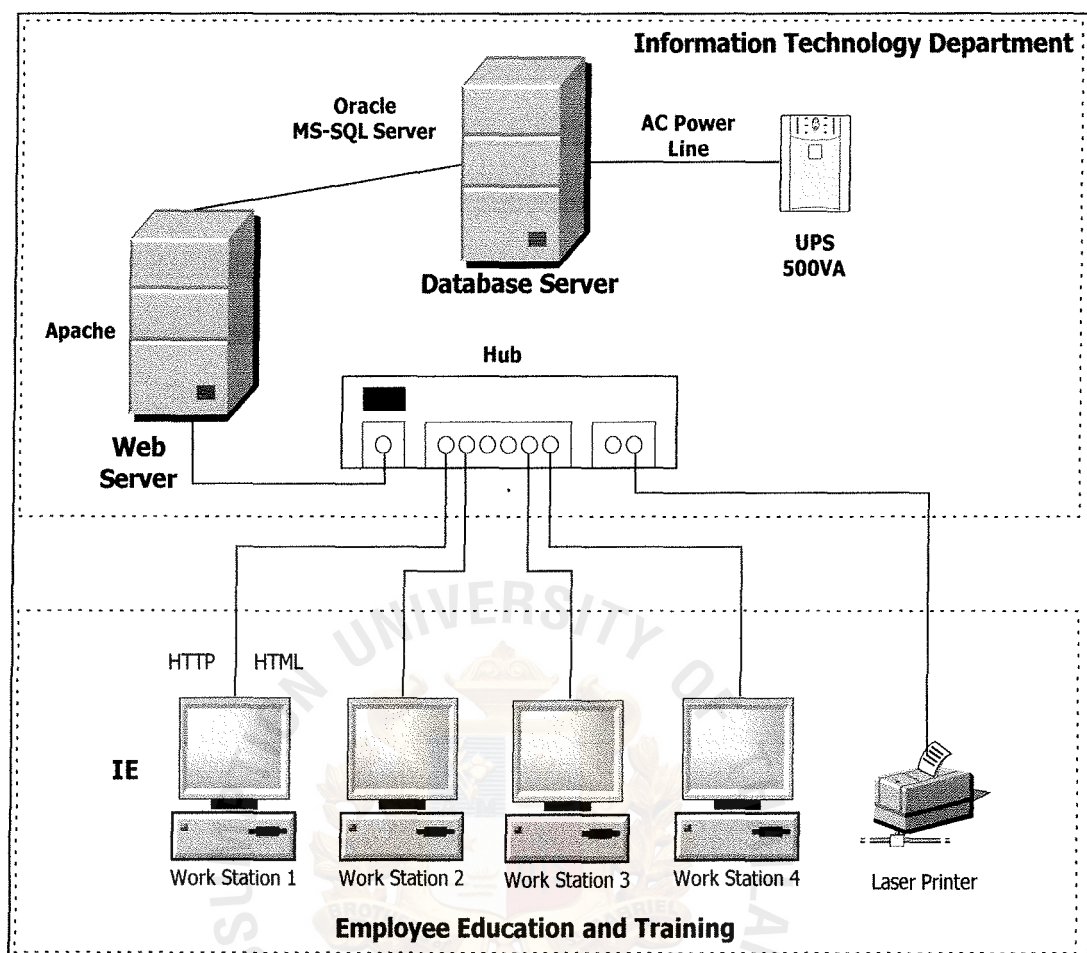
Figure 3.4.   Network Configuration of the Proposed System.

3.6   Security and Controls

According to information technology security policy of the bank, the following minimum requirement of security standard must be applied to every computerized system to prevent unauthorized access and alteration to the system.

(1)   Identification

The system must have the unique User ID and Administrative System ID. The procedure to control the creating of User ID must be set up to ensure the proper verification over the system users. The user responsibility to the system must be specified in advance before granting authorized level

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to each user. Every User ID must have an owner and can prove their existence. User ID must not be shared among users. Administrative System ID must be carefully assigned to the responsible person for managing all Users ID of the system. System log is required to keep track of all changes made to the system.

(2)   Authentication

The password is required to authenticate the assigned user. The system/security parameter of password feature must be carefully configured to ensure the password is properly defined and monitored. The characteristics of good password feature are the specification of minimum range of password (normally 6-8 lengths), non-displaying password on system screen, forces user to change password automatically when the password is expired in specified duration, and locks User ID when entering wrong password more than specified time. The users must keep their password secretly to prevent unauthorized persons to use their password to enter the system and cause any unauthorized alteration to the system.

(3)   Authorization

The authorized level of each user must be carefully assigned to limit the area of accessing to the system information because of the sensitivity of data and software. The user authorization should be updated when the users change their responsibility or are deleted from the system when the users resign. These user authorizations have to be reviewed every 3 months to ensure that the users have the appropriate authorization in the system.

(4)   Auditing

The system must have audit trail to investigate the system in case of unauthorized access and alteration to the system. The audit trail may be in the form of system log to monitor the changes to the system and the access violation. This log file has to be reviewed by the assigned person on a consistent basis.

(5)   Operation Environment

The system must separate the development area and the operation area when developing the new application program. This practice ensures the proper control over the unauthorized modification of the developed program in the operation area because any new or modified programs must be tested in the development area before migrating into the operation area.

(6)   Backup and Recovery

The backup and recovery procedures are required to ensure the availability of system information. The backup may be done on a daily, weekly or monthly basis, according to backup schedule. The recovery process must be cleared to ensure that all relevant persons know how to restore information from backup media into the recovered system.

3.7   Cost and Benefit Analysis

When the proposed system is developed to replace the existing system, the details of both cost and benefit of the new system compared with the old system must be illustrated. Therefore, the tables and figures of cost information are constructed to provide clear picture of the comparison of both systems costs. Furthermore, the benefits of the new system are presented in both tangible and intangible terms. Finally, the

analysis techniques, which are break-even analysis and payback period, are applied to show the benefits over the cost after the implementation of the proposed system.

(1) Cost of the manual system

The manual system is operated manually, and incurs both fixed cost and annual operating cost. For fixed cost, there are hardware cost, application software cost and hardware maintenance cost. And for annual operating cost, it includes office supplies & miscellaneous expenses and salary cost.

The office equipment that the trader officers use in their operation are one laser printer for printing training needs summary report, monthly training plan and quota, monthly training summary report and four personal computers to keep training transaction information.

The training team that operates the manual system includes:

(a) One division manager to manage and control training management system, including training needs, training budget and follow-up.

(b) One training supervisor to control and prepare monthly training plan and participants quota which must be followed yearly by the plan of yearly training needs and participants.

(c) Two training officers to prepare the training course, including participants and instructor confirmation, training room and coffee break reservation, course pre-test and post-test and follow-up.

However, the nature of manual system produces much paperwork, and it causes the paper cost to be very high when compared with the computerized system.

The details of the existing system cost are summarized in Table 3.9.

Table 3.9. Cost of the Existing System, Baht.

Cost Items		Years				
		1	2	3	4	5
Fixed Cost:						
Hardware Cost:						
Laser Printer	1 unit @ 26,500	5,300	5,300	5,300	5,300	5,300
Client Computer	2 units @ 45,000	18,000	18,000	18,000	18,000	18,000
Total Hardware Cost		23,300	23,300	23,300	23,300	23,300
Software Cost:						
Client Software	2 units @ 10,000	4,000	4,000	4,000	4,000	4,000
Total Software Cost		4,000	4,000	4,000	4,000	4,000
Implementation Cost:						
Installation Cost		8,000	0	0	0	0
Total Implementation Cost		8,000	0	0	0	0
Total Fixed Cost		35,300	27,300	27,300	27,300	27,300
Operating Cost:						
Office Supplies & Miscellaneous Cost:						
Stationary	30,000 Per Annum	30,000	31,500	33,075	34,729	36,465
Paper	40,000 Per Annum	40,000	42,000	44,100	46,305	48,620
Utility	30,000 Per Annum	30,000	31,500	33,075	34,729	36,465
Miscellaneous	60,000 Per Annum	60,000	63,000	66,150	69,458	72,930
Total Annual Office Supplies & Miscellaneous Cost		160,000	168,000	176,400	185,220	194,481
Salary Cost:						
Division Manager	1 person @ 45,000/month	540,000	567,000	595,350	625,118	656,373
Training Supervisor	1 person @ 25,000/month	300,000	315,000	330,750	347,288	364,652
Training Staff	3 persons @ 15,000/month	540,000	567,000	595,350	625,118	656,373
Training Supervisor Over Time Cost	1 person @ 8,000/month	96,000	100,800	105,840	111,132	116,689
Training Staff Over Time Cost	3 persons @ 5,000/month	180,000	189,000	198,450	208,373	218,791
Total Annual Salary Cost		1,656,000	1,738,800	1,825,740	1,917,027	2,012,878
Maintenance Cost:						
Hardware Maintenance		5,000	5,250	5,513	5,788	6,078
Total Annual Operating Cost		1,821,000	1,912,050	2,007,653	2,108,035	2,213,437
Total Manual System Cost		1,856,300	1,939,350	2,034,953	2,135,335	2,240,737

Table 3.10. Five Years' Accumulated Existing System Cost, Baht.

Year	Total Existing System Cost	Accumulated Existing System Cost
1	1,856,300	1,856,300
2	1,939,350	3,795,650
3	2,034,953	5,830,603
4	2,135,335	7,965,938
5	2,240,737	10,206,675
Total	10,206,675	-

(2)   Cost of the proposed system

The proposed system cost is also classified into fixed cost and annual operating cost. Fixed cost includes hardware cost, software cost, people-ware cost (only the salary cost of specialized persons who are involved in developing the new system), and implementation cost, whereas annual operating cost has the same cost categories as incurred in the manual system cost.

With the newly computerized system, it requires the investment in computer hardware and software. The additional salary cost is paid to the people who are involved in the system development process. Before implementing the proposed system, the training and installation costs are spent according to the project budget.

The new system reduces over time salary cost in the training operation that they can operate the system without heavy workload. An IT specialist is hired to maintain the database of portfolio management system who is the database administrator. He is responsible for maintaining and solving the developed system in case of any problems. The details of the proposed system cost are summarized in Table 3.11.

Table 3.11. Estimated Cost of the Proposed System, Baht.

Cost Items		Years				
		1	2	3	4	5
Fixed Cost:						
Hardware Cost:						
Server	1 unit @ 60,000	12,000	12,000	12,000	12,000	12,000
Client Computer	4 unit @ 45,000	36,000	36,000	36,000	36,000	36,000
Laser Printer	1 unit @ 26,500	5,300	5,300	5,300	5,300	5,300
UPS	1 unit @ 5,000	1,000	1,000	1,000	1,000	1,000
Total Hardware Cost		54,300	54,300	54,300	54,300	54,300
Software Cost:						
Server Software	1 unit @ 30,000	6,000	6,000	6,000	6,000	6,000
Client Software	4 unit @ 10,000	8,000	8,000	8,000	8,000	8,000
Total Software Cost		14,000	14,000	14,000	14,000	14,000
People-Ware Cost:						
System Analyst	1 Person @ 4 mth @ 60,000	240,000	-	-	-	-
Programmer	3 Person @ 4 mth @ 25,000	200,000	-	-	-	-
Database Specialist	1 Person @ 1 mth @ 25,000	75,000	-	-	-	-
Network Specialist	1 Person @ 1 mth @ 20,000	40,000	-	-	-	-
Total People-Ware Cost		555,000	-	-	-	-
Implementation Cost:						
Training Cost		60,000	-	-	-	-
Installation Cost		40,000	-	-	-	-
Total Implementation Cost		100,000	-	-	-	-
Total Fixed Cost		723,300	68,300	68,300	68,300	68,300
Operating Cost:						
People-Ware Cost:						
Division Manager	1 person @ 45,000/month	540,000	567,000	595,350	625,118	656,373
Training Staff	2 persons @ 15,000/month	360,000	378,000	396,900	416,745	437,582
Database Admin.	1 person @ 25,000/month	300,000	315,000	330,750	347,288	364,652
Total Annual People-Ware Cost		1,200,000	1,260,000	1,323,000	1,389,150	1,458,608
Office Supplies & Miscellaneous Cost:						
Stationary	10,000 Per Annum	10,000	10,500	11,025	11,576	12,155
Paper	5,000 Per Annum	5,000	5,250	5,513	5,788	6,078
Utility	15,000 Per Annum	15,000	15,750	16,538	17,364	18,233
Miscellaneous	30,000 Per Annum	30,000	31,500	33,075	34,729	36,465
Total Annual Office Supplies & Miscellaneous Cost		60,000	63,000	66,150	69,458	72,930

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Table 3.11. Estimated Cost of Proposed System, Baht (Continued).

Cost Items	Years				
	1	2	3	4	5
Maintenance Cost:					
Server Maintenance Cost	-	5,000	5,000	5,000	5,000
Clients Maintenance Cost	-	3,000	3,000	3,000	3,000
Total Maintenance Cost	-	8,000	8,000	8,000	8,000
Total Operating Cost	1,260,000	1,331,000	1,397,150	1,466,608	1,539,538
Total Proposed System Costs	1,983,300	1,399,300	1,465,450	1,534,908	1,607,838

Table 3.12. Five Years' Accumulated Proposed Cost, Baht.

Year	Total Proposed Cost	Accumulated Proposed Cost
1	1,983,300	1,983,300
2	1,399,300	3,382,600
3	1,465,450	4,848,050
4	1,534,908	6,382,958
5	1,607,838	7,990,795
Total	7,990,795	-

(3) Comparison of system cost

After both the manual system cost and proposed system cost are identified, the comparison table is constructed to reveal the cost saving after implementing the proposed system. The figures of the comparison of the system cost are summarized in Table 3.13.

Table 3.13. The Comparison of the Accumulated Existing Cost and Accumulated Proposed Costs, Baht.

Year	Accumulated Existing Cost	Accumulated Proposed Cost
1	1,856,300	1,983,300
2	3,795,650	3,382,600
3	5,830,603	4,848,050
4	7,965,938	6,382,958
5	10,206,675	7,990,795

(4)   Benefit analysis

The benefits of the proposed system can be classified into tangible and intangible benefits. The tangible benefit can be expressed in monetary values, whereas the intangible benefit is qualitative, and is therefore difficult to measure. The details of these benefits can be summarized as follows:

Tangible Benefits

The tangible benefit of the proposed system is shown in Table 3.14, and grouped into three main categories as follows:

(a)   Cost saving

The proposed system introduces the new way in handling the training tasks. Over time operation is not necessary because the new system helps reducing the operation time consumption. The demand for paper and stationary is reduced because the training information will be stored in electronic form (web database). Thus, the proposed system saves the operating cost, which are salary cost, office supplies and miscellaneous expenses.

(b)   Operation time improvement

From the comparison of the total operation time between the existing system and the proposed system, it can be concluded that the new system can improve the operation time from 4 hours 30 minutes to 30 minutes. This operation time improvement relieves the training staff to perform other tasks. The full details of operation time comparison are presented in Chapter 5.

(c)   Elimination of the possible long-run cost

The proposed system provides the efficiency for training processes for training officer, relevant division managers and employees to track training information and their training status online. Therefore, the proposed system can eliminate the possible recruitment cost of the training staff in the future.

Table 3.14. Summarized Tangible Benefit of the Proposed System, Baht.

Benefits Items	Year 1	Year 2	Year 3	Year 4	Year 5
Salary Cost:					
1.Training Officer (1 person@15,000/m)	180,000	189,000	198,450	208,373	218,791
2. Training Supervisor (1 person@25,000/m)	300,000	315,000	330,750	347,288	364,652
3. Officer Over Time (3 person@5,000/m)	96,000	100,800	105,840	111,132	116,689
4. Supervisor Over Time (1 person@8,000/m)	180,000	189,000	198,450	208,373	218,791
Total Salary Cost	756,000	793,800	833,490	875,165	918,923
Office Supplies Cost:					
1. Stationary (1,667 Baht per month)	20,000	21,000	22,050	23,153	24,310
2. Paper (2,917 Baht per month)	35,000	36,750	38,588	40,517	42,543
3. Utility (1,250 Baht per month)	15,000	15,750	16,538	17,364	18,233
4. Miscellanouse (2,500 Baht per month)	30,000	31,500	33,075	34,729	36,465
Total Office Supplies & Miscellaneous Cost	100,000	105,000	110,250	115,763	121,551
Elimination of the Possible Long Run Cost					
1.Training Officer (1 person@15,000/m)	180,000	189,000	198,450	208,373	218,791
2. Training Supervisor (1 person@25,000/m)	300,000	315,000	330,750	347,288	364,652
3. Officer Over Time (3 person@5,000/m)	96,000	100,800	105,840	111,132	116,689
4. Supervisor Over Time (1 person@8,000/m)	180,000	189,000	198,450	208,373	218,791
Total Long Run Cost Elimation	756,000	793,800	833,490	875,165	918,923
Total Tangible Benefit	1,612,000	1,692,600	1,777,230	1,866,092	1,959,396

Intangible Benefit

The intangible benefits of the proposed system are the improvement of training processes for either training officer or employees. It is not only help reducing human errors but also improving for better decision making for management and employees' morale.

(5)   Break-even analysis

Break-even analysis shows the point where the accumulative cost of the existing system is equal to the accumulative cost of the proposed system. At the beginning, the cost of the proposed system is higher than the cost of the existing system. The difference comes from the development

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cost incurred at the first year of the new system implementation. But for the long term, the proposed system can reduce the annual operating cost, especially salary cost and office supplies cost.

The break-even point of the proposed system is depicted in Figure 3.5. The purposed system cost is less than the existing system cost in the second year. Thus, it can be concluded that the break-even point will occur approximately 1 year and 3 months after the system has been operated. This result is satisfactory for investing and implementing the proposed system because it will incur less operating cost than the existing system in the long run operation.

Accumulated Cost, baht
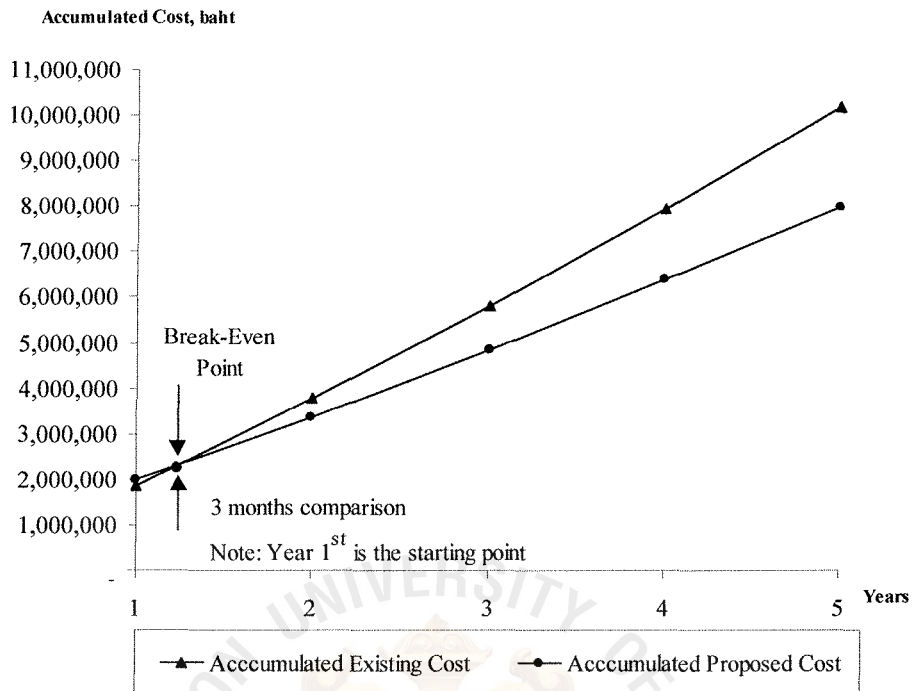
Figure 3.5.   Break-Even Point Analysis.

(6)   Payback period

Payback period is the commonly used technique to assess the value of investment. Generally, payback period is the period that cash flow can recover the initial investment within a specified period. To reflect the real value of money, the time value of money concept also applies in this analysis. The discount rate is required to calculate the discount value of all costs and benefits after the first year back to present value at the present year. If the payback period is performed without time adjusting the costs and benefits (time value of money), non-time-adjusted paybacks tend to over-optimistic and misleading.

After the lifetime cost and benefit are discounted, payback period can be computed. The acceptance of the project occurs only when the project's

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payback period is less than or equal to predefined payback period guideline, which is generally 3 years.

Figure 3.6 shows the payback period of the proposed system that has already been calculated to evaluate the candidate solution (See the full details of payback calculation in Table C.4 on Appendix C). The lifetime costs are gradually increasing over the five-year period because operating costs are being incurred. But it also can be noticed that the lifetime benefits are occurring at a much faster pace. The result of payback period is 2 years and 7 months, which is less than the predefined maximum desired payback period (3 years). Thus, this project is acceptable to implement with the return on investment to recover the initial investment within three years.
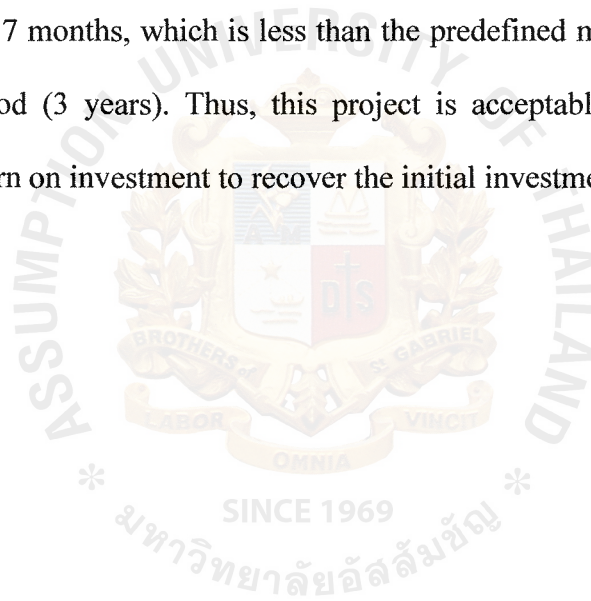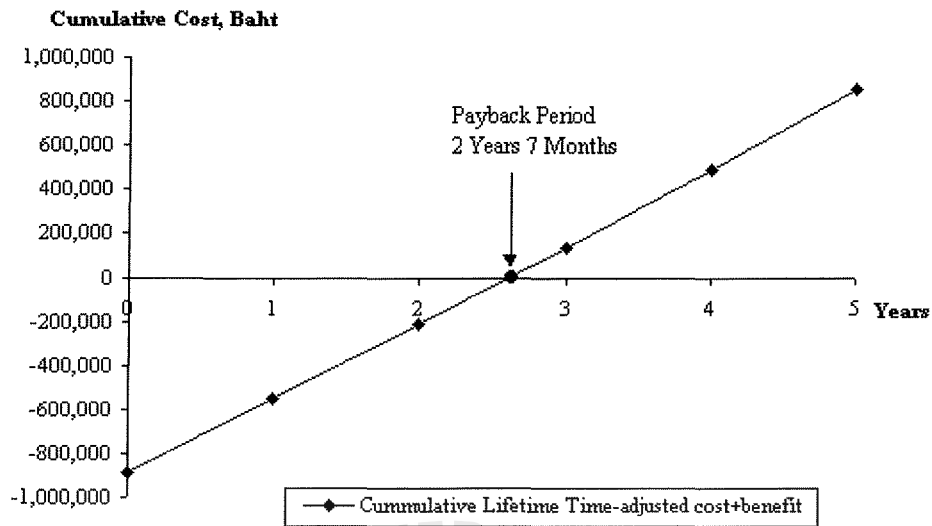
Figure 3.6.   Payback Period Analysis of the Proposed System.

(7)   Net Present Value (NPV)

Net Present Value (NPV) analysis is the discount cash flow approach for evaluating the most effective investment alternatives. The cash flow includes both cash inflow and cash outflow from the system implementation.

With this technique, the discount rate must be set for calculating the present value of all cash flows in the project. The discount rate is the required rate of return on investment that generally equals to interest rate that investment amount would be received if the investment is not made.

After all required parameters are collected, the calculation will be done. Then the calculation results will be used for ranking the investment alternatives. The project will be accepted only when its NPV is greater than

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zero. If all alternatives have the positive NPV, the decision will be based on the highest NPV, that alternatives will be selected.

For the proposed system, the required rate of return is 3.00% per annum. The analysis indicates that NPV values of all candidates are positive. But candidate 1 gives NPV of 851,183 Baht, which is the highest value among all alternatives. The detailed calculation of NPV analysis for each candidate is shown in Appendix C.

IV. PROJECT IMPLEMENTATION

4.1 Overview of Project Implementation

Based on the work performed in the previous chapter, the proposed system is ready to be implemented in the current operation. The typical processes of system implementation are presented in brief details as follows:

(1) Construction Stage

This stage aims to develop the information system that can fulfill the business objectives. After the system development is complete, testing needs to be done to ensure that it would operate properly. Prior to the system testing, the following tasks must be completed first hardware and software acquisition and installation, and site and data preparation.

(2) Delivery Stage

In the delivery stage, the objective is to make the system conversion to be as smooth as possible without any disruption to the existing system. It includes network configuration, training and conversion plan.

After the proposed system is launched in the current environment, users should evaluate the system performance in order to identify the difficulties that are discovered in the actual operation.

4.2 Stage of Project Implementation

From the overview of the project implementation section, the project implementation processes must be identified into more specific details. To simplify the implementation processes, the overall processes can be categorized into six main stages as follows:

(1)   Program Coding

As the proposed system is designed in a modular approach, this makes the programming easier for the programmer to develop the proposed system. It enables programmers to focus on the users' requirements in coding.

After program coding is complete, the next step is to design a graphic user interface for users to interact with the proposed system according to system design section.

(2)   Hardware and Software Acquisition and Installation

The company needs to acquire new hardware and software for the proposed system. The needed hardware are server and client workstations, because the old computers had low capacity to process the new application. Regarding software acquisition, the required server software are database server, web server and application server. For the client workstations, the required software is only application software.

For hardware and software installation, both need the technical support staff for installation.

(3)   Training

Training is provided to both end-user and system administrator. User training describes how to use the proposed system in their workspace. It enables the users to do some basic configurations and controls over their daily operations. For the system administration, training will focus on technical aspects of the proposed system. It describes how to configure and control the system, such as maintaining and creating new User ID and password.

(4)   Site and Data Preparation

The Computer Operation Department is responsible for preparing the site to implement the proposed system. LAN connection and other facilities should be ready before the developed system is implemented. However, the server and client machine need to be configured to ensure that it can support the operation of the proposed system.

The data preparation is the responsibility of the training officer, that is the system owner, which will prepare data to input into the proposed system.

(5)   System Testing

Test plan, test script and expected test result must be prepared to ensure that the proposed system is working properly. The development team will do stub test, unit test, system test and user acceptance test for the proposed system.

Stub test measures if the individual module can work correctly; while unit test evaluates the functions of the entire modules when they are integrated with each other. For system test, it is done to ensure that the application program written in isolation can work properly when integrated into the total system. If all testing results are satisfactory, the proposed system will be ready for conversion.

(6)   Conversion Plan

Before converting the old system to new system, the conversion plan must be prepared to serve as a guideline for the entire conversion process. The main objective of conversion plan is to ensure that the responsible

persons and tasks are clearly identified. This would help the conversion process to operate smoothly.

4.3 Training and Documentation

Before the new system is fully implemented, the training and documentation must be prepared for the system users. In addition, the document that may prove useful in developing the new system must be collected. The user manual must clearly identify how to use the proposed system in the work areas. In addition, all system features must be described for the system administrator to be able to configure it correctly. The training needs of system users must be reviewed, and the training session should be in-group to encourage group learning possibilities.

4.4 Conversion

This project selects the parallel conversion to convert the old system to the new system. Both the old and new systems will operate concurrently during the initial period for a specific time frame. This is done to ensure that all major problems in the new system have been discovered and solved before the old system is discarded. Once the time frame is reached, the existing system is then discarded and replaced by the proposed system.

4.5 System Support

When the proposed system has been placed into operation, the ongoing maintenance of the system needs to be done. There are four major areas of system support as follows:

(1) System Maintenance

The purpose of system maintenance is to fix any possible program errors that occur after the system is implemented. The system analyst and

programmer must coordinate to solve the program bugs and, sometimes, advise the users to fix the system troubles by themselves.

(2) System Recovery

As system failure is inevitable, it generally results in system crash and possible loss of data. Thus, a recovery plan must be specified to identify the roles and responsibilities of each unit in recovering the system.

(3) End-User Assistance

Although the training session has been conducted, users still need assistance in daily operation. It includes observing the system usage, conduct user satisfaction survey, change procedures, provide additional training, etc.

(4) System Enhancement

After the purposed system operates during some periods of times, it is necessary to evaluate its performance against a standard measurement of system capacity. The evaluation result will serve as the criteria in deciding to improve the system or not. This system evaluation and improvement may be done quarterly to guarantee that the system is still working in the current situation.

V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The project study indicates that the proposed system introduces a new way to handle and manage the training task. In the existing system, most information tasks are done manually. The results are human errors, slow response time to users, and high operation costs, especially salary costs. To improve the current operation, this project is proposed to solve the mentioned problems, and improve the normal operation. For the new system, the information technology is utilized to simplify the training task, and increase the efficiency.

The proposed system will improve the current operation in terms of both cost and time. It saves cost for the management who requires reducing department operating cost, and time for users in searching the required information. The benefit of cost and time saving can be proved by the work performed in the previous section: Cost and Benefit Analysis.

According to cost and benefit analysis section, the table and figure reveal the fact that the proposed system incurs less operating cost than the existing system. Some cost items that are incurred in the existing system cost can be eliminated and reduced, such as salary cost, office supplies and miscellaneous expenses, etc. In the cost comparison table, the cost of the manual system is less than the cost of the proposed system during the first two years because the proposed system incurs some development cost in the first year of its implementation. But the benefit will be explored and become clear after break-even point in the second year.

The proposed system will also spend less time to operate than the manual system. This fact is illustrated in the following additional table.

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

Process	Manual System	Proposed System
Training Needs Survey	16 Hrs	20 Minutes
Training Needs Analysis	24 Hrs	8 Hrs
Training Course Operation	8 Hrs	20 Minutes
Follow Up	8 Hrs	20 Minutes
Report Generation	16 Hrs	10 Minutes

The detail of this operation time improvement can be summarized as follows:

(1)   Training Needs Survey: The existing system spends 16 hours to survey training needs of the company employees. This long duration comes from waiting for the training needs survey result from the company employees. In contrast, the proposed system provides the graphical user interface to ease the training needs survey process through electronic form.

(2)   Training Needs Analysis: The existing system consumes 24 hours to analyze the training needs. The time is spent to search for the information of career path, training budget and instructor in order to analyze the training needs which are stored in MS Excel. The proposed system will provide the data stores which the information can be retrieved, searched and classified.

(3)   Training Course Operation: This process is also a time-consuming task to accomplish for the existing system. The training staff spend too much time in issuing training plan and expected participants for each course, distributing the training plan and waiting for participant response. The proposed system introduces online training plan and employee training status search in order to respond to the expected participants through web database.

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(4) Follow-Up: The long duration comes from waiting for the training follow-up survey result from the relevant division managers and employees. The proposed system provides the graphical user interface to ease the follow- up process of redemption data through electronic form.

(5) Report Generation: The manual system uses Microsoft Excel to prepare the report and distribute it to the related parties. It consumes too much time to finish the report because the training information must be arranged into predefined format, and the result must be checked with the raw data before printing the report. This process can be improved through the report generation feature embedded in the proposed system. The report can be selected and generated automatically according to user requirement.

5.2 Recommendations

At present information technology plays an important role in the global business. The business firms can gain the competitive advantage if they apply the information system in their business properly. This project is an example of applying information system into some parts of business processes. Furthermore, it also results in the cost reduction and benefit from the margin derived by the reduction of operating cost.

However, the proposed system needs continuous support from the development team for 6 months to 1 year in order to observe the actual performance, solve the unexpected problem or improve the system if necessary.

In addition, the developed system may be expanded to support the head office in Bangkok and Lardkrabang Factory. If the full training information systems are integrated and implemented, it will provide the full efficiency and effectiveness to manage the training of the overall company successfully. Furthermore, the developed system is also supported the distance learning or E-learning in the near future plan.

APPENDIX   A

ENTITY RELATIONSHIP DIAGRAM
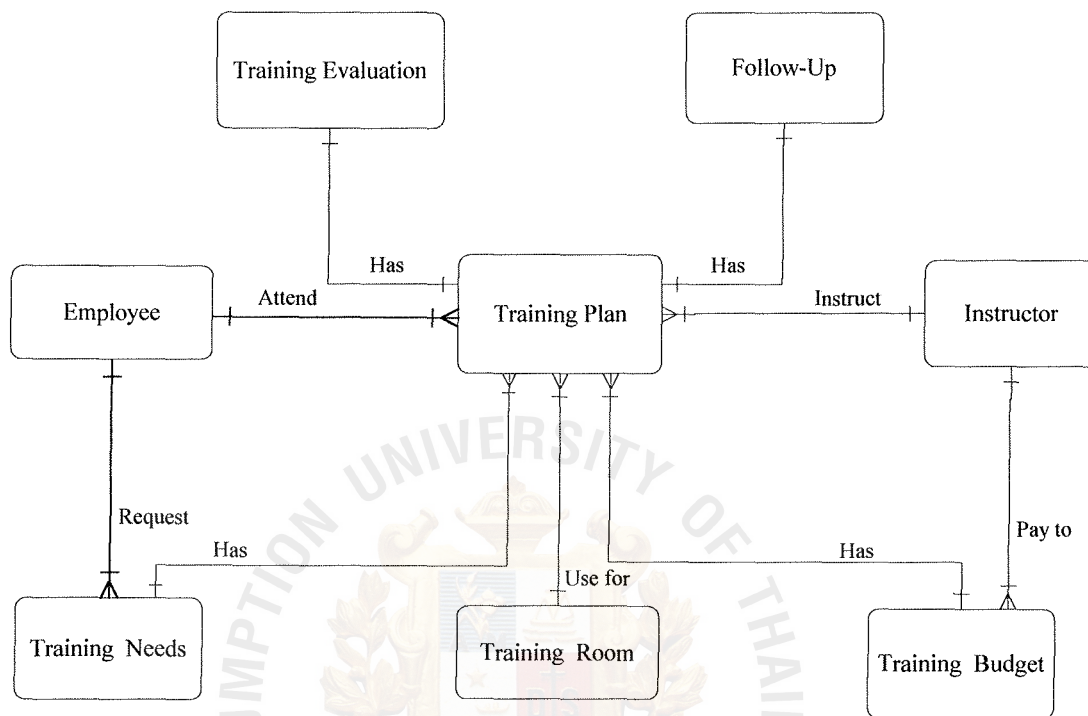
Figure A.1. Context Data Model of the Proposed System.

61
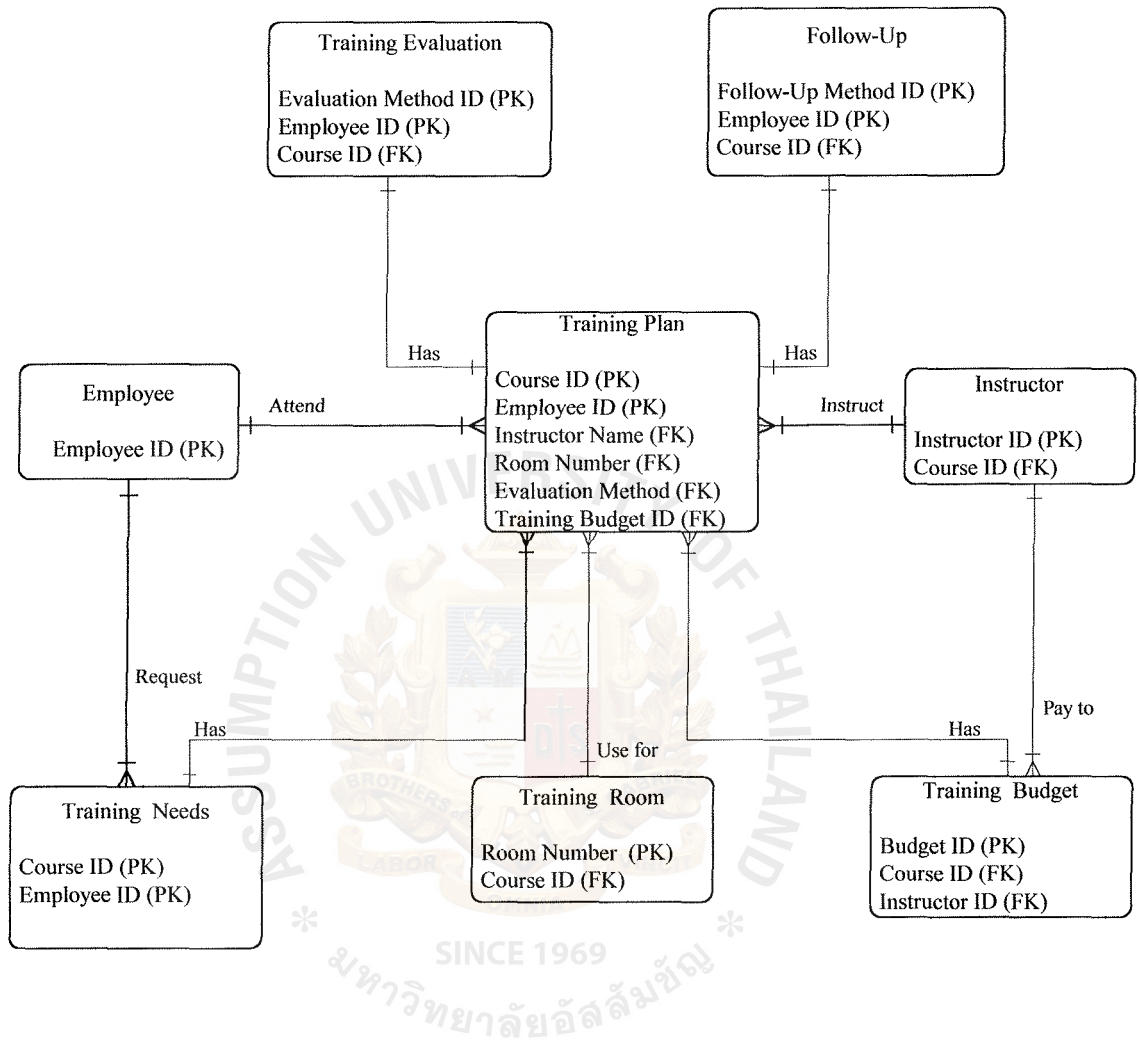
Figure A.2.   Key-Based Data Model of the Proposed System.

Training Evaluation

Evaluation Method ID (PK)
Course ID (FK)
Employee ID (FK)
Pre-test Result
Post-test Result
Course Evaluation Result

Follow-Up

Follow-Up Method ID (PK)
Course ID (FK)
Employee ID (FK)
Follow Up Result

Employee

Employee ID (PK)
Employee Name
Division
Section
Rank
Position
Employment Date
Education
Address
Phone Number

Training Plan

Course ID (PK)
Employee ID (PK)
Course Type
Course Name
Course Period
Instructor Name (FK)
Training Time
Room Number (FK)
Evaluation Method ID(FK)
Follow Up Method (FK)
Budget ID (FK)

Instructor

Instructor ID (PK)
Instructor Name
Institute Name
Work Experience
Address
Phone Number
Course ID (FK)

Has

Has

Attend

Instruct

Request

Has

Has

Pay to

Use for

Training Needs

Course ID (PK)
Employee ID (PK)
Course Type
Course Name
Course Period

Training Room

Room Number (PK)
Building Number
Course ID (FK)

Training Budget

Budget ID (PK)
Course ID (FK)
Instructor ID (FK)
Instructor Expense
Operation Expense
Total Expense

Figure A.3.   Fully Attributed Data Model of the Proposed System.

63
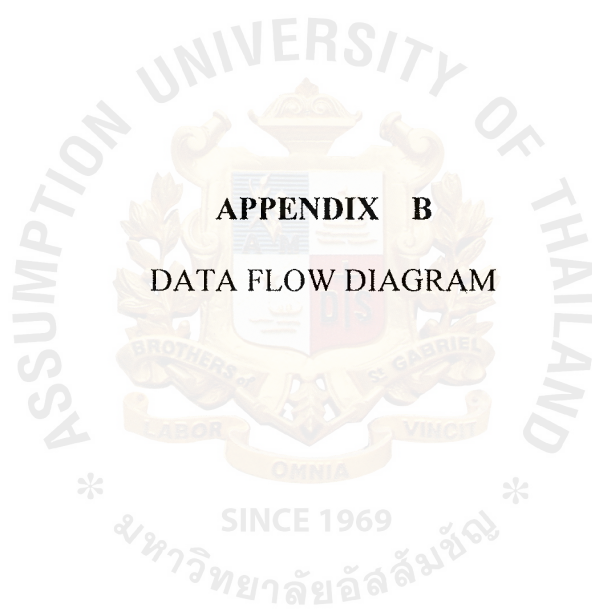
APPENDIX   B

DATA FLOW DIAGRAM
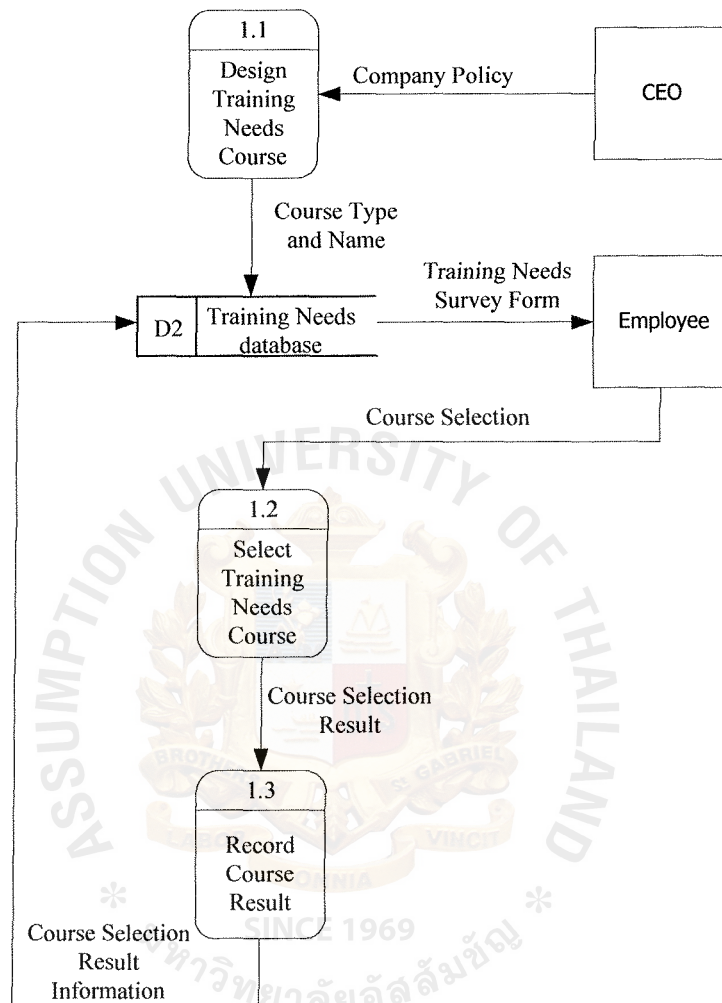
Figure B.1.   Data Flow Diagram of Training Needs Survey Process.
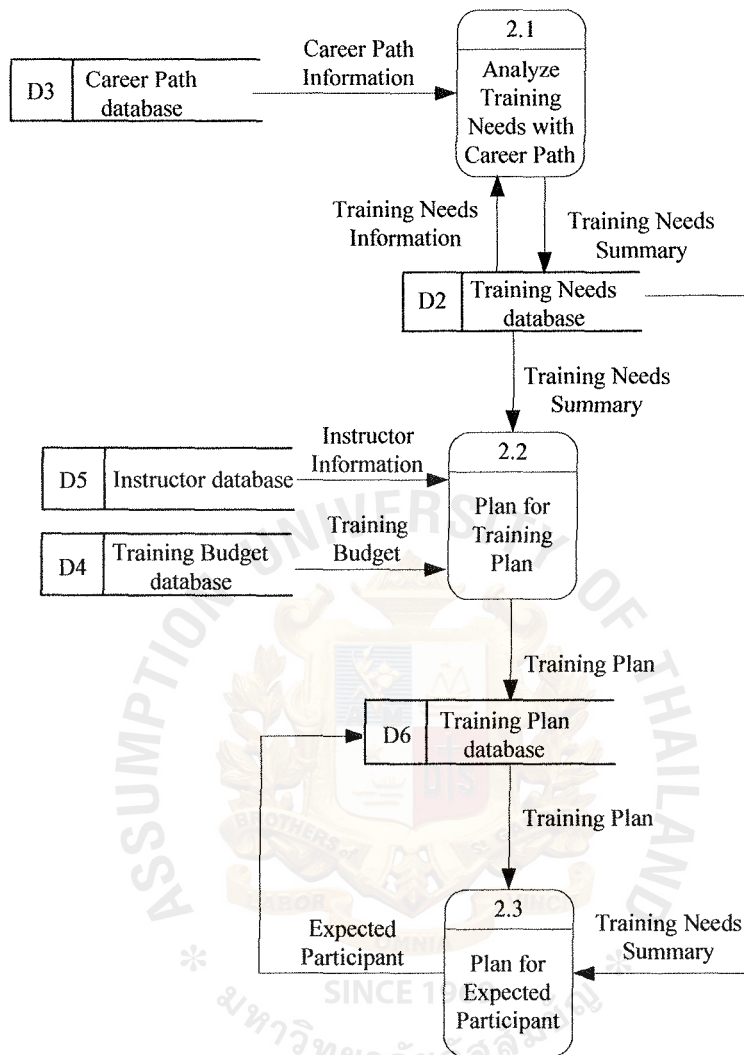
Figure B.2. Data Flow Diagram of Training Needs Analysis Process.
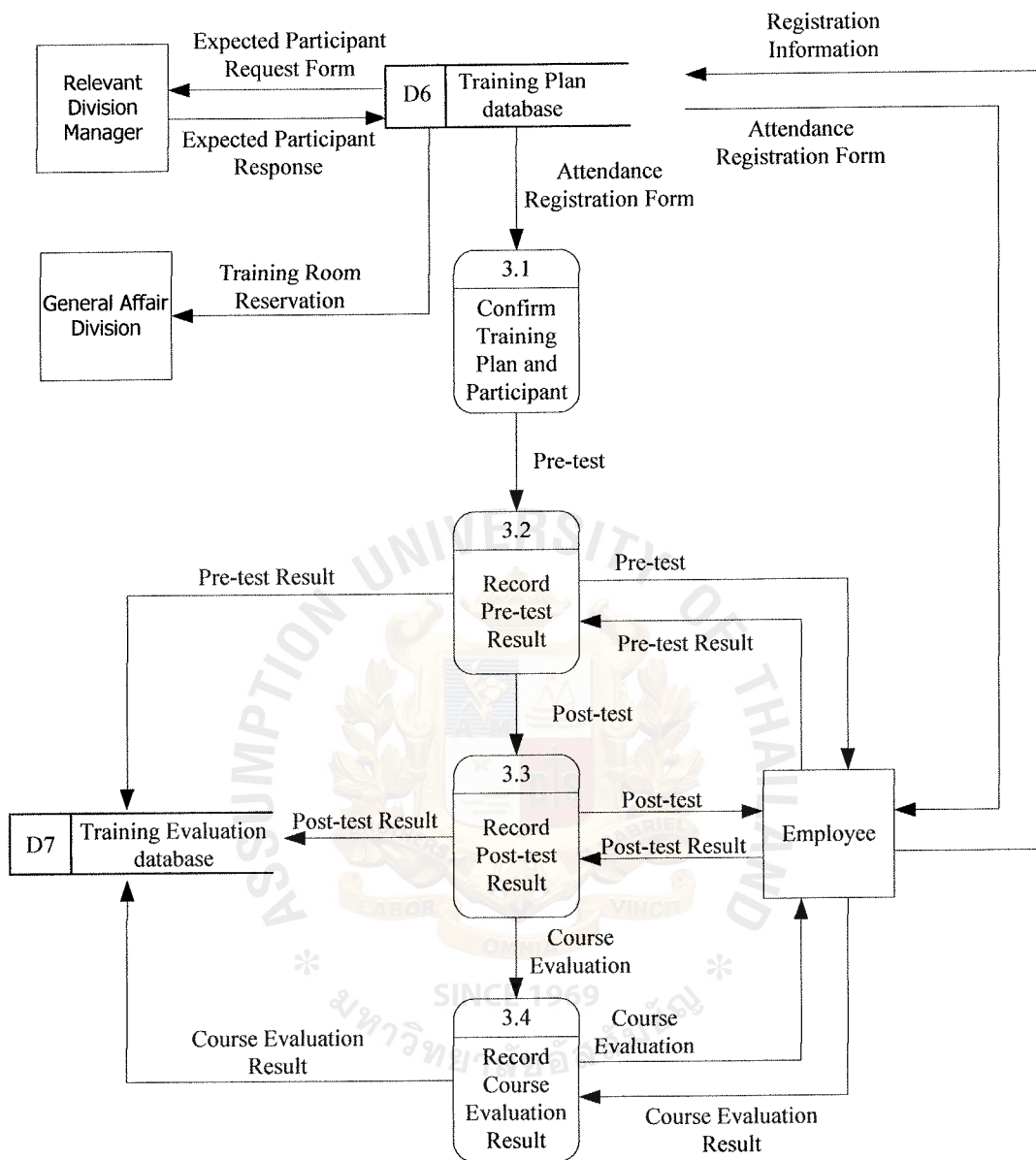
Figure B.3.   Data Flow Diagram of Training Course Operation Process.
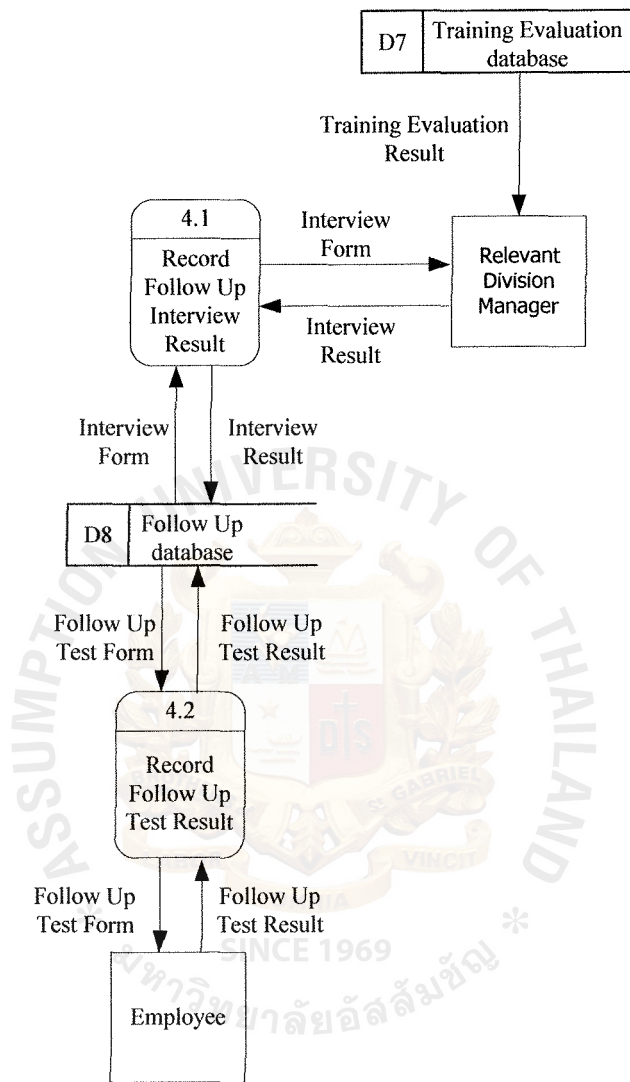
Figure B.4.   Data Flow Diagram of Follow Up Process.
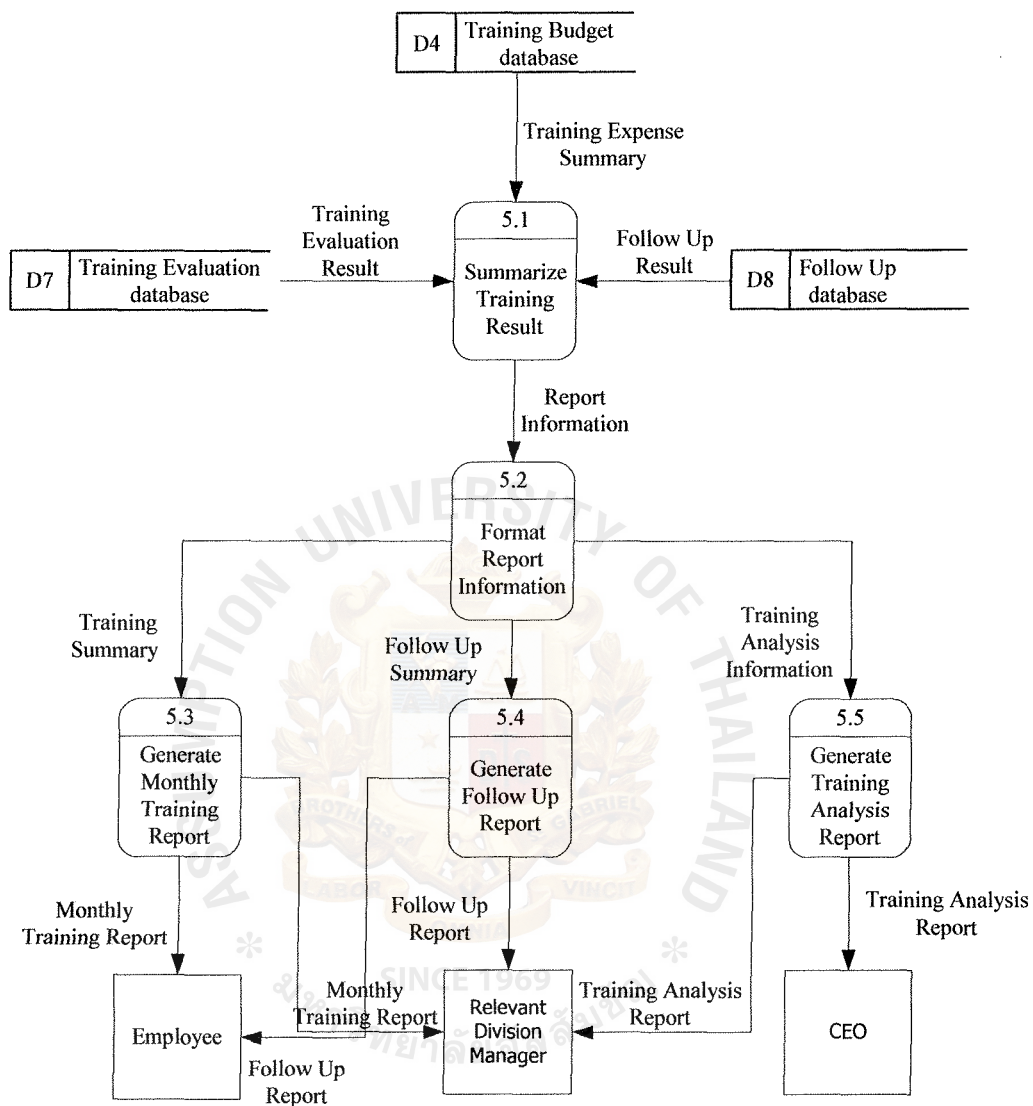
Figure B.5.   Data Flow Diagram of Report Generation Process.

APPENDIX   C

FEASIBILITY ANALYSIS

Table C.1.   Estimated Cost of Candidate 1, Baht.

Cost Items	Price
Development Cost:	
Hardware:	
1 Server	60,000.00
2 Clients	90,000.00
1 Laser Printer	26,500.00
1 UPS	5,000.00
Total Hardware Cost	181,500.00
Software:	
1 Server Software	30,000.00
2 Client Software	20,000.00
Total Software Cost	50,000.00
Personnel:	
1 System Analyst (6 months @ 40,000 Baht/month)	240,000.00
2 Programmer (4 months @ 25,000 Baht/month)	200,000.00
1 Database Specialist (3 months @ 25,000 Baht/month)	75,000.00
1 Network Specialist (1 month @ 20,000 Baht/month)	40,000.00
Total Personnel Cost	555,000.00
Implementation Cost:	
Training Cost	60,000.00
Installation Cost	40,000.00
Total Implementation Cost	100,000.00
Total Development Cost	886,500.00
Project Annual Operating Cost:	
User:	
1 Department Manager (45,000 Baht per month)	540,000.00
2 Training Officer (15,000 Baht per month)	360,000.00
System Support:	
1 Database Administration (25,000 Baht per month)	300,000.00
Office Suppliers & Miscellaneous Cost:	
Stationary (834 Baht per month)	10,000.00
Paper (417 Baht per month)	5,000.00
Utility (1,250 Baht per month)	15,000.00
Miscellaneous Expense (2,500 Baht per month)	30,000.00
Maintenance Cost:	
Hardware Maintenance Cost (5,000 Baht per year)	5,000.00
Software Maintenance Cost (3,000 Baht per year)	3,000.00
Project Annual Operating Cost	1,268,000.00
Total Projected Annual Cost	2,154,500.00

Table C.2. Estimated Cost of Candidate 2, Baht.

Cost Items	Price
Development Cost:	
Hardware:	
1 Server	60,000.00
2 Clients	90,000.00
1 Laser Printer	26,500.00
1 UPS	5,000.00
Total Hardware Cost	181,500.00
Software:	
3 Server Software	30,000.00
4 Client Software	20,000.00
Total Software Cost	50,000.00
Personnel:	
1 System Analyst (6 months @ 40,000 Baht/month)	240,000.00
2 Programmer (4 months @ 25,000 Baht/month)	200,000.00
1 Database Specialist (3 months @ 25,000 Baht/month)	75,000.00
1 Network Specialist (1 month @ 20,000 Baht/month)	40,000.00
Total Personnel Cost	555,000.00
Implementation Cost:	
Training Cost	70,000.00
Installation Cost	60,000.00
Total Implementation Cost	130,000.00
Total Development Cost	916,500.00
Project Annual Operating Cost:	
User:	
1 Department Manager (45,000 Baht per month)	540,000.00
2 Training Officer (15,000 Baht per month)	360,000.00
System Support:	
1 Database Administration (25,000 Baht per month)	300,000.00
1 Network Administration (25,000 Baht per month)	300,000.00
Office Suppliers & Miscellaneous Cost:	
Stationary (834 Baht per month)	10,000.00
Paper (417 Baht per month)	5,000.00
Utility (1,250 Baht per month)	15,000.00
Miscellaneous Expense (2,500 Baht per month)	30,000.00
Maintenance Cost:	
Hardware Maintenance Cost (8,000 Baht per year)	8,000.00
Software Maintenance Cost (5,000 Baht per year)	5,000.00
Project Annual Operating Cost	1,573,000.00
Total Projected Annual Cost	2,489,500.00

Table C.3. Estimated Cost of Candidate 3, Baht.

Cost Items	Price
Development Cost:	
Hardware:	
1 Server	60,000.00
2 Clients	90,000.00
1 Laser Printer	26,500.00
1 UPS	5,000.00
Total Hardware Cost	181,500.00
Software:	
1 Server Software	30,000.00
2 Client Software	20,000.00
Total Software Cost	50,000.00
Personnel:	
1 System Analyst (3 months @ 60,000 Baht/month)	180,000.00
2 Programmer (4 months @ 40,000 Baht/month)	320,000.00
1 Database Specialist (6 months @ 40,000 Baht/month)	240,000.00
2 Network Specialist (2 month @ 30,000 Baht/month)	60,000.00
Total Personnel Cost	800,000.00
Implementation Cost:	
Training Cost	70,000.00
Installation Cost	60,000.00
Total Implementation Cost	130,000.00
Total Development Cost	1,161,500.00
Project Annual Operating Cost:	
User:	
1 Department Manager (45,000 Baht per month)	540,000.00
2 Training Officer (15,000 Baht per month)	360,000.00
System Support:	
1 Database Administration (25,000 Baht per month)	300,000.00
Office Suppliers & Miscellaneous Cost:	
Stationary (834 Baht per month)	10,000.00
Paper (417 Baht per month)	5,000.00
Utility (1,250 Baht per month)	15,000.00
Miscellaneous Expense (2,500 Baht per month)	30,000.00
Maintenance Cost:	
Hardware Maintenance Cost (10,000 Baht per year)	10,000.00
Software Maintenance Cost (8,000 Baht per year)	8,000.00
Project Annual Operating Cost	1,278,000.00
Total Projected Annual Cost	2,439,500.00

Table C.4 Payback Period for Candidate 1, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development Cost:	-886,500					
Annual Operating Cost:		-1,268,000	-1,331,000	-1,397,550	-1,467,428	-1,540,799
Discount factors for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-adjusted costs (adjusted to present value)	-886,500	-1,231,228	-1,255,133	-1,278,758	-1,303,076	-1,329,709
Cumulative time-adjusted costs over life time:	-886,500	-2,117,728	-3,372,861	-4,651,619	-5,954,695	-7,284,404
Benefits derived from operation of new system:	0.00	1,612,000	1,692,600	1,777,230	1,866,092	1,959,396
Discount factors for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-adjusted benefits (adjusted to present value)	0.00	1,565,252	1,596,122	1,626,165	1,657,089	1,690,959
Cumulative time-adjusted benefits over lifetime:	0.00	1,565,252	3,161,374	4,787,539	6,444,629	8,135,587
Cumulative lifetime time-adjusted cost + benefit	-886,500	-552,476	-211,487	135,920	489,934	851,183

Table C.5. Payback Period for Candidate 2, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development Cost:	-916,500					
Annual Operating Cost:		-1,573,000	-1,331,000	-1,397,550	-1,467,428	-1,540,799
Discount factors for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-adjusted costs (adjusted to present value)	-916,500	-1,527,383	-1,255,133	-1,278,758	-1,303,076	-1,329,709
Cumulative time-adjusted costs over life time:	-916,500	-2,443,883	-3,699,016	-4,977,774	-6,280,850	-7,610,559
Benefits derived from operation of new system:	0.00	1,612,000	1,692,600	1,777,230	1,866,092	1,959,396
Discount factors for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-adjusted benefits (adjusted to present value)	0.00	1,565,252	1,596,122	1,626,165	1,657,089	1,690,959
Cumulative time-adjusted benefits over lifetime:	0.00	1,565,252	3,161,374	4,787,539	6,444,629	8,135,587
Cumulative lifetime time-adjusted cost + benefit	-916,500	-878,631	-537,642	-190,235	163,779	525,028

Table C.6. Payback Period for Candidate 3, Baht.

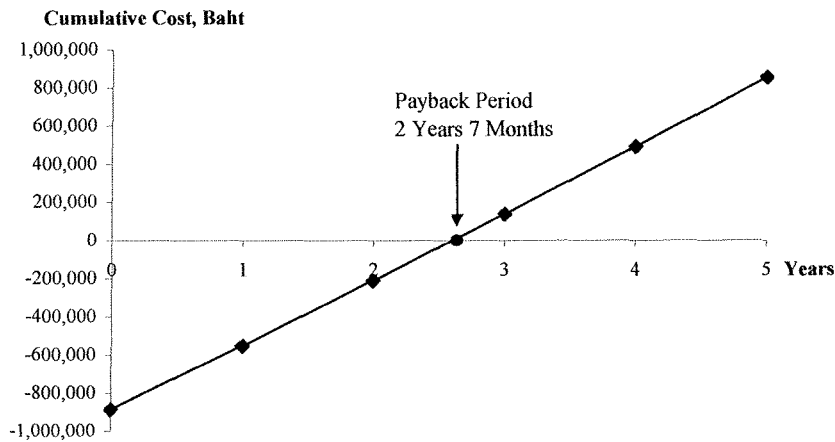| Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development Cost:	-1,161,500					
Annual Operating Cost:		-1,278,000	-1,331,000	-1,397,550	-1,467,428	-1,540,799
Discount factors for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-adjusted costs (adjusted to present value)	-1,161,500	-1,240,938	-1,255,133	-1,278,758	-1,303,076	-1,329,709
Cumulative time-adjusted costs over life time:	-1,161,500	-2,402,438	-3,657,571	-4,936,329	-6,239,405	-7,569,114
Benefits derived from operation of new system:	0.00	1,612,000	1,692,600	1,777,230	1,866,092	1,959,396
Discount factors for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-adjusted benefits (adjusted to present value)	0.00	1,565,252	1,596,122	1,626,165	1,657,089	1,690,959
Cumulative time-adjusted benefits over lifetime:	0.00	1,565,252	3,161,374	4,787,539	6,444,629	8,135,587
Cumulative lifetime time-adjusted cost + benefit	-1,161,500	-837,186	-496,197	-148,790	205,224	566,473

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Cumulative Cost, Baht

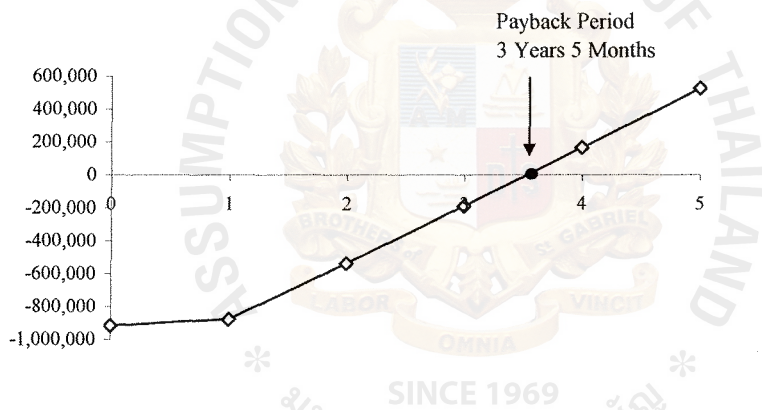Figure C.1.   Payback Period for Candidate 1.

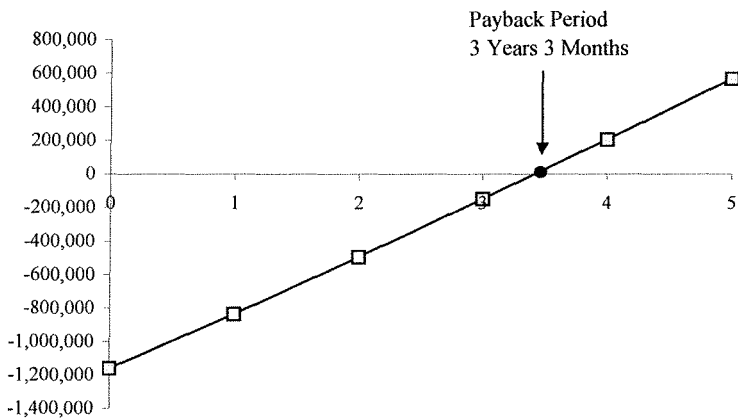
Figure C.2.   Payback Period for Candidate 2.

Figure C.3.   Payback Period for Candidate 3.

Table C.7.　Net Present Value for Candidate 1, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development Cost	-886,500					
Annual Operating Cost		-1,268,000	-1,331,000	-1,397,550	-1,467,428	-1,540,799
Discount factors for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-adjusted costs (adjusted to present value)	-886,500	-1,231,228	-1,255,133	-1,278,758	-1,303,076	-1,329,709
Cumulative time-adjusted costs over life time						-7,284,404
Benefits derived from operation of new system	0.00	1,612,000	1,692,600	1,777,230	1,866,092	1,959,396
Discount factors for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-adjusted benefits (adjusted to present value)	0.00	1,565,252	1,596,122	1,626,165	1,657,089	1,690,959
Cumulative time-adjusted benefits over lifetime	0.00	1,565,252	3,161,374	4,787,539	6,444,629	8,135,587
Cumulative time-adjusted cost + benefit						851,183

Table C.8.　Net Present Value for Candidate 2, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development Cost	-916,500					
Annual Operating Cost		-1,573,000	-1,331,000	-1,397,550	-1,467,428	-1,540,799
Discount factors for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-adjusted costs (adjusted to present value)	-916,500	-1,527,383	-1,255,133	-1,278,758	-1,303,076	-1,329,709
Cumulative time-adjusted costs over life time						-7,610,559
Benefits derived from operation of new system	0.00	1,612,000	1,692,600	1,777,230	1,866,092	1,959,396
Discount factors for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-adjusted benefits (adjusted to present value)	0.00	1,565,252	1,596,122	1,626,165	1,657,089	1,690,959
Cumulative time-adjusted benefits over lifetime	0.00	1,565,252	3,161,374	4,787,539	6,444,629	8,135,587
Cumulative time-adjusted cost + benefit						525,028

Table C.9.　Net Present Value for Candidate 3, Baht.

Cost Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development Cost	-1,161,500					
Annual Operating Cost		-1,278,000	-1,331,000	-1,397,550	-1,467,428	-1,540,799
Discount factors for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-adjusted costs (adjusted to present value)	-1,161,500	-1,240,938	-1,255,133	-1,278,758	-1,303,076	-1,329,709
Cumulative time-adjusted costs over life time						-7,569,114
Benefits derived from operation of new system	0.00	1,612,000	1,692,600	1,777,230	1,866,092	1,959,396
Discount factors for 3%	1.000	0.971	0.943	0.915	0.888	0.863
Time-adjusted benefits (adjusted to present value)	0.00	1,565,252	1,596,122	1,626,165	1,657,089	1,690,959
Cumulative time-adjusted benefits over lifetime	0.00	1,565,252	3,161,374	4,787,539	6,444,629	8,135,587
Cumulative time-adjusted cost + benefit						566,473

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APPENDIX   D

STRUCTURE DESIGN
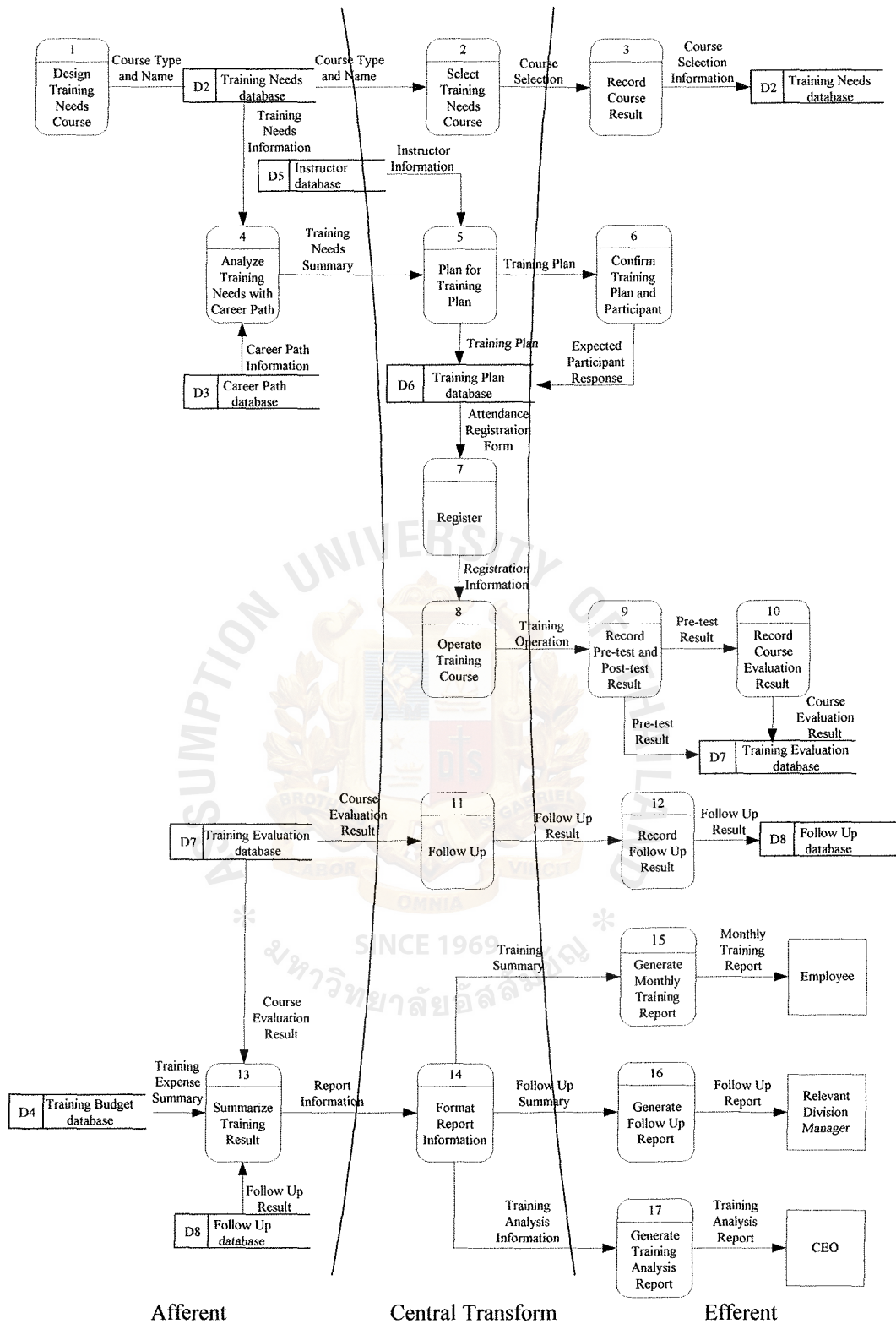
Figure D.1.   Partitioned Data Flow Diagram of Training Information System.

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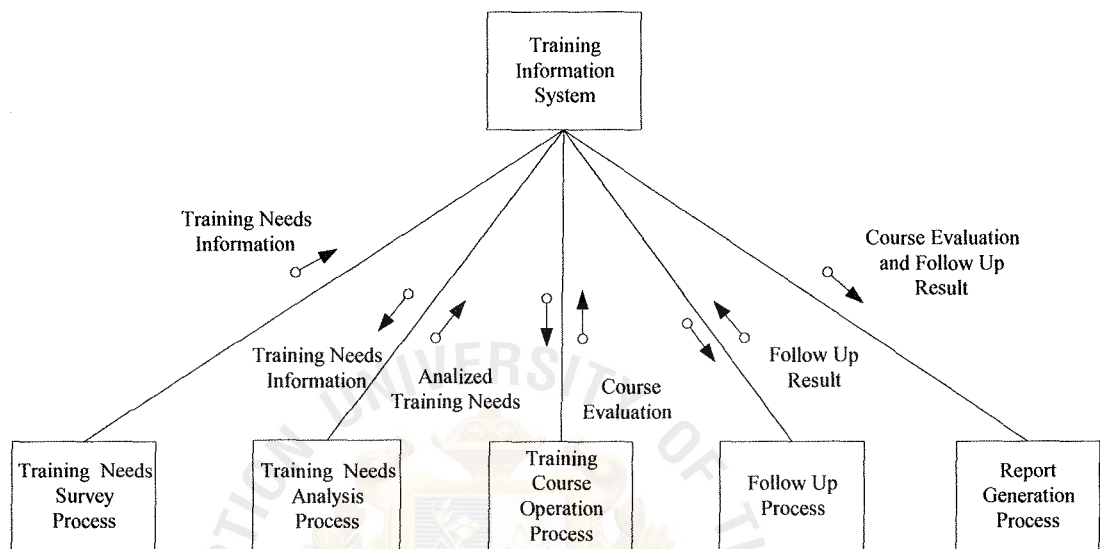
Figure D.2.   Structure Chart of Training Information System.
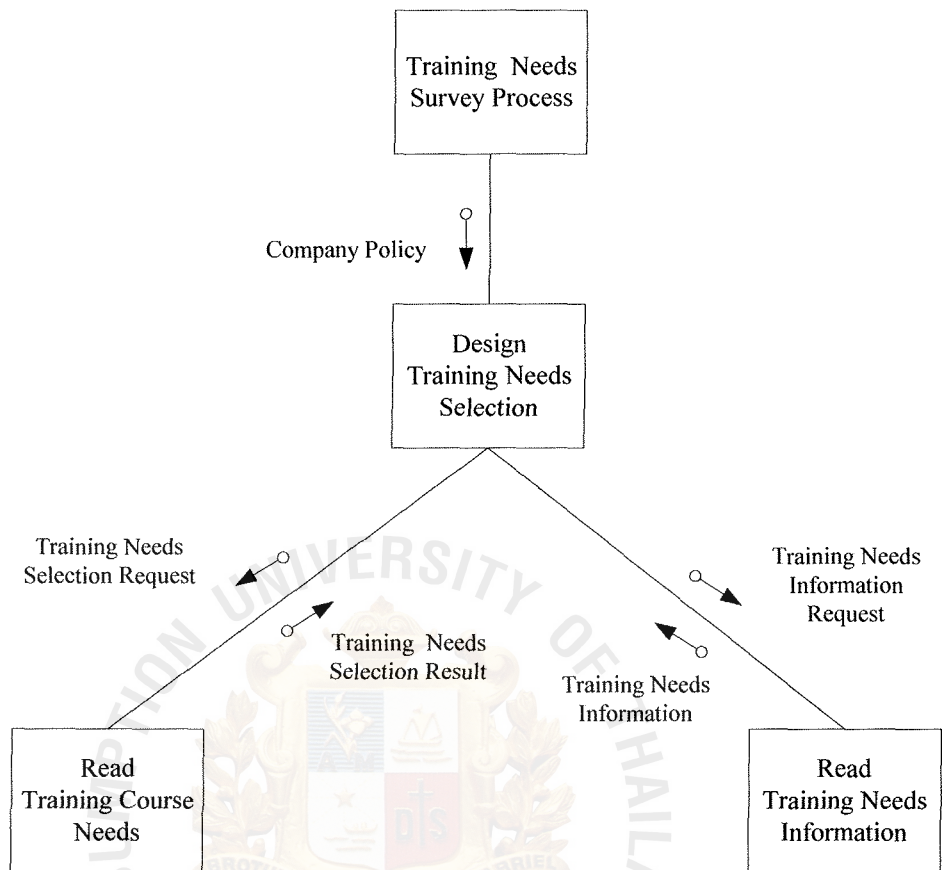
Figure D.3.   Structure Chart of Training Needs Survey.
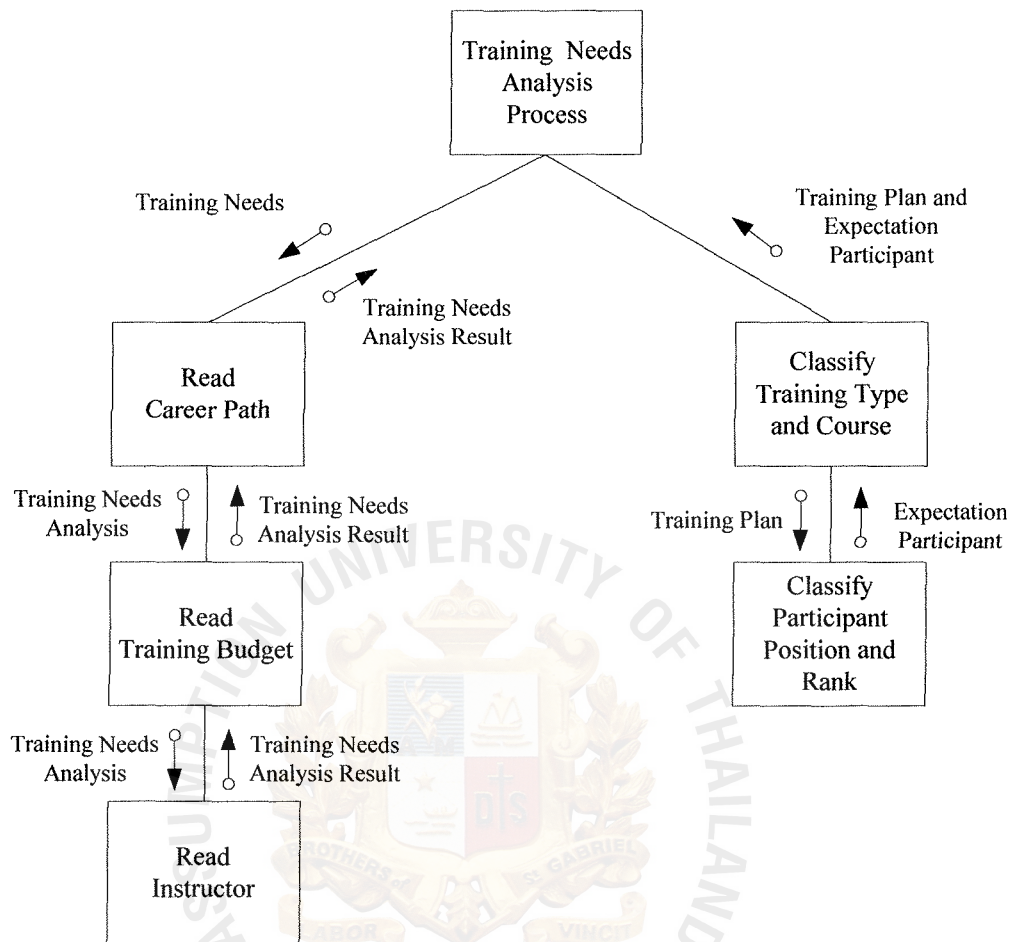
Figure D.4.   Structure Chart of Training Needs Analysis.
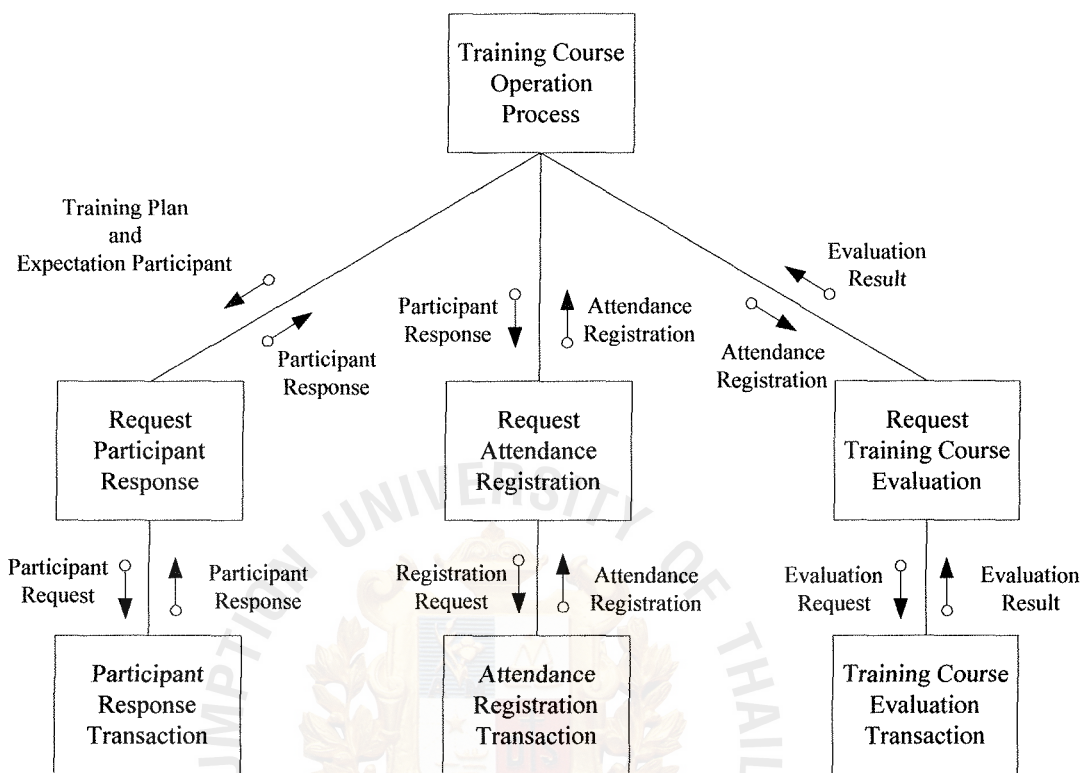
Figure D.5. Structure Chart of Training Course Operation.
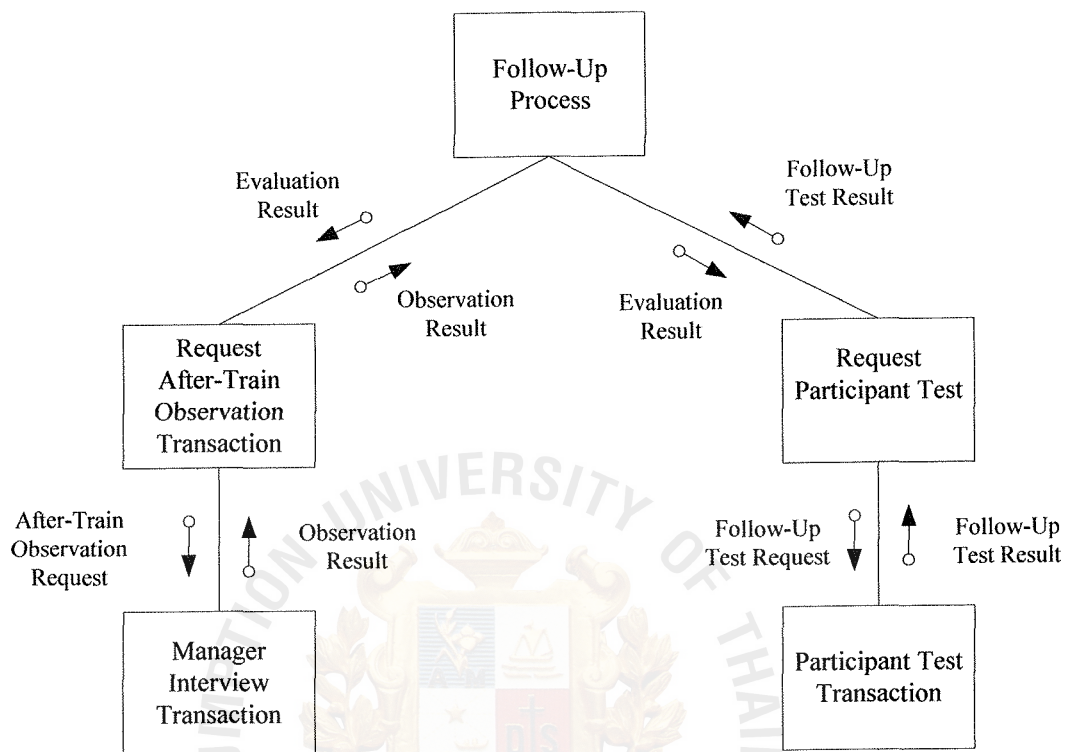
Figure D.6. Structure Chart of Follow-Up.
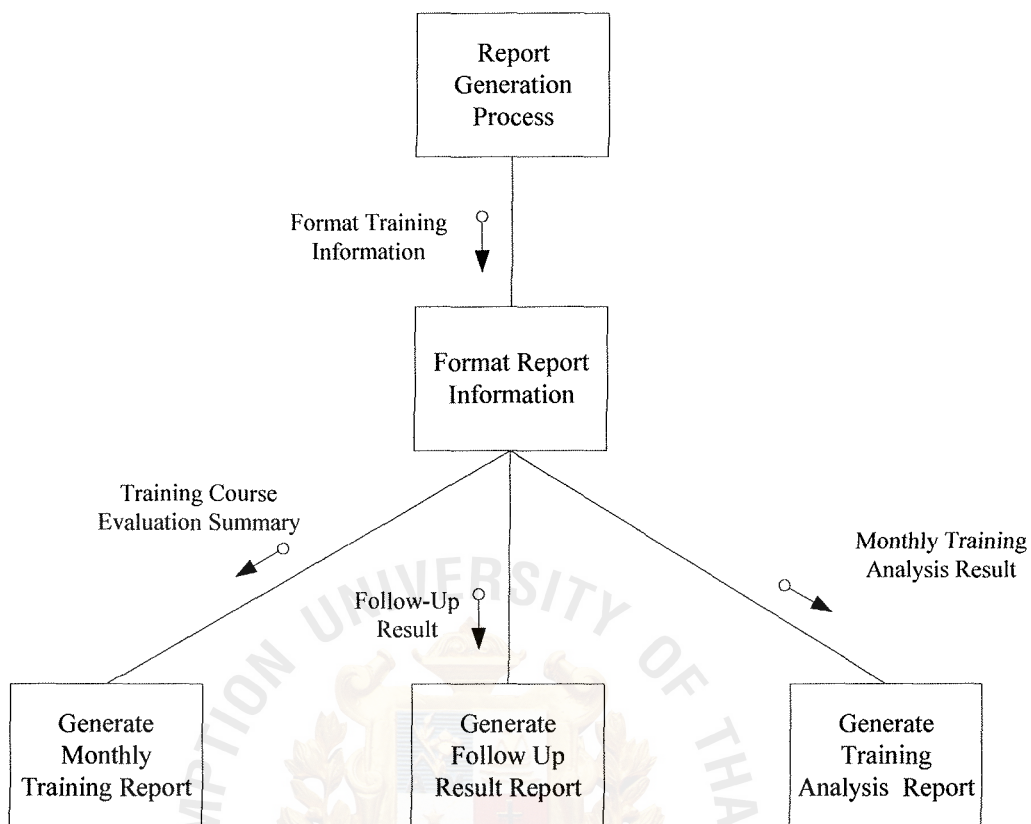
Figure D.7.   Structure Chart of Report Generation.

APPENDIX   E

PROCESS SPECIFICATION

Table E.1.   Process Specification of Design Training Needs Survey.

Items	Description
Process Name:	Training Needs Survey
Data In:	Company Policy
Data Out:	Course Selection Result
Process:	(1) Receive Company Policy from CEO. (2) Design training needs course into Training Needs Database. (3) Employee gets Training Needs Survey Form from Training Needs database. (4) Employee selects Training Needs Course. (5) Record Course Selection Result into Training Needs database.
Attachment:	(1) Employee (2) Company Policy (3) Training Needs database

Table E.2.   Process Specification of Design Training Needs Course.

Items	Description
Process Name:	Design Training Needs Course
Data In:	Training Needs Course Type and Name
Data Out:	Course Type and Name Training Needs Survey Form
Process:	(1) Receive Company Policy from CEO. (2) Design Training Needs Course Type. (3) Design Training Needs Course Name. (4) Create Training Course Name ID into Training Needs database.
Attachment:	(1) Company Policy (2) Training Needs database (3) Training Needs Survey Form (4) Design Training Needs Course Process

Table E.3.   Process Specification of Select Training Needs Course.

Items	Description
Process Name:	Select Training Needs Course
Data In:	Training Needs Survey Form
Data Out:	Course Selection Result
Process:	(1) Employee gets Training Needs Survey Form from Training Needs database. (2) Employee selects training course.
Attachment:	(1) Employee (2) Training Needs Survey Process (3) Training Needs database (4) Select Training Needs Course Process

Table E.4.   Process Specification of Record Course Result.

Items	Description
Process Name:	Record Course Result
Data In:	Course Selection Result Information
Data Out:	Employee Training Needs Information
Process:	(1) Receive Course Selection Result (2) Record Course Selection Result Information into Training Needs database.
Attachment:	(1) Training Needs database (2) Record Course Result Process

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Table E.5.   Process Specification of Training Needs Analysis.

Items	Description
Process Name:	Training Needs Analysis
Data In:	Training Needs Information
Data Out:	Training Plan and Expected Participant
Process:	(1) Get Training Needs Information from Training Needs database. (2) Get Career Path Information from Career Path database. (3) Analyze Training Needs with Career Path. (4) Summarize Training Needs into Training Needs database. (5) Get Training Needs Summary from Training Needs database. (6) Get Training Budget from Training Budget database. (7) Get Instructor from Instructor database. (8) Plan for Training Plan and Expected Participant (Classified by division, section, position and rank) into Training Plan database.
Attachment:	(1) Training Needs database (2) Career Path database (3) Training Budget database (4) Instructor database (5) Training Plan database

Table E.6.   Process Specification of Analyze Training Needs with Career Path.

Items	Description
Process Name:	Analyze Training Needs with Career Path
Data In:	Training Needs Information Career Path Information
Data Out:	Training Needs Summary
Process:	(1) Get Training Needs Information from Training Needs database. (2) Get Career Path Information from Career Path database. (3) Analyze Training Needs Information with Career Path Information. (4) Summarize Analyzed Training Needs into Training Needs Database.
Attachment:	(1) Training Needs database. (2) Career Path database.

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Table E.7.   Process Specification of Planning for Training Plan.

Items	Description
Process Name:	Planning for Training Plan
Data In:	Training Needs Summary Training Budget Information Instructor Information
Data Out:	Training Plan
Process:	(1) Get Training Needs Summary from Training Needs database. (2) Get Training Budget Information from Training Budget database. (3) Adjust Training Needs with Training Budget. (4) Get Training Instructor Information from Instructor database. (5) Plan for Training Plan into Training database.
Attachment:	(1) Training Needs database (2) Training Budget database (3) Instructor database (4) Training Plan database

Table E.8.   Process Specification of Planning for Expected Participant.

Items	Description
Process Name:	Planning for Expected Participant
Data In:	Training Needs Information Training Plan
Data Out:	Expected Participant
Process:	(1) Get Training Needs Summary from Training Needs database (2) Get Training Plan from Training Plan database. (3) Classify Expected Participant's division, section, position, rank for each Training Course. (4) Summarize Expected Participant for each Training Course into Training Plan database.
Attachment:	(1) Training Needs database (2) Training Plan database

Table E.9.   Process Specification of Training Course Operation.

Items	Description
Process Name:	Training Course Operation
Data In:	Attendance Registration Form
Data Out:	Test and Course Evaluation Result
Process:	(1) Get Attendance Registration Form from Training Plan database. (2) Receive Training Pre-test Result from Employee. (3) Record Pre-test Result into Training Evaluation database. (4) Receive Training Post-test Result from Employee. (5) Record Post-test Result into Training Evaluation database. (6) Receive Training Course Evaluation Result from Employee. (7) Record Course Evaluation Result into Training Evaluation Result database.
Attachment:	(1) Employee (2) Training Plan database (3) Attendance Registration Form (4) Pre-test, Post-test and Evaluation Form (5) Training Evaluation database

Table E.10.   Process Specification of Confirm Attendance Participant

Items	Description
Process Name:	Confirm Attendance Participant
Data In:	Expected Participant Response Information
Data Out:	Attendance Registration Form
Process:	(1) Relevant Division Manager reads Training Plan and Expected Participant Division, Section, Position and Rank from Training Plan database. (2) Relevant Division Manager gets Expected Participant Request Form from Training Plan database. (3) Record Expected Participant Response into Training Plan database. (4) Employee gets Expected Participant Response Information from Training Plan database. (5) Employee gets Attendance Registration Form from Training Plan database. (6) Record Attendance Registration into Training Plan database.
Attachment:	(1) Employee (2) Training Plan database (3) Attendance Registration Form.

Table E.11.   Process Specification of Record Pre-test Result.

Items	Description
Process Name:	Record Pre-test Result
Data In:	Pre-test
Data Out:	Pre-test Result
Process:	(1) Receive Pre-test Result from Employee. (2) Record Pre-test Result into Training Evaluation database.
Attachment:	(1) Employee (2) Pre-test (3) Training Evaluation Result database

Table E.12. Process Specification of Record Post-test Result.

Items	Description
Process Name:	Record Post-test Result
Data In:	Post-test
Data Out:	Post-test Result
Process:	(1) Receive Post-test Result from Employee. (2) Record Post-test Result into Test and Course Evaluation database.
Attachment:	(1) Employee (2) Post-test (3) Test and Course Evaluation Result database

Table E.13. Process Specification of Record Course Evaluation Result.

Items	Description
Process Name:	Record Course Evaluation Result
Data In:	Course Evaluation
Data Out:	Course Evaluation Result
Process:	(1) Receive Course Evaluation Result from Employee. (2) Record Course Evaluation Result into Training Evaluation database.
Attachment:	(1) Employee (2) Course Evaluation (3) Training Evaluation database

Table E.14.　Process Specification of Follow-Up.

Items	Description
Process Name:	Follow-Up
Data In:	Training Evaluation Result
Data Out:	Follow-Up Interview Result Follow-Up Test Result
Process:	(1) Relevant Division Manager reads Training Evaluation Result from Training Evaluation Result database. (2) Relevant Division Manager gets Interview Form from Follow-Up database. (3) Record Interview Result into Follow-Up database. (4) Employee gets Follow-Up Test Form from Follow-Up database. (5) Record Follow-Up Test Result into Follow-Up database.
Attachment:	(1) Relevant Division Manager (2) Employee (3) Training Evaluation Result database (4) Follow-Up database

Table E.15.　Process Specification of Record Follow-Up Interview Result.

Items	Description
Process Name:	Record Follow-Up Interview Result
Data In:	Training Evaluation Result Interview Form
Data Out:	Follow-Up Interview Result
Process:	(1) Relevant Division Manager reads Training Evaluation Result from Training Evaluation Database. (2) Relevant Division Manager gets Interview Form from Follow-Up database. (3) Record Interview Result into Follow-Up database.
Attachment:	(1) Relevant Division Manager (2) Training Evaluation Result database (3) Follow-Up database (4) Interview Form

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Table E.16. Process Specification of Record Follow-Up Test Result.

Items	Description
Process Name:	Record Follow-Up Test Result
Data In:	Follow-Up Test Form
Data Out:	Follow-Up Test Result
Process:	(1) Employee gets Follow-Up Test Form from Follow- Up database. (2) Record Follow-Up Test Result into Follow-Up database.
Attachment:	(1) Employee (2) Follow-Up database (3) Follow-Up Test

Table E.17. Process Specification of Report Generation.

Items	Description
Process Name:	Report Generation
Data In:	Training Expense Summary Training Evaluation Result Follow-Up Result
Data Out:	Monthly Training Report Follow-Up Report Training Analysis Report
Process:	(1) Get Training Expense Summary from Training Budget database. (2) Get Training Evaluation Result from Training Evaluation database. (3) Get Follow-Up Result from Follow-Up database. (4) Send Monthly Training Report to Employee and Relevant Division Manager. (5) Send Follow-Up Report to Employee and Relevant Division Manager. (6) Send Training Analysis Report to Relevant Division Manager and CEO.
Attachment:	(1) Training Budget database (2) Training Evaluation Result database (3) Follow-Up database (4) Employee (5) Relevant Division Manager (6) CEO

Table E.18. Process Specification of Summarize Training Result.

Items	Description
Process Name:	Summarize Training Result
Data In:	Training Expense Summary Training Evaluation Result Follow-Up Result
Data Out:	Report Generation
Process:	(1) Get Training Expense Summary from Training Budget database. (2) Get Training Evaluation Result from Training Evaluation database. (3) Get Follow-Up Result from Follow-Up database. (4) Send Report Information to Format Report Process.
Attachment:	(1) Training Budget database (2) Training Evaluation database (3) Follow-Up database (4) Format Report Information Process

Table E.19. Process Specification of Format Report Information.

Items	Description
Process Name:	Format Report Information
Data In:	Report Format
Data Out:	Monthly Training Summary Follow Up Summary Training Analysis Information
Process:	(1) Receive Report Information from Summarize Training Result Process. (2) Send Monthly Training Summary to Generate Monthly Training Report Process. (2) Send Follow-Up Summary to Generate Follow-Up Report. (4) Send Training Analysis Report to Generate Training Analysis Report.
Attachment:	(1) Summarize Training Result Process (2) Generate Monthly Training Report Process (3) Generate Follow-Up Result Report Process (4) Generate Training Analysis Report Process

Table E.20.   Process Specification of Generate Monthly Training Report.

Items	Description
Process Name:	Generate Monthly Training Report
Data In:	Monthly Training Summary
Data Out:	Monthly Training Report
Process:	(1) Receive Monthly Training Summary from Format Report Information Process. (2) Produce Monthly Training Report according to the predefined format. (3) Send Monthly Training Report to Employee and Relevant Division Manager
Attachment:	(1) Format Report Information Process (2) Employee (3) Relevant Division Manager

Table E.21.   Process Specification of Generate Follow-Up Result Report.

Items	Description
Process Name:	Generate Follow-Up Report
Data In:	Follow-Up Summary
Data Out:	Follow-Up Report
Process:	(1) Receive Follow-Up Summary from Format Report Information Process. (2) Produce Follow-Up Report according to the predefined format. (3) Send Follow-Up Report to Employee and Relevant Division Manager
Attachment:	(1) Format Report Information Process (2) Employee (3) Relevant Division Manager

Table E.22. Process Specification of Generate Training Analysis Report.

Items	Description
Process Name:	Generate Training Analysis Report
Data In:	Training Analysis Information
Data Out:	Training Analysis Report
Process:	(1) Receive Training Analysis Information from Format Report Information Process. (2) Produce Training Analysis Report according to the Predefined format. (3) Send Training Analysis Report to Relevant Division Manager.
Attachment:	(1) Format Report Information Process (2) Relevant Division Manager (3) CEO

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APPENDIX F

DATA DICTIONARY

Table F.1. Data Dictionary of Training Information Database.

Field Name	Meaning
Address	Address of Training Instructor.
Address	Address of employee.
Budget ID	Identification Number of Training Budget.
Building Number	Building number of company's training room.
Course Evaluation Result	Result of Course Evaluation after training.
Course ID	Identification number of Training Course.
Course Period	Period of training course.
Course Type	Type of Training Course (Management, Production, Quality, Health and Safety, Human Relation).
Division	Work Division of employee.
Education	Graduated Education of employee.
Employee ID	Identification number of company employee.
Employee Name	Name and Surname of company employee.
Employment Date	Start Employment Date of employee.
Evaluation Method	Evaluation Method of training course. (Pre-test, Post-test, Case Study, Practice)
Instructor Expense	Expense of Training Instructor of each course.
Instructor ID	Identification number of Training Instructor.
Instructor Name	Name and Surname of Training Instructor.
Interview Result	Follow Up Interview after training to Relevant Division Manager who authorizes trained employee
Operation Expense	Expense of Training Operation of each course.
Phone Number	Contact Number of employee.
Phone Number	Contact Number of Training Instructor.
Position	Work Position Name of employee.
Post-test Result	Result of Test after training.
Pre-test Result	Result of Test before training.
Rank	Work Position Rank Level of employee (Worker: w1-w3, Foreman: F1-F3, Staff: C1-C4, Supervisor: S, Manager: M1-M5)

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Table F.1.   Data Dictionary of Training Information Database (continued).

Field Name	Meaning
Room Number	Room number of company's training room.
Section	Work Section of employee.
Total Expense	Total expense, comes from Instructor Expense plus with Operation Expense.
Training Time	Time of Training course.
Work Experience	Work Experience of Training Instructor.

Table F.2.   Data Dictionary of Data Flow Diagram.

Field Name	Type	Description
CEO	External Entities	Chief of executive officer who manages and controls the company.
Employee	External Entities	Person who are employed to work for the company.
Company Policy	Data Flow	Yearly company policy from CEO.
Course Type and Name Selection	Data Flow	Course type and name from design training needs course process.
Training Needs Survey Form	Data Flow	Digital form employee training needs survey to employee.
Course Selection	Data Flow	Training needs course can be selected in training needs survey form.
Course Selection Result	Data Flow	Result of Training Needs Course after employee selection
Course Selection Result Information	Data Flow	Result information which is recorded into training needs database.
Design Training Needs Course	Process	Design training course for training needs survey.
Select Training Needs Course	Process	Employee select training needs course.
Record Training Needs Course	Process	Training needs course result is recorded in training needs database.
Training Needs database	Data Store	Store information about training needs of employee.
Career Path Information	Data Flow	Information from Career Path External Database.
Career Path database	External Database	Store career path information of Human Resources Division
Analyze Training Needs with Career Path	Process	Analyze and adjust employee training needs with career path information.
Training Needs Summary	Data Flow	Summary of training needs after training needs analysis.
Training Needs Information	Data Flow	Information from training needs data store for training needs analysis.
Instructor Information	Data Flow	Information about instructor from instructor data store.
Training Budget	Data Flow	Training budget information from training budget data store.
Plan for Training Plan	Process	Plan for yearly and monthly training plan

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Table F.2. Data Dictionary of Data Flow Diagram (continued).

Field Name	Type	Description
Training Plan	Data Flow	Yearly and monthly training plan
Training Plan database	Data Store	Store information about yearly and monthly training plan.
Plan for Expected Participant	Process	Classify expected participant by division, section, position and rank, according to employee training needs.
Expected Participant	Data Flow	Classified expected participant information for each training course of the month which is put into training plan data store.
Expected Participant Request Form	Data Flow	Digital form for expected participant request to relevant division manager
Expected Participant Response	Data Flow	Relevant division manager responses expected participant.
Relevant Division Manager	External Entities	Person who manages and controls subordinates.
General Affair Division	External Entities	Division which manages and controls general affair of the company, including training room reservation.
Training Room Reservation	Data Flow	Reserve training rooms to General Affair Division
Expected Participant Response Information	Data Flow	Employee reads expected participant response information from training plan data store before training attendance date.
Attendance Registration Form	Data Flow	Employee, who is expected participant, registers training attendance into digital attendance registration form 3 days before training date.
Confirm Training Plan and Participant	Process	Confirm expected participant and training budget.
Training Budget	Data Flow	Budget for each training course.
Training Expense	Data Flow	Expense for each training course.
Training Budget database	Data Store	Store information about training budget and expense.
Pre-test	Data Flow	Test before training to employee who is participant.
Pre-test Result	Data Flow	Result of test before training.
Record Pre-test Result	Process	Result of test before training is recorded into training evaluation data store.

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Table F.2.   Data Dictionary of Data Flow Diagram (continued).

Field Name	Type	Description
Post-test	Data Flow	Test after training employee who is participant.
Post-test Result	Data Flow	Result of test after training.
Record Post-test Result	Process	Result of test after training is recorded into training evaluation data store.
Course Evaluation	Data Flow	Employee who is participant evaluates the course and instructor after training.
Course Evaluation Result	Data Flow	Result of course and instructor evaluation after training by employee who is participant.
Training Evaluation database	Data Store	Store information of pre-test result, post-test result and course and instructor evaluation.
Training Evaluation Result	Data Flow	Result of pre-test, post-test and course and instructor information that comes from training evaluation data store.
Interview Form	Data Flow	Digital follow up interview form, asking about employee who was participant, to relevant division manager.
Interview Result	Data Flow	Result of interview about employee who was participant from relevant division manager.
Record Follow Up Interview Result	Process	Record interview result into follow up data store.
Follow Up database	Data Store	Store information about follow-up result.
Record Follow Up Test Result	Process	Record follow-up test result from employee who was participant into follow up data store.
Follow Up Test Form	Data Flow	Digital follow-up test form for testing employee who was participant.
Follow Up Test Result	Data Flow	Result of follow-up test from employee who was participant.
Training Expense Summary	Data Flow	Summary of course training operation and instructor expense.
Follow Up Result	Data Flow	Result of follow-up interview and follow-up test.

Table F.2. Data Dictionary of Data Flow Diagram (continued).

Field Name	Type	Description
Summarize Training Result	Process	Summarize training evaluation result, follow up result and training expense.
Report Information	Data Flow	Information used for generating report.
Format Report Information	Process	Arrange report information to fit into predefined format.
Monthly Training Summary	Data Flow	Training summary information used for generating monthly training report.
Follow Up Summary	Data Flow	Follow up summary information used for generating follow up report.
Training Analysis Information	Data Flow	Training analysis information used for generating training analysis report.
Generate Monthly Training Report	Process	Produce monthly training report to employee who was participant and relevant division manager.
Generate Follow Up Report	Process	Produce follow up report to employee who was participant and relevant division manager.
Generate Training Analysis Report	Process	Produce training analysis report to relevant division manager and CEO.
Monthly Training Report	Data Flow	Complete monthly training report for reporting to employee who was participant and relevant division manager.
Follow Up Report	Data Flow	Complete follow up report for reporting to employee who was participant and relevant division manager.
Training Analysis Report	Data Flow	Complete training analysis report for CEO.

APPENDIX   G

DATABASE DESIGN

Table G.1.   Structure of Employee Table.

Name	Type	Null	Foreign Key to table	Check	Key Type
EMPLOYEE_ID	Number (4)	Not			Primary Key
EMPLOYEE_NAME	Text (30)	Not			Attribute
DIVISION	Text (30)	Not			Attribute
SECTION	Text (30)	Not			Attribute
RANK	Text (2)	Not			Attribute
POSITION	Text (15)	Not			Attribute
EMPLOYMENT DATE	Text (9)	Not			Attribute
EDUCATION	Text (30)	Not			Attribute
ADDRESS	Text (50)	Not			Attribute
PHONE_NUMBER	Text (12)	Not			Attribute

Table G.2.   Structure of Training Needs Table.

Name	Type	Null	Foreign Key to table	Check	Key Type
COURSE_ID	Number (4)	Not			Primary Key
EMPLOYEE_ID	Number (4)	Not			Primary Key
COURSE_TYPE	Text (20)	Not			Attribute
COURSE_NAME	Text (100)	Not			Attribute
COURSE_PERIOD	Text (50)	Not			Attribute

Table G.3.   Structure of Instructor Table.

Name	Type	Null	Foreign Key to table	Check	Key Type
INSTRUCTOR_ID	Number (4)	Not			Primary Key
INSTRUCTOR_NAME	Text (30)	Not			Attribute
INSTITUTE_NAME	Text (50)	Not			Attribute
WORK_EXPERIENCE	Text (200)	Not			Attribute
ADDRESS	Text (50)	Not			Attribute
PHONE_NUMBER	Text (10)	Not			Attribute
COURSE_ID	Number (4)	Not			Foreign Key

Table G.4.   Structure of Training Budget Table.

Name	Type	Null	Foreign Key to table	Check	Key Type
BUDGET_ID	Number (4)	Not			Primary Key
COURSE_ID	Number (4)	Not			Foreign Key
INSTRUCTOR_ID	Number (4)	Not			Foreign Key
INSTRUCTOR_EXPENSE	Number (7)	Not			Attribute
OPERATION_EXPENSE	Number (7)	Not			Attribute
TOTAL_EXPENSE	Number (10)	Not			Attribute

Table G.5.   Structure of Training Room Table.

Name	Type	Null	Foreign Key to table	Check	Key Type
ROOM_NUMBER	Number (2)	Not			Primary Key
BUILDING_NUMBER	Number (2)	Not			Attribute
COURSE_ID	Number (4)	Not			Foreign Key

Table G.6.   Structure of Training Plan Table.

Name	Type	Null	Foreign Key to table	Check	Key Type
COURSE_ID	Number (4)	Not			Primary Key
EMPLOYEE_ID	Number (4)	Not			Primary Key
COURSE_TYPE	Text (15)	Not			Attribute
COURSE_NAME	Text (30)	Not			Attribute
COURSE_PERIOD	Number (2)	Not			Attribute
INSTRUCTOR_NAME	Text (30)	Not			Foreign Key
TRAINING_TIME	Text (10)	Not			Attribute
ROOM_NUMBER	Number (2)	Not			Foreign Key
EVA_METHOD_ID	Number (4)	Not			Foreign Key
FOLLOW_UP_METHOD ID	Number (4)	Not			Foreign Key
BUDGET_ID	Number (4)	Not			Foreign Key

Table G.7.   Structure of Training Evaluation Table.

Name	Type	Null	Foreign Key to table	Check	Key Type
EVA_METHOD_ID	Number (4)	Not			Primary Key
EMPLOYEE_ID	Number (4)	Not			Foreign Key
COURSE_ID	Number (4)	Not			Foreign Key
PRE-TEST_RESULT	Number (5)	Not			Attribute
POST-TEST_RESULT	Number (5)	Not			Attribute
COURSE_EVALUATION _ RESULT	Text (50)	Not			Attribute

Table G.8.   Structure of Follow-Up Table.

Name	Type	Null	Foreign Key to table	Check	Key Type
FOLLOW_UP_METHOD_ ID	Number (4)	Not			Primary Key
EMPLOYEE_ID	Number (4)	Not			Foreign Key
COURSE_ID	Number (4)	Not			Foreign Key
FOLLOW_UP_RESULT	Text (50)	Not			Attribute

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APPENDIX   H

WEB INTERFACE DESIGN
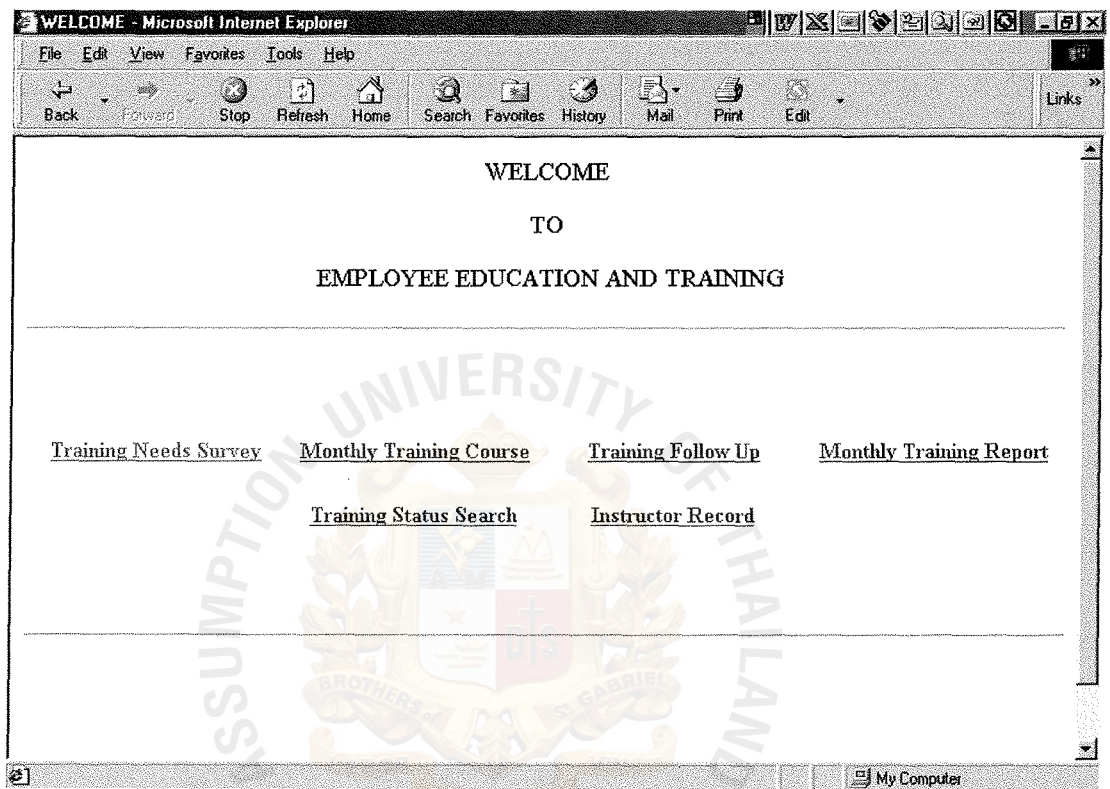
Figure H.1.   Web Interface Screen: Main Menu Screen.

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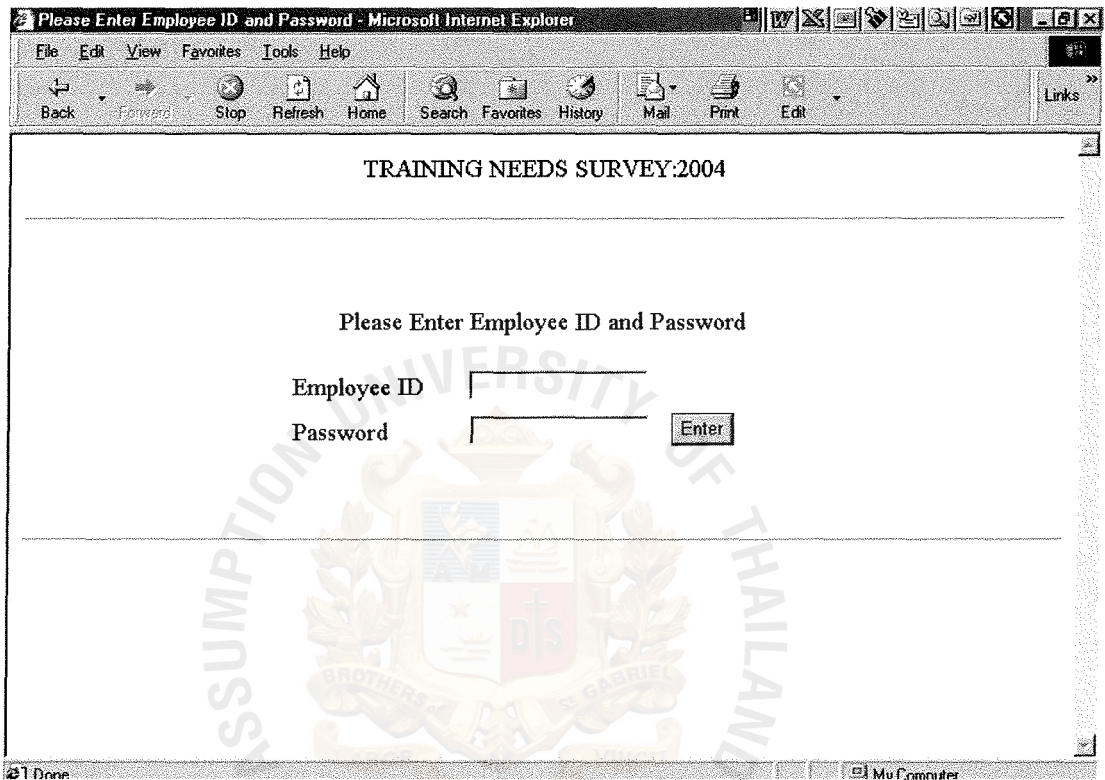
Figure H.2.   Web Interface Screen: Login Screen.

Figure H.3.   Web Interface Screen: Training Needs Survey Screen.

MONTHLY TRAINING COURSE

MARCH / 2004

Course Name	Date	Number of Expected Participant						Participant Response
		PC	PE	QC	R&D	QA	PP	
Company System								
TQM	3/Feb/04	1	2	2	1	2	1	Attend
5S	10/Feb/04	1	1	1	1	1	1	Attend
Six Sigma	18/Feb/04	2	2	1	1	1	1	Attend
TS16949	25/Feb/04	1	1	2	1	2	1	Attend
Computer								
MS Access	15/Feb/04	1	1	1	1	1	1	Attend
Minitab	23/Feb/04	2	2	1	1	1	1	Attend
Production								
JIT	27/Feb/04	3	2	1	1	1	1	Attend

Check employee attendance status please click here

Done   My Computer

Figure H.4.   Web Interface Screen: Monthly Training Plan Screen.

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Figure H.5.   Web Interface Screen: Participant Response Screen.

Figure H.6.   Web Interface Screen: Employee Training Status Search Screen.

APPENDIX I

REPORT DESIGN

Monthly Training Report

Training Title: Statistical Process Control

Training Date :   5/1/04

Instructor: ☐ Internal ☑ External

Source: LVM (Asia) Co.,Ltd.

Training Type: ☑ In-house ☐ Out side

Scheme type: ☑ Training Needs ☐ QMS   ☐ Safety

No.	Employee's Name	ID	Division	Pre-test (%)	Post test (%)
1	Mr. Somchai	83038	QA	50%	100%
2	Ms. Somying	73034	QA	60%	97%
3	Mr. Thawee	60420	QA	75%	90%
4	Mr. Krisda	85065	QA	80%	100%
5	Ms. Kanya	88084	QA	70%	90%
6	Mr. Phiroon	65089	QA	50%	100%
7	Mr. John	75055	QA	0%	95%
8	Mr. Thanate	69099	QA	40%	90%

Figure I.1.   Monthly Training Report design.

Training Analysis Report

Training Title: Statistical Process Control
Training Date :   5/1/04
Scheme type: ☑ Training Needs   ☐ QMS   ☐   Safety
Training type: ☑ In-house   ☐ Out side
Instructor: ☐   Internal   ☑ External
Source: LVM (Asia) Co.,Ltd.
Training Fee: 15,000 TBH/manday
Trainee: 8 persons
Everage training cost per head (ECH) : 1,875 (TBH)

No.	Employee's Name	ID	Section	Division	%IET	CH (TBH)	Balance (TBH)
1	Mr. Somchai	83038	PQC	QA	150.00%	2812.5	937.5
2	Ms. Somying	73034	PQC	QA	97.00%	1818.75	-56.25
3	Mr. Thawee	60420	PQC	QA	90.00%	1687.5	-187.5
4	Mr. Krisda	85065	PQC	QA	50.00%	937.5	-937.5
5	Ms. Kanya	88084	PQC	QA	90.00%	1687.5	-187.5
6	Mr. Phiroon	65089	PQC	QA	150.00%	2812.5	937.5
7	Mr. John	75055	PQC	QA	95.00%	1781.25	-93.75
8	Mr. Thanate	69099	PQC	QA	135.00%	2531.25	656.25
						Total	1068.75

Remark :
Cost/head (CH) = ECT x %IET TBH (TBH)
Balance = CH-ECT (TBH)

% Individual Effectiveness of Training (%IET)
% IET = % post test x % effectiveness

% Everage Effectiveness of Training (%EET)
%EET = (%IET1 + %IET2 + %IET3 +............)/ number of trainee

Figure I.2.   Training Analysis Report design.

Follow-up Report

Training Title: Statistical Process Control

Training Date :   5/1/04

Training Type: ☑ In-house   ☐ Out side

Scheme type: ☑ Training Needs   ☐ QMS   ☐ Safety

No.	Employee's Name	ID	Division	Pre-test (%)	Post test (%)	1	2	3	4	%IET
1	Mr. Somchai	83038	QA	50%	100%				✓	150.00%
2	Ms. Somying	73034	QA	60%	97%			✓		97.00%
3	Mr. Thawee	60420	QA	75%	90%			✓		90.00%
4	Mr. Krisda	85065	QA	80%	100%		✓			50.00%
5	Ms. Kanya	88084	QA	70%	90%			✓		90.00%
6	Mr. Phiroon	65089	QA	50%	100%				✓	150.00%
7	Mr. John	75055	QA	0%	95%			✓		95.00%
8	Mr. Thanate	69099	QA	40%	90%				✓	135.00%
								%EET		107.13%

(Level columns 1–4 fall under the heading "Level")

Remark

Skill level

1-level: incompetence = 0% effectiveness

2-level: able to do job under supervision = 50% effectiveness

3-level: can perform task = 100% effectiveness

4-level: able to train others or leader = 150% effectiveness

% Individual Effectiveness of Training (%IET)

% IET = % post test **x** % effectiveness

% Everage Effectiveness of Training (%EET)

%EET = (%IET1 + %IET2 + %IET3 +............)/ number of trainee

Figure I.3.   Follow-up Report design.

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