



Construction Consultant Management Information System

by

Mr. Chumpol Hinthong

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

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

August, 2001

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Project Title Construction Consultant Management Information System


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


Approval Committee:



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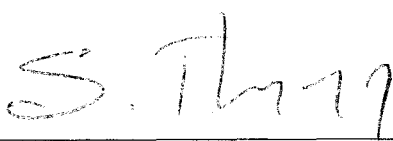
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ABSTRACT

The project is concerned with analysis and design of a Consultant Management System for a construction company. Consultant Management is considered to be a tool that assists the company to minimize the operation costs and control the schedule of construction operations. The existing manual system is first studied and analyzed to locate the problems and to find the suitable and possible solutions and areas for improvements. The current problems include the missing of material information, the length of progress report generation and inaccurate information to support decision-making for the management.

A computerized Consultant Management System, developed using system analysis and design techniques, is proposed to replace the existing manual system. The databases and user interface screens are designed and implemented using MS Access 97. The new system helps to eliminate unnecessary paper work, speed up reporting and provide accurate and up-to-date information for management. The cost and benefit analysis is carried out and the results obtained indicate that the proposed system is worth an investment.

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I. INTRODUCTION

1.1 Background of the Project

Arun Chaiseri Consulting Engineers Co., Ltd. is a consulting company that provides Construction Design, Construction Management, and Mechanical, Electrical and Environmental Engineering. The company faces many problems concerned with construction site and estimation division. This is due to the lack of data material price list, labor cost and supplier information, information of Construction Company and the uncollected project summary reports. The company has many projects to estimate and manage. The company needs to set the evaluate cost of the project and propose to the owner so it must take the data item off to find the overall cost. At the construction site, company's staffs may need to find some material price or labor cost of each data item when they need to do the additional work. Nowadays nobody collects the information in formal form so they have many paper catalogues and documents.

The company has decided to create a new computerized material and project information system, as it is a major operation of the company, which should have been more effective. Moreover, the company has planned for an ISO certification, so the system reduced the document and can collect the information for operation. The computerized system serves to be a competitive strategy to increase the reliability of owner who needs to ask some information about the material. The system can collect not only the information of material in Thailand but also record the new material information that has not been in Thailand. This would help the company to find the new technology information of construction.

1.2 Objectives of the Project

The objectives of the project are as follows:

- (1) To analyze the existing problems.
- (2) To design a computer information system to handle the information of material and cost center in effectiveness.
- (3) To develop a software package for material information system to design and build that can achieve the following goals.
 - (a) Minimum time consumption.
 - (b) Reliability of information.
 - (c) Fast and efficient searching of material, project and supplier information.
 - (d) Capability to issue necessary reports and ad-hoc queries to management.
 - (e) To eliminate the redundancy data and get the accurate cost center.

1.3 Scope of the Project

The project scope covers the information for consultant management, which includes the following:

- (1) To create all information files of materials, suppliers, labor cost, contractor and projects.
- (2) To update materials, suppliers, labor cost, contractor and projects data.
- (3) To calculate a budget for the project.
- (4) To update budget of the project.
- (5) Generate progress reports and management reports.

1.4 Deliverables

- (1) Create detail of material report.
- (2) Create cost center report.
- (3) Create project summary report.
- (4) Create list of supplier of each material.
- (5) Create contractor information report.
- (6) Create database design.
- (7) Create source code for the database.

1.5 Project Plan

Project Schedule is shown in Figure 1.1 that can be set as following:

- (1) System Analysis should be in 1.5 month.
- (2) System Design should be in 1.5 month.
- (3) System Implementation should be in 1 month.

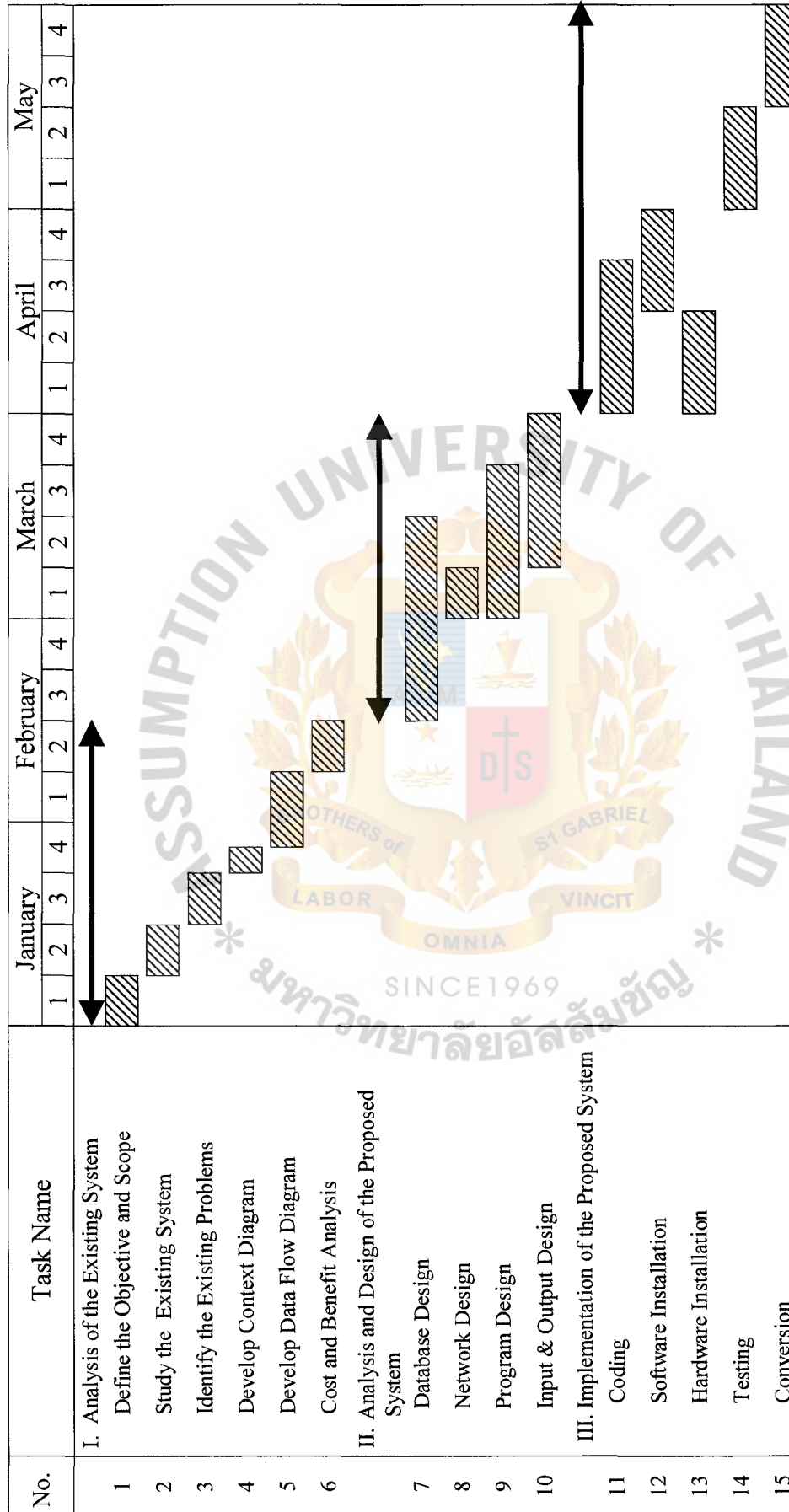


Figure 1.1. Project Plan of Consultant Management Information System.

II. THE EXISTING SYSTEM

2.1 Background of the Organization

Arun Chaiseri Consulting Engineers Co., Ltd. was founded in 1979 as a structural engineering consultant. At the time of establishment, the number of the company's staff was eight. The number increased to over 140 employees at present. The number of projects carried out by the company totaled over 400 projects. Among these are Thailand's tallest building 'Baiyoke 2', a 60,000 seated Chalerm Phra Kiat Stadium and the famous Queen Sirikit National Convention Center.

Since the establishment, the company has been offering structural design services to many clients in both public and private sectors. The designs are of various types, namely high-rise building, low-rise building, industrial factory, underground structure, telecommunication tower, airport, long-span structural and silo.

In 1988, the Construction Management Division was officially set up to offer services in fields of construction supervision, project management, damage investigation, repair and renovation and other engineering consultancy. Prior to the forming of the group, the company has conducted more than 20 projects of such field. Nowadays the number of projects counted to more than 40 including large-scale projects such as Rama 9 Hospital (Extension), Vejthani Hospital, Pattaya Beach Condotown, Jomtien Condominium, Bangkok Phuket Hospital, Bangkok Hadyai Hospital and Piling work for Ramaland Building.

In 1992, the company established the Research and Development Division to keep up with advanced technology and to conduct research for better implementation of structural design and construction. Prior to the establishment of the group, the company has introduced many construction techniques to Thailand's construction industry. In

1980, the company employed large diameter bore piles for the first time in Thailand for the Royal Orchid Hotel project. In the same year, the company introduced Micropile of the partially collapsed building. In 1985 the very first ultra deep basement of the Grand China Tower (formerly known as International Trade Center) utilizing diaphragm wall and top-down construction technique was designed by the company. In 1991, the Tuned Liquid Damper was designed to suppress excess vibration of the 90-stories Baiyoke 2 Tower. The backbone of company is shown at Figure 2.1. Organization Chart of Arun Chai Seri Consulting Co., Ltd.



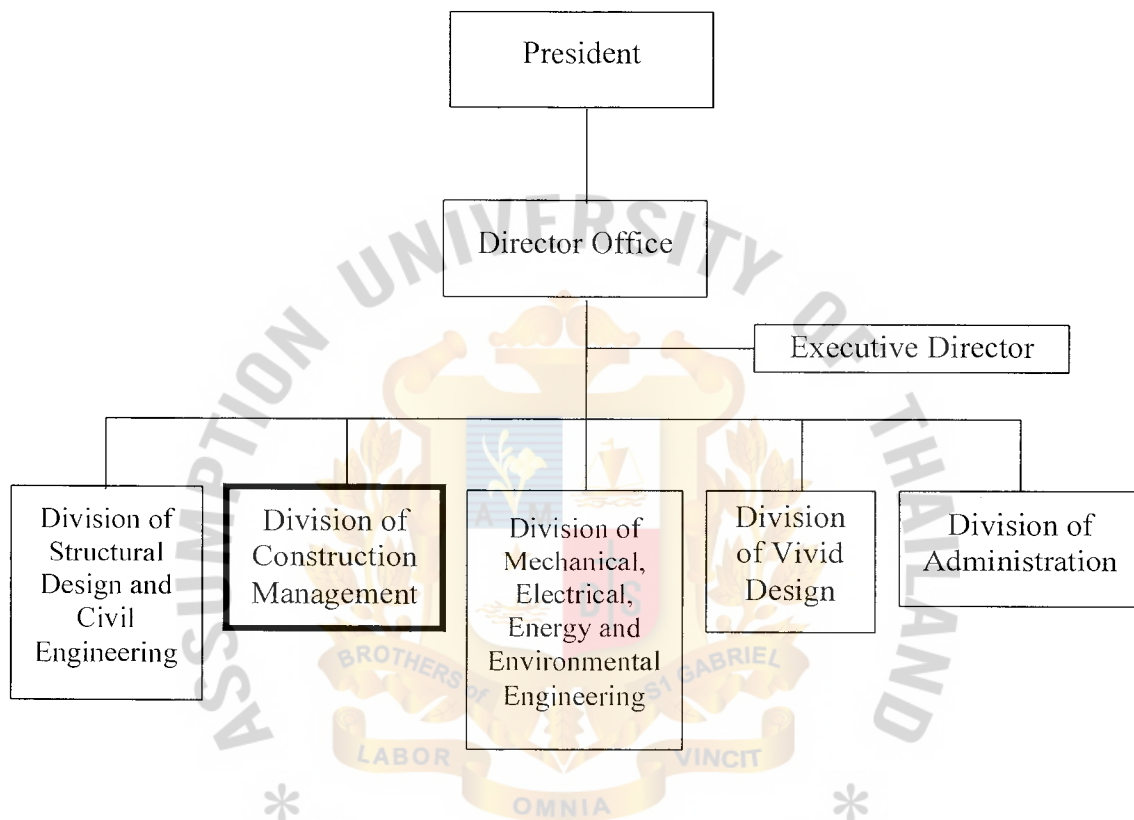


Figure 2.1. Organization Chart of Arun Chaiseri Consulting Engineers Co., Ltd.

2.2 Current Problems and Areas for Improvement

The current system causes many problems:

- (1) The information of materials can be easily lost.
- (2) The information of materials is not updated.
- (3) The information of suppliers cannot be easily found.
- (4) The information of materials were not classified into categories.
- (5) The information of past projects were not summarized.

2.3 Existing System

The existing consultant management system is a manual system which consists of 2 parts, which are estimation part and project control part. The first part is responded by office staffs who will contact the suppliers to gather information of material and collect the data from past projects. This information is mostly kept on the paper, so it can be lost very easily. The information is used for project estimation of which calculations and report preparation are done using MS Excel spreadsheet program.

Construction site's staff responds to the latter part by using the data that are in the form of paper document to create progress report and variation work report.

III. THE PROPOSED SYSTEM

3.1 System Specifications

Arun Chaiseri Consulting Engineers Co., Ltd. requires an effective Consultant Management Information system, which can solve the problems that occur in the existing system and can facilitate the processes of consultant management.

In order to achieve the goal, the proposed Consultant Management Information system should have the component as follows:

- (1) Supplier Database should be designed to keep the information of suppliers, from which all concerned staff can get the same and accurate information.
- (2) Material Database is designed to support estimated engineers, site engineers and project engineers to get the accurate data and to classify the material data into categories. These will help the engineers to select the right material for specific conditions.
- (3) Contractors and Labor Cost Database is developed to keep the information of contractor companies and their labor cost that depends on the materials.
- (4) Project Database is designed to record the information of projects such as project summary, progress of project, project estimation. This database needs to be updated monthly by project engineers who stay at construction sites. They can access remotely from their sites to the database to update the progress of project. The Project Database can also facilitate the construction manager and company board to get the latest update about the project.

3.2 System Design

3.2.1 System Processes

The proposed system is designed to control the major activities of consultant management system consisting of the following processes:

Process 1: Supplier Information

The process Supplier Information will obtain the information of suppliers and record it to supplier database. These will keep the details of suppliers such as supplier name, address, telephone number, supplied material, name of salesman. When staff contacts supplier's salesman and get the information. He records the information to database and other staffs can retrieve the data from the database. This process contains the branch processes that are Insert, Delete and Update. The process does not need to be updated frequently except when suppliers change their information.

Process 2: Update Material

The process Update Material will be integrated with process Supplier Information. The information between suppliers and materials are linked together. When an engineer wants to search some material details to estimate or to find the material specification that meet to the design requisition, if the specification does not have enough detail he can inform to supplier and request it. The process receives raw data from a supplier and Contractor Company. The information will be kept in the material database that can be classified to detail of material and price.

Process 3: Update Contractor and Labor Cost

This process will record the detail of contractor company and labor cost. The labor cost will be integrated with material name so the engineer will know the labor cost for this material of each company. The process will have branch processes that are

Insert, Update and Delete process. The data will be kept into the Contractor and Labor Cost database.

Process 4: Create Report and Estimation

This process will get the data from Supplier Database, Material and Contractor Database and Labor Cost Database. Engineer will obtain the data from all databases to clarify the accurate and suitable data for the project. When he verifies all the suitable data, he will send it back to the process to create the estimation report or change order report. Another function is creating progress report and sending it to the owner. This function is responsible by Project Engineer; he will access the data from construction site to database server, which is settled at head office, to update the project data. He will retrieve the data of previous month from database and update the data. Then he sent the data to the process to create the progress report.

3.2.2 Proposed Database

A proposed database system for the Consultant Management Information System provides several benefits as follows:

- (1) Increasing data accessibility for users to extract needed information from the data resources.
- (2) Improving data quality by reducing data duplication and redundancy.
- (3) Improving data control with more consistency in data description.
- (4) Improving data security by preventing unauthorized person access to data.

Database design of the proposed system is carried out and the file specifications are given in Appendix D.

3.2.3 Process Specification

Process specification provides further description of elementary-level processes. This is shown in Appendix C.

3.2.4 Structure Chart

A structure chart is a graphical tool that divided the program into smaller modules. It focuses on the process themselves. It proposed a very small module of programming constructs for developing code. This is shown in Appendix D.

3.2.5 Data Dictionary

Data Dictionary defines the meaning and components of terminator, data stored and data flow. This is shown in Appendix B.

3.2.6 Graphical User Interface Design

The graphic user interface designs are creating the input screen and outcomes of the input for the system. This is shown in Appendix E.



3.3 Hardware and Software Requirements

Table 3.1. The Hardware Specification for Server.

Hardware	Specification
CPU	Pentium III 866 MHz, or higher
Cache	512 KB Level 1
Memory	128 MB or Higher
Hard Disk	20 GB or higher
CD-Rom Drive	50x
Floppy Drive	1.44 MB
Network Adapter	Ethernet 10-Base T
Display Adapter	32 MB SVGA cards
Display	17" Flat Screen
UPS	1000 VA
Printer	Laser printer

Table 3.2. The Software Specification for the Server.

Software	Specification
Operating System	Microsoft Windows 2000
Database Server	Microsoft SQL Server 7.0
Development Tools	Microsoft Access 97 and MS Visual Basic

Table 3.3. The Hardware Specification for Each Client Machine.

Hardware	Specification
CPU	Celeron 600 MHz, or higher
Cache	128 KB
Memory	64 MB or Higher
Hard Disk	8.4 GB or higher
CD-Rom Drive	50x
Floppy Drive	1.44 MB
Network Adapter	Ethernet 10-Base T
Display Adapter	SVGA Card
Display	15" Flat Screen

Table 3.4. The Software Specification for Each Client Machine.

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

3.4 Security and Control

User Access Control (Authentication)

The system selects ID/Password system to protect unauthorized person. Every user who wants to access via the network will be given an Identification Number (ID), User name and password for accessing to server and system. The user will be asked for the user's login and password when he accesses into the system. The system permits only authorized person to access the system. This is the network security.

Data Access Control

All the data can be updated or maintained by authorized users who are allowed to access to the system and programs. These are not for all users to do, normal users can access to system and program for retrieving the data. For the updating and maintenance parts, some staffs have the authorization to edit the data and system. This is the data security control policy.

Back up and Recovery

Back up all files when the database files are updated and modified. The back up should be done within that day and keep all files separately in the safe place.

Other Control

The server computer will be kept in air-conditioned room that controls temperature and humidity. The air-conditioned equipment must operate by using emergency electricity. This will protect the fault that may occur from normal electricity.

Ensure that users get adequate training on the use of computer.

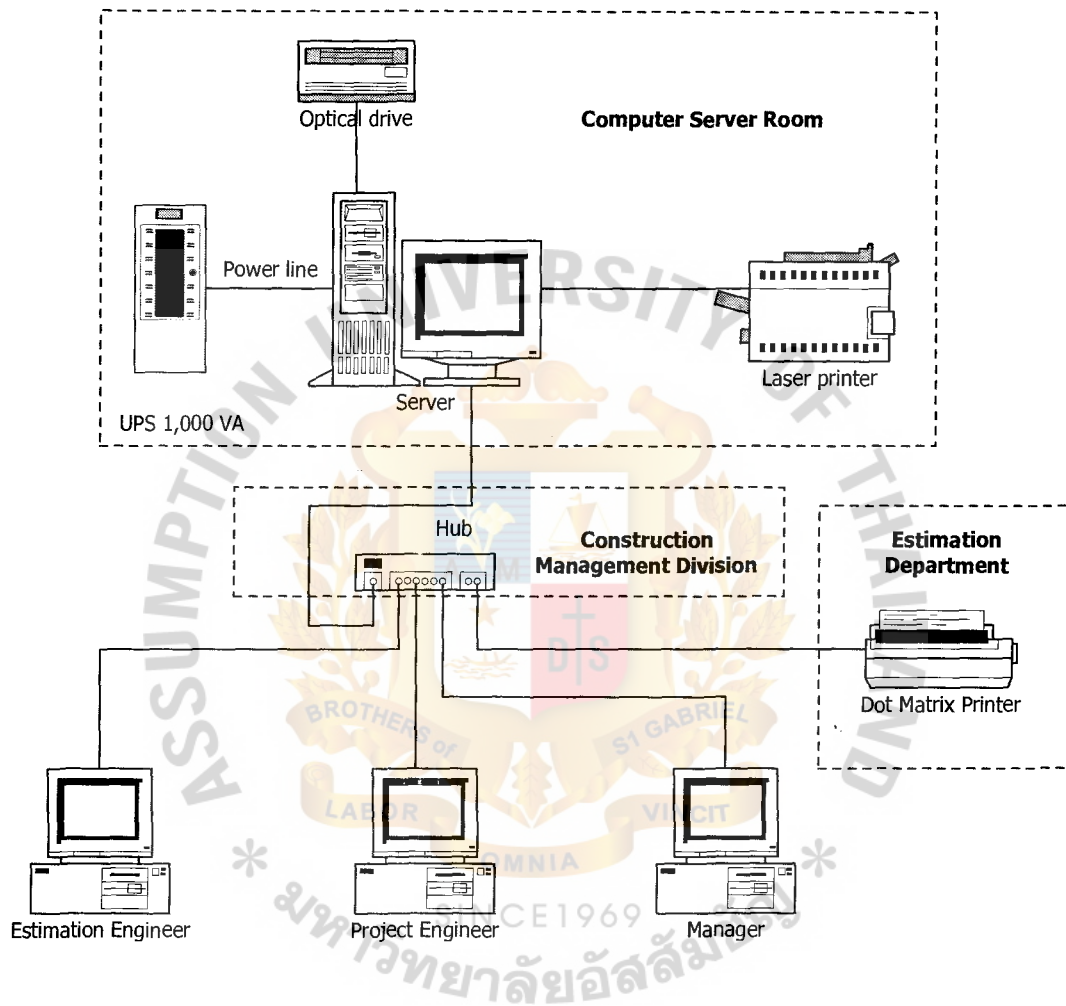


Figure 3.1. Hardware Configuration of the Proposed System.

3.5 Cost and Benefit Analysis

3.5.1 Cost Analysis

(1) Investment Cost

(a) Hardware Cost

1 set of Server	150,000	Baht
3 sets of PC Client (@ 45,000)	135,000	Baht
1 set of UPS 10,000 VA	10,000	Baht
4 sets of Ethernet LAN Cards	6,000	Baht
UTP Cable	10,000	Baht
1 set of JazDrive 2 GB	13,000	Baht
1 set of Digital Camera	34,500	Baht
1 set of Laser Printer	24,500	Baht
1 set of Inkjet Printer	20,000	Baht
Total Hardware Cost	403,000	Baht

(b) Software Cost

MS. Windows 2000	35,000	Baht
MS Windows 98 (3 sets)	20,000	Baht
MS Office 97 (3 sets)	20,000	Baht
Total Software Cost	75,000	Baht

(c) Development Cost

Software Development & Training Cost	100,000	Baht
Total Development Cost	100,000	Baht

Total Investment Cost (403,000+75,000+100,000) = 578,000 Baht

(2) Annual Operating Cost

	Baht/Year
(a) Diskette (High density 3.5" x 10 boxes @ 150.00)	1,500 Baht
(b) JazDisk 1 GB (For Backup)	3,300 Baht
(c) Paper	10,000 Baht
(d) Toner and Inkjet Color toner	30,000 Baht
(e) Ribbon	1,000 Baht
(f) Maintenance Cost	50,000 Baht
(g) Other	30,000 Baht
Total Annual Operation Cost	125,800 Baht

3.5.2 Benefit Analysis

The computerized system provides both tangible and intangible benefits as follows:

Tangible Benefit

- (1) Reducing Overtime Expenses 96,000 Baht

For existing system, the company normally pay overtime wages for 1 engineer and 1 technician about 8,000 baht per month.

The computerized system will reduce the overtime expense around 96,000 baht per year.

- (2) Saving Salary of staff employees 234,000 Baht

Due to the reduction form 4 technicians and 3 engineers to 3 technicians and 2 engineers, the yearly salary cost saving is around 234,000 baht per year.

$(7,500+12,000) \times 12$

Total Saving 330,000 Baht

Intangible Benefits

- (1) Provide accurate information and faster access for better decision-making.
- (2) Improve the efficiency of operation.
- (3) To improve quality of the process.
- (4) To achieve customer satisfaction.
- (5) To reduce the time consuming.
- (6) Making data more rapidly and easier to use and keep.

3.5.3 Calculation of Payback Period

After feasibility analysis of candidate system from candidate system matrix and feasibility analysis matrix (see Appendix G) the candidate solution 2, which has more score than the other, is chosen so payback analysis can be calculated by using candidate solution 2.

Payback period is determined by calculating the number of years required accumulation of earnings sufficiently to cover the cost of the proposed system. The payback period is shown as follows:

$$P = \frac{I}{(1 - T) \times R}$$

P = Payback period (Year)

I = Investment Costs

R = Average annual return on investment (tangible benefit subtracted by operating cost)

T = Tax rate in percentage (30 %)

$$\begin{aligned} P &= \frac{578,000}{(1 - 0.3) (330,000 - 85,800)} \\ &= 3.38 \text{ Years} \end{aligned}$$

Payback period (after tax) for the proposed system is 3.38 years

3.5.4 Calculation of Break Even Year

Break Even Analysis

The concept of break-even analysis is compared between the current system and the new system. The cost of the new system is compared with the existing system to determine which point that the new system cost is equal to the existing system cost.

The Figure 3.2 shows such a break-even analysis, in which the cost of proposed system initially would be higher than the current system. But the slope of new system curve is less steep than the existing system. In 10 months, the new system would have reached the break-even point and thereafter it becomes more economical to operate than the current system.



Cost of the Existing System

Table 3.5. Cost of the Existing System, Baht.

Cost Items	Years				
	1	2	3	4	5
1. Manpower					
- 3 Engineers. 1person @ 12,000	432,000.00	475,200.00	522,720.00	574,992.00	632,491.20
- 4 Technicians. 1 person @ 7,500	360,000.00	396,000.00	435,600.00	479,160.00	527,076.00
- O.T. Payment	96,000.00	105,600.00	116,160.00	127,776.00	140,553.60
12 months x (200 baht x 20 hours + 100 baht x 2 x 20 hours) (10% Increasing/year)					
2. Supplies (paper, etc.)	35,000.00	38,500.00	42,350.00	46,585.00	51,243.50
(10% Increasing/year)					
3. Space Rental	35,000.00	36,750.00	38,587.50	40,516.88	42,542.72
(5% Increasing/year)					
4. Utility	20,000.00	22,000.00	24,200.00	26,260.00	29,282.00
(10% Increasing/year)					
Total	978,000.00	1,074,050.00	1,179,617.50	1,295,649.88	1,423,189.02
Accumulated Cost	978,000.00	2,052,050.00	3,231,667.50	4,527,317.38	5,950,506.39

Table 3.6. Cost of the New System, Baht.

Cost Items	Years				
	1	2	3	4	5
1. Investment Cost	115,600.00	115,600.00	115,600.00	115,600.00	115,600.00
2. Manpower					
- 2 Engineers 1 person @ 12,000	288,000.00	316,800.00	348,480.00	383,328.00	421,660.80
- 3 Technicians 1 person @ 7,500	270,000.00	297,000.00	326,700.00	359,370.00	395,307.00
3. Supplies (paper, etc.)	75,800.00	83,380.00	91,718.00	100,889.80	110,978.78
(10% Increasing/year)					
4. Space Rental	70,000.00	73,500.00	77,175.00	81,033.75	85,085.44
(5% Increasing/year)					
5. Maintenance	50,000.00	55,000.00	60,500.00	66,550.00	73,250.00
(10% Increasing/year)					
4. Utility	50,000.00	55,000.00	60,500.00	66,550.00	73,250.00
(10% Increasing/year)					
5. Training 300 hrs @ 200 baht/hr.	60,000.00	15,000.00	15,000.00	15,000.00	15,000.00
6. Trainers	50,000.00	-	-	-	-
Total	1,029,400.00	1,011,280.00	1,095,673.00	1,188,321.55	1,290,042.02
Accumulated Cost	1,029,400.00	2,040,680.00	3,136,353.00	4,324,673.55	5,614,716.57

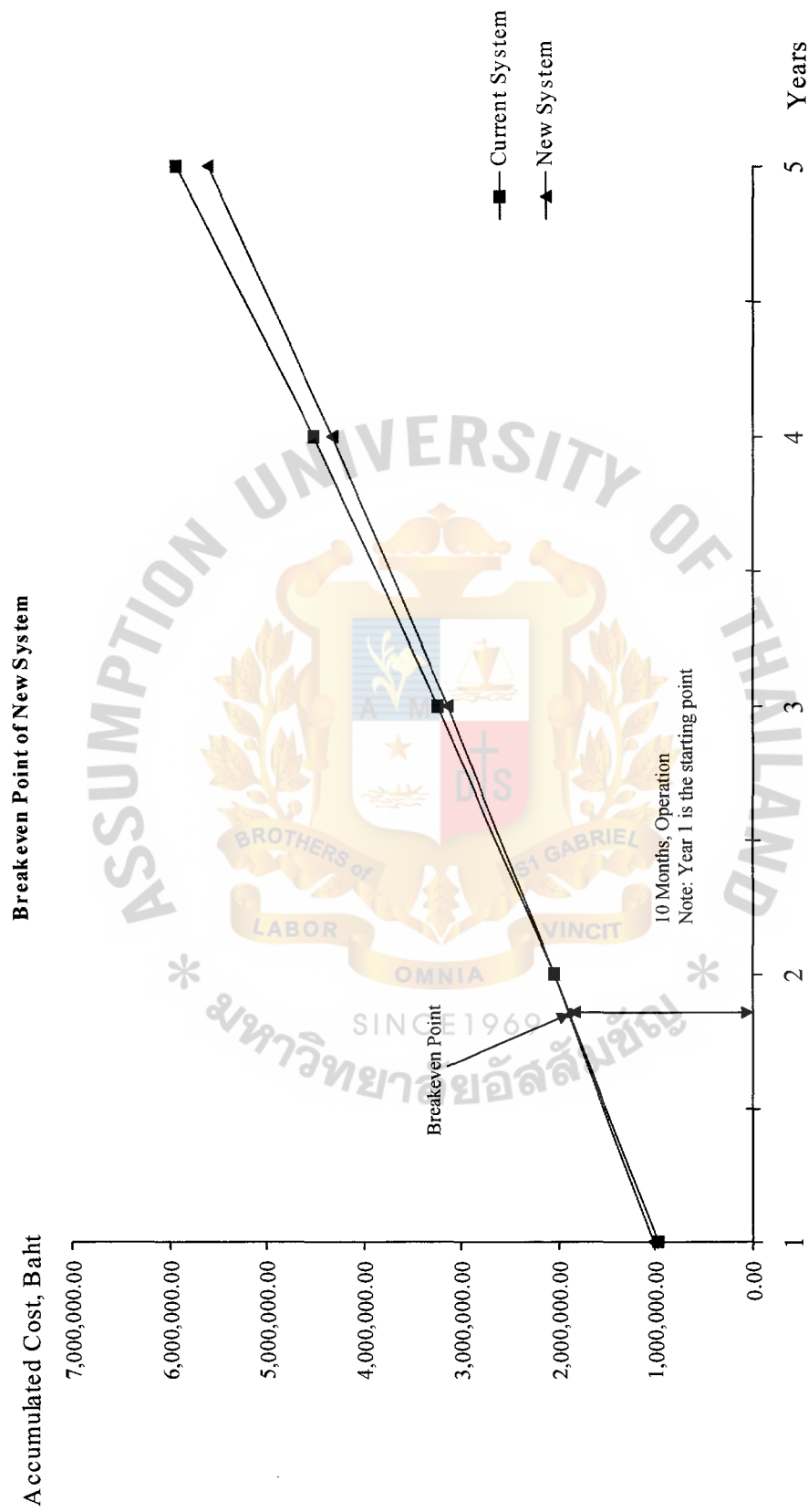


Figure 3.2. Breakeven Point of New System.

Table 3.7. Payback Analysis, Baht.

Cost Items	Years					
	0	1	2	3	4	5
Development cost:	-578,000.00					
Operation & Maintenance Cost (5% increase annually):		-85,800.00	-94,380.00	-103,818.00	-114,199.80	-125,619.78
Discount factor for 12%:	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted costs (adjusted to present value):	-578,000.00	-76,362.00	-75,504.00	-73,710.78	-73,087.87	-71,603.27
Cumulative time-adjusted costs over lifetime:	-578,000.00	-654,362.00	-729,866.00	-803,576.78	-876,664.65	-948,267.93
Benefits derived from operation of new system:		330,000.00	363,000.00	399,300.00	439,230.00	483,153.00
Discount factor for 12%:	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted benefits (adjusted to present value):		293,700.00	290,400.00	283,503.00	281,107.20	275,397.21
Cumulative time-adjusted benefits over lifetime:		293,700.00	584,100.00	867,603.00	1,148,710.20	1,424,107.71
Cumulative lifetime time-adjusted costs + benefits:	-578,000.00	-360,662.00	-145,766.00	64,026.22	272,045.55	475,839.48
Net Present Value:						475,839.48
Return of Investment (ROI):						0.50

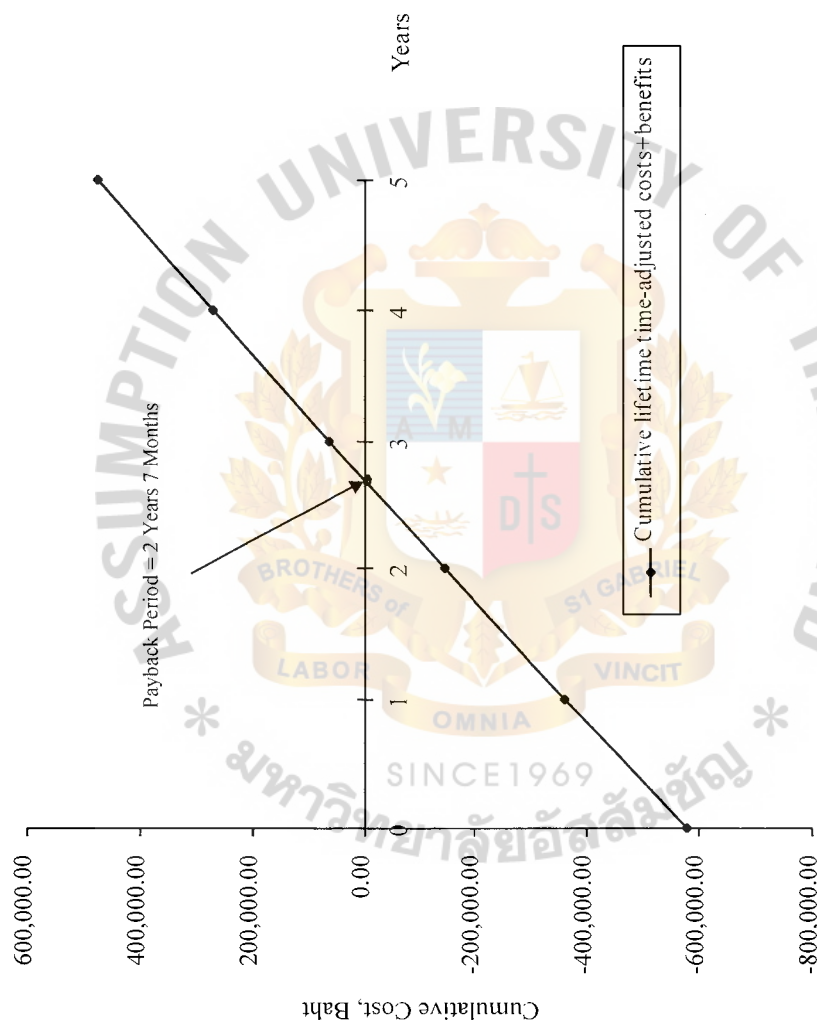


Figure 3.3. Payback Period of Proposed System.

IV. PROJECT IMPLEMENTATION

4.1 Overview of Project Implementation Schedule

The implementation process is set up when the new system is approved. The new process is designed and programmed following the user requirement. The implementation phase of the project includes as following stages:

(1) Coding

Program coding is the first step of the implementation. Coding is the process of writing program instructions that can be run on computer hardware. It transforms the modules to the run-able system. This system uses MS Access 97 and Microsoft Visual Basic to create coding.

(2) Installing the system – Data Conversion

Since the existing system is not computerized system, the installation uses the parallel conversation methods. The method allows users to continue to work without interference during installing the new system. The existing system is still being used without loss the time if some problem or error occurs during installation of the new system.

(3) Documentation

Documents about system programs of the proposed system and the use are developed.

(4) Training

After the installation of the proposed system has been finished, everyone who will be affected by the new system should have an opportunity to participate in the training. If people do not understand the new procedures they will be responsible for conducting or if they are unsure

about how the new system will affect to their job, they will be more likely to sabotage its performance than to make it work.

(5) Testing

The purpose of program testing is to reveal errors in programs. It consists of running a new program, which appears to be working correctly, with sample data. An integrated software testing approach usually consists of several stages, including module testing, program testing, system testing, and acceptance testing. System testing ensures that all programs make up the new system work together. Acceptance testing evaluates whether the new system meets user requirements under normal operating conditions.

4.2 Test Plan and Results

The test is designed to determine whether specific goals and objectives meet the Consultant Management Information System. The primary concern is the compatibility of individual modules that has been designed with different specification for data length, data type and data element name. A complete schedule of testing involves the following:

- (1) Testing individual program of Consultant Management Information System.
- (2) Creating test data. Data testing can be done by creating an extensive set of test data to cover all interconnecting program testing.
- (3) Link/String/Single-Thread testing.
- (4) System/Multiple-Thread testing. System testing is carried out by running the whole system to make sure that the whole system programs run properly and meet the original programming specification.
- (5) Backup and Restart testing.

Testing the program begins after training of the new system functions. The parallel test is the best way to stimulate actual operation of the system. In parallel testing, the proposed system operates along with the existing system, and cross checks system accuracy. The period of parallel running should be tested. Users use the parallel running for 3 months until they confirm that all processes and output reports are correct. The new program is implemented and quit the old one.



V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In the current condition of Thai economic crisis and fierce business competition of the existing manual system is not efficient in coping with general function and fast information system. The reports from manual processing did not finish on time for management decision. Also, the reports are not accurate due to the improper collection of the information.

The computerized system has been designed to solve the problems and the operation efficiency and also to serve every degree of employee's requirements. The information can be retrieved easily whenever it is needed, as well as updating data can be implemented on data redundancy. The Consultant Management Information of the computerized system will create more accurate and up-to-date reports. Moreover, the security of data is controlled therefore data which is accidentally caused by the nature disaster and humans, will not be easily damaged or lost. Besides, the major benefit from this computerized system can reduce the delay time of project. With the computerized system, the company can control the schedule of project on time and the cost of the project. The computerized system saves administration costs as well since fewer personnel will be hired to handle the information system of the company. Although costs in investment period are high, in the long run, it is less than using the manual system as shown in break-even analysis. All the benefits, which the computerized system provides to the users and management, identify that the system can improve the efficiency of the data management to be in a better condition.

Table 5.1. Table of Achievement of Consultant Management Information System.

Process	Manual System	Computerized System
Process Supplier Information.	30 Minutes	10 Minutes
Process Updated Material.	30 Minutes	10 Minutes
Process Update Contractor and Labor Cost.	1 hour	20 Minutes
Process Create Report & Estimation.	2 hours	30 Minutes
Total	4 hours	1 hour 10 Minutes

(1) Process Create Report & Estimation

In the existing system, the Process Create Report & Estimation is the manual process. Users type every detail in this process. The Process Create Report & Estimation is computerized so it reduces the process of typing the detail. It creates the reports automatically.

(2) Other Process

Process Supplier Information, Process Updated Material and Process Update Contractor and Labor Cost are manual processes in the existing system. Users search every detail, create new data manually, and store data manually. The Computerized System, users do some process automatically faster than users in the old system.

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

spends less time than each process of the existing system. This can be concluded that the proposed system is more efficient and effective than the existing system.

5.2 Recommendations

The proposed system is the first step towards computerization. The computerized system can be modified for further expansions easily or more developed further according to user's requirements.

In the future, the information system of Arun Chaiseri Consulting Engineers Co., Ltd. will be implemented online system. When the other department in the company install computers and implement computerized systems, the Consultant Management System can be online to link with the other departments information system by sending the information and reports via the electronic mail or file transfer protocol (FTP). This will reduce more costs of paper usage of the company. Moreover, the company will use the technology of telecommunication to solve the problem at remote site. This will reduce the cost of communication when the remote site is established at the other province that is far away from head office, and can solve the problem that may be occurred instantaneously. Construction manager can follow the progress of work of each site to manage the project schedule.



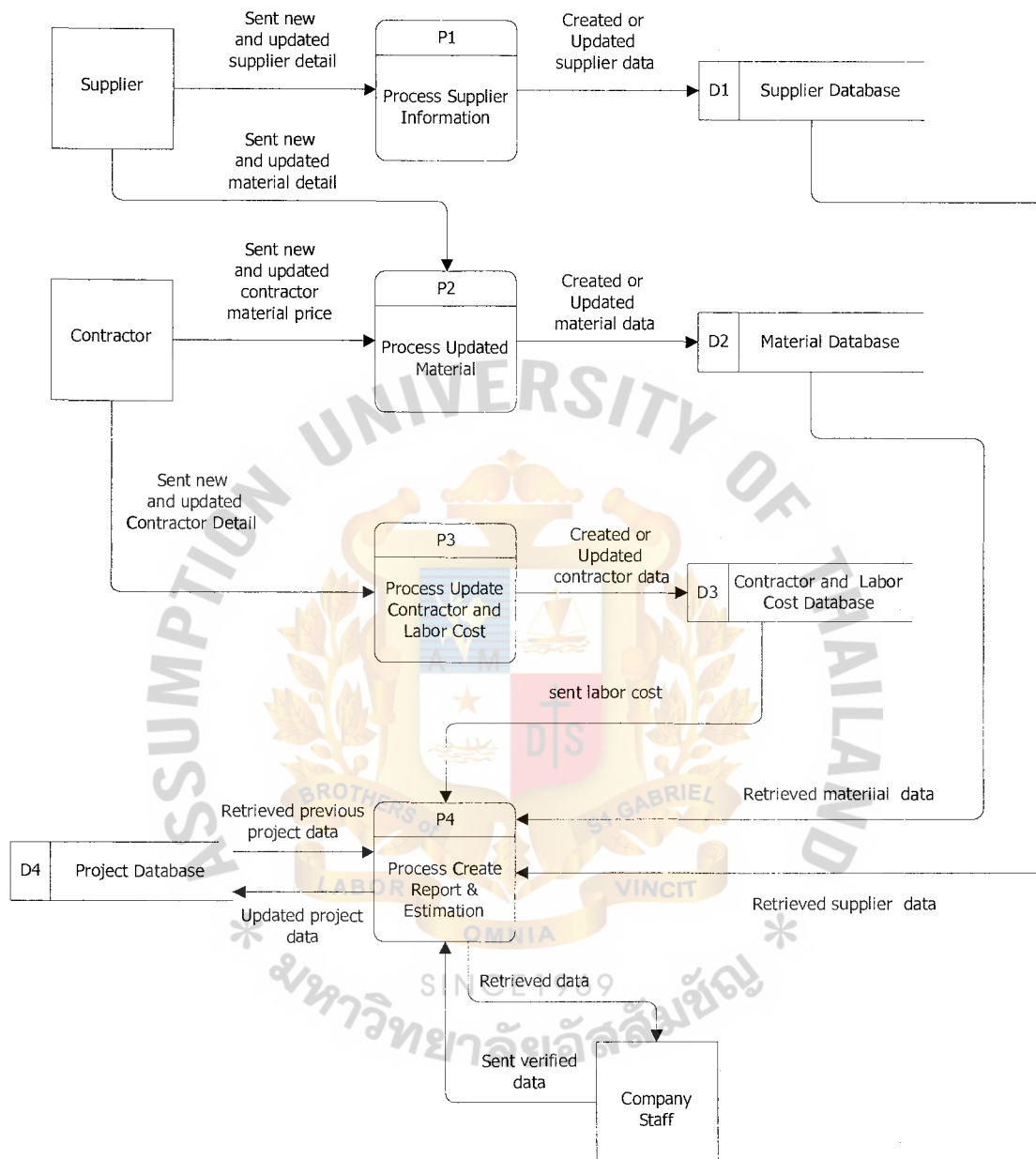


Figure A.1. Data Flow Diagram Level 0 (Proposed System).

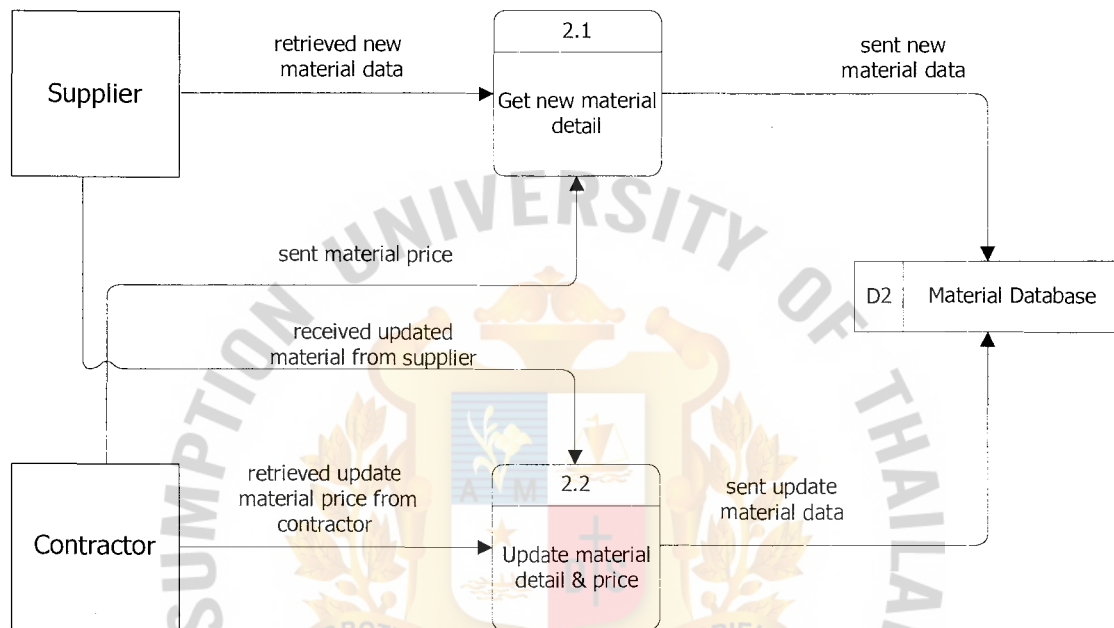


Figure A.2. Data Flow Diagram Level 1: Process 2 Updated Material.

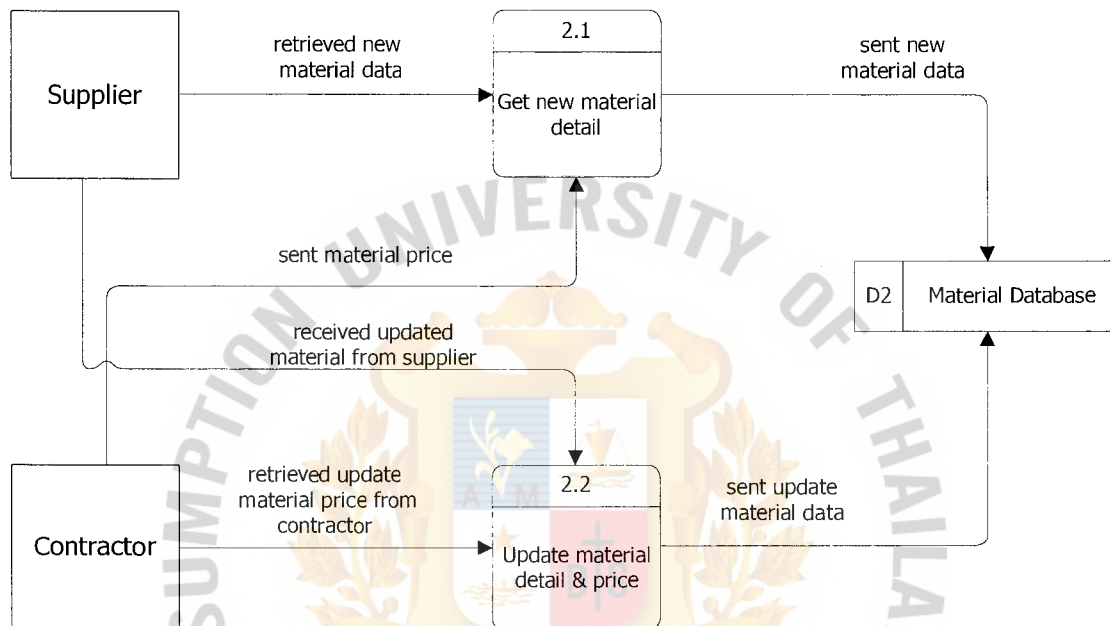


Figure A.3. Data Flow Diagram Level 1: Process 2 Updated Material.

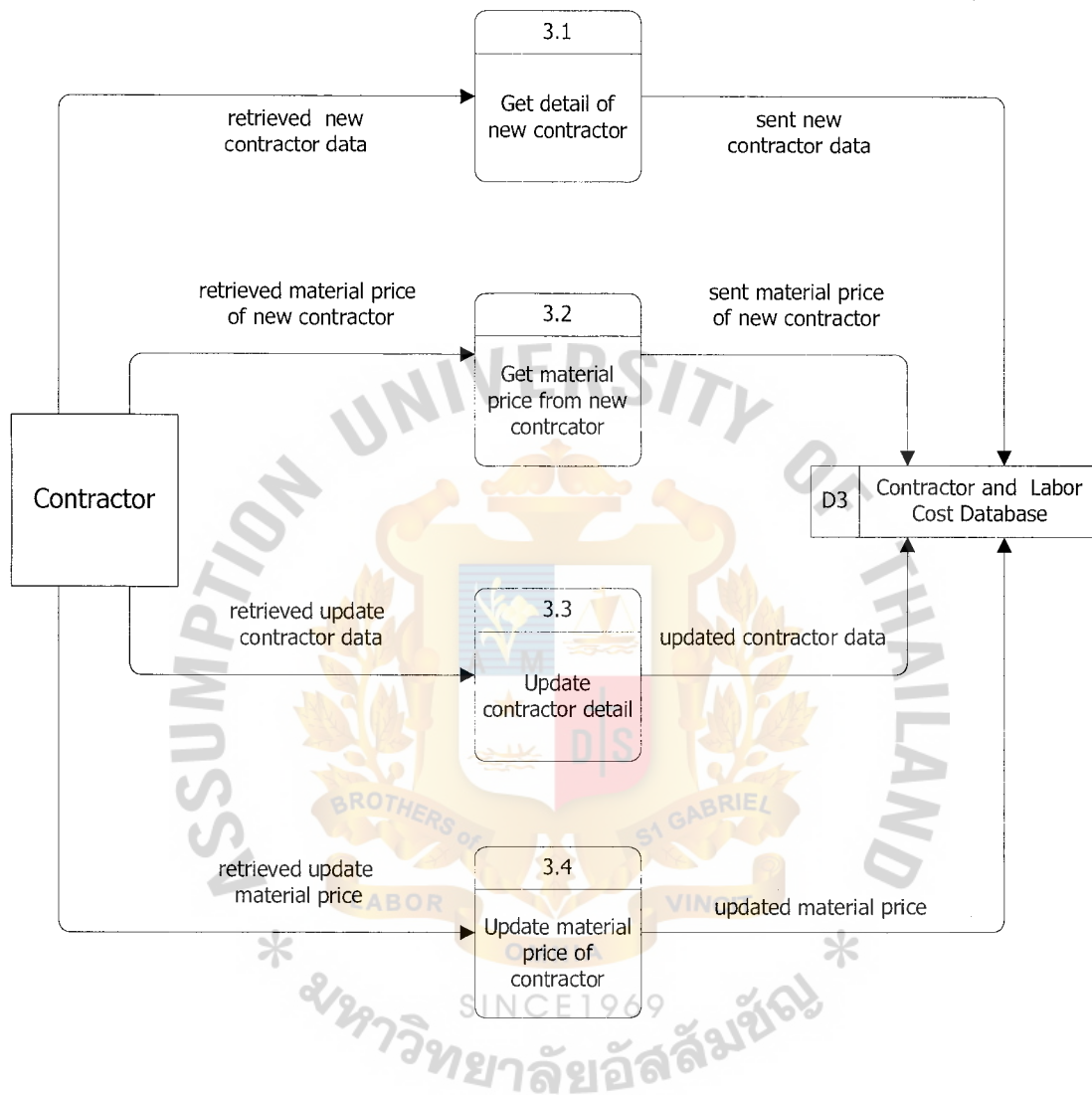


Figure A.4. Data Flow Diagram Level 1: Process 3 Update Contractor and Labor Cost.

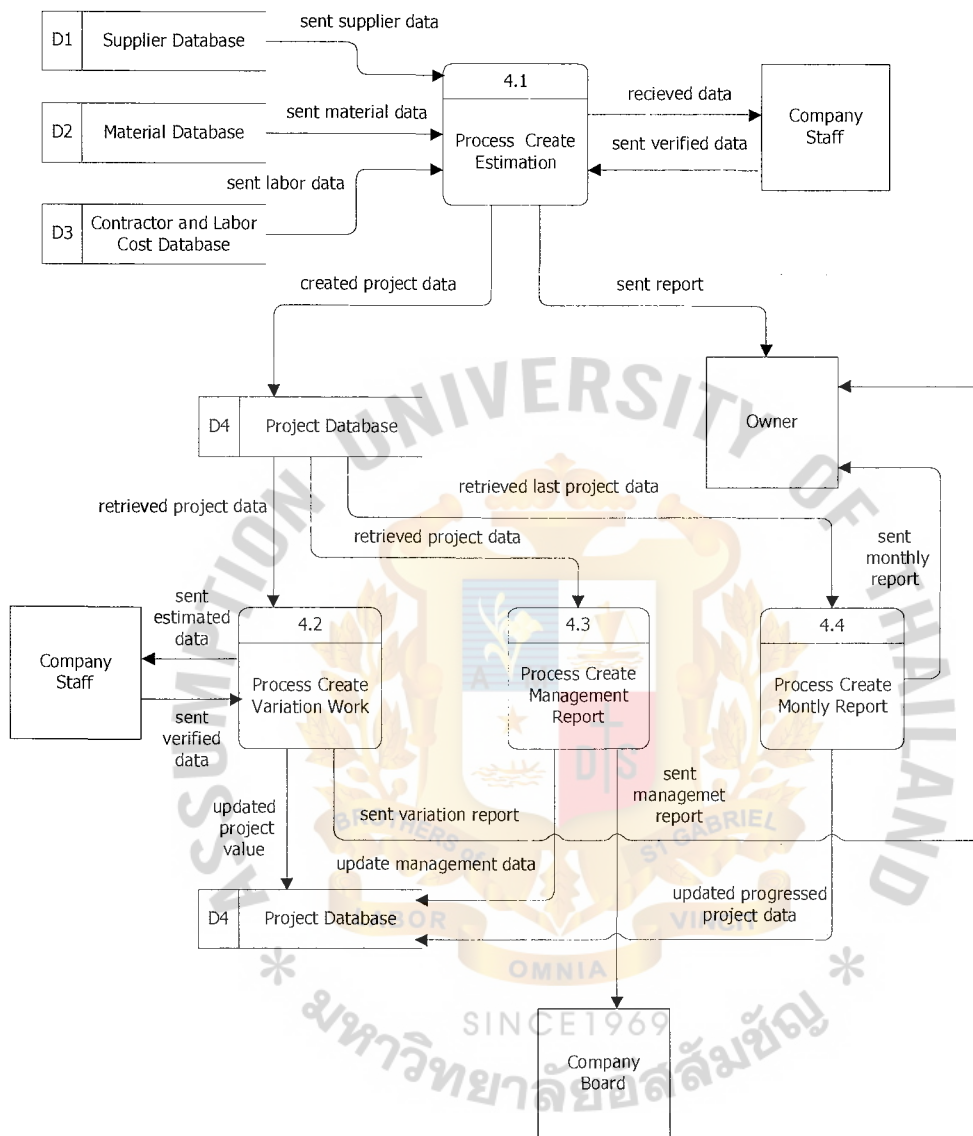


Figure A.5. Data Flow Diagram Level 1: Process 4 Create and Update Report.



DATA DICTIONARY

Table B.1. Data Dictionary of Consultant Management Database.

Field Name	Meaning
Actual Progress	Indicated time of each month that indicate the percent of actual work
Address1	Address of supplier company
Address2	Address of contractor company
Address3	Address of company's staff
Amphur1	Amphur of supplier
Amphur2	Amphur of contractor
Amphur3	Amphur of company's staff
Brand	Brand name of material
Contacted Person1	Name of supplier company's contacted person
Contacted Person2	Name of contractor company's contacted person
Ctr ID	Identification number of contractor company
Ctr_Mat Unit	Unit of material that is supplied by contractor
Ctr_Mat price	Material price of contractor company
Date of revision	Date of project revision
Department	Department of each staff
Est. No.	Identification number of estimation
Est. Project Name	Name of project that is estimated
Fax1	Fax number of supplier
Fax2	Fax number of contractor
Labor Cost	Cost of labor that corresponded to material of each contractor
Mat Desc.	Description of each material
Mat ID	Identification number of material
Mat name	Material name
Name	Name of staff
Project Desc.	Description of project that explain the information of each project
Project ID	Identification number of project
Project Name	Name of project that is occupied by company
Province1	Province of supplier
Province2	Province of contractor
Province3	Province of company's staff

Table B.1. Data Dictionary of Consultant Management Database (Continued).

Field Name	Meaning
Revision No.	Number of project revision
Schedule Progress	Indicated time of main schedule that contractor sent before project start
S_M disc. rate	Discount rate of material price in percentage
S_M unit	Unit of material that is supplied by supplier
S_M price	Price of material that is supplied by supplier
Supplier ID	Identification number of supplier company
Supplier Name	Name of supplier who supplies material
Staff ID	Identification number of staff in company
Surname	Surname of staff
Telephone1	Telephone number to contact supplier
Telephone2	Telephone number to contact contractor
Telephone3	Telephone of company's staff
Zip Code	Zip code of contractor company



APPENDIX C

PROCESS SPECIFICATION

PROCESS SPECIFICATION

Table C.1. Process Specification of Process 1.1.

Items	Descriptions
Process Name:	Get New Supplier Information
Data In:	New Supplier Data
Data Out:	Supplier Record
Process:	(1) Get necessary new supplier data, supplier name, address, phone number, etc. and assign new supplier ID. (2) Record new supplier data into supplier database.
Attachment	(1) Supplier (2) Data Store D1.

Table C.2. Process Specification of Process 1.2.

Items	Descriptions
Process Name:	Get Update Supplier Detail
Data In:	Supplier Data
Data Out:	Supplier Record
Process:	(1) Retrieve the existing data form supplier database. (2) Update the existing supplier data. (3) Record the updated supplier data into supplier database.
Attachment	(1) Supplier (2) Data Store D1.

Table C.3. Process Specification of Process 2.1.

Items	Descriptions
Process Name:	Get New Material Detail
Data In:	New Material Data
Data Out:	Material Record
Process:	<ol style="list-style-type: none"> (1) Get necessary detail of material, material name, material brand, material description, etc. from supplier and assign new ID of material. (2) Get the material price from contractor. (3) Record the new material data into database. (4) Repeat step (1) until the new material data has already been established.
Attachment	<ol style="list-style-type: none"> (1) Supplier (2) Contractor (3) Data Store D2.

Table C.4. Process Specification of Process 2.2.

Items	Descriptions
Process Name:	Update Material Detail and Price
Data In:	Material data from supplier, Material price from contractor.
Data Out:	Material Record
Process:	<ol style="list-style-type: none"> (1) Get update material data and price from supplier and contractor (2) Update the existing material data. (3) Repeat step (1) until all of update material data has been established.
Attachment	<ol style="list-style-type: none"> (1) Supplier (2) Contractor (3) Data Store D2.

Table C.5. Process Specification of Process 3.1.

Items	Descriptions
Process Name:	Get Detail of New Contractor
Data In:	New Contractor Data
Data Out:	Contractor Record
Process:	<ol style="list-style-type: none"> (1) Get new contractor company data, company name, address, telephone etc. and assign new contractor ID. (2) Record new contractor data into contractor database.
Attachment	<ol style="list-style-type: none"> (1) Contractor (2) Data Store D3.

Table C.6. Process Specification of Process 3.2.

Items	Descriptions
Process Name:	Update Contractor Detail
Data In:	Modified Contractor Data
Data Out:	Contractor Record.
Process:	<ol style="list-style-type: none"> (1) Retrieve the existing data from contractor database. (2) Get the update contractor data and modified the record. (3) Record the update contractor into contractor database.
Attachment	<ol style="list-style-type: none"> (1) Contractor (2) Data Store D3.

Table C.7. Process Specification of Process 4.1.

Items	Descriptions
Process Name:	Create Estimation
Data In:	<ul style="list-style-type: none"> (1) Record of Material (2) Record of Labor Cost (3) Verified Material and Labor Cost Data.
Data Out:	<ul style="list-style-type: none"> (1) Data of material price from supplier, contractor and Labor price. (2) Budget of project. (3) Estimation Report.
Process:	<ul style="list-style-type: none"> (1) Get the record of material price and labor cost from material database and contractor database. (2) These data will be verified by company staff to find the suitable price of each project. (3) If the value of project is not suitable, repeat step (1) until the requirement of project has been established (4) Keep the record into the project database. (5) Create the estimation report to owner.
Attachment	<ul style="list-style-type: none"> (1) Company Staff (2) Owner (3) Data store D2 (4) Data store D3 (5) Data store D4

Table C.8. Process Specification of Process 4.2.

Items	Descriptions
Process Name:	Create Variation Work
Data In:	(1) Project Data (2) Verified Variation Work Data.
Data Out:	(1) Estimated Variation Data (2) Updated Project Data (3) Variation Report
Process:	(1) Retrieve existing project data and sent it to company staff at construction site. (2) Staff will add the new variation work of each site. (3) Update the project value in project database. (4) Sent the variation work report to the owner
Attachment	(1) Company Staff (2) Owner (3) Data store D4

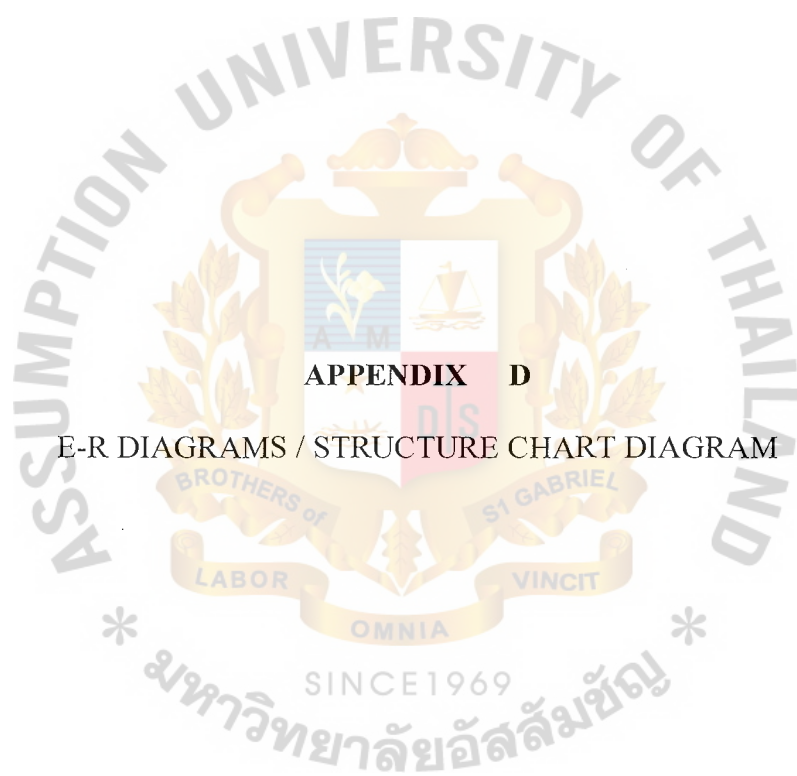
Table C.9. Process Specification of Process 4.3.

Items	Descriptions
Process Name:	Create Management Report
Data In:	Project Data
Data Out:	(1) Update Project Data (2) Management Report
Process:	(1) Get the detail of each project and the progress of each project that were updated by construction site. (2) Create the management report and sent to company board.
Attachment	(1) Company Board (2) Data store D4

Table C.10. Process Specification of Process 4.4.

Items	Descriptions
Process Name:	Create Monthly Report
Data In:	Existing Project Data
Data Out:	(1) Update Project Data (2) Monthly Report
Process:	(1) Retrieve the last month project data and its progress. (2) Record the updated project data into project database. (3) Send the monthly report to owner.
Attachment	(1) Owner (2) Data store D4





APPENDIX D

E-R DIAGRAMS / STRUCTURE CHART DIAGRAM

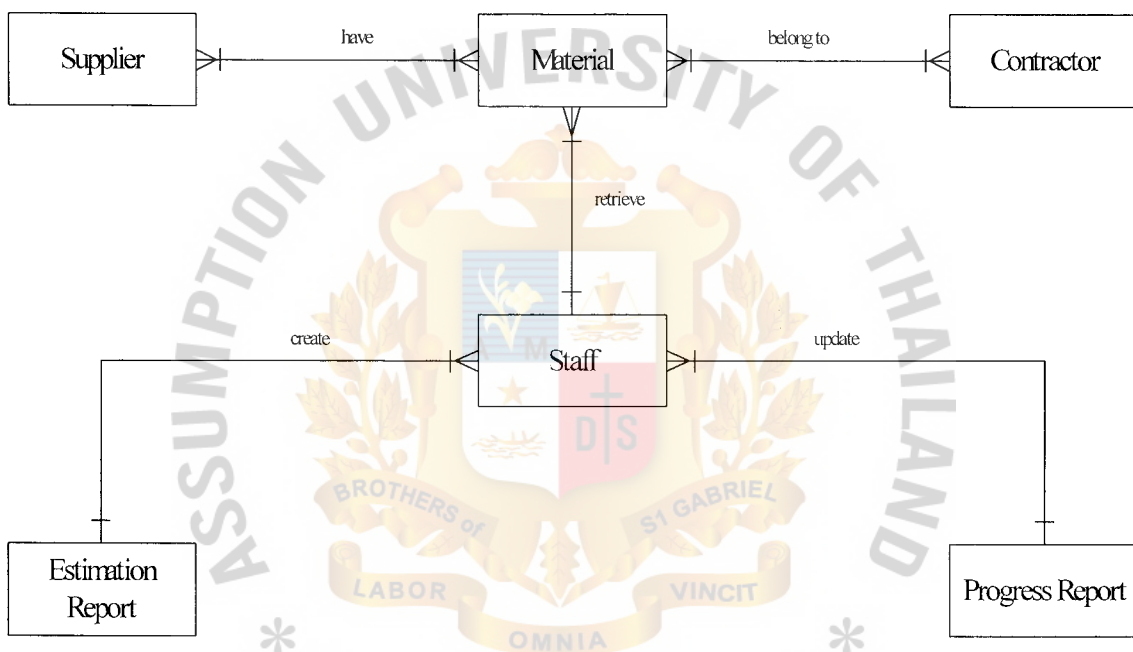


Figure D.1. Context E-R Diagram.

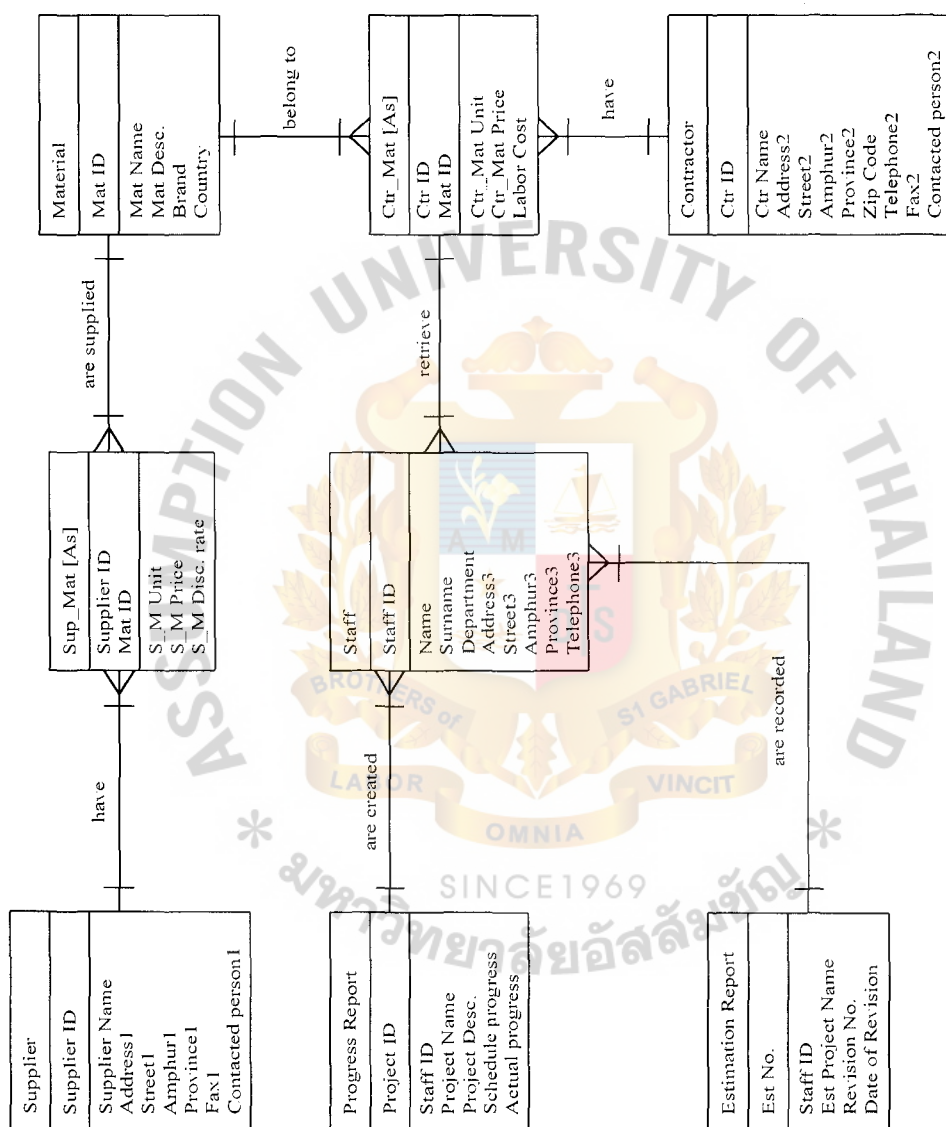


Figure D.2. Fully Attribute E-R Diagram.

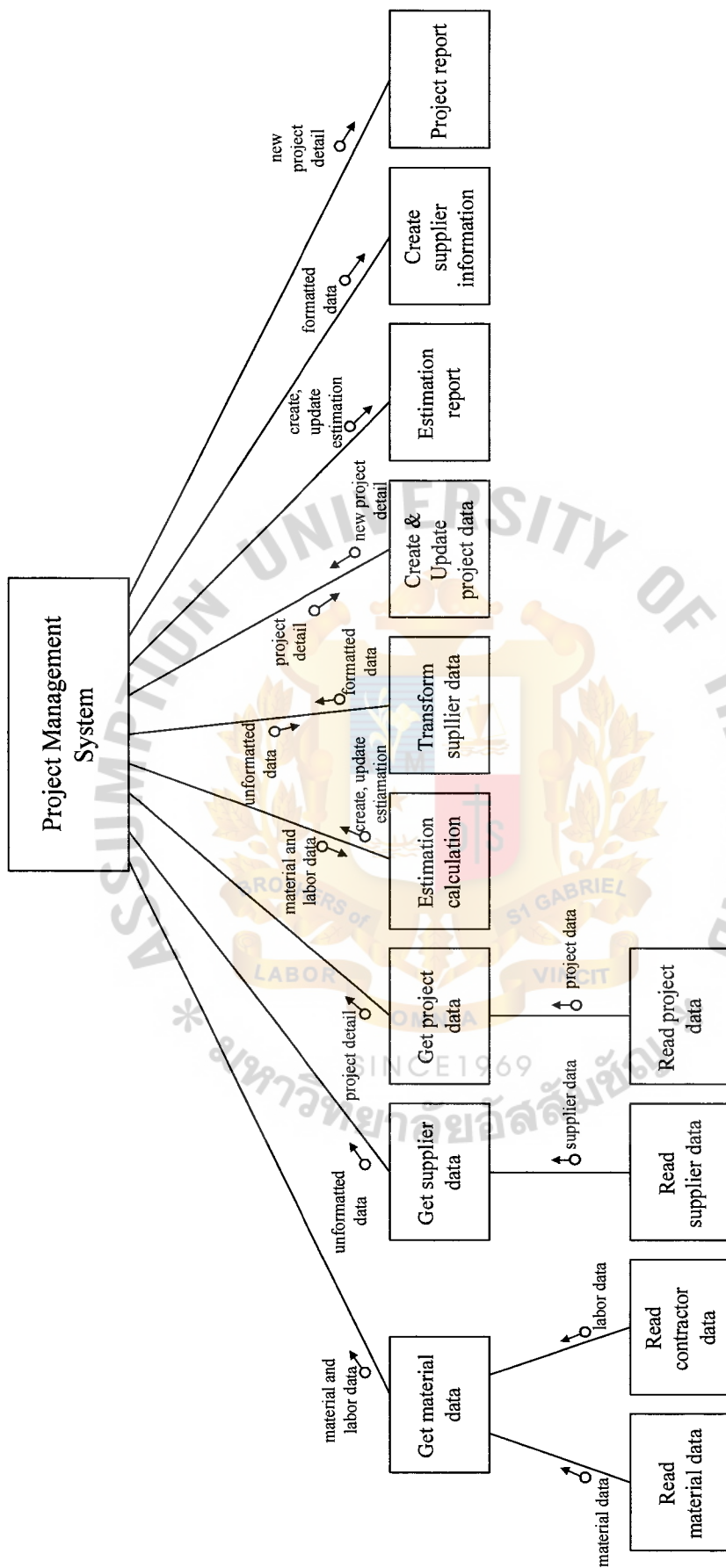


Figure D.3. Structure Chart of Project Management.



APPENDIX E

USER INTERFACE DESIGN

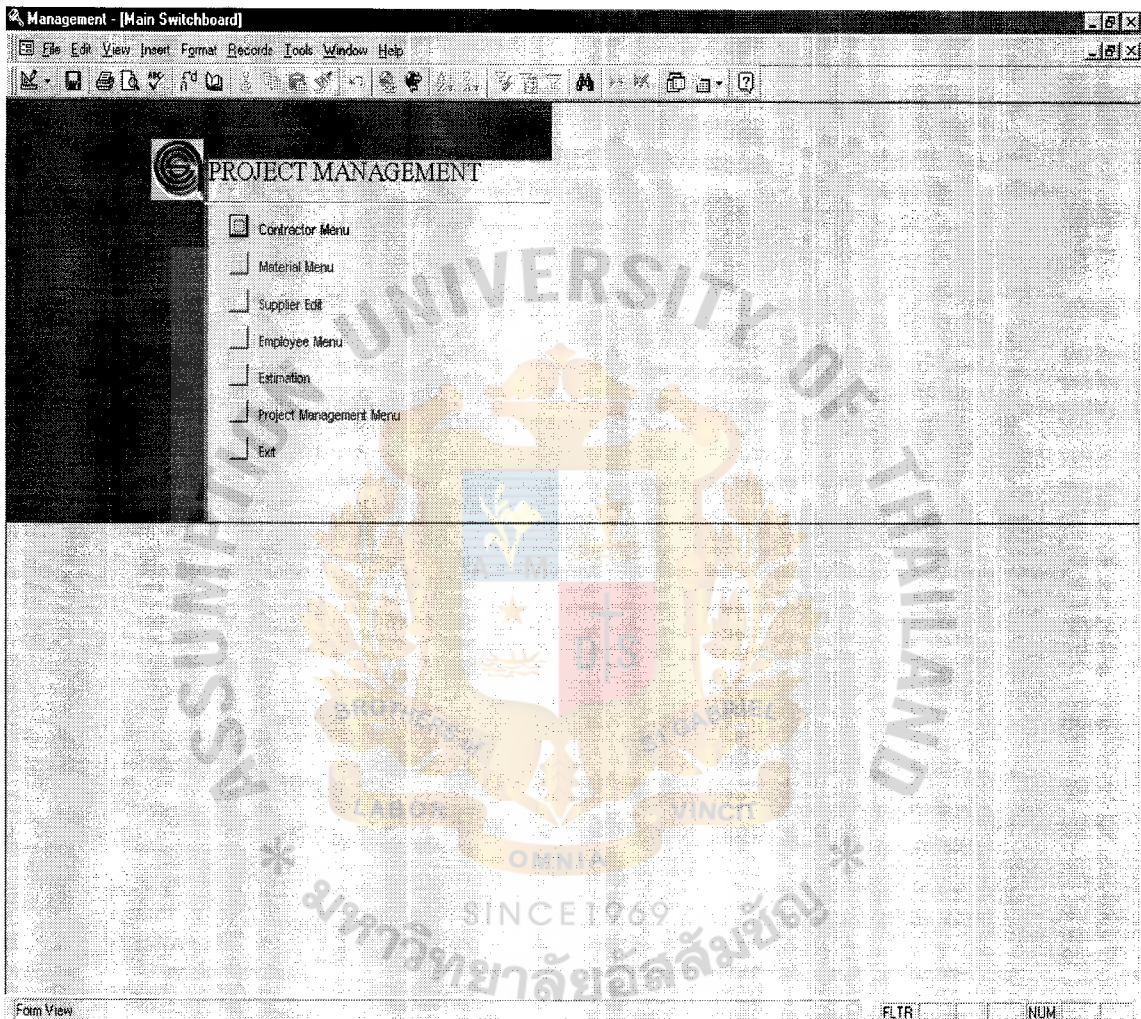


Figure E.1. Main Menu Screen.

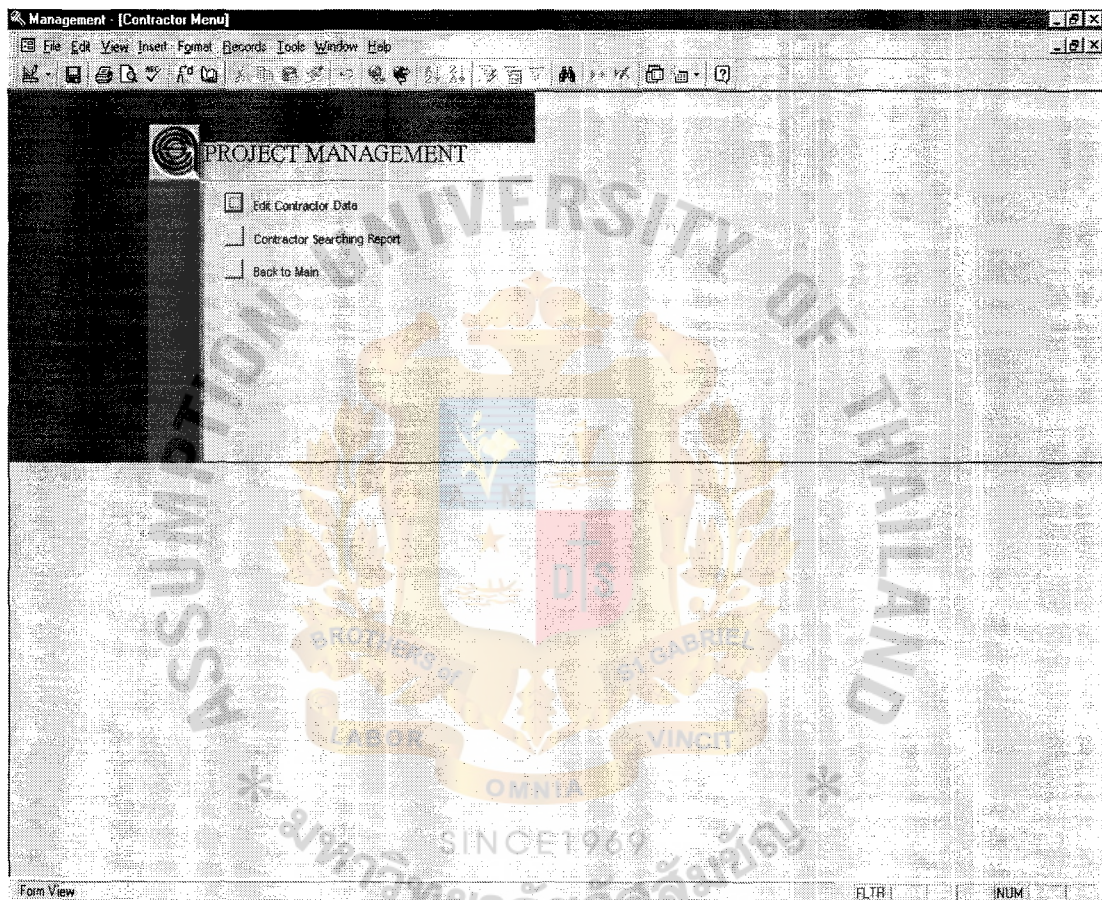


Figure E.2. Contractor Menu Screen.

Management - [Contractor]

File Edit View Insert Format Records Tools Window Help

Ctrl ID:

Company Name: บริษัท เบญจมาศ จำกัด

Type: Main

Address: 555 ซ. ร่มจิตต์ อ.ราชสีห์

Amphur: ภูเก็ต

Province: กรุงเทพฯ

Telephone: 6694040

Fax: 6694020

Contacted person: คุณจรูญ จันทร์จำรัสแสง

Material	Material Name	Unit	Material Price	Labor Price
P0001	PVC pipe dia 1/4"	m.	23.00	8.00
A0001	Ceramic Tile 4"x4"	Sq.m.	420.00	150.00
A0002	Ceramic Tile 8"x8"	Sq.m.	450.00	150.00
A0003	Ceramic Tile 12"x12"	Sq.m.	470.00	150.00

Record: 1 of 8

Add Save Delete Exit

Start Management - [Contractor] 12:38

Figure E.3. Input Contractor Data Screen.

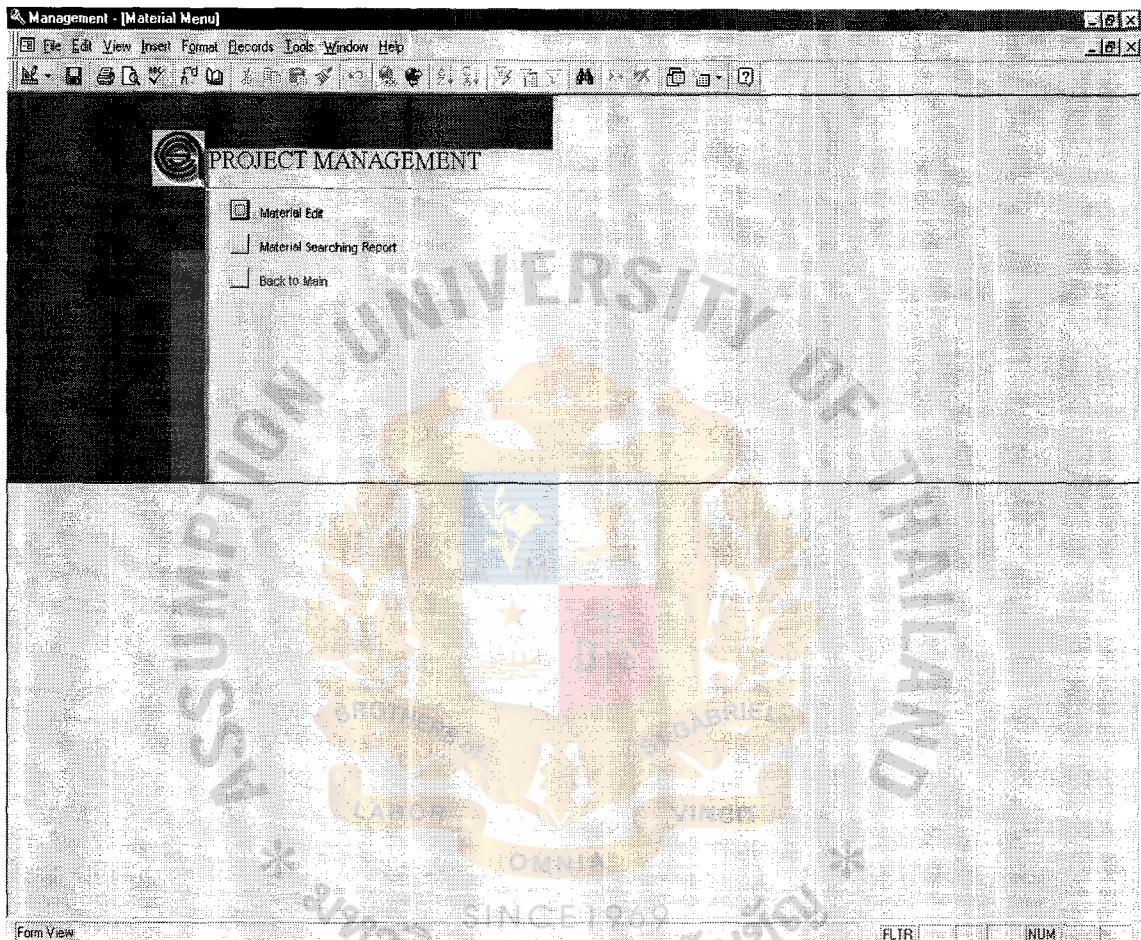


Figure E.4. Material Menu Screen.

Management - [Material]

File Edit View Insert Format Records Tools Window Help

Mat ID: A0001

Material Name: Ceramic Tile 4"x4"

Description: กระเบื้องปูพื้นและผนังสีมาตรฐานขนาด 4 นิ้ว

Previous Next Add Save Delete Exit

Record: 1 of 23

Form View

NUM

Figure E.5. Material Input Screen.

Management - [Supplier]

File Edit View Insert Format Records Tools Window Help

Supplier ID: 1

Supplier Name: IFC System Co.,Ltd.

Address: 600/893 Sevalee Village.

Street: Phaholyothin79

Amphur: lamlookga

Province: bangkok

Telephone: 9920157-9,9920168-9

Fax: 9920170

Contacted Person: กิตติศักดิ์ เจริญรัตน์

Brand: Soanchem

Material	Material Name	Unit	Unit Price	Discount Rate	Net Price
S0001	Polyurethane floor coating DVL-6000	Sq.m.	2,000.00	%	1,700.00
*					

Record: 1 of 1

Previous Next Add Save Delete Exit

Record: 1 of 6

Form View

NUM

Figure E.6. Supplier Input Screen.

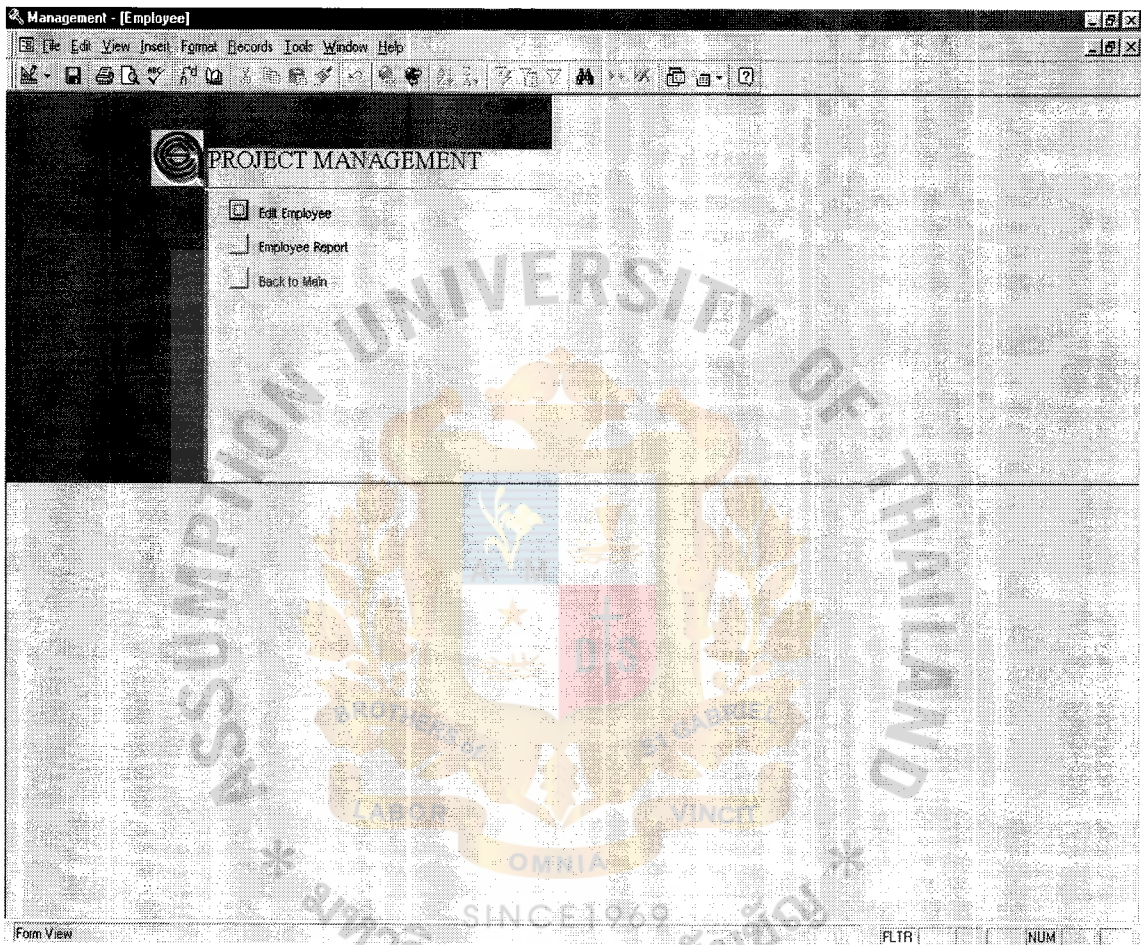


Figure E.7. Employee Menu Screen.

Management - [Employee]

File Edit View Insert Format Records Tools Window Help

Employee ID: CM3702

Name: Ponthep

Surname: Rukwong

Address: 11/45 Soi Ladprao 1

Street: Ladprao

Amphur: Jatujak

Province: Bangkok

Zip Code: 10900

Department: CM

Position: Construction Manager

Phone:

Emp. Project subform

Project No	Project Name	Status	Work Description
1	โรงพยาบาลกรุงเทพหาดใหญ่	Construction Manager	ตรวจสอบงานโครงสร้าง
2	สถาบันพัฒนาฝีมือแรงงานกลาง	Construction Director	ช่วยตรวจสอบแบบโครงสร้าง

Record: 1 of 2

Add Save Delete Close

Record: 1 of 6

Form View

Figure E.8. Employee Input Screen.

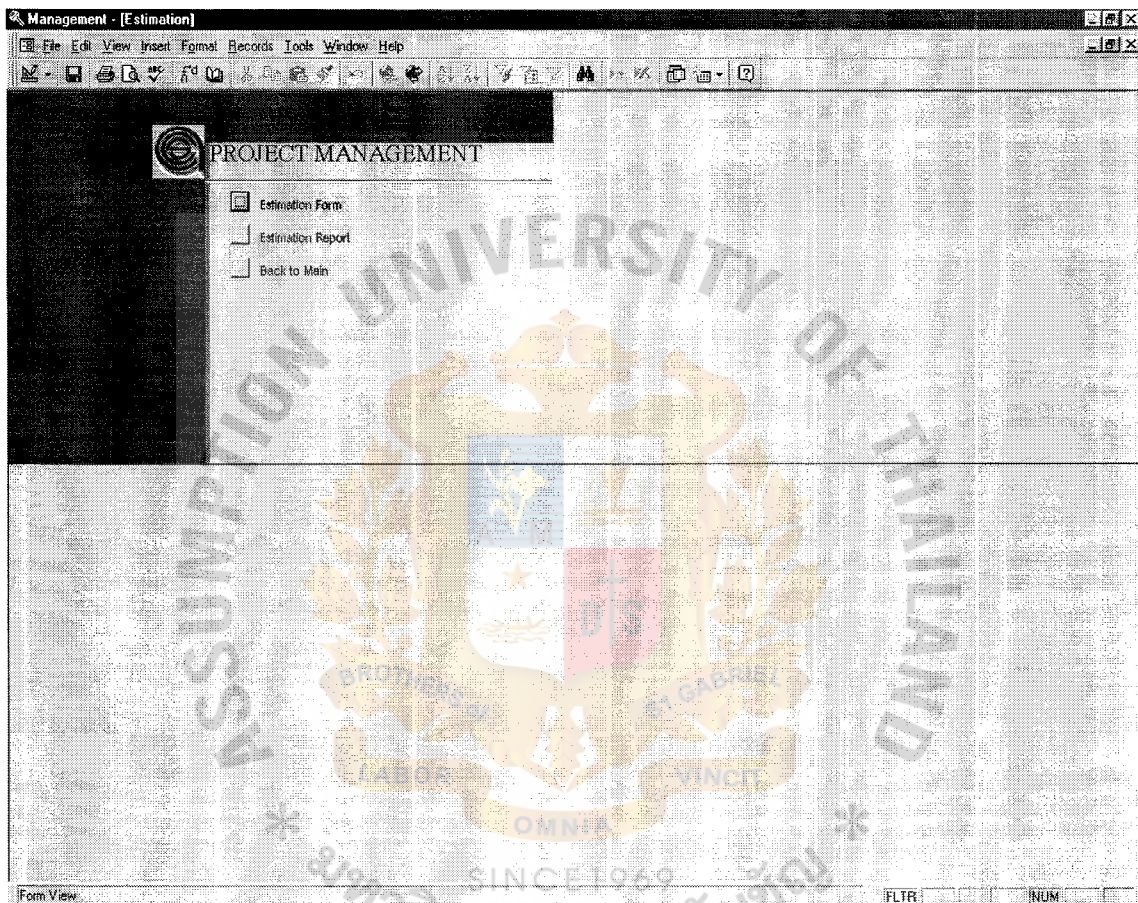


Figure E.9. Estimation Menu Screen.

Management - [Estimation]

File Edit View Insert Format Records Tools Window Help

Est No: 4101
 Ctr No: 2
 Project Name: The Pizza
 Revision No: 0
 Date of revision: 12 /6/ 01
 Project Value: 327,500.00
 Staff Id:

Estimation Query subform

Ctr ID	Mat Name	QTY	Mat Unit	Ctr_Mat	Ctr_Labor	Total
2	Steel Bar SD-40 dia 12 mm.	5 ton		12,000.00	2,000.00	70,000.00
2	Ceramic Tile 8"x8"	100 Sq.m.		410.00	160.00	57,000.00
2	Ceramic Tile 4"x4"	200 Sq.m.		400.00	160.00	112,000.00
2	Ceramic Tile 12"x12"	150 sq.m.		430.00	160.00	88,500.00

Record: 1 of 4

Form View

Figure E.10. Estimation Input Screen.

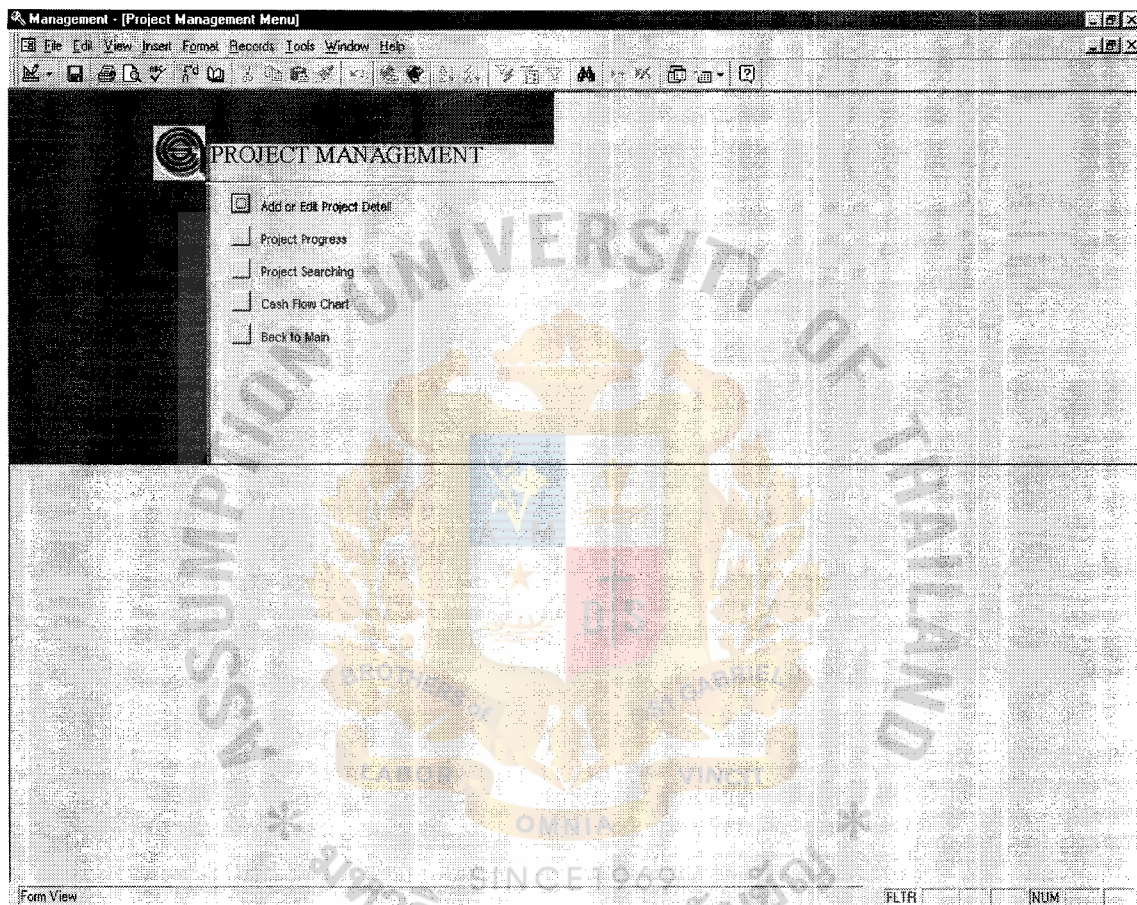


Figure E.11. Project Menu Screen.

Management - [Project]

File Edit View Insert Format Records Tools Window Help

Project ID: 3

Project Name: สถาบันพัฒนาฝีมือแรงงานกลาง

Address:

Street: อาคารพิเศษโครงการ 3

Amphur: บางพลี

Province: สมุทรปราการ

Owner: กรมพัฒนาฝีมือแรงงาน

Owner Address:

Structure Designer: SPA Architecture Co.,Ltd.

Architecture Designer: SPA Architecture Co.,Ltd.

MEE Designer: SPA Architecture Co.,Ltd.

Start Date: 01-Oct-99 Total Day: 739

End Date: 08-Jul-01

Project Progress

Month: 1/7/99

Main Schedule (%): 0.00

Actual Schedule (%): 0.00

Accumulated Day: 0

Remaining Day: 739

Extension Day: 0

Record: 14 | 2 | of 2

Form View

Piling Contractor:

Piling Value: 0.00

Structure Contractor:

Structure value: 0.00

Architecture Contractor:

Architecture Value: 0.00

MEE Contractor:

MEE Value: 0.00

Project Value: 395,000,000.00

Project Progress

80

60

40

20

0

Jul '99

Sep '99

Nov '99

Jan '00

Mar '00

May '00

Jul '00

Sep '00

Nov '00

Jan '01

Sum Of Main Schedule

Sum Of Actual

Figure E.12. Project Data & Project Progress Input Screen.



Contractor Finding Result				
Company Name				
บริษัท เบญจมาศ จำกัด.				
Type	Telephone	Fax	Contacted person	
Main	6694040	6694020	คุณเจริญ จันทร์จรัสแสง	

Figure F.1. Contractor Searching Result Screen.

Employee Report

Project Name โรงพยาบาลกรุงเทพหาดใหญ่

Project End 30/6/2541

Position	Name	Surname	Status
Construction Manager	Pornthep	Rukwong	Construction Manager
ME&E Eng.	Chanin	Boonyathorn	Mechanical Engineer
ME&E Eng.	Suwat	Ngamngon	Electrical Engineer

Project Name สถาบันพัฒนาฝีมือแรงงานกลาง

Project End 8/7/2544

Position	Name	Surname	Status
Arch Technician	Pithan	Srirawat	Arch. Technician
Construction Manager	Pornthep	Rukwong	Construction Director
Resident Eng.	Pitarn	Thammarak	Resident & Structure Eng.
Structure Technician	Songkram	Pewngam	Structure & Architect

Figure F.2. Employee of Each Project Report.

Estimation Report

Estimation No. 4101

Project Name The Pizza

Revision No 0

Date of reivision 12-มิ.ย.-44

Project Value 327,500.00

Material Name	Q'TY	Unit	Material Price	Labor Price	Total
Ceramic Tile 12"x12"	150	sq.m.	430.00	160.00	88,500.00
Ceramic Tile 4"x4"	200	Sq.m.	400.00	160.00	112,000.00
Ceramic Tile 8"x8"	100	Sq.m.	410.00	160.00	57,000.00
Steel Bar SD-40 dia 12 mm.	5	ton	12,000.00	2,000.00	70,000.00
				Total	327,500.00

Figure F.3. Project Estimation Report.

Management Report

Project Name	Remaining Day	Main Schedule %	Actual Schedule %
โรงพยาบาลกรุงเทพหาดใหญ่	607	0.00	0.00
	577	2.20	2.19
	516	3.50	3.48
	485	5.50	5.47
สถาบันพัฒนาฝีมือแรงงานกลาง	739	0.00	0.00
	708	8.10	9.39
	678	11.22	12.52
	647	12.62	13.60
	616	14.01	13.90
	586	14.26	16.45
	555	15.28	18.48
	532	17.31	20.00
	504	18.58	23.41
	473	21.63	26.71
	443	21.88	27.47

Figure F.4. Project Management Report.

Material Searching Report

Material Name	PVC pipe dia 1/2"					
Description	ท่อน้ำ PVC ขนาด 15 มม.					
Brand	Supplier Name	Unit Price	Unit	Discount Rate	Net Price	
Thai pipe	ACME Co.,Ltd	250.00	M.	15.00%	212.50	

Material Name	PVC pipe dia 3/4"					
Description	ท่อน้ำ PVC ขนาด 20 มม.					
Brand	Supplier Name	Unit Price	Unit	Discount Rate	Net Price	
Thai pipe	ACME Co.,Ltd	280.00	M.	10.00%	252.00	

Figure F.5. Material Searching Result Screen.

Project Progress Report

Project Name	โรงพยาบาลกรุงเทพขนาดใหญ่				
Address	Street	เลขที่ 15 Amphur	หน้าใหญ่	Province	สงขลา
Owner	บริษัท โรงพยาบาลกรุงเทพขนาดใหญ่ จำกัด				
Structure Designer:	Actec Co.,Ltd.	Architecture Designer:		Teac Co.,Ltd.	ME&E Designer: Pass Engineering Co.,Ltd.
Piling Contractor	Southern Concrete Co.,Ltd.		Piling Value		22,000,000.00
Structure Contractor	Kay Thai Co.,Ltd.		Structure value		200,000,000.00
Architecture Contractor	Kay Thai Co.,Ltd.		Architecture Value		130,000,000.00
ME&E Contractor	Jardine Matheson Thailand Co., Ltd.		ME&E Value		105,000,000.00
Project Value	460,000,000.00		Project Start	1/11/2539	Project End 30/6/2541
Month	Total Day	Main Schedule %	Actual Schedule %	Remaining Day	Extension Day
1/11/2539	0	0.00	0.00	607	0
1/12/2539	30	2.20	2.19	577	0
1/1/2540	61	3.50	3.48	516	0

Figure F.6. Project Progress Report.

Project Searching Report

Project Name	โรงพยาบาลกรุงเทพหาดใหญ่
Project Value	460,000,000.00
Address	
Street	เพชรเกษม 15
Amphur	หาดใหญ่
Province	สงขลา
Owner	บริษัท โรงพยาบาลกรุงเทพหาดใหญ่ จำกัด
Structure Designer	Actec Co.,Ltd.
Architecture Designer	Teac Co.,Ltd.
ME&E Designer	Pass Engineering Co.,Ltd. & Technic Design Co.,Ltd
Structure Contractor	Kay Thai Co.,Ltd.
Architecture Contractor	Kay Thai Co.,Ltd.
ME&E Contractor	Jardine Matheson Thailand Co.,Ltd.

Figure F.7. Project Searching Report.



APPENDIX G

FEASIBILITY ANALYSIS

Table G.1. Candidate Systems Matrix.

Characteristics	Candidate 1	Candidate 2	Candidate 3
Portion of computerized	Software package would be purchased and customized to satisfy Construction Management functionality.	Material information and project information is fulfilled.	Same as candidate 2.
Brief description of that portion of the system that would be computerized in this candidate.			
Benefits	Time saving and quick implementation because it is in package.	Fully support the requirement of users and saving maintenance cost for long term.	Same as candidate 2.
Brief description of the business benefits that would be realized of this candidate.			
Servers and Workstations	Technically architecture dictates Pentium III, MS Windows 2000, MS SQL for Server and Celeron, MS Windows 98 SE for clients.	Same as candidate 1.	Same as candidate 1.
A description of the servers and workstations needed to support this candidate.			
Software Tools Needed	MS Visual C++ and MS Access for clients to provide report.	MS Access 97 Internet Explorer	MS Visual Basic 6.0
Software tools needed to design and build the candidate (e.g., database management system, emulators, operating system, language, etc.).			
Not generally applicable if applications software packages are to be purchased.			
Application Software	Package Solution.	Custom Solution.	Same as candidate 2.
A description of the software to be purchased, built, accessed, or some combination of			

Table G.1. Candidate Systems Matrix (Continued).

Characteristics	Candidate 1	Candidate 2	Candidate 3
these technique.			
Method of Data Processing	Client/Server.	Same as candidate 1.	Same as candidate 1.
Generally some combination of: online, batch, deferred batch, remote batch, and real-time.			
Output Devices and Implications	(1) HP LAN Laser Jet 5si printer	Same as candidate 1.	Same as candidate 1.
A description of output devices that would be used, special output requirements (e.g., network, preprinted forms, etc.) and output considerations (e.g., timing constraints).			
Input Devices and Implications	Keyboard & Mouse.	(1) Fuji digital camera. Keyboard & mouse.	Same as candidate 2.
A description of input methods to be used, input devices (e.g., keyboard, mouse, etc.) special input requirements (e.g., new or revised forms from which data would be input), and input considerations (e.g., timing of actual inputs).			
Storage Devices and Implications	MS SQL Server DBMS with 80 GB capability.	Same as candidate 1	Same as candidate 1.
Brief description of what data would be stored, what data would be accessed from existing stores, what storage media would be used, how much storage capacity would be needed, and how data would be organized.			

Table G.2. 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. Political. A description of how well received this solution would be from both user management, user, and organization perspective.	30%	Only Support Business requirement and Reports current processes would be modified to take the advantage of software. Score: 65	Fully supports for essential user requirement. Score: 90	Fully supports of user requirement. Score: 95
Technically Feasibility Technology. An assessment of the maturity, availability (or ability to acquire), and desirability of the computer technology needed to support this candidate. Expertise. An assessment of the technical expertise needed to develop, operate, and maintain the candidate system.	30%	The product is newly version in market and new software that is only support for variety business. It has only been on the market for 5 weeks. Majority of product is a risk and company charges any support fee for technical support. Required to IT expertise in C++ to perform modification for integration requirement. Score: 55	The software is an online processing solution that satisfies the requirement of material information and project information. Microsoft Access can create data table and report to fulfill the user requirement. The program can support application programming interface that is MS Visual Basic. Score: 90	MS Visual Basic is the software language and object oriented programming. The language is easy to create application that access to database and good interface for user. Programmers and their staff can easier to learn and support the requirement of users. Score: 95

Table G.2. Feasibility Analysis Matrix (Continued).

Feasibility Criteria	Wt.	Candidate 1	Candidate 2	Candidate 3
Economic Feasibility	30%			
Cost to develop:		Approximately 713,000.00.	Approximately 578,000.00	Approximately 682,800.00
Payback period (discounted):		Approximately 3.21 years	Approximately 2.69 years	Approximately 3.69 years
Net present value:		Approximately 383,994.25	Approximately 475,839.48	Approximately 232,081.12
Detailed calculations:		See Table G.4	See Table G.6	See Table G.8
		Score: 70	Score: 95	Score: 80
Schedule Feasibility	10%	About 2 months	About 5 months	9 - 10 months
An assessment of how long the solution will take to design and implement.		Score: 85	Score: 80	Score: 70
Ranking		65.5	90.5	88

Table G.3. Costs for a Candidate Solution 1, Baht.

Cost Items	Amount
Investment Cost	
Personnel	
1. System Analyst 1 person (50 hours per months x 2 months = 100 hours @ 250 baht/hr)	25,000.00
2. Programmer 2 persons (50 hours/month/person x 1 month = 100 hours @ 150 baht/hr)	15,000.00
3. Database Specialist 1 person (50 hours/month/person x 1 month = 100 hours @ 200 baht/hr)	20,000.00
Expense	
1. Training cost for 4 users (5,000 baht/person)	20,000.00
New Hardware and Software Cost	
1. Hardware cost (Server & Client)	403,000.00
2. Server Software	150,000.00
3. Client Software	80,000.00
Total Investment Cost	713,000.00
Projected Annual Operating Cost	
Personnel	
1. Engineers 2 persons (12,000 baht/month/person)	288,000.00
2. Technician 3 persons (7,500 baht/month/person)	270,000.00
Expenses	
1. Supplies cost (paper, etc.)	55,800.00
2. Space Rental	60,000.00
3. Maintenance cost	20,000.00
4. Utility	45,000.00
5. Training 300 hours (200 baht/hour)	60,000.00
6. Trainers	70,000.00
Total Projected Annual Operating Cost	868,800.00

Table G.4. Payback Analysis of Candidate Solution 1, Baht.

Cost Items	Years					
	0	1	2	3	4	5
Development cost:	-713,000.00					
Operation & Maintenance Cost (10% increase annually):		-75,800.00	-83,380.00	-91,718.00	-100,889.80	-110,978.78
Discount factor for 12%:	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted costs (adjusted to present value):	-713,000.00	-67,462.00	-66,704.00	-65,119.78	-64,569.47	-63,257.90
Cumulative time-adjusted costs over lifetime:	-713,000.00	-780,462.00	-847,166.00	-912,285.78	-976,855.25	-1,040,113.16
Benefits derived from operation of new system:		330,000.00	363,000.00	399,300.00	439,230.00	483,153.00
Discount factor for 12%:	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted benefits (adjusted to present value):		293,700.00	290,400.00	283,503.00	281,107.20	275,397.21
Cumulative time-adjusted benefits over lifetime:		293,700.00	584,100.00	867,603.00	1,148,710.20	1,424,107.71
Cumulative lifetime time-adjusted costs + benefits:	-713,000.00	-486,762.00	-263,066.00	-44,682.78	171,854.95	383,994.25
Net Present Value:						383,994.25
Return of Investment (ROI):						0.37

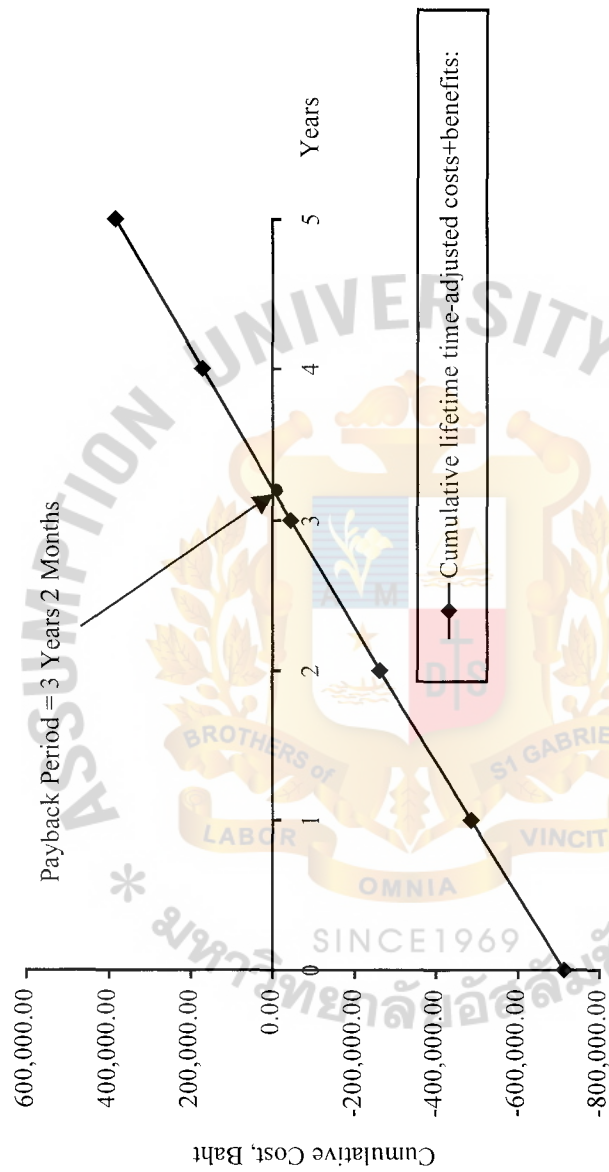


Figure G.1. Payback Period of Candidate Solution 1.

Table G.5. Costs for a Candidate Solution 2, Baht.

Cost Items	Amount
Investment Cost	
Personnel	
1. System Analyst 1 person (50 hours per months x 4 months = 200 hours @ 250 baht/hr)	50,000.00
2. Programmer 2 persons (50 hours/month/person x 2 months = 200 hours @ 150 baht/hr)	30,000.00
Expense	
1. Training cost for 4 users (5,000 baht/person)	20,000.00
New Hardware and Software Cost	
1. Hardware cost (Server & Client)	403,000.00
2. Server Software	35,000.00
3. Client Software	40,000.00
Total Investment Cost	578,000.00
Projected Annual Operating Cost	
Personnel	
1. Engineers 2 persons (12,000 baht/month/person)	288,000.00
2. Technician 3 persons (7,500 baht/month/person)	270,000.00
Expenses	
1. Supplies cost (paper, etc.)	55,800.00
2. Space Rental	60,000.00
3. Maintenance cost	30,000.00
4. Utility	45,000.00
5. Training 300 hours (200 baht/hour)	60,000.00
6. Trainers	70,000.00
Total Projected Annual Operating Cost	923,800.00

Table G.6. Payback Analysis of Candidate Solution 2, Baht.

Cost Items	Years					
	0	1	2	3	4	5
Development cost:	-578,000.00					
Operation & Maintenance Cost (5% increase annually):		-85,800.00	-94,380.00	-103,818.00	-114,199.80	-125,619.78
Discount factor for 12%:	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted costs (adjusted to present value):	-578,000.00	-76,362.00	-75,504.00	-73,710.78	-73,087.87	-71,603.27
Cumulative time-adjusted costs over lifetime:	-578,000.00	-654,362.00	-729,866.00	-803,576.78	-876,664.65	-948,267.93
Benefits derived from operation of new system:		330,000.00	363,000.00	399,300.00	439,230.00	483,153.00
Discount factor for 12%:	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted benefits (adjusted to present value):		293,700.00	290,400.00	283,503.00	281,107.20	275,397.21
Cumulative time-adjusted benefits over lifetime:		293,700.00	584,100.00	867,603.00	1,148,710.20	1,424,107.71
Cumulative lifetime time-adjusted costs + benefits:	-578,000.00	-360,662.00	-145,766.00	64,026.22	272,045.55	475,839.48
Net Present Value:						475,839.48
Return of Investment (ROI):						0.50

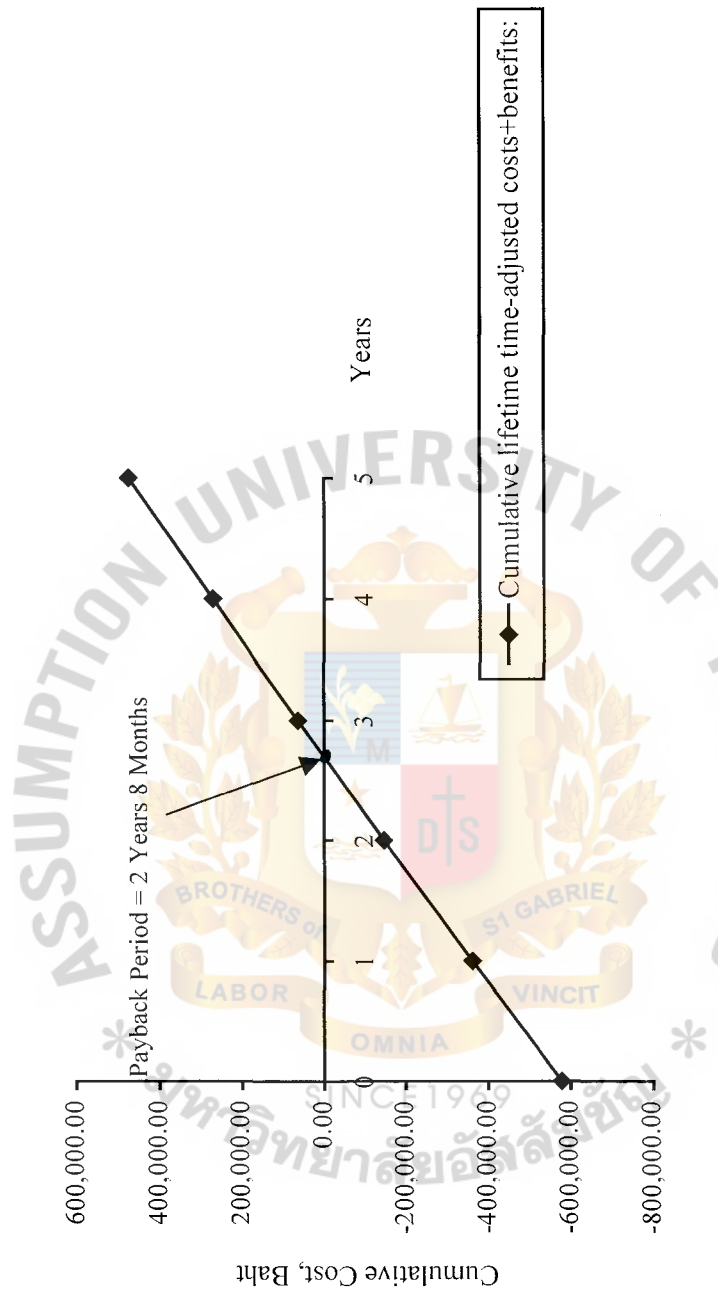


Figure G.2. Payback Period of Candidate Solution 2.

Table G.7. Costs for a Candidate Solution 3, Baht.

Cost Items	Amount
Investment Cost	
Personnel	
1. System Analyst 1 person (50 hours per months x 6 months = 300 hours @ 250 baht/hr)	75,000.00
2. Programmer 4 persons (50 hours/month/person x 1 month = 600 hours @ 150 baht/hr)	90,000.00
3. GUI Designer 1 person (30 hours/month/person x 2 months = 60 hours @ 180 baht/hr)	10,800.00
4. Database Specialist 1 person (15 hours/month/person x 1 month = 45 hours @ 200 baht/hr)	9,000.00
Expense	
1. Training cost for 4 users (5,000 baht/person)	20,000.00
New Hardware and Software Cost	
1. Hardware cost (Server & Client)	403,000.00
2. Server Software	35,000.00
3. Client Software	40,000.00
Total Investment Cost	682,800.00
Projected Annual Operating Cost	
Personnel	
1. Engineers 2 persons (12,000 baht/month/person)	288,000.00
2. Technician 3 persons (7,500 baht/month/person)	270,000.00
Expenses	
1. Supplies cost (paper, etc.)	68,000.00
2. Space Rental	60,000.00
3. Maintenance cost	50,000.00
4. Utility	45,000.00
5. Training 300 hours (200 baht/hour)	60,000.00
6. Trainers	70,000.00
Total Projected Annual Operating Cost	911,000.00

Table G.8. Payback Analysis of Candidate 3, Baht.

Cost Items	Years					
	0	1	2	3	4	5
Development cost:	-628,800.00					
Operation & Maintenance Cost (5% increase annually):		-118,000.00	-129,800.00	-142,780.00	-157,058.00	-172,763.00
Discount factor for 12%:	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted costs (adjusted to present value):	-628,800.00	-105,020.00	-103,840.00	-101,373.80	-100,517.12	-98,475.37
Cumulative time-adjusted costs over lifetime:	-628,800.00	-787,820.00	-891,660.00	-993,033.80	-1,093,550.92	-1,192,026.29
Benefits derived from operation of new system:		330,000.00	363,000.00	399,300.00	439,230.00	483,153.00
Discount factor for 12%:	1.00	0.89	0.80	0.71	0.64	0.57
Time-adjusted benefits (adjusted to present value):		293,700.00	290,400.00	283,503.00	281,107.20	275,397.21
Cumulative time-adjusted benefits over lifetime:		293,700.00	584,100.00	867,603.00	1,148,710.20	1,424,107.71
Cumulative lifetime time-adjusted costs + benefits:	-628,800.00	-494,120.00	-307,560.00	-125,430.80	55,159.28	232,081.12
Net Present Value:						232,081.12
Return of Investment (ROI):						0.19

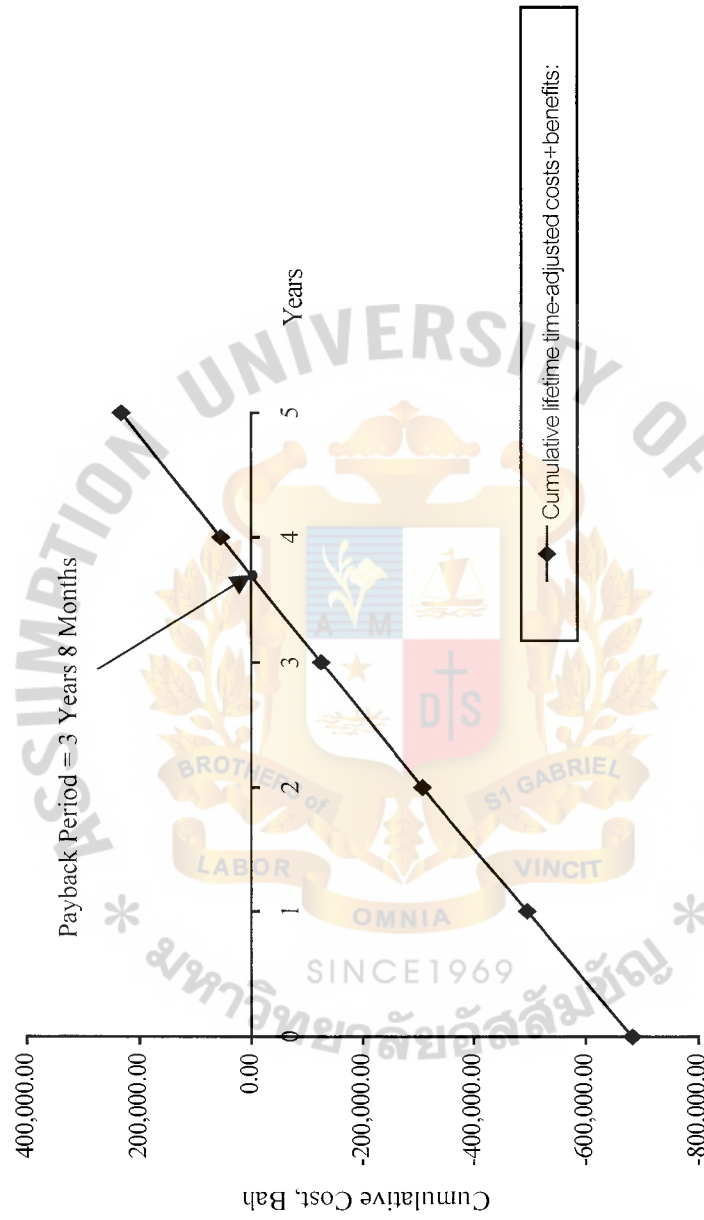


Figure G.3. Payback Period of Candidate Solution 3.

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