



An Information System For a Made-To-Order Furniture Company

by

Mr. Viroj Vienvattana

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

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

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Project Title An Information System of a Made-To-Order Furniture
Company

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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.

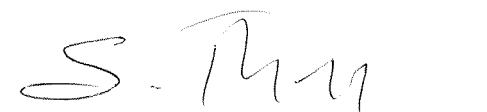
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ABSTRACT

The purpose of this system development project is to design a computerized information system for a furniture factory business. The new proposed system is expected to provide user friendliness with shorter time consuming operation together with shared and accurate information. The new system is designed to operate in the intranet environment, web interface style, using PHP and MySQL™. The analyst believes, with the new proposed technology, users would receive quick queries, ease of use, system flexibility and increased productivity.

Current existing information system of Samret Kanchang Factory is based on manual system. Most of the data are stored on paper and set of notebooks. All staff need to maintain handwritten documents, which are error-prone and time consuming. Hence, the existing manual system is not suitable for current business processes, and it needs to be changed to a computerized system.

Within a budget constraint, this proposed system replaces the existing manual business operations with standard and easy maintenance technologies. The efficient and effective proposed system will prove itself and drive Samret Kanchag Factory to achieve its business goals in the current competitive market.

ACKNOWLEDGEMENTS

This system development project requires several people's cooperation. Without them, this project cannot be absolutely completed. The writer would like to take this opportunity to express gratitude to all people who sacrificed their valuable time to provide the needed information for this system project.

The writer is deeply grateful to Assoc. Prof. Dr. Suphamit Chittayasothorn, the advisor of this project, for spending his valuable time in counseling, correcting and motivating him. The writer is also indebted to all committee members of the degree of Master of Science in Computer Information System for constructive feedback and valuable guidance on the modification to be included in this project. The writer thanks all Professors who conducted the courses that lead him to finalizing the CIS degree.

The writer thanks his parents who gave the first lesson of his life and always teach him in his every day life. The writer also thanks his wife, who was an ardent cheerleader, supporter, and friend throughout the project. Her contribution shows in many subtle ways and is indeed instrumental in achieving the final result.

TABLE OF CONTENTS

<u>Chapter</u>	<u>Page</u>
ABSTRACT	i
ACKNOWLEDGEMENTS	ii
LIST OF FIGURES	v
LIST OF TABLES	ix
I. INTRODUCTION	1
1.1 Background of the Project	1
1.2 Objectives of the Project	2
1.3 Scope of the Project	2
1.4 Deliverables	6
1.5 Project Plan	6
II. THE EXISTING SYSTEM	10
2.1 Background of the Organization	10
2.2 Existing Business Functions	14
2.3 Current Problems and Areas for Improvement	19
III. THE PROPOSED SYSTEM	22
3.1 System Specifications	22
3.2 System Design	23
3.3 Hardware and Software Requirement	29
3.4 Security and Control	33
3.5 Cost and Benefit Analysis	34
IV. PROJECT IMPLEMENTATION	44
4.1 Overview of Project Implementation	44

<u>Chapter</u>	<u>Page</u>
4.2 System Programming	44
4.3 Testing	45
4.4 Training	46
4.5 Conversion	47
V. CONCLUSTIONS AND RECOMMENDATIONS	50
5.1 Conclusions	50
5.2 Recommendations	52
APPENDIX A CONTEXT DATA FLOW DIAGRAM	53
APPENDIX B STRUCTURED CHART	59
APPENDIX C PROCESS SPECIFICATION	60
APPENDIX D ENTITY RELATIONSHIP DIAGRAM	85
APPENDIX E DATABASE DESIGN	88
APPENDIX F DATA DICTIONARY	104
APPENDIX G SCREEN DESIGN	132
APPENDIX H OUTPUT DESIGN	183
BIBLIOGRAPHY	194

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1.1 Project Plan (Gantt Chart)	9
2.1 Organization Chart of Samret Kanchang Factory, Made-To-Order Business	13
3.1 Network Configuration	33
3.2 Cost Comparison between Manual and Computerized System	39
3.3 Payback Analysis	43
A.1 Context Diagram for the Proposed System	53
A.2 Level 0 of Data Flow Diagram of the Proposed System	54
A.3 Level 1 of Process 1 “Manage Order” of the Proposed System.	55
A.4 Level 1 of Process 2 “Manage Material” for the Proposed System	56
A.5 Level 1 of Process 3 “Production” for the Proposed System.	57
A.6 Level 1 of Process 4 “Shipment” for the Proposed System	58
B.1 Structured Chart for the Proposed System	59
D.1 Context Data Model (ER Diagram) of the Proposed System	85
D.2 Key Based Data Model (ER Diagram) of the Proposed System	86
D.3 Fully Attributed Data Model (ER Diagram) of the Proposed System	87
G.1 Login Screen	132
G.2 Main Menu Screen	133
G.3 Customer Main Screen	134
G.4 Customer Input Screen	135
G.5 Customer Edit Screen	136
G.6 Supplier Main Screen	137
G.7 Supplier Input Screen	138

<u>Table</u>	<u>Page</u>
G.8 Supplier Edit Screen	139
G.9 Material Main Screen	140
G.10 Material Input Screen	141
G.11 Material Edit Screen	142
G.12 Product Main Screen	143
G.13 Product Input Screen	144
G.14 Product Edit Screen	145
G.15 Material Allocation Screen	146
G.16 Material Cost Screen	147
G.17 Product Price Screen	148
G.18 Administrative Screen	149
G.19 Quotation Main Screen	150
G.20 Quotation Input Screen	151
G.21 Quotation Edit Screen	152
G.22 Pending Quotation Screen	153
G.23 Order Main Screen	154
G.24 Order Input Screen	155
G.25 Order Input, Using Quotation, Screen	156
G.26 Order Edit Screen	157
G.27 Pending Material Screen	158
G.28 Purchase Order Main Screen	159
G.29 Purchase Order, use Allocation, Screen	160
G.30 Purchase Order Input Screen	161

<u>Figure</u>	<u>Page</u>
G.31 Purchase Order Edit Screen	162
G.32 Pending Job Assignment Screen	163
G.33 Job Assignment Main Screen	164
G.34 Job Assignment Input Screen	165
G.35 Pre Shipment Screen	166
G.36 Shipment Main Screen	167
G.37 Shipment Voucher Screen	168
G.38 Tax Invoice Screen	169
G.39 Pending Tax Invoice Screen	170
G.40 Billing Invoice Main Screen	171
G.41 Billing Invoice Input Screen	172
G.42 Shipment Detail Screen	173
G.43 Shipment Voucher Edit Screen	174
G.44 Tax Invoice Edit Screen	175
G.45 Billing Invoice Edit Screen	176
G.46 Pending Order Report Screen	177
G.47 Pending Purchase Order Report Screen	178
G.48 Material Stock Report Screen	179
G.49 Product Stock Report Screen	180
G.50 Revenue Report Screen	181
G.51 Expense Report Screen	182
H.1 Quotation	183
H.2 Purchase Order	184

<u>Figure</u>	<u>Page</u>
H.3 Shipment Voucher	185
H.4 Tax Invoice	186
H.5 Bill Invoice	187
H.6 Receipt	188
H.7 Material Allocation Report	189
H.8 Material Cost Report	189
H.9 Material Cost List	189
H.10 Product Price Report	190
H.11 Product Price List	190
H.12 Pending Order Report	191
H.13 Pending Material Report	191
H.14 Material Stock Report	192
H.15 Product Stock Report	192
H.16 Revenue Report	192
H.17 Expense Report	193

<u>Table</u>	<u>Page</u>
C.12 Process Specification of Calculate Material Requirement	74
C.13 Process Specification of Order Material	75
C.14 Process Specification of Receive Material	76
C.15 Process Specification of Assign Work to Employee	78
C.16 Process Specification of Checkout Material	78
C.17 Process Specification of Produce Product	79
C.18 Process Specification of Prepare Shipment Voucher	80
C.19 Process Specification of Prepare Billing Invoice	82
C.20 Process Specification of Prepare Receipt	83
E.1 Allocation Table	88
E.2 Cost Table	88
E.3 Customer Table	89
E.4 Invoice Table	90
E.5 Job Table	91
E.6 Material Table	92
E.7 Order Table	93
E.8 Order_Purchase Table	94
E.9 Order_Voucher Table	95
E.10 Product Table	95
E.11 Price Table	96
E.12 Purchase Table	97
E.13 PurchaseDetail Table	98
E.14 Quotation Table	98

LIST OF TABLES

<u>Table</u>	<u>Page</u>
3.1 Hardware Specification for the Intranet Server	30
3.2 Hardware Specification for Each Client Machine	30
3.3 Software Specification for the Intranet Server	31
3.4 Software Specification for Each Client Machine	32
3.5 Manual System Cost Analysis	36
3.6 Five Year Accumulated Manual Cost	36
3.7 Computerized System Cost Analysis	37
3.8 Five Year Accumulated Computerized Cost	38
3.9 The Comparison of the System Costs	38
3.10 Comparison Between Cost and Benefit of Computerized System	41
5.1 Degree of Achievements of the Proposed System	51
C.1 Process Specification of Made-To-Order	60
C.2 Process Specification of Manage Order	61
C.3 Process Specification of Manage Material	64
C.4 Process Specification of Production	65
C.5 Process Specification of Shipment	66
C.6 Process Specification of Manage New Product Acquisition	68
C.7 Process Specification of Calculate Material Usage	69
C.8 Process Specification of Calculate Product Price	69
C.9 Process Specification of Generate Quotation	71
C.10 Process Specification of Receive Order	72
C.11 Process Specification of Verify Material Requirement	74

I. INTRODUCTION

1.1 Background of the Project

The existing manual system is the major factor, which causes many businesses to slow down in their growth. Nowadays, most of the top management periodically acquires the new system, which provides faster and more accurate information, to replace the existing system. Eventhough, the new acquisition incurs cost and consumes a lot of resources, there is a breakeven point in every investment. Normally, a good replacing new system should provide shorter breakeven period, generate more revenue and create a lot of benefits. The main factor of any investment is achieving the main business goal, profit.

Samret Kanchang Factory is classified as a Small & Medium Size Enterprise (SME). The main business area is producing metal office furniture products, which require accurate information regarding the whole production system. The main activity of Samret Kanchang Factory is normally dealing with the customers' orders. Other activities are material acquisition, production and shipment. Each activity interrelates with each other, and any bottleneck may possibly halt the whole production of the factory.

Currently, the existing manual system cannot provide certified response, accuracy and sufficient information. It is also more costly each day. The staff has to do repeated jobs daily which also takes a long time. The factory faces a variety of problems, such as inaccurate product price list, delayed production, late shipment, late payment from the customer, incorrect information and out-of-date information, etc., which cause inefficiency and ineffectiveness in factory management.

Due to the existing problems, a computerized system is designed for a Made-To-

Order Furniture factory to replace the manual process of the existing system. The existing system will be analyzed, and redesigned in order to replace it with the new system to match with the business processes. Moreover, the new computing system is planned to serve the daily business process with accurate and quick information. Effectiveness and efficiency in business is expected from the new system without any obligation.

1.2 Objectives of the Project

The objectives of this development project are as follows:

- (1) To analyze the problems of the existing system and understand the users' requirements.
- (2) To design a new computer based system which is relevant to the business requirement in order to replace the existing manual system.
- (3) To develop and implement the Made-To-Order system for Samret Kanchang Factory.
- (4) To provide management staff with effective business process.
- (5) To maintain valuable information with accuracy and timeliness.
- (6) To minimize errors on any document output, i.e. Quotation, Purchase Order, Shipment Voucher, Tax Invoice, etc.

1.3 Scope of the Project

This project development has been designed to solve the problems of the existing manual system. The system will be an on-line Intranet system, which provides timeliness and accurate information. The scope of this system project will cover major parts and concerned information, which include the following:

- (1) Maintain shared and valuable information.

A relational database is designed to keep necessary information as

follows:

- (a) Customer: information of all companies and/or individuals, who interact and/or place product order to the factory.
- (b) Customer Order: information of the product order placed by the customer.
- (c) Invoice: information of Billing Invoice.
- (d) Job Assignment: information of the job assignment related to the customer's order during production process.
- (e) Material: information of all materials related to the products, which the factory produces.
- (f) Material Cost: information of the material unit cost according to the supplier.
- (g) Material Allocation: information of the required number of material units, related to a relevant unit of product.
- (h) Material Supply: information of material transactions.
- (i) Product: information of all products, which the factory produces for the customers.
- (j) Product Price: information of the product unit price according to the customer.
- (k) Purchase Order: information of Purchase Order, issued to the supplier.
- (l) Quotation: information of the Quotation, proposed to the customer.
- (m) Shipment Voucher: information of Shipment Voucher and Tax Invoice.

- (n) Supplier: information of all companies and/or individual, who interact and/or supply the material to the factory.

(2) Quotation Process

Quotation is one of the mandatory document outputs, which management staff will record, print a hard copy, obtain the authorized signature and fax it to the customers.

(3) Receive Customer Orders Process

For a customer placing any purchase order, either via fax or telephone, management staff need to record the details and obtain the confirmation from the customer, if necessary.

(4) Material Acquisition Process

The process of controlling the material transaction is one of the basic requirements, even though the material is provided by the customer. The Purchase Order is a mandatory document output because some suppliers require a formal document, while other suppliers accept the orders, which are placed via the telephone.

(5) Assign Customer Order to Production Line Process

Once the required material is in place, management staff will assign the pending product order to the available employee. Tracking status of individual assignment will help management staff know the current status of production.

(6) Shipment Process

Everyday, management staff will check the product inventory and plan the shipment route. Either a Shipment Voucher or Tax Invoice is the document output used for this process. In case of cash payment during the

delivery process, management staff also need to prepare the Receipt, which is related to the Tax Invoice, for the customers. Moreover, a Billing Invoice will be generated based on the pending Tax Invoice and sent to the relevant customers during the shipment process.

(7) Create Management Reports

Periodically, summary reports for investigating the overall status of the factory are generated as follows:

- (a) Product Price List: shows the unit price of products.
- (b) Material Cost List: shows the unit cost of materials.
- (c) Report of Material Allocation: shows the details of material usage units required for a unit of product.
- (d) Report of Pending Tax Invoice: shows the Billing Invoice pending for the payment.
- (e) Report of Pending Material Acquisition: shows the material and number of units that are waiting.
- (f) Report of Pending Customer Order: shows the product and remaining quantity of customer orders, which are waiting for production.
- (g) Report of Material Inventory Balance: shows the remaining quantity of material.
- (h) Report of Product Inventory Balance: shows the product and quantity of inventory.
- (i) Periodic Income Report: periodic summary of total amount related to the Receipt and Tax Invoice.
- (j) Periodic Expense Report: periodic summary of total amount

related to the generated Purchase Order.

1.4 Deliverables

The deliverables for the project on An Information System for a Made-To-Order Furniture Factory are as follows:

- (1) A Software Package written in PHP as the front-end tools and MySQLTM as the back-end engine.
- (2) A user manual of the proposed system.
- (3) Screen layout of the user interface.
- (4) Document outputs.
- (5) Management reports.

1.5 Project Plan

Every organization needs a smooth operation because it reflects how well their business process is. The analyst needs to deliver the right function and the right information to the right people who need it. The analyst of this project chooses a traditional methodology, The System Development Life Cycle (SDLC), as a guideline to deliver the proposed system to Samret Kanchang Factory.

At the beginning, the analyst discussed with the management level of Samret Kanchang Factory in order to define the most suitable period for conducting this system development. The analyst sent the draft project schedule according to the proposed tasks to the management of Samret Kanchang Factory for approval. The time frame was chosen, together with the promised resources and budget. The final project plan of this system development project has been defined into 3 phases as shown below:

- (1) System Analysis

System Analysis is the phase of investigating the existing manual system. The analyst worked closely with key users and management level in

order to fully understand the existing business processes. Analyst, management level and users can recommend for any improvement in the existing business processes during this period. Once the analyst was able to identify the existing problems and all users' requirements was collected, the scope of the new proposed system was defined and recorded. Management level and users of Samret Kanchang Factory were reviewed, adjusted, and approved. Once the scope had been defined and agreed, the analyst could move further to the next phase, System Design.

(2) System Design

System Design is the most important phase in SDLC because the proposed system might fail if the analyst does not perform well during this phase. During this phase, the analyst analyzed, interpreted and compiled all requirements from the existing system and inputs from the users; thereafter, he defined and designed a logical view of the new proposed system. Famous methodologies were applied during this phase, including Structured Design and Prototype. The outputs from this phase are logical views of the proposed system, i.e. Context Diagram, Data Flow Diagram, Process Specification, Structure Chart, Entity-Relationship Diagram, Data Dictionary, etc. In fact users and management level do not understand those logical concept documents; therefore, some basic prototype concepts i.e. screen and output example are used for facilitating the analyst in order to obtain agreement on those logical designs.

(3) Implementation & Evaluation

Implementation & Evaluation phase is the period for developing the proposed system according to the proposed system design. Thereafter, come

the steps of placing the new hardware and software on top of the manual system, testing against the proposed system in many levels of acceptance, and training the users before the formal conversion started. Once the proposed system was started, the analyst together with users and management evaluated the proposed system. The old manual system could be ignored, if users and management accepted the new proposed system.



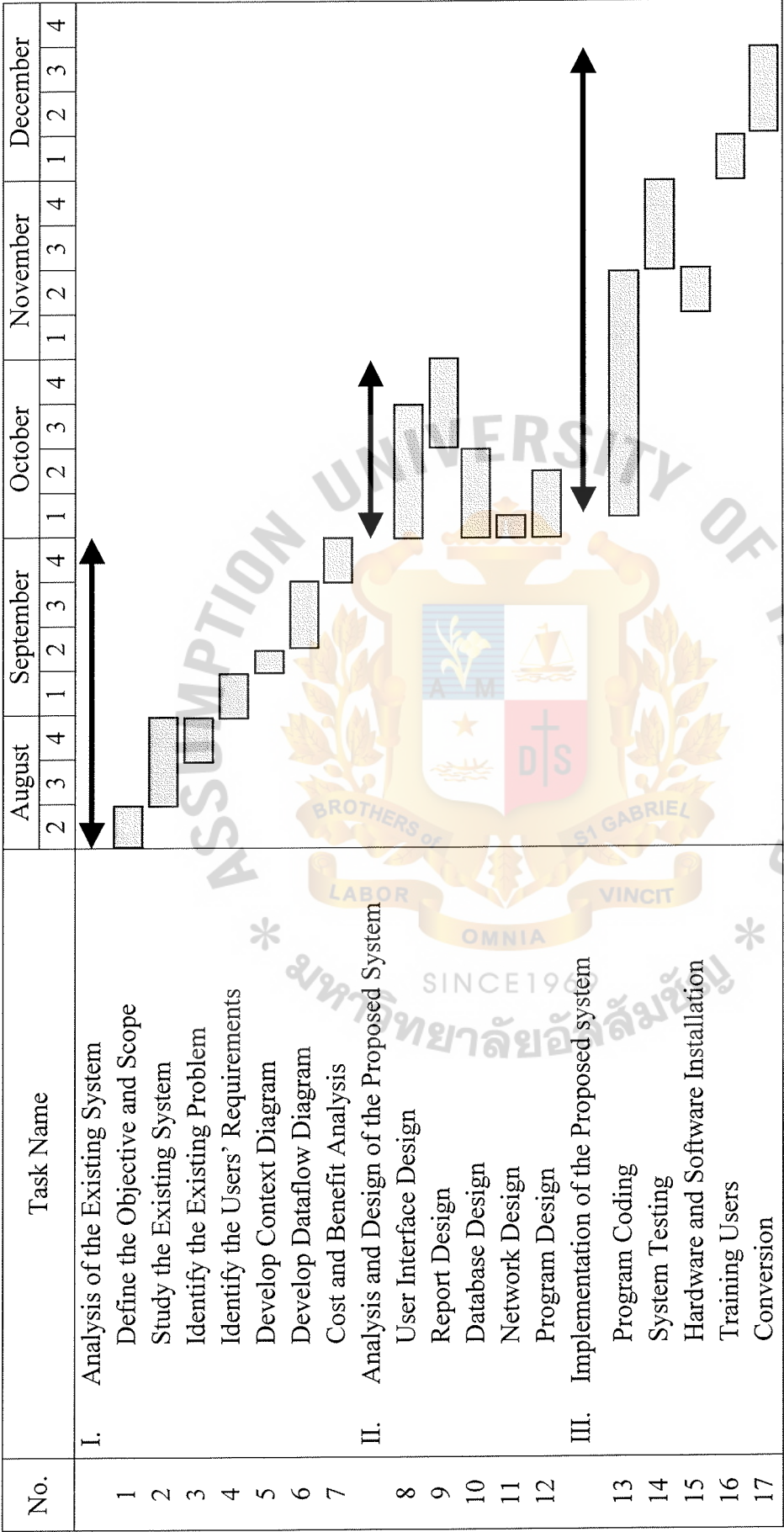


Figure 1.1. Project Plan (Gantt Chart).

II. THE EXISTING SYSTEM

2.1 Background of the Organization

Mr. Samret Vienvattanah established Samret Kanchang Factory in May 1969. In the beginning stage, the factory aimed to produce wood furniture of Catholic Church in Thailand. After 1975, the factory added more products, especially aluminum and metal products to its production. Then it gradually increased the capacity in the production lines as well as the number of its customers.

Samret Kanchang Factory covers many product lines of metal and aluminum industry as follows:

- (1) Aluminum T-Bar
- (2) Aluminum Window
- (3) Air Condition Filter and Parts
- (4) Motorcycle Parts
- (5) Car Accessories
- (6) Etc.

At the beginning, the factory was operated by the family and relatives but it gradually changed by hiring administrative staff to operate the fast daily business since year 1999. Currently, the factory is operating with 1 manager and 3 management staff in the current fast growing economy in Thailand. The factory manager planned to add more staff for supporting new potential customers in the coming years. With the current situation, all staff need to write down all information details on paper notebook and in fact this manual operation causes a lot of frustration in the growing business. With the existing manual system, the factory cannot respond to the dynamic economy causing many known problems.

In 1996, management of the factory tried to acquire the first computer information system by buying the first computer workstation for the office. The purpose is to keying the information of its production into Microsoft Excel but it failed to support normal business processes due to many factors. The workstation cannot prove the accuracy of information, and normally the staff made mistakes by keying wrong and duplicate data. Worst, the staff ignored and resisted the computer because writing down the information on paper notebook is easier and faster due to the small number of customers.

For year 2004, the factory manager initiated that Samret Kanchang Factory should acquire a real and working information system for supporting the growing revenue. The new information system should provide accurate and fast information to the business processes. In fact, there is a good sign for a shorter breakeven-point; even though there is a limited budget for this investment. Together with the new system, there are a number of benefits and improvements compared to the existing manual system. The new system should give efficiency and effectiveness to the factory's business in order to push the factory achieve its main target, profit.

According to the plan, the factory manager reorganized the cross-functional sections of Samret Kanchang Factory as follows:

(1) Managerial Section

The managerial section is responsible for product and material registration, pricing and costing information, quotation process and order management. All sensitive and valuable information are maintained by this section

(2) Purchasing Section

This section will manage 2 functionalities; material ordering and

maintaining the material inventory. Mainly, staff in this section are responsible for ordering the material according to the confirmed orders. This section will maintain material transactions, which reflect the inventory status of each needed materials. This section has no authorization in issuing any purchase order without the approval from factory manager.

(3) Production Section

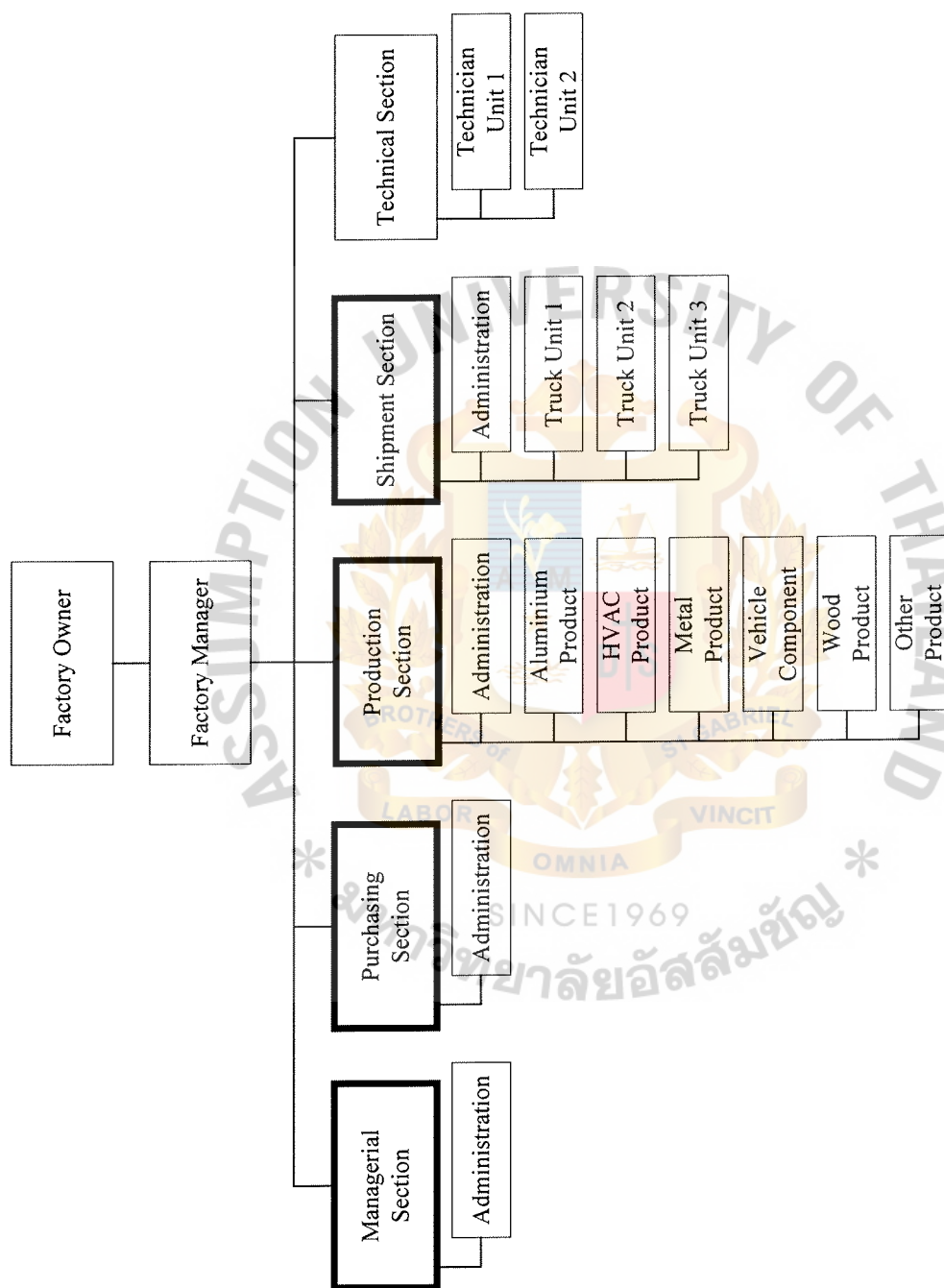
Staff in this section are responsible for all tasks related to production. They are responsible to assign any pending product to the available employee. They are responsible for the status of each assignment according to the current situation of production, starting from assigning the product, withdrawing the material and updating product inventory status.

(4) Shipment Section

Staff in this section are responsible for arranging daily shipment process based on predefined route and delivery status of the product inventory. All formal documents; shipment voucher, tax invoice, receipt and billing invoice are managed by this section.

(5) Technical Section

Normally staff in this section are responsible for any mechanical issues in the factory. They setup the machine for production according to the ordered products. Another responsibility is the machine maintenance, both for planned and unplanned circumstances.



2.2 Existing Business Functions

The existence of Samret Kanchang Factory is based on manual operations to perform the business tasks. The main business functions of factory are divided into four which are listed as follows:

(1) Order Management Process

- (a) When the management staff receive new product enquiries from customers, factory manager will be noticed for evaluating production feasibility.
- (b) The factory manager will make a justification based on the current situation of the factory; i.e. complexity of production, timing, production capacity, etc.
- (c) Once the new product has been approved by the factory manager, material name and calculated quantity per unit of the queried product will be recorded on paper. The staff will use the information for material cost checking.
- (d) Staff shall enquire the market price of relevant materials from various suppliers and write down the material cost on the same paper sheet. If the market price is received from the new supplier, the staff needs to write down the supplier information on the white board. This process is repeated and until the staff receive satisfactory and lowest market price.
- (e) After finding out the lowest market price of the material, the same small piece of paper, which records the material unit cost, is forwarded back to the factory manager. The final product price is calculated based on many arbitrary factors depending on the customer.

- (f) The product price of all enquiries will be informed back to the customer via telephone or a handwritten quotation.
- (g) For the existing products, the staff also need to verify the price with the factory manager because there is no record of the products' price lists.
- (h) A customer has 2 methods for placing the order; either via telephone or by faxing the purchase order to the factory. Once the staff receive the order, he/she writes down all order information into a notebook.
- (i) The factory has a policy that there is neither ordering the material nor starting the production until confirmation has been received from the customer. On a daily basis, the staff will make a call to the customer for confirmation. This step can be ignored if customers place an order via faxing the purchase order to the factory.
- (j) During the confirmation process, the number of ordering product can be changed or cancelled. The staff update the notebook accordingly to the most update volume and mark on the relevant order for confirmation status.
- (k) After confirmation has been received, the staff start the next process, material order management.

(2) The Material Management Process

- (a) In a normal case, Samret Kanchang Factory is responsible for acquiring the material for production. There is an exception for a few customers, who supply material for factory production. In an exception case, the staff noted down a small marking, regarding non-acquisition of materials, on the relevant line of order in the notebook.

- (b) Generally, the staff order the material automatically after receiving the order confirmation from the customers. Since there is only a few number of suppliers in the aluminum industry, the purchasing process is quite straightforward and easy for the factory. In fact, the staff need to make a call to each supplier to recheck the material unit price before placing the order because a few of SME supplier have the price list provided.
- (c) The factory manager is responsible to choose the supplier for each customer's order. There is some possibility to group the required material from all pending orders and purchase from one supplier. Mostly the material used by the factory is produced and sold by the arbitrary supplier.
- (d) Normally, the management staff place the purchase orders via the telephone to small and medium size suppliers. Suppliers rarely recheck the material purchase orders, because Samret Kanchang Factory is operated by family members; so every order, even placing via the telephone, is trusted and accepted. Handwritten purchase order is another option for large suppliers, which require a formal document for any material order.
- (e) On the material shipment date, the management staff manually count the material on trucks before loading them onto the loading or inventory area. If the shipment is valid, the staff is responsible to sign on the shipment voucher, if it exists and is required. Materials will be kept in the loading area with a piece of paper attached to identify the owner of the material; in general it is the customers who place the

product orders.

- (f) In some cases, customers are responsible for material supply. Normally, the factory charges only the labor cost for this kind of order. Except in material acquisition, the management staff manage this kind of order in the same operation.

(3) The Production Process

- (a) After receiving the required materials from supplier or customers, production can start automatically. This process depends on material availability and planned shipment date of each order.
- (b) Generally, staff do not know the status of employee in production line. Staff need to walk into the workshop area, monitor and ask for the status of assignment from employee. Once the staff know the available and matched employees, the matched pending products are assigned verbally to that employee. The location of material is notified in the same period of time.
- (c) After assigning the products to employee, the staff walk back to the management office and write down the assignment amount in the same notebook.
- (d) Employees are responsible for material checkout from the assigned location. They withdraw the specific quantity of materials and start producing the defined quantity of the final product.
- (e) Once they finish, employees notify the management staff for the quantity of final products. The staff are responsible to write down the amount of final products in the notebook and assign a new product to the employee, if possible.

- (f) In general, customers make a call to the factory, asking for the final product and/or material remaining in stock. The staff check in the notebook and recheck by counting the material and/or product in stock physically. This task might consume a lot of time and generally cannot give the correct number to the customer.
 - (g) Possibly, customer can ask for product shipment before the predefined shipment date, or return the material, or change product, etc. The staff make the adjustment on his/her arbitrary for the request with support from the factory manager.
 - (h) Generally, shipment process is performed daily because most customers want the product as soon as possible. The staff activate the shipment process daily if there is any product left in the inventory.
- (4) The Shipment Process
- (a) Normally, the management staff generate the Bill of Invoice after the shipment. The staff write down the Bill of Invoice for any pending Tax Invoice. Those Bills of Invoice are physically sent to the customers, requesting for payment of all credit tax invoices. Receipts are sent to the customers after payment has been made.
 - (b) Management staff arrange the daily shipment depending on the delivery date or the customers' request, but normally shipment is done everyday to the specific route.
 - (c) If there is any pending shipment product, management staff will write down the shipment voucher to arrange the shipment route.
 - (d) Daily, either the Shipment Voucher or Tax Invoice is written and workers load the relevant products onto the truck and deliver them to

the relevant customers. Drivers bring either the Shipment Voucher or Tax Invoice, together with the relevant Bill of Invoice, to the customers. If cash payment is made on the delivery date, staff manually write the receipts and send them to the customers simultaneously.

2.3 Current Problems and Areas for Improvement

Currently, the factory runs its operations with a manual system. The management staff have to record all the information on paper and all the jobs are done manually. Therefore, it causes many problems, such as loss of paper space, recording error, waste of time to retrieve information, slow in process, and loss of data. Also, it causes a lot of problems when dealing with the customers.

The problems that have been found during the analysis phase are:

- (1) Timeliness
 - (a) Pricing needs to wait for Factory manager's approval.
 - (b) Purchase Order needs to wait for Factory manager's approval.
 - (c) Handwritten output needs a lot of time to produce.
 - (d) Inventory checking needs a lot of time.
- (2) Accuracy
 - (a) Costing and Pricing information does not reflect the actual market price.
 - (c) Handwritten output uses the wrong pricing and/or costing.
 - (d) Purchasing is over the required amount of material.
 - (e) Inventory checking does not reflect the actual inventory.
 - (f) Duplication and incorrect data from manual handwriting.

(3) Reliability

- (a) Handwritten output causes a lot of confusion and errors.
- (b) Costing and pricing information have no defined date and need double verification process.
- (c) Lost of paper notebook and/or piece of paper.
- (d) Lost of paper document during shipment.
- (e) Business expansion is already limited under the existing system.

(4) Economy

- (a) Waste of stationary from handwriting
- (b) Costing method does not reflect the lowest material price and normally order incorrect required amount.
- (c) High fees from telephone bills due to material price checking.
- (d) Bills of Invoice always miss the date of payment.
- (e) Overtime charge due to reports and material inventory checking.
- (f) Inefficient shipment process.

Areas for improvement that are found during the analysis phase are:

(1) Timeliness

- (a) Keeping pricing records, with aging regulation method.
- (b) Keeping inventory status by using shared records.
- (c) Using shared information to produce fast and accurate document outputs.

(2) Accuracy

- (a) Perform data validation during inserting a new record.
- (b) Using constraint technique in relational databases.
- (c) Process any business flow by using stored data more than

accepting new input data

- (d) Using shared information to produce fast and accurate document outputs.

(3) Reliability

- (a) Using stored information for processing.
- (b) Reprinting feature for all document outputs.
- (c) Using shared information to produce fast and accurate document outputs.
- (d) Performing periodic system backup.

(4) Economy

- (a) Enable viewing on screen feature to check report output before printing.
- (b) Using stored information for the purchasing process, i.e. costing, material usage, etc.
- (c) Using stored information for arranging the shipment process, i.e. generating the tax invoice from grouping the product per customer. Also shows the pending Tax Invoice of the relevant customer in order to generate the Bill of Invoice on time.

III. THE PROPOSED SYSTEM

3.1 System Specification

This system development project uses the combined methods of System Development Life Cycle Method and Structured Analysis Development Method for implementation.

The System Development Life Cycle or SDLC is classically thought of as a set of activities that analyst and users carry out to develop and implement an information system. It includes 6 activities: preliminary investigation, requirements determination, system design, software development, system testing and implementation.

The Structured Analysis Development Method focuses on specifying what the system or application is required to do. In fact, it does not state how the requirement should be accomplished or how the application should be implemented. Rather, it allows analyst and users to review the logical elements (what the system should do) apart from the physical components it uses (computer, screen, data storage, etc).

The Analyst interviewed many users in order to gather the details of the existing business processes and their opinions on why things happen as they do and their ideas for improving the processes. Detail investigations also required the study of manuals and reports, actual observation of work activities, and collection of samples of forms and documents to fully understand the existing processes.

As the details are gathered, analyst studied all requirements to identify the mandatory features of the new system, including both the information the system should produce and operational features such as processing controls, response times, and input and output methods. The structured documents are generated, review, revised and approved by the users. These documents are only a formal mean for the developer to

understand the new proposed system.

3.2 System Design

The design of an information system produces the details that state how a system will meet the requirements, identified during the system analysis. This stage is referred as a logical design, in contrast to the process of developing the program software, which is referred as a physical design.

The new system design is to convert the user requirements into a computer based system. The design of the new proposed system begins with the identification of the system problems to develop the objectives of the new system that most satisfy the users. The main objective of this activity is to design the new system that is focused on solving the users' problems.

The computer information system was introduced to improve the efficiency and effectiveness of the current business situation by cutting some of the manual activities and reducing the flow of data that is unnecessary for the new information system. Context Diagram, Data Flow Diagram (DFD), Entity Relationship Diagram (ER Diagram), Structured Chart, Process Specification and Data Dictionary are used as models for the development of the proposed system.

3.2.1 Context Diagram

Context Diagram is a technical project-scoping tool that identifies the interface of the system including people who use the system, the data (or control) from or to the system, and external systems that interface the system in question. It identifies what data the system sends to and receives from the users, and how the inputs of the system are related to the outputs. It is an overview of an organizational system that shows the system boundaries, external entities that interact with the system, and the major information flows between the entities and the system. Figure A.1. in appendix A

shows the Context Diagram of the proposed system.

3.2.2 Data Flow Diagram (DFD)

Data Flow Diagram is a graphic representation of data movement between the external entities, various internal processes and storages within the studied system. It models sources and destinations of data (external entities), data inputs and outputs (data flows), actions that transform input into output and data maintained by an information system (storage).

It is useful and easy to understand the modeling tool. It has broad application and usability across most software development projects. It is easily integrated with data modeling, workflow modeling tools, and textual specifications. Together with these, it provides the analysts and developers with solid models and specifications. Moreover it is simple and easy to understand by users and can be easily extended and refined with further specifications into a physical version for the development team.

(1) Level 0 Diagram

Level 0 Diagram is the explosion of the Context Diagram. Normally, all inputs and outputs specified in the first diagram are constants with all subsequent diagrams. This diagram represents a system's major processes, data flows, and data stores at a high level of details. Figure A.2. in Appendix A shows the Level 0 Diagram of the proposed system. There are four main processes of the proposed system as follows:

(a) Manage Order Process

This process manages the customer orders including registering the new product and material. Other valuable information such as supplier, customer, material costing and product pricing information is managed in this process. The

main focus is order receiving, including confirmation of follow up process of the placed orders. The main document output from this process is Quotation.

(b) Manage Material Process

This process manages the flow of material, including material purchasing, material receiving and material inventory. The main document output from this process is Purchase Order.

(c) Production Process

This process manages the job assignment in the production line. Flows in this process are related to job assignment, assignment status, materials transaction and product inventory. There is no document output from this process.

(d) Shipment Process

This process manages the shipment process, mainly generating the formal document outputs: Shipment Voucher, Tax Invoice, Receipt and Bill of Invoice. Controlling the checkout process of product inventory is performed in this process as well.

(2) Level 1 Diagram

Each process in Level 0 Diagram may in turn be exploded to create a more detailed child diagram. The rules of creating the diagrams, vertical balancing, dictates that a child diagram cannot produce the output or receive the input that the parent process does not produce or receive. Figure A.3. to Figure A.5. in Appendix A show the Level 1 Diagram of the proposed system.

3.2.3 Structure Chart

Structure Chart is a graphical modeling method that depicts the procedure logic of the program in a basic format consistent with the layout of the structured program. It is one that is developed from the top down and modular, that is, broken down into manageable components. The structure chart of the proposed system is shown in Appendix B.

3.2.4 Process Specifications

Process specification is created for primitive processes on a data flow diagram as well as for some higher-level processes that explode to the child diagrams. It explains the decision-making logic and formulas that will transform the process-input data into the output. The process specifications of the proposed system are shown in Appendix C.

3.2.5 Entity Relationship Diagram

Entity relationship diagram is the diagram showing the Database structure of the system. It shows the tables (or relations) and the relationship among those tables. It shows the keys and the attributes of each table and also the cardinality of the tables which is shown by the crow feet or the straight line near the table symbol (which is shown by a rectangle) to show how the tables are related, such as one to one (1:1), one to many (1:M), many to one (M:1) or many to many (M:M).

Appendix D shows the three levels of data modeling of the proposed system:

- (1) Context ERD (Figure D.1.) determines the fundamental entities, relationships and cardinalities among the relations.
- (2) Key-based ERD (Figure D.2.) determines the primary key [PK] and foreign key [FK] of the relations.
- (3) Fully-Attributes ERD (Figure D.3.) determines all the attributes of each relation.

3.2.6 Relational Database Design

Database design is the most important in system design. The Relational Database model has been selected for the proposed system. Using the selected model, Database is optimized with the normalization concept. The analyst applied the ER-to-Relational Mapping rules as follows:

- (1) Map any regular entity type into the table.
- (2) Map any weak entity type into the table.
- (3) For 1:1 relationship, use primary key as foreign key in the defined table.
- (4) For 1:M relationship, use primary key of M side as foreign key in 1 side.
- (5) For M:M relationship, create additional table and use primary key of both sides as concatenated key.
- (6) Map any multivalued attribute into the table.
- (7) Map each n-ary relationship into the table.

Using the seven rules above, the analyst designed the relational tables as follows:

- (1) Allocation
- (2) Cost
- (3) Customer
- (4) Invoice
- (5) Job
- (6) Material
- (7) Product
- (8) Price
- (9) Purchase
- (10) Purchasedetail
- (11) Order

(12) Order_Purchase

(13) Order_Voucher

(14) Quotation

(15) Quotationdetail

(16) Supplier

(17) Supply

(18) Voucher

The description of tables of the proposed system is shown in Appendix E.

3.2.7 Data Dictionary

All definition of elements in the system: data flows, processes, and data stores are described in detail in the data dictionary. Any definition of a data item name or the contents of a particular data flow is available in the dictionary. The data dictionary of the proposed system is shown in Appendix F.

3.2.8 Screen Design

The major objective of the input design is to provide convenience for users, and to input the data into the standard format. The input design should keep the screen simple with good layout and ensure that the forms can keep all the necessary information. The volume of data to be input should be minimized. The more data are input, the greater the potential number of input errors and the longer it takes to input the data. Thus, numerous considerations should be given to the data that are captured for input. The screen design is shown in Appendix G.

3.2.9 Document and Report Design

A good output should display the information to screen output and paper output. The output screen should be easy to read, showing all the required information. The output screen helps to decrease errors in the final output on paper, which is a common

media for the computer system. With the proposed system, users can review and correct the incorrect data on screen before printing it out on the paper output. The report design is shown in Appendix H.

3.3 Hardware and Software Requirement

3.3.1 Hardware Specification

There are only four staff in the management office and no one has computer literacy. From that point, maintenance of a complex technology hardware might be a major disadvantage of the proposed system. Another constraint is the budget limitation. The high-tech hardware acquisition might be over the budget and hiring a computer expert to fix the problem onsite is expensive. According to those factors; a standard, and less complex peer-to-peer hardware is adopted in the proposed system, with low maintenance cost expectation. The following are the hardware specifications for the proposed Intranet Server and client machines of the Samret Kanchang Factory, which are shown in Tables 3.1 and 3.2 respectively.

Table 3.1. Hardware Specification for the Intranet Server.

Hardware	Specification
CPU	Intel® Pentium® 4 Processor 2.8 GHz or higher
Memory	256MB DDR 400 or higher
Hard Disk	HDD 40 GB (7,200 rpm) or higher
CD ROM Drive	52X CD ROM
Display Adapter	Intel 865G on-die VGA with DVMT 2.0 Technology
Display	CRT Monitor 15" Black (AC-511)
Network Interface Card	LAN on board 10/100/1000 Mbps
Backup Device	IOMEGA ZipDrive USB
UPS	Leonics OA 750VA

Table 3.2. Hardware Specification for Each Client Machine.

Hardware	Specification
CPU	Intel® Celeron™ Processor D330 or higher
Memory	128MB DDR400 or higher
Hard Disk	HDD 40 GB (7,200 rpm) or higher
Display Adapter	Intel 865G on-die VGA with DVMT 2.0 Technology
Display	CRT Monitor 15" Black
Network Interface Card	LAN on board 10/100/1000 Mbps

3.3.2 Software Specification

Due to budget limitation, half of the software requirement is license free software. The analyst consulted with the management level for feasibility of the proposed system with a freeware. The analyst also mentioned the disadvantages of the freeware, such as features limitation and support maintenance. Eventhough, there is some minor risk in using freeware; the proposed system can operate with full capabilities and minimal downtime. The major incurred cost is the Operating System, which bundled into the cost of hardware acquisition. The following are the software requirements for the Intranet Server of the proposed system.

Table 3.3. Software Specification for the Intranet Server.

Software	Specification
Operating System	Microsoft® Windows® XP Professional
Web Server	Apache Web Server
Application Server	PHP
Database Server	MySQL™ version 4.0.21

In the Intranet System, all client machines will have a capacity only high enough to run a Web Browser, such as Microsoft Internet Explorer. However, they should have specification higher than that, because it is necessary to run other office applications software, such as word processing or excel spreadsheet. Therefore, in general standard, all clients should have the specification for running Microsoft Operating System and

Microsoft Office. Table 3.4 shows the software specification for each client machine of the proposed system.

Table 3.4. Software Specification for Each Client Machine.

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

3.3.3 The Proposed Network System

The need to share valuable information is another factor for developing the network in the management office. Cost saving in sharing the expensive devices between users is another factor of the network. Basic client-server network architecture is used to connect users and resources together.

Basic star topology of Local Area Network is applied to this proposed system. A workstation with fixed TCP/IP address will be acting as the server by installing database and web server engine. The remaining workstations are connected to the server via hub. All workstations share the printer via the printer queue, which is enabled by the operating system.

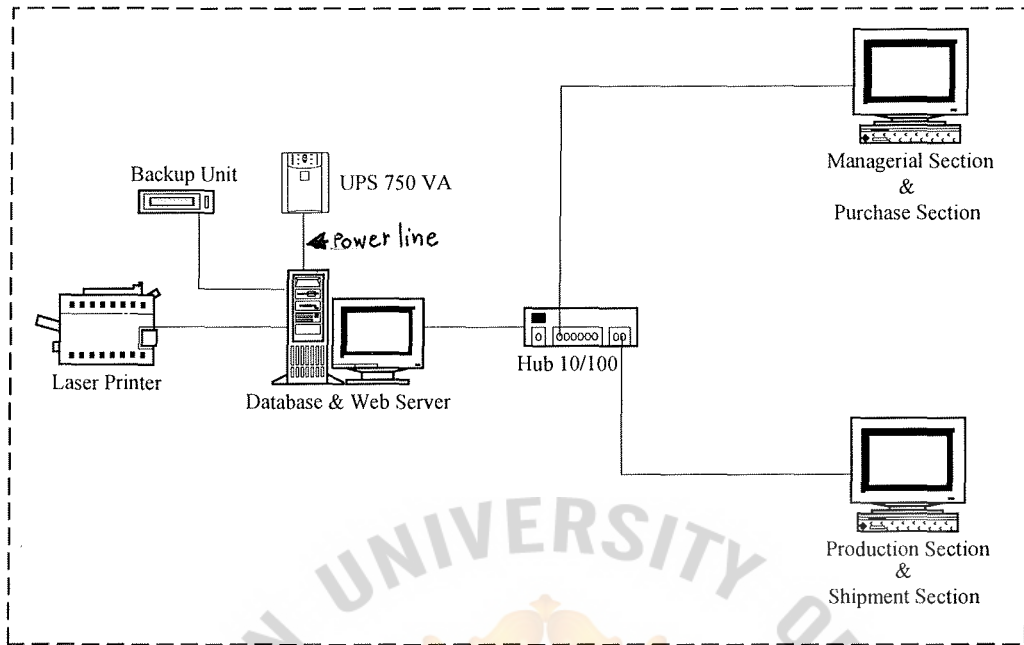


Figure 3.1. Network Configuration.

3.4 Security and Control

Information and data are important and it is confidential for every organization. A security control is used for this purpose. Only authorized persons can access this database. The security control is divided into four parts, which are as follows.

- (1) Physical security and control
 - (a) No unauthorized person can access the management office.
 - (b) The manager's room will be locked after office hours.
 - (c) Ensure that hard copies of costing and pricing are not distributed to the unauthorized persons.
- (2) Logical security and control
 - (a) Data entry must follow the procedure and format.
 - (b) Using RDBMS engine to validate the data constraints.

- (c) All out-of-date reports and forms are destroyed.
- (3) Personal Security
 - (a) Authorized persons use login feature of Microsoft XP, and force the password aging.
 - (b) Authorized persons use Login ID and password to access the proposed system.
- (4) Other security and control
 - (a) Using UPS (Uninterrupted Power Supply) for the Intranet Server in case of power outage.
 - (b) Periodic backup of database and needed files on the Intranet Server.
 - (b) Virus protection.

3.5 Cost and Benefit Analysis

A comparison between the costs of the existing system and the proposed system is needed for proving whether the project is feasible and reasonable to continue for developing the proposed system or not. For instance, some organizations only consider financial "returns" while others believe that IT's benefits include both financial and non- financial returns.

There are four categories of feasibility tests:

(1) Operational Feasibility

This is a measurement of how well the suggested solution will be applicable in the existing organization. It is also a measure of how people or the end users feel with regards to the proposed system.

(2) Technical Feasibility

This is a measurement of a practicality of a specific technical solution and the availability of technical resources and expertise.

(3) Schedule Feasibility

This is a measurement of how reasonably the project schedule is laid out throughout the predefined period.

(4) Economic Feasibility

This is a measurement of the cost-effectiveness of a problem or solution. This measurement is normally related to the financial calculation in order to prove the effectiveness of the investment.

The analyst selected economic feasibility or cost-benefit analysis methodology for this system development project.

3.5.1 Cost Analysis

The costs fall into two categories; the costs associated with developing the system and the cost associated with operating the system.

(1) Investment Cost

- (a) Hardware Purchase.
- (b) Software Development.
- (c) Implementation cost, including preparation of computer site, training, and documentation for a new system.
- (d) Personal hours for analysis, design, programming and testing.

(2) Operating Cost

- (a) Hardware and software maintenance contracts
- (b) Daily personnel cost
- (c) Office supplies and miscellaneous cost.

Tables 3.5. - 3.7. illustrate the existing manual system costs, and estimated computerized system costs for the proposed new system. The cost comparison between two systems is shown in Table 3.9.

Table 3.5. Manual System Cost Analysis (in Baht).

Cost Description	Year				
	1	2	3	4	5
<u>Operating Cost:</u>					
Salary Cost: (increase 10% per year)					
Factory Manager 1 person @20,000	240,000.00	264,000.00	290,400.00	319,440.00	351,384.00
Staff 4 persons @8,000	384,000.00	422,400.00	464,640.00	511,104.00	562,214.40
Total Annual Salary Cost:	<u>624,000.00</u>	<u>686,400.00</u>	<u>755,040.00</u>	<u>830,544.00</u>	<u>913,598.40</u>
<u>Office Supplies & Miscellaneous Cost:</u>					
Stationary Per Annual	5,000.00	5,500.00	6,050.00	6,655.00	7,320.50
Paper Per Annual	6,000.00	6,600.00	7,260.00	7,986.00	8,784.60
Utility Per Annual	4,000.00	4,400.00	4,840.00	5,324.00	5,856.40
Miscellaneous Per Annual	4,000.00	4,400.00	4,840.00	5,324.00	5,856.40
Total Annual Office Supplies & Miscellaneous Cost	<u>19,000.00</u>	<u>20,900.00</u>	<u>22,990.00</u>	<u>25,289.00</u>	<u>27,817.90</u>
Total Manual System Cost	643,000.00	707,300.00	778,030.00	855,833.00	941,416.30

Table 3.6. Five Years Accumulated Manual Cost (in Baht).

Year	Total Manual Cost	Accumulated Cost
1	643,000.00	643,000.00
2	707,300.00	1,350,300.00
3	778,030.00	2,128,330.00
4	855,833.00	2,984,163.00
5	941,416.30	3,925,579.30
Total Cost	3,925,579.30	-

Table 3.7. Computerized System Cost Analysis (in Baht).

Cost Description		Year				
		1	2	3	4	5
<u>Fixed Cost:</u>						
<u>Hardware Cost:</u>						
Intranet Server	1 Unit@34,000.00	34,000.00	-	-	-	-
Client Machine	2 Units@25,800.00	51,600.00	-	-	-	-
UPS	1 Unit@3,950.00	3,950.00	-	-	-	-
Backup Device	1 Unit@7,900.00	7,900.00	-	-	-	-
Hub	1 Unit@1,490.00	1,490.00	-	-	-	-
Laser Printer	1 Unit@10,890.00	10,890.00	-	-	-	-
UTP Cat5	30m@400.00	400.00	-	-	-	-
Total Hardware Cost		<u>110,230.00</u>	-	-	-	-
<u>Software Cost:</u>						
MS Office Standard License	4@6,000.00	24,000.00	-	-	-	-
Total Software Cost		<u>24,000.00</u>	-	-	-	-
<u>Development Cost</u>						
System Analyst	1 person@20,000.00	20,000.00	-	-	-	-
Developer	1 person@20,000.00	20,000.00	-	-	-	-
Total Development cost		<u>40,000.00</u>	-	-	-	-
Total Fixed Cost		174,230.00	-	-	-	-
<u>Operating Cost:</u>						
Personal Cost:						
Maintenance Cost			10,000.00	11,000.00	12,100.00	13,310.00
Factory Manager 1 person	@20,000	240,000.00	264,000.00	290,400.00	319,440.00	351,384.00
Staff 3 persons	@8,000	288,000.00	316,800.00	348,480.00	383,328.00	421,660.80
Total Annual Personal Cost:		528,000.00	590,800.00	649,880.00	714,868.00	786,354.80
<u>Office Supplies & Miscellaneous Cost:</u>						
Stationary	Per Annual	2,500.00	2,750.00	3,025.00	3,327.50	3,660.25
Paper	Per Annual	4,500.00	4,950.00	5,445.00	5,989.50	6,588.45
Utility	Per Annual	5,000.00	5,500.00	6,050.00	6,655.00	7,320.50
Miscellaneous	Per Annual	2,000.00	2,200.00	2,420.00	2,662.00	2,928.20
Total Annual Office Supplies & Miscellaneous Cost		<u>14,000.00</u>	<u>15,400.00</u>	<u>16,940.00</u>	<u>18,634.00</u>	<u>20,497.40</u>
Total Operating Cost		542,000.00	606,200.00	666,820.00	733,502.00	806,852.20
Total Computerized System Cost		716,230.00	606,200.00	666,820.00	733,502.00	806,852.20

Table 3.8. Five Years Accumulated Computerized Cost (in Baht).

Year	Total Computerized Cost	Accumulated Cost
1	716,230.00	716,230.00
2	606,200.00	1,322,430.00
3	666,820.00	1,989,250.00
4	733,502.00	2,722,752.00
5	806,852.20	3,529,604.20
Total Cost	3,529,604.20	-

Table 3.9. The Comparison of the System Costs (in Baht).

Year	Accumulated Manual Cost	Accumulated Computerized Cost
1	643,000.00	716,230.00
2	1,350,300.00	1,322,430.00
3	2,128,330.00	1,989,250.00
4	2,984,163.00	2,722,752.00
5	3,925,579.30	3,529,604.20

For better illustration, the analyst used a graphic portrayal of the spreadsheet, which shows a break-even chart in Figure 3.2.

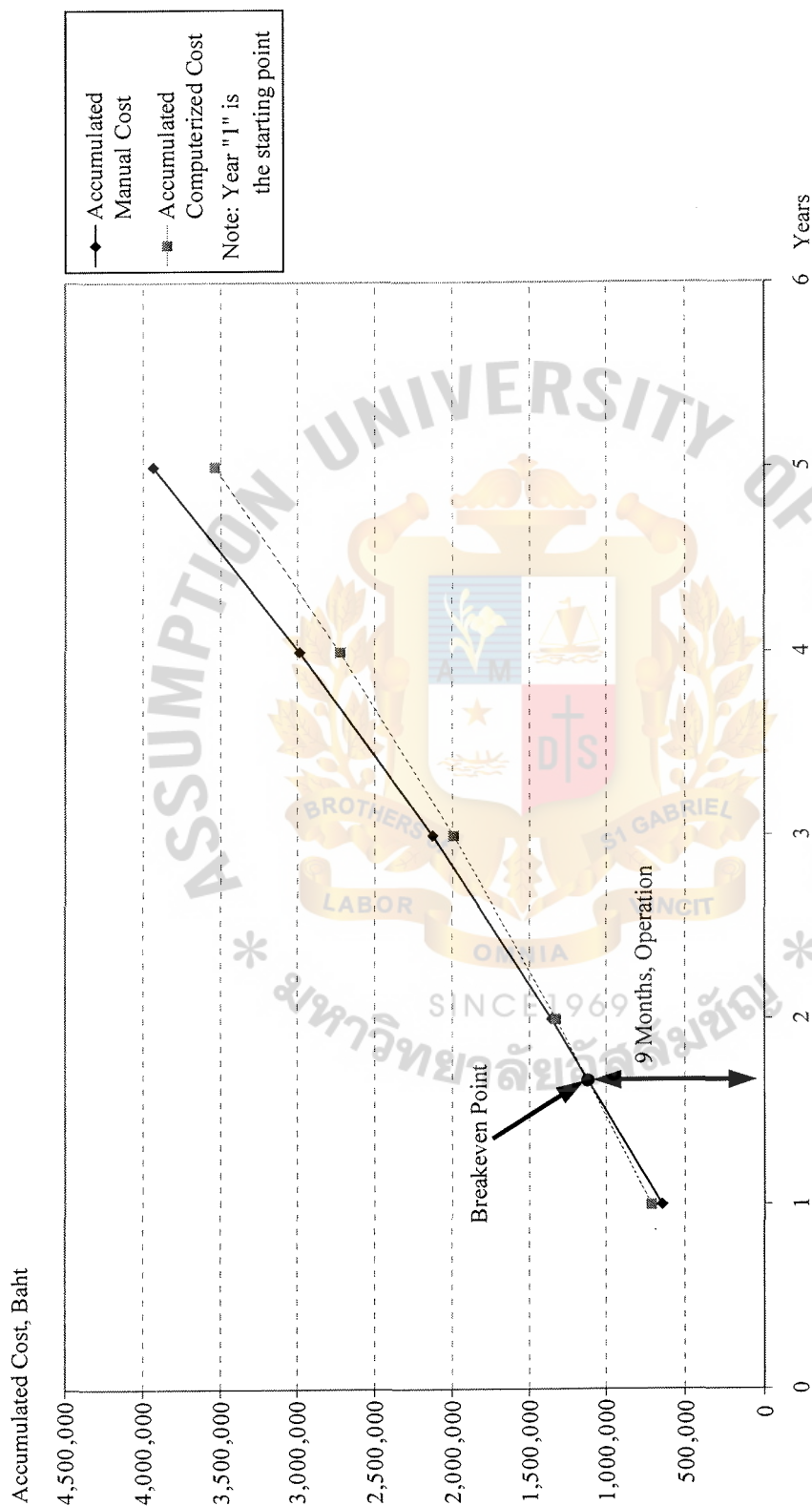


Figure 3.2. Cost Comparison between Manual and Computerized System.

3.5.2 Benefit Analysis

(1) Tangible Benefit

(a)	Cost reduction of stationery	5,000	Baht
(b)	Cost reduction of human labor	96,000	Baht
(c)	Cost reduction of overtime	75,000	Baht
(d)	Cost reduction of material inventory	175,000	Baht
(e)	Cost reduction of shipment process	275,000	Baht
	Total Tangible Benefit	626,000	Baht

(2) Intangible Benefit

- (a) Improved efficiency of operations
- (b) Reduced data redundancy
- (c) Reduced the human error
- (d) Faster information retrieval
- (e) Accurate information
- (f) Reduced cycle time for each task
- (g) Better user satisfaction

3.5.3 Payback Analysis

Beyond the Cost Analysis and Benefit Analysis, there are three other common financial measures to study the economic feasibility, which are: payback analysis, return on investment, and net present value.

Table 3.10. shows the comparison between cost and benefit of the proposed computerized system in Baht currency. The analyst used the information from this table to analyze the cost-effectiveness of the proposed system.

Table 3.10. Comparison Between Cost and Benefit of Computerized System (in Baht).

Cost Items	Years					
	0	1	2	3	4	5
Development Cost	174,230.00	-	-	-	-	-
Operating Cost	-	542,000.00	606,200.00	666,820.00	733,502.00	806,852.20
Discount Factor at 12%	1.00	0.88	0.77	0.68	0.60	0.53
Time – Adjusted Cost	174,230.00	476,960.00	469,441.28	454,419.16	439,877.75	425,801.66
Cumulative Cost - Adjusted Cost over lifetime	<u>174,230.00</u>	<u>651,190.00</u>	<u>1,120,631.28</u>	<u>1,575,050.44</u>	<u>2,014,928.18</u>	<u>2,440,729.84</u>
Benefit derived from the new proposed system	0.00	626,000.00	688,600.00	757,460.00	833,206.00	916,526.60
Discount Factor at 12%	1.00	0.88	0.77	0.68	0.60	0.53
Time – Adjusted Benefit	0.00	550,880.00	533,251.84	516,187.78	499,669.77	483,680.34
Cumulative Benefit - Adjust Benefit over lifetime	<u>0.00</u>	<u>550,880.00</u>	<u>1,084,131.84</u>	<u>1,600,319.62</u>	<u>2,099,989.39</u>	<u>2,583,669.73</u>
Adjusted Cumulative Lifetime - Cost + Benefit	<u>-174,230.00</u>	<u>-100,310.00</u>	<u>-36,499.44</u>	<u>25,269.18</u>	<u>85,061.21</u>	<u>142,939.89</u>

(1) Payback Period

The payback analysis technique is a simple and popular method for determining if and when an investment will repay for itself. Because system development costs are incurred long before benefits begin to accrue, it will take some time for the benefits to overtake costs. After implementation, additional operating expenses that must be recovered will incur. Payback analysis determines how much time will lapse before accrued benefits overtake accrued and continuing costs. This period of time is called the *payback period*.

The Analyst analyzes the payback of the proposed system with the existing system to compare the budget cost with the actual cost and when it will recover.

$$\begin{aligned}
 \text{Formula} &= \text{Last year of negative cash flow difference} + \{ \text{Cumulative} \\
 &\quad \text{difference last negative year} / \text{Absolute value of} \\
 &\quad \text{cumulative difference [last negative} + \text{first positive}] \} \\
 &= 3 + (-36,499.44 / ([-36,499.44 + 25,269.18])) \\
 &= 3 + (-36,499.44 / 61,768.68) \\
 &= 2.40 \text{ Years}
 \end{aligned}$$

Payback period for the project is 2.40 years, so it is feasible even if the value of the baht is lower.

(2) Net Present Value of this Investment

$$\begin{aligned}
 \text{Formula} &= \text{Total Cumulative Adjusted Benefit} - \text{Total Cumulative} \\
 &\quad \text{Adjusted Cost} \\
 &= 2,583,669.73 - 2,440,729.84 \\
 &= 142,939.89
 \end{aligned}$$

(3) Return On Investment

$$\begin{aligned}
 \text{Formula} &= 1 / \text{Payback} \\
 &= 1 / 2.40 \\
 &= 0.41 \%
 \end{aligned}$$

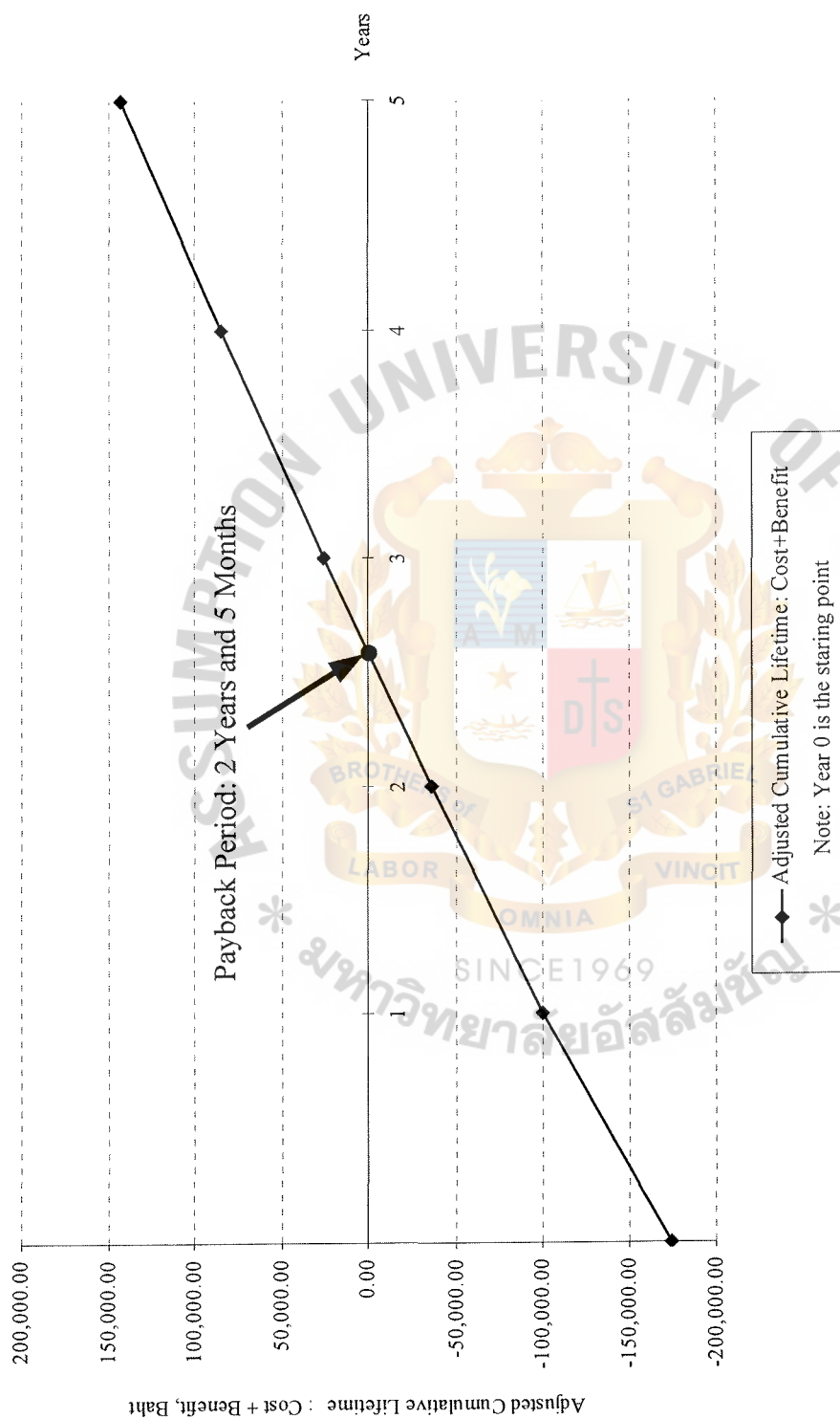


Figure 3.3. Payback Period.

IV. PROJECT IMPLEMENTATION

4.1 Overview of Project Implementation

System implementation is a planned conversion from solution specifications established during system analysis and design into a fully operational information system. It is a constructive process of developing the new system and delivery of that new proposed system into the existing business operation.

During this phase, the analyst is involved in a series of application development tasks, system installation, and application evaluation. All necessary system programs and code modules are designed and developed during the period of application development. User training, data conversion, and the new system going live are involved in system installation. Once the new proposed system goes live and has fully operative functions, evaluation of the new system is a mandatory conclusion of this system development project.

Developer and the analyst worked together in order to design, develop, document, integrate and test the new system. Developer uses the structured design for referencing the code design, developing, and testing the system. Document related to the module of the new proposed system is the responsibility of the developer during the coding period. In order to guarantee the new system meets the requirement; the analyst worked closely with the developer during the testing period. The users are involved during the testing, training, and evaluation period.

4.2 System Programming

PHP has been chosen as the tools for coding the new proposed system. With web technologies, PHP provides the modular coding and reuse object technique, in order to shorten the timeliness of system programming. PHP coding is used to support more

functions and increase the performance of the application. This project also adopts the software version control technique in order to control modular source codes. Developer used the checked-in and checked-out method in order to get the relevant source code for either modification or building a new application software version. This technique is very helpful for reducing the errors caused by the developer during development.

4.3 Testing

Testing is a basic, valuable, and working technique in order to prove and guarantee the business functionalities of the proposed system. All parties in this system development project; analyst, users, and developer, are involved in this validation process. All functionalities of the proposed system are repeatedly tested until it meets the business requirements and there is no programmatic execution error in any functionality. As earlier mentioned, software version control is adopted in order to make sure modification has been made to the right portion of the codes. The testing techniques used in this system development project are follows:

(1) Sub Testing

This is the smallest unit of testing which is conducted by developer during development of the proposed system.

(2) Unit Testing

Developer performs the testing of an individual program or module. It is done by checking and running each unit of the program to identify and eliminate execution errors. The program is tested in all possible situations that the developer must handle. Data will be tested with both correct and erroneous data.

(3) System Testing

Once all modules have been separately tested, Link Testing or System Testing is another testing which is conducted again for the proposed system. This is the testing of two or more programs that depend on each other to make sure that the programs work together properly. Thereafter, testing of the whole program that involves the entire information system was conducted. Developer and the analyst tested all the processing that the new proposed application can perform, such as test of actual data, queried and printed reports in order to simulate the actual operations of the factory.

(4) User Acceptance Testing

Because the proposed system cannot be accepted by only the developer's and the analyst's testing, the users are involved for another testing called UAT or User Acceptance Testing. Users developed the acceptance criteria and make the final decision whether to accept or reject the proposed system. The users tested the proposed system by using simulated test (using simulated data) and/or actual test (using real data) to evaluate system performance – throughput and response time of the system, and to see the performance of the system in the peak workload processing to make sure that the proposed system is free of errors and ready to be placed in production.

4.4 Training

Due to the small number of users, group training is used for this system development project. User manual is a formal document for guiding the users of the new proposed system. One of the workstation is installed with the proposed system, labeled as the training system. With this workstation, users can use it for their training

purposes. The training was conducted after office hours and divided into sub module trainings, which are functionally independent. The analyst demonstrated the overview application flow and explained screen by screen. Thereafter, the analyst demonstrated the total flow of application, starting from receiving order until shipment process. Users are assigned with practices, which can be performed on the training workstation. Users can raise any question regarding the application in order to get clarification. Once the proposed system goes live, this training system was uninstalled and reconfigured as the client of the live system.

4.5 Conversion

Conversion is the process of changing from the existing system to the new proposed system. Normally, it involves many elements: hardware, software, process and information. The process is completed when the new proposed system becomes a routine operative system. There are four conversion approaches as follows:

(1) Direct Conversion

The immediate discontinuing of the old existing system when a new system is introduced. Appropriate when the old system has no value or the new one is so different that comparison between the two systems are meaningless. It is inexpensive, but there is no backup system.

(2) Parallel Conversion

Operating the old existing system and the new proposed system simultaneously for a period of time. It protects the company from errors, but it is costly and stressful for employees to process all transactions twice.

(3) Phase-in Conversion

Gradually replacing elements of the old existing system with a new proposed system. Cost of creating temporary interface between the old

existing system and the new proposed system and the time required to make the gradual changeover are major disadvantage factors.

(5) Pilot Conversion

Implementing in a part of the new proposed system as a pilot. When problems in the system are resolved, the new system could be implemented to all remaining parts in the organization. Good for solving conversion problems and allows training in a live environment. Major disadvantages are long conversion time and necessity of extra interface between old existing and new proposed system.

The analyst chooses a combination between parallel and direct conversion for this system development project. Users parallelly entered all existing information directly into the new proposed system during the testing and training period.

Since this is the new computer system, the analyst first discussed with the users in order to choose the first date of month as go live schedule. Once the system is ready and users are well trained, the users and the analyst arranged a meeting for choosing the exact date to go live. All users used the computerized system on the predefined date of go live scheduling, and all manual activities are defined as a backup plan. Administrative tasks related to the new proposed system; i.e. backup methodology, are defined, tested and deployed together with the new system.

Two weeks of evaluation period of the new proposed system was arranged from the first date of go live plan. During the two weeks of evaluation period, the users, the analyst and the management monitored and recorded any outstanding issues. In case of unexpected error from system programming, the developer handled it case by case and new minor version was released at the beginning of the next business day.

At the end of two weeks period; the analyst, cooperating with the users and

factory management, worked as the steering committee in order to make the final decision of accepting the new proposed system. Once acceptance was defined, the manual system could be permanently destroyed because it is totally different from the new proposed system.



V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The proposed information system is concerned with solving the problems of the old manual system by replacing it with the new computerized system. The analyst used the classical steps of SDLC (System Development Life Cycle), which are planning, analysis, design, implementation and maintenance for the development project.

The existing problems of the old manual system are timeliness, data redundancy, data accuracy and a lot of human errors. A new computerized system is designed to solve those problems. It will help the users operate the same tasks in an easier and faster way. Moreover, the new proposed Intranet system will improve staff performance and also increase efficiency and effectiveness of data processing. Cost-Benefit analysis in section 3.4 shows the cost comparison between the existing cumulative manual system cost and the proposed cumulative system cost. From the graphical diagram, it is shown that the cost of computerized system is less than the cost of the existing manual system and it is worth to invest in the new proposed system. Also, the payback analysis in section 3.4 shows a good potential in shortening the payback period with an approximate half of return from this investment.

The processes of the new proposed system are less than the old manual system because a lot of tasks are automated. The reorganized workflow improved all overlapped processes. Hardware and software are brought into the new system to facilitate the work of users and make processing faster and easier. With the new system, users or staff can reduce human error, which is a major issue in the old manual system. This system development project can cover all the users' requirements and achieve the business purpose as displayed in Table 5.1.

Table 5.1. Degree of Achievements of the Proposed System.

Description	Existing System	Proposed System
Pricing Process	> 30 Minutes	5 Minutes
Order Entry Process	15 Minutes	2 Minutes
Inventory Control Process	> 1 Hour	< 15 Minutes
Job Assignment	15 – 30 Minutes	5 Minutes
Prepare Quotation	15 Minutes	2 Minutes
Prepare Purchase order	15 Minutes	2 Minutes
Prepare Shipping Document	15 Minutes	2 Minutes
Billing Process	15 Minutes	2 Minutes

Referring to Table 5.1., the proposed system achieved all business requirements and prove the concept of this investment. There are three major improvements as shown below:

- (1) Pricing process: the proposed system reduced the time for registering or retrieving product pricing. Staff can use the recorded price to confirm any customer, if the price is within the valid period. The system is no longer error prone because all prices are recorded and confirmed.
- (2) Inventory Control process: the proposed system gave an accurate balance within a short period of time. All transactions are grouped, and calculated without error or physical counting at the storage area.
- (3) Job assignment process: the proposed system gave the information of each assignment in the production line. Staff assigned and tracked the actual activities in the production line with a short and accurate process.

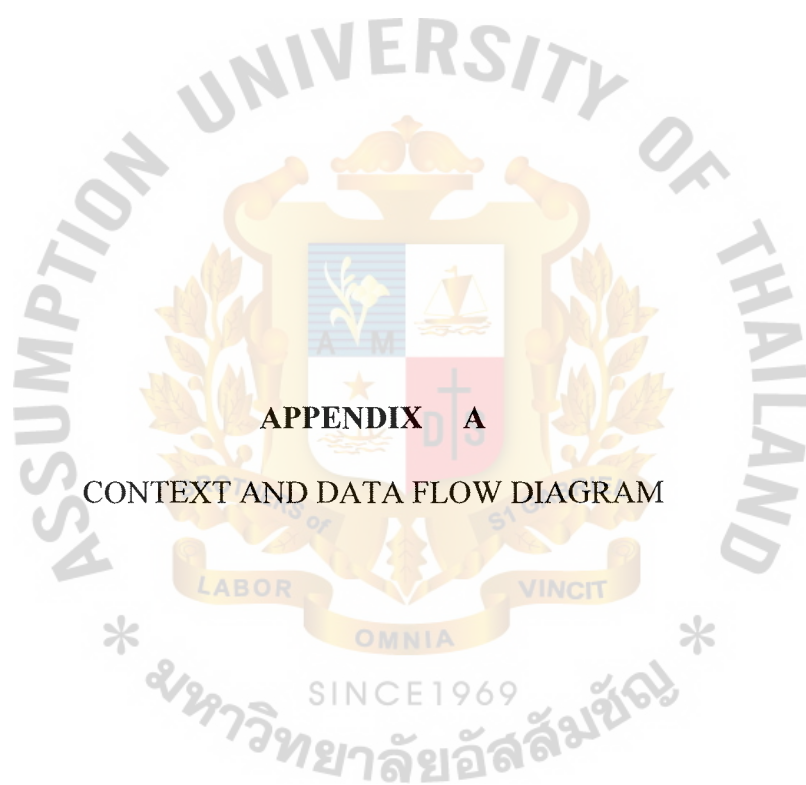
5.2 Recommendations

The system development life cycle is so named because systems development is a process that never ends. Thus, even when a system is completely specified, designed, developed, and running, it is continually being enhanced or maintained.

Enhancement and maintenance may require returning to one of the earlier stages of the system development process. Changing business conditions can play just as great a role as changing technologies in creating the need for systems to be maintained or enhanced.

After completing this system project development, the analyst wants to point out some enhancement for Samret Kanchang Factory as follows:

- (1) The proposed system should provide functionality of security control in business functions i.e. staff should not view the costing data.
- (2) Because the factory has never used computers before, there is a need to train users comprehensively and continuously. Moreover, the specifications of hardware and software of this proposed system is quite high; therefore, the proposed technologies should be used at least for the next 5 years.
- (3) This new proposed system should enhance developing of a new payroll system. Thereafter, employee information should be retrieved from the payroll system instead of keying the information directly. Also, assignment data should be used in salary calculation in the new system as well.
- (4) If possible, the factory should convert some section of this system to the real public Internet application, especially the order management system and inventory balancing report. It will reduce the cost of maintaining customers' orders via the normal method, i.e. telephone, fax.



APPENDIX A

CONTEXT AND DATA FLOW DIAGRAM

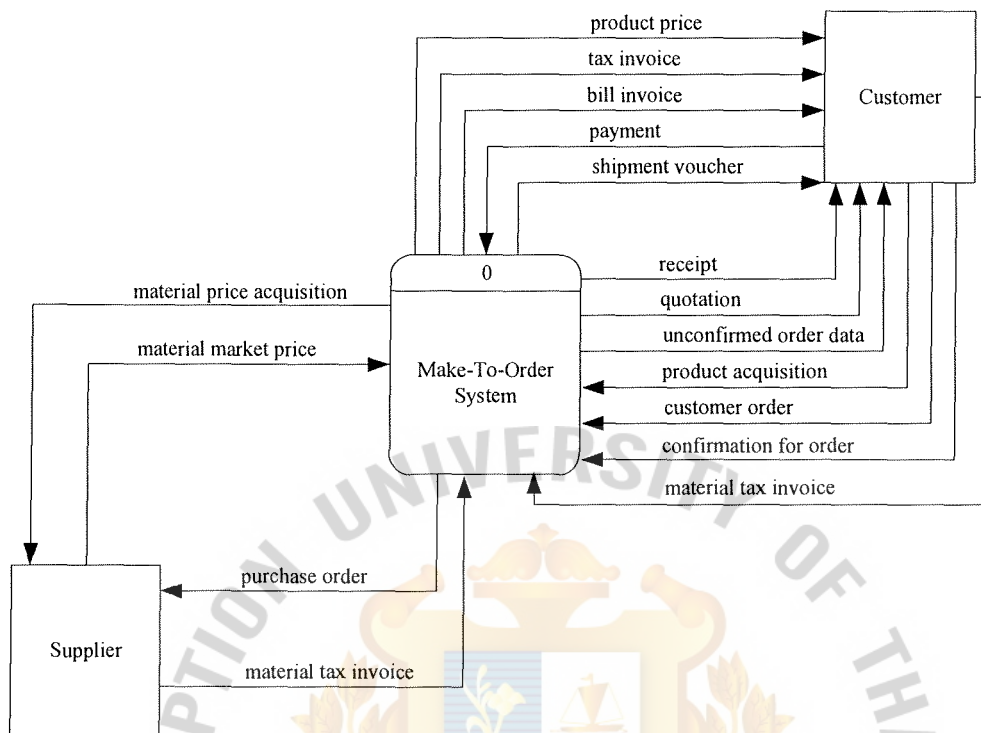


Figure A.1. Context Diagram for the Proposed System.

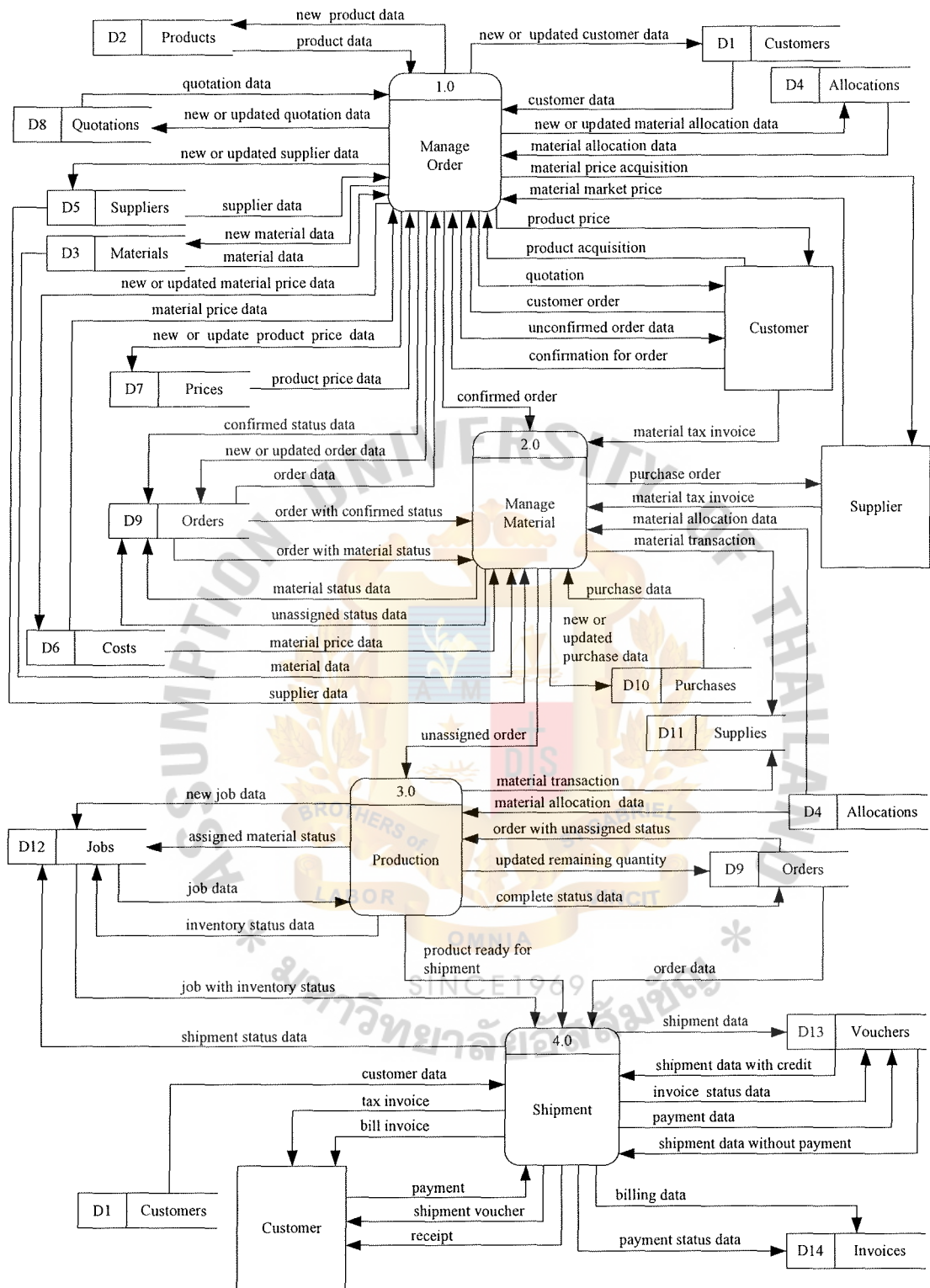


Figure A.2. Level 0 of Data Flow Diagram of the Proposed System.

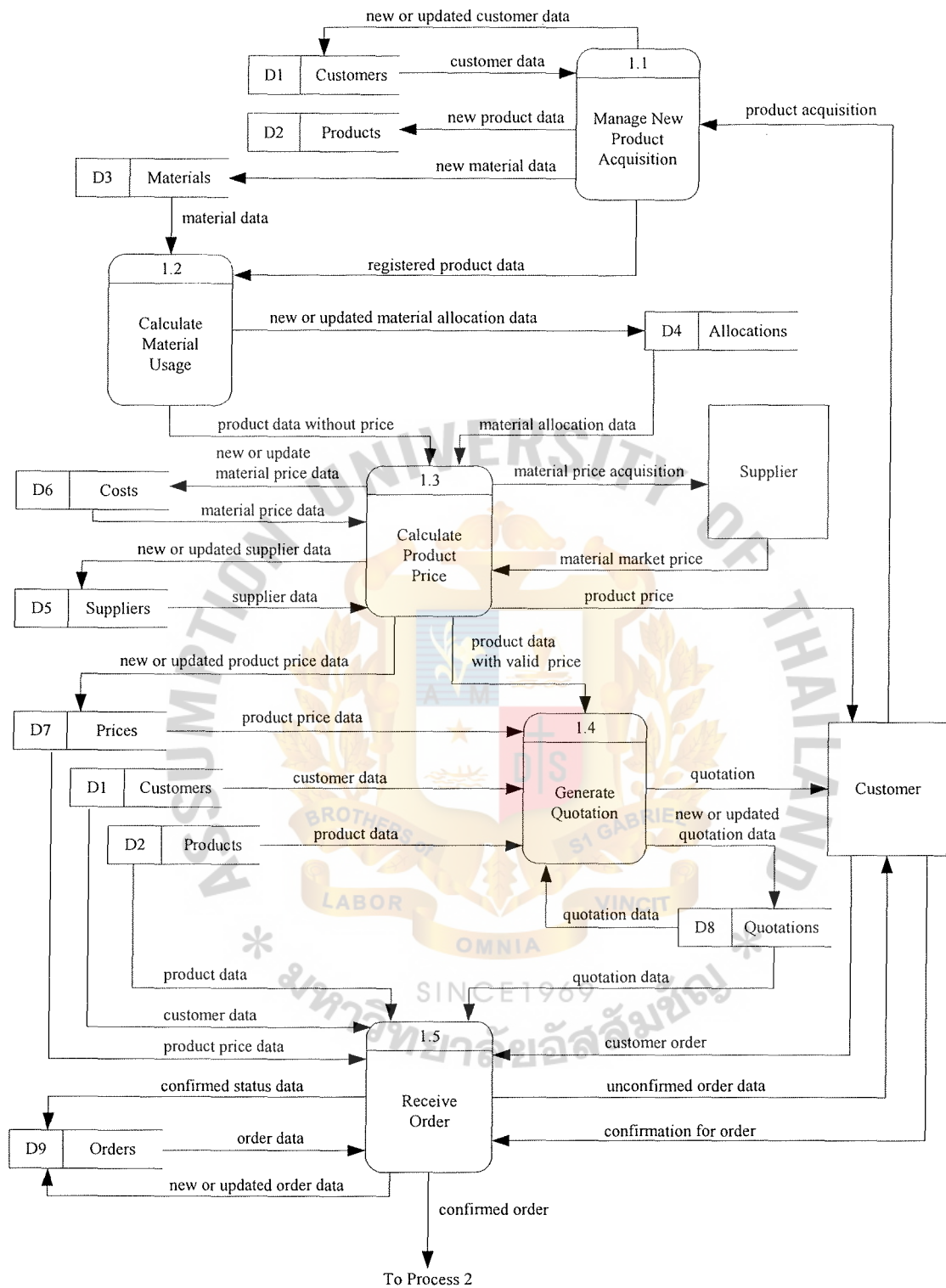


Figure A.3. Level 1 of Process 1 “Manage Order” of the Proposed System.

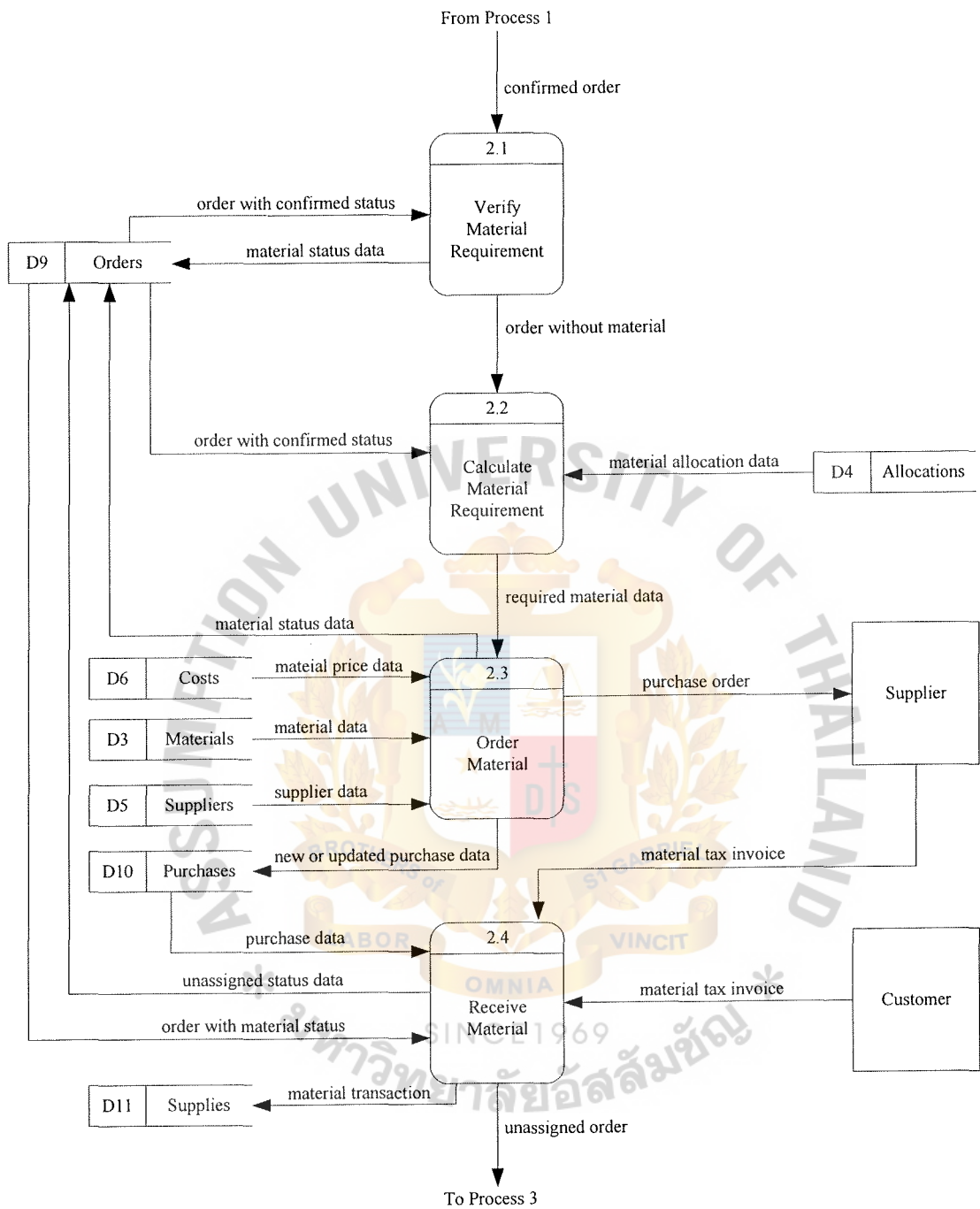


Figure A.4. Level 1 of Process 2 “Manage Material” for the Proposed System.

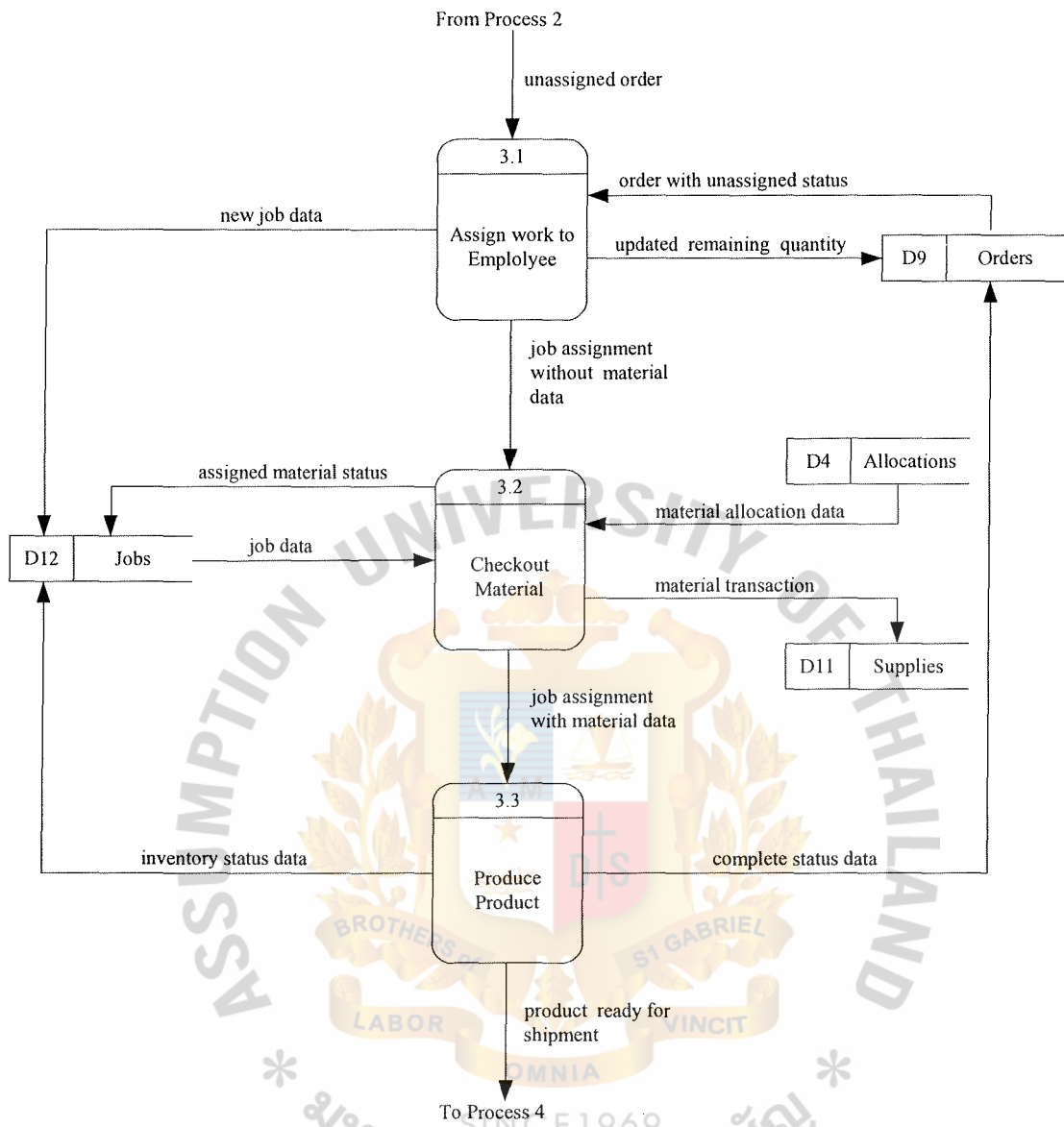


Figure A.5. Level 1 of Process 3 “Production” for the Proposed System.

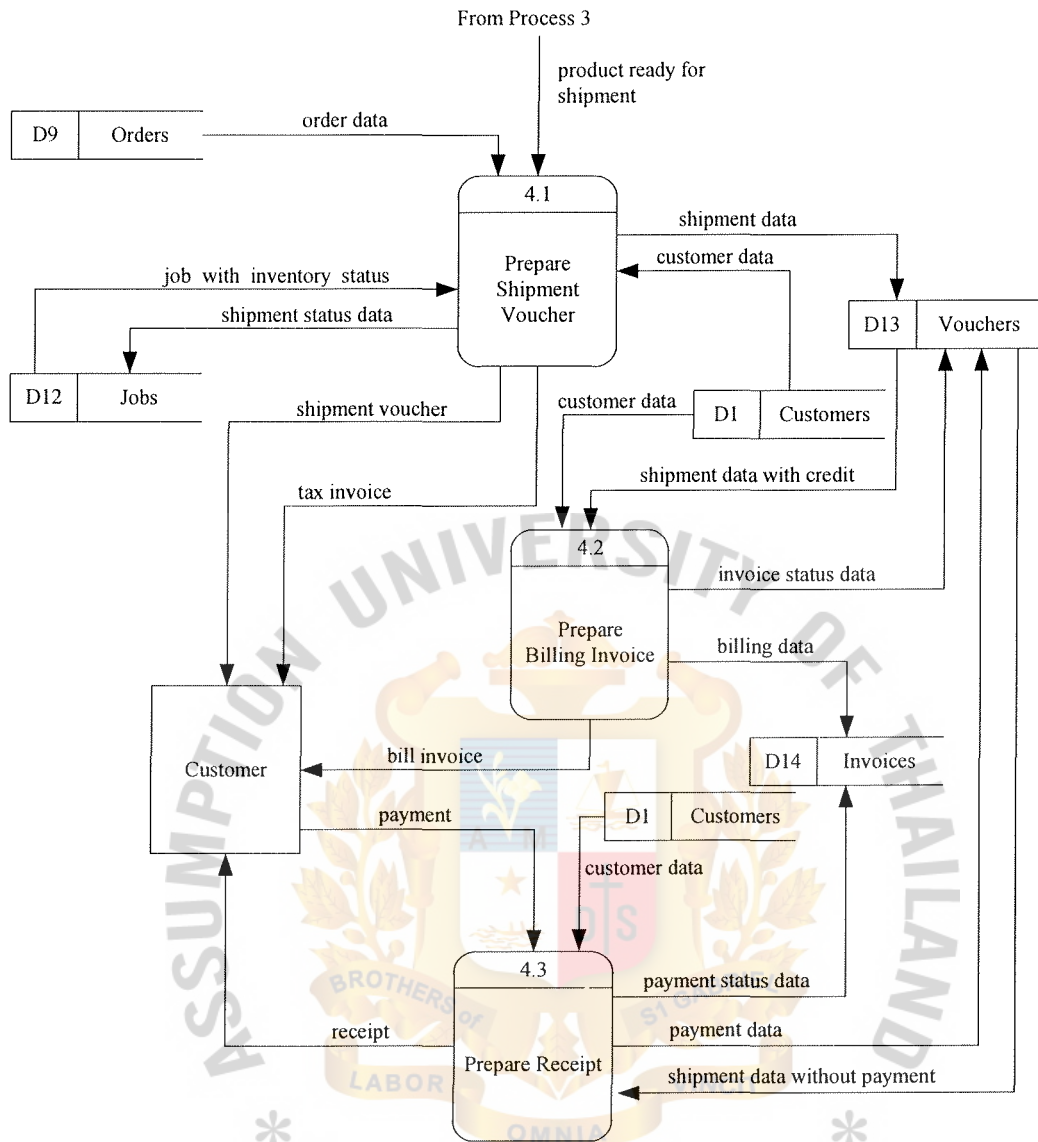
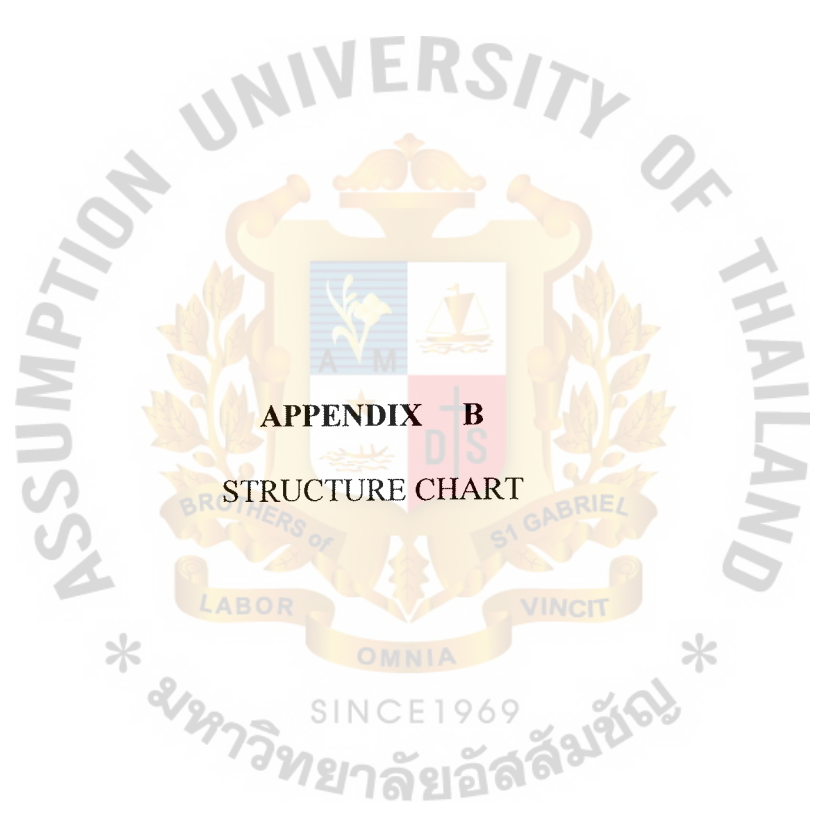


Figure A.6. Level 1 of Process 4 “Shipment” for the Proposed System.



APPENDIX B

STRUCTURE CHART



APPENDIX C
PROCESS SPECIFICATION

Table C.1. Process Specification of Made-To-Order.

Items:	Description:
Process Number:	0
Process Name:	Made-To-Order System
Data In:	- product acquisition - customer order - confirmation for order - material market price - material tax invoice - payment
Data Out:	- quotation - product price - unconfirmed order data - material price acquisition - purchase order - shipment voucher - tax invoice - bill invoice - receipt
Process:	- Manage Order - Manage Material - Production - Shipment
Attachment:	- Customer

Table C.1. Process Specification of Made-To-Order (Continued).

Items:	Description:
Attachment:	- Supplier - Customers (D1) - Products (D2) - Materials (D3) - Allocations (D4) - Suppliers (D5) - Costs (D6) - Prices (D7) - Quotations (D8) - Orders (D9) - Purchases (D10) - Supplies (D11) - Jobs (D12) - Vouchers (D13) - Invoices (D14)

Table C.2. Process Specification of Manage Order.

Items:	Description:
Process Number:	1.0
Process Name:	Manage Order
Data In:	- product acquisition

Table C.2. Process Specification of Manage Order (Continued).

Items:	Description:
Data In:	- customer order - confirmation for order - material market price - product data - customer data - material allocation data - quotation data - supplier data - material data - material price data - product price data - order data
Data Out:	- new product data - new or update customer - new or updated material allocation data - material price acquisition - new or updated quotation data - new or updated supplier data - new material data - new or updated material price data - new or updated product price data - product price

Table C.2. Process Specification of Manage Order (Continued).

Items:	Description:
Data Out:	- quotation - new or updated order data - unconfirmed order data - confirmed status data - confirmed order
Process:	- Manage New Product Acquisition - Calculate Material Usage - Calculate Product Price - Generate Quotation - Receive Order
Attachment:	- Customer - Supplier - Customers (D1) - Products (D2) - Materials (D3) - Allocations (D4) - Suppliers (D5) - Costs (D6) - Prices (D7) - Quotations (D8) - Orders (D9)

Table C.3. Process Specification of Manage Material.

Items:	Description:
Process Number:	2.0
Process Name:	Manage Material
Data In:	- confirmed order - material tax invoice - material allocation data - purchase data - supplier data - material data - material price data - order with material status - order with confirmed status
Data Out:	- purchase order - material transaction - new or updated purchase data - unassigned status data - material status data - unassigned order
Process:	- Verify Material Requirement - Calculate Material Requirement - Order Material - Receive Material
Attachment:	- Customer

Table C.3. Process Specification of Manage Material (Continued).

Items:	Description:
Attachment:	- Supplier - Material (D3) - Allocations (D4) - Suppliers (D5) - Costs (D6) - Orders (D9) - Purchases (D10) - Supplies (D11)

Table C.4. Process Specification of Production.

Items:	Description:
Process Number:	3.0
Process Name:	Production
Data In:	- unassigned order - material allocation data - assigned material data - order with unassigned status
Data Out:	- material transaction - new job data - inventory status data - updated remaining quantity

Table C.4. Process Specification of Production (Continued).

Items:	Description:
Data Out:	- complete status data - product ready for shipment
Process:	- Assign Work to Employee - Checkout Material - Produce Product
Attachment:	- Allocations (D4) - Orders (D9) - Supplies (D11) - Jobs (D12)

Table C.5. Process Specification of Shipment.

Items:	Description:
Process Number:	4.0
Process Name:	Shipment
Data In:	- product ready for shipment - order data - job with inventory status - customer data - shipment data with credit - shipment data without payment - payment

Table C.5. Process Specification of Shipment (Continued).

Items:	Description:
Data Out:	- shipment data - shipment status data - invoice status data - payment status data - payment data - shipment voucher - tax invoice - billing data - bill invoice - receipt
Process:	- Prepare Shipment Voucher - Prepare Billing Invoice - Prepare Receipt
Attachment:	- Customer - Customers (D1) - Orders (D9) - Jobs (D12) - Vouchers (D13) - Invoices (D14)

Table C.6. Process Specification of Manage New Product Acquisition.

Items:	Description:
Process Number:	1.1
Process Name:	Manage New Product Acquisition
Data In:	- product acquisition - customer data
Data Out:	- new or updated customer data - new product data - new material data
Process:	If customer sends product acquisition to the factory then If it is a new product then If customer is new or updated information, record it Record the new product information If new material required, record the new material Process for recording material allocation. End if End if
Attachment:	- Customer - Customers (D1) - Products (D2) - Materials (D3)

Table C.7. Process Specification of Calculate Material Usage.

Items:	Description:
Process Number:	1.2
Process Name:	Calculate Material Usage
Data In:	- registered product data - material data
Data Out:	- new or updated material allocation data - product data without price
Process:	If the new product has no allocation data then Read material data Calculate material usage per unit of new product Record material allocation data for further usage End if
Attachment:	- Materials (D3) - Allocations (D4)

Table C.8. Process Specification of Calculate Product Price.

Items:	Description:
Process Number:	1.3
Process Name:	Calculate Product Price
Data In:	- product data without price - material allocation data - material price data

Table C.8. Process Specification of Calculate Product Price (Continued).

Items:	Description:
Data In:	- material market price - supplier data
Data Out:	- material price acquisition - new or update material price data - new or updated supplier data - new or updated product price data - product price with valid price - product price
Process:	If the product has no specific price then Retrieve required material for the product Check material cost If costing is not updated then Query material market price from various suppliers If new supplier has contacted, record the information End if Update current market price of relevant materials Calculate the unit price of product, and record it End if Inform customer for the price of queried product If customer wants the quotation document, continue to the next process
Attachment:	- Customer

Table C.8. Process Specification of Calculate Product Price (Continued).

Items:	Description:
Attachment:	- Supplier - Allocations (D4) - Suppliers (D5) - Costs (D6) - Prices (D7)

Table C.9. Process Specification of Generate Quotation.

Items:	Description:
Process Number:	1.4
Process Name:	Generate Quotation
Data In:	- product data with valid price - customer data - product data - product price data - quotation data
Data Out:	- new or updated quotation data - quotation
Process:	If customer requires the quotation document then Create quotation data for relevant product Print quotation document and fax it to customer If there is any adjustment then

Table C.9. Process Specification of Generate Quotation (Continued).

Items:	Description:
Process:	Retrieve the relevant quotation and edit, fax to customer End if End if
Attachment:	- Customer - Customers (D1) - Products (D2) - Prices (D7) - Quotations (D8)

Table C.10. Process Specification of Receive Order.

Items:	Description:
Process Number:	1.5
Process Name:	Receive Order
Data In:	- quotation data - customer data - product data - product price data - customer order - confirmation for order - order data
Data Out:	- new or updated order data

Table C.10. Process Specification of Receive Order (Continued).

Items:	Description:
Data Out:	- unconfirmed order data - confirmed order data - confirmed order
Process:	If customer places an order relevant to the valid quotation then Create order from quotation Else If customer places an order directly, record the order End if If there is any new and unconfirmed order then Acquire confirmation from customer If customer confirms the order then Update order with confirmation status Notify material section to acquire the material End if End if
Attachment:	- Customer - Customers (D1) - Products (D2) - Prices (D7) - Quotations (D8) - Orders (D9)

Table C.11. Process Specification of Verify Material Requirement.

Items:	Description:
Process Number:	2.1
Process Name:	Verify Material Requirement
Data In:	- confirmed order - order with confirmed status
Data Out:	- order without material - material status data
Process:	If there is any order with confirmed status then Retrieve relevant information of the specific order If customer supplies the material then Update relevant order with material waiting status End if End if
Attachment:	Orders (D9)

Table C.12. Process Specification of Calculate Material Requirement.

Items:	Description:
Process Number:	2.2
Process Name:	Calculate Material Requirement
Data In:	- order without material - order with confirmed status - material allocation data

Table C.12. Process Specification of Calculate Material Requirement (Continued).

Items:	Description:
Data Out:	- required material data
Process:	If there is any order with confirmed status then Read all confirmed orders and group into the products Calculate the total required materials for all products End if
Attachment:	- Allocations (D4) - Orders (D9)

Table C.13. Process Specification of Order Material.

Items:	Description:
Process Number:	2.3
Process Name:	Order Material
Data In:	- required material data - material data - supplier data - material price data
Data Out:	- material status data - new or updated purchase data - purchase order
Process:	If all required materials have been defined then Create new purchase order

Table C.13. Process Specification of Order Material (Continued).

Items:	Description:
Process:	If supplier needs purchase order then Print Purchase Order and fax it to the supplier Else Place the order to supplier via phone End if Update all relevant orders with material waiting status End if
Attachment:	- Supplier - Material (D3) - Suppliers (D5) - Costs (D6) - Orders (D9) - Purchases (D10)

Table C.14. Process Specification of Receive Material.

Items:	Description:
Process Number:	2.4
Process Name:	Receive Material
Data In:	- material tax invoice - purchase data - order with material status

Table C.14. Process Specification of Receive Material (Continued).

Items:	Description:
Data Out:	- material transaction - unassigned status data - unassigned order
Process:	Customer or supplier will send material tax invoice together with material shipment If supplier delivers the material then Retrieve all relevant orders from the purchase order Update those orders with unassigned status data Else Retrieve relevant order, normally having material waiting status Update order with unassigned status data End if Create checkin transaction for those received material Notify production section for material arrival
Attachment:	- Customer - Supplier - Purchase (D10) - Supplies (D11)

Table C.15. Process Specification of Assign Work to Employee.

Items:	Description:
Process Number:	3.1
Process Name:	Assign Work to Employee
Data In:	- unassigned order - order with unassigned status
Data Out:	- new job data - updated remaining quantity - job assignment without material data
Process:	Read all pending order with unassigned status If there is any pending order then Pickup order, which is close to the shipment date Assign number of product to employee Record the assignment Update relevant order with new remaining quantity Notify checkout material process End if
Attachment:	- Orders (D9) - Jobs (D12)

Table C.16. Process Specification of Checkout Material.

Items:	Description:
Process Number:	3.2

Table C.16. Process Specification of Checkout Material (Continued).

Items:	Description:
Process Name:	Checkout Material
Data In:	- job assignment without material data - job data - material allocation data
Data Out:	- material transaction - job assignment with material data - assigned material status
Process:	Read all pending orders without material status If there is any pending order without material status then Read assigned quantity of product from relevant job Check material requirement for relevant job Assign material to job and change status Create checkout transaction for those material Notify production process for material location End if
Attachment:	- Allocations (D4) - Supplies (D11) - Jobs (D12)

Table C.17. Process Specification of Produce Product.

Items:	Description:
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Table C.17. Process Specification of Produce Product (Continued).

Items:	Description:
Process Number:	3.3
Process Name:	Produce Product
Data In:	- job assignment with material data
Data Out:	- product ready for shipment - inventory status data - complete status data
Process:	If job has been assigned with all required material then Employee can start production If employee has finished product then Update job with inventory status. If relevant customer order has been completed then Update relevant order with complete status End if End if Notice shipment section for product ready for shipment End if
Attachment:	- Orders (D9) - Jobs (D12)

Table C.18. Process Specification of Prepare Shipment Voucher.

Items:	Description:
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Table C.18. Process Specification of Prepare Shipment Voucher (Continued).

Items:	Description:
Process Number:	4.1
Process Name:	Prepare Shipment Voucher
Data In:	- product ready for shipment - order data - job with inventory status - customer data
Data Out:	- shipment status data - shipment data - shipment voucher - tax invoice
Process:	If any product is ready for shipment then Read jobs with inventory status Read relevant order data to verify condition If VAT required then create tax invoice data If VAT not required then create shipment voucher data Update relevant jobs with shipment status Print shipment voucher or tax invoice and send it to customer End if
Attachment:	- Customer - Customers (D1) - Orders (D9)

Table C.18. Process Specification of Prepare Shipment Voucher (Continued).

Items:	Description:
Attachment:	- Voucher (D13) - Jobs (D12)

Table C.19. Process Specification of Prepare Billing Invoice.

Items:	Description:
Process Number:	4.2
Process Name:	Prepare Billing Invoice
Data In:	- shipment data with credit - customer data
Data Out:	- invoice status data - billing data - bill invoice
Process:	Retrieve all non-paid Tax Invoices If Tax Invoice is due for payment then Create new billing data Update Tax Invoice with relevant Bill of Invoice No Print Bill of Invoice and send it to customer End if
Attachment:	- Customer - Customers (D1) - Vouchers (D13)

Table C.19. Process Specification of Prepare Billing Invoice (Continued).

Items:	Description:
Attachment:	- Invoices (D14)

Table C.20. Process Specification of Prepare Receipt.

Items:	Description:
Process Number:	4.3
Process Name:	Prepare Receipt
Data In:	- payment - shipment data without payment - customer data
Data Out:	- payment data - payment status data - receipt
Process:	If customer places payment to factory then If customer pays for Bill of Invoice then Update Bill of Invoice with paid status. Retrieve all relevant Tax Invoices from Bill of Invoice No. Update those Tax Invoices with payment data Else Update specific Tax Invoice with payment data End if

Table C.20. Process Specification of Prepare Receipt (Continued).

Items:	Description:
Process:	Print receipt and send it to customer. End if
Attachment:	- Customer - Customers (D1) - Vouchers (D13) - Invoices (D14)





APPENDIX D
ENTITY RELATIONSHIP DESIGN

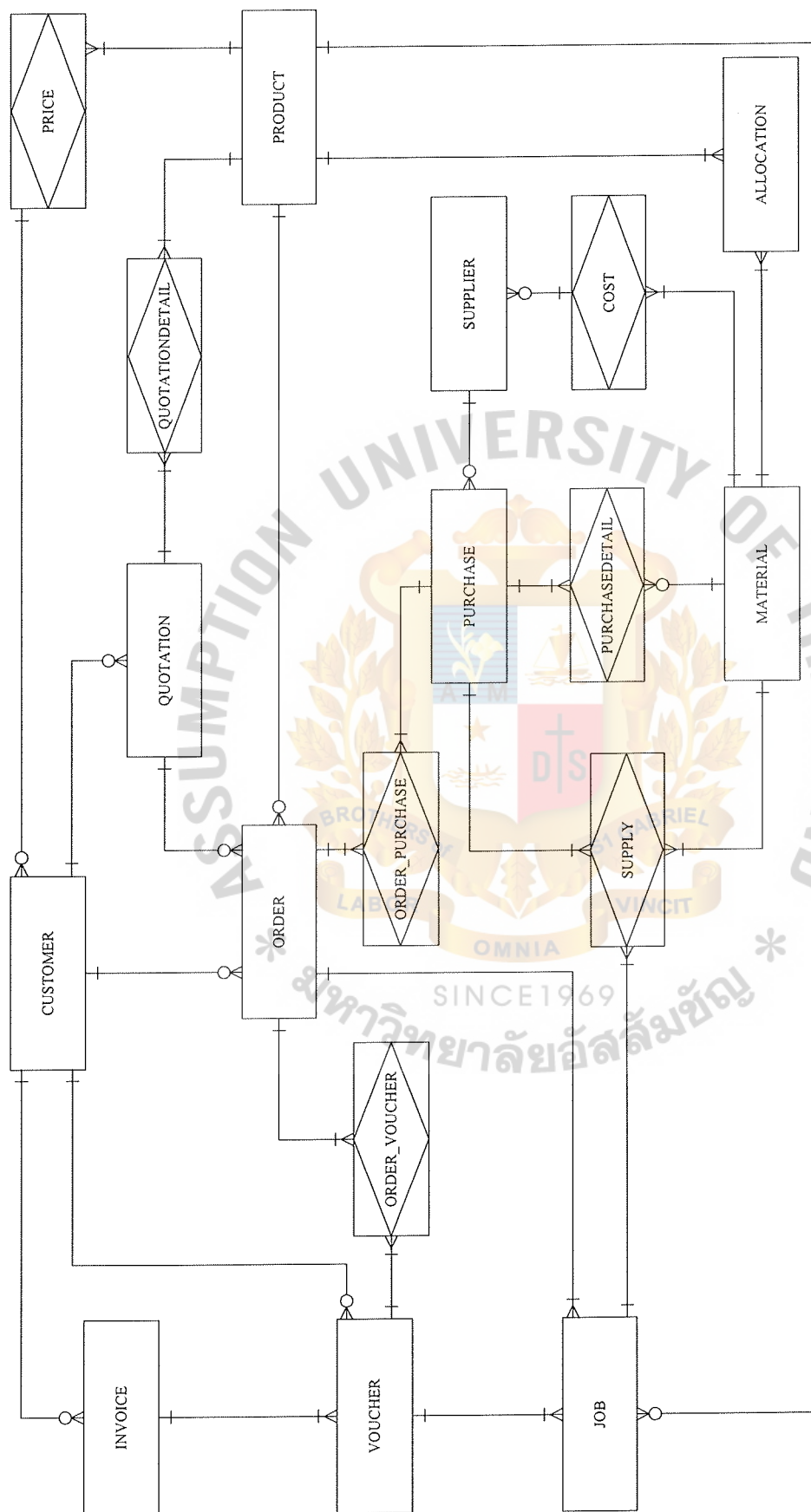


Figure D.1. Context Data Model (ER Diagram) of the Proposed System.

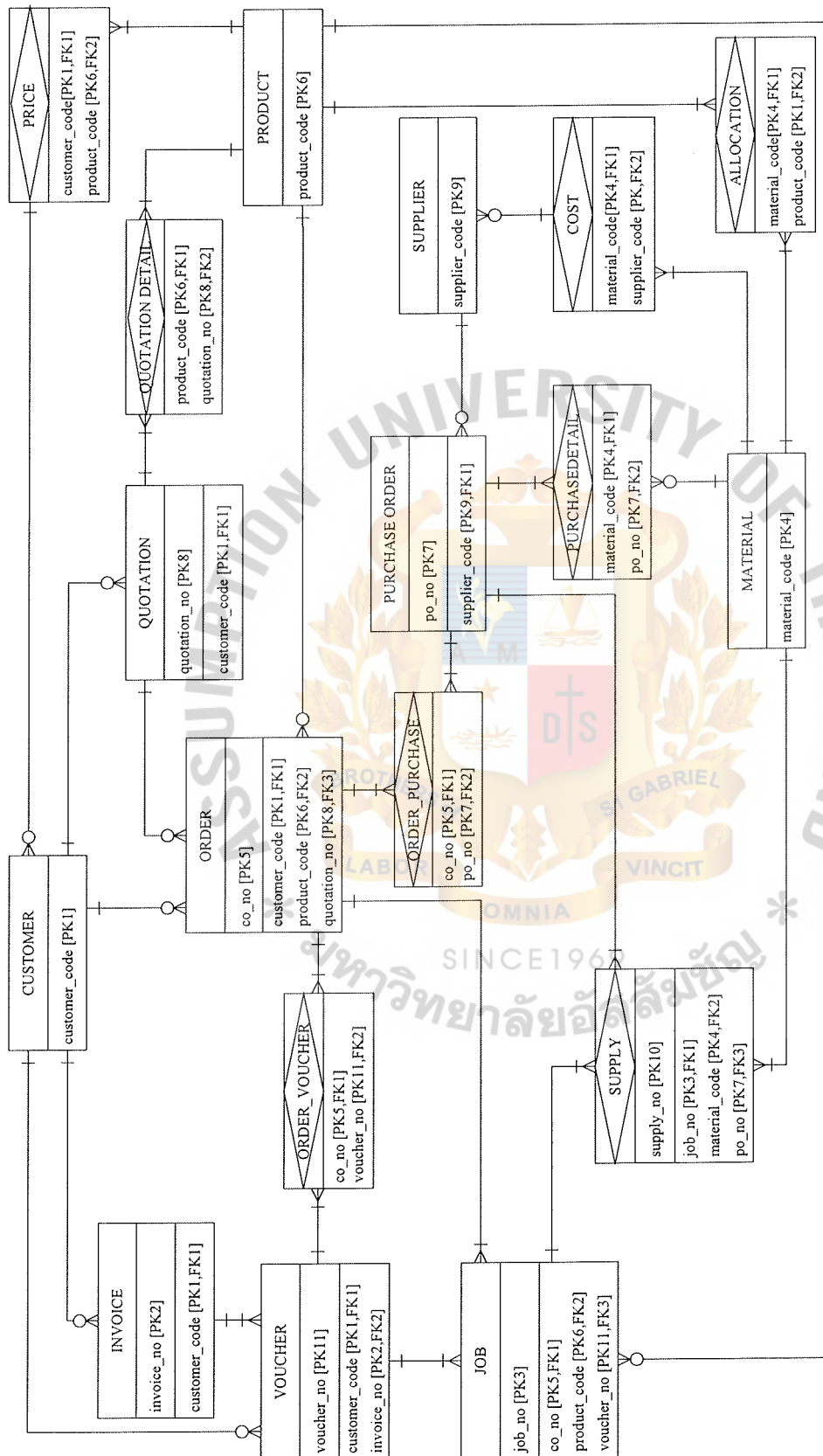


Figure D.2. Key Based Data Model (ER Diagram) of the Proposed System.

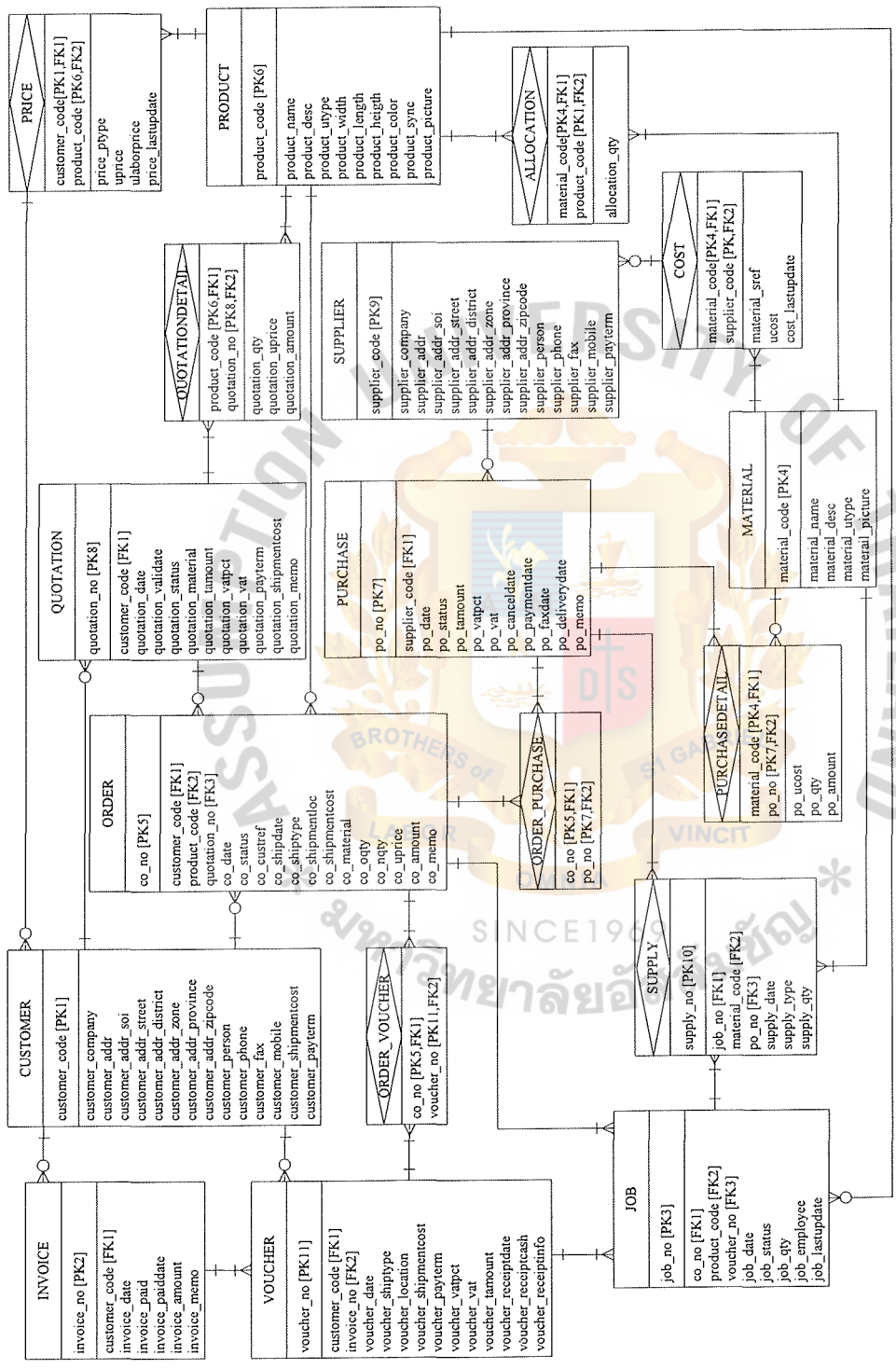


Figure D.3. Fully Attributed Data Model (ER Diagram) of the Proposed System.



APPENDIX E

DATABASE DESIGN

Table E.1. Allocation Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	Material_Code	varchar2(5)	Y			Material	Concatenated Key
2	Product_Code	varchar2(5)	Y			Product	Concatenated Key
3	Allocation_Qty	integer					Attribute

Table E.2. Cost Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	Material_Code	varchar2(5)	Y			Material	Concatenated Key
2	Supplier_Code	varchar2(5)	Y			Supplier	Concatenated Key
3	Material_Stref	varchar2(15)					Attribute
4	Ucost	number(8,2)					Attribute
5	Cost_Lastupdate	date					Attribute

Table E.3. Customer Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	Customer_Code	varchar2(5)	Y	Y			Primary Key
2	Customer_Company	varchar2(100)	Y	Y			Attribute
2	Customer_Addr	varchar2(100)					Attribute
3	Customer_Addr_Soi	varchar2(50)					Attribute
4	Customer_Addr_Street	varchar2(50)					Attribute
5	Customer_Addr_District	varchar2(50)					Attribute
6	Customer_Addr_Zone	varchar2(50)					Attribute
7	Customer_Addr_Province	varchar2(50)					Attribute
8	Customer_Addr_Zipcode	varchar2(6)					Attribute
9	Customer_Person	varchar2(50)			Y		Attribute
10	Customer_Phone	varchar2(15)					Attribute
11	Customer_Fax	varchar2(15)			Y		Attribute

Table E.3. Customer Table (Continued).

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
12	Customer_Mobile	varchar2(15)			Y		Attribute
13	Customer_Shipmentcost	number(8,2)			Y		Attribute
14	Customer_Payterm	integer			Y		Attribute

Table E.4. Invoice Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	Invoice_No	varchar2(8)	Y	Y			Primary Key
2	Customer_Code	varchar2(5)	Y			Customer	Attribute
3	Invoice_Date	date					Attribute
4	Invoice_Memo	varchar2(255)					Attribute
5	Invoice_Paid	boolean					Attribute
6	Invoice_Paiddate	date					Attribute

Table E.4. Invoice Table (Continued).

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
7	Invoice_Amount	number(8,2)					Attribute

Table E.5. Job Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	Job_No	varchar2(8)	Y	Y			Primary Key
2	CO_no	varchar2(8)	Y			Order	Attribute
3	Voucher_No	varchar2(8)	Y			Voucher	Attribute
4	Product_Code	varchar2(5)	Y			Product	Attribute
5	Job_Date	date					Attribute
6	Job_Status	char(3)					Attribute
7	Job_Qty	integer					Attribute
8	Job_Employee	varchar2(20)					Attribute

Table E.5. Job Table (Continued).

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
9	Job_Lastupdate	date			Y		Attribute

Table E.6. Material Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	Material_Code	varchar2(5)	Y	Y			Primary Key
2	Material_Name	varchar2(20)	Y	Y			Attribute
3	Material_Desc	varchar2(255)					Attribute
4	Material_Utype	varchar2(10)					Attribute
5	Material_Picture	varchar2(20)			Y		Attribute

Table E.7. Order Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	CO_No	varchar2(8)	Y	Y			Primary Key
2	CO_Date	date					Attribute
3	Quotation_No	varchar2(8)			Y	Quotation	Attribute
4	Customer_Code	varchar2(5)	Y			Customer	Attribute
5	Product_Code	varchar2(5)	Y			Product	Attribute
6	CO_Status	char(3)					Attribute
7	CO_Custref	varchar2(20)			Y		Attribute
8	CO_Shipdate	date					Attribute
9	CO_Shiptype	byte					Attribute
10	CO_Shipmentloc	varchar2(255)			Y		Attribute
11	CO_Shipmentcost	number(8,2)			Y		Attribute
12	CO_Material	boolean					Attribute

Table E.7. Order Table (Continued).

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
13	CO_Oqty	integer					Attribute
14	CO_Nqty	integer					Attribute
15	CO_Uprice	number(8,2)					Attribute
16	CO_Amount	number(8,2)					Attribute
17	CO_Memo	varchar2(255)			Y		Attribute

Table E.8. Order_Purchase Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	CO_No	varchar2(8)	Y			Order	Concatenated Key
2	PO_No	varchar2(8)	Y			Purchase	Concatenated Key

Table E.9. Order_Voucher Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	CO_No	varchar2(8)	Y			Order	Concatenated Key
2	Voucher_No	varchar2(8)	Y			Voucher	Concatenated Key

Table E.10. Product Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	Product_Code	varchar2(5)	Y	Y			Primary Key
2	Product_Name	varchar2(20)	Y	Y			Attribute
3	Product_Desc	varchar2(255)					Attribute
4	Product_Utype	varchar2(10)					Attribute
5	Product_Width	number(8,4)			Y		Attribute
6	Product_Length	number(8,4)			Y		Attribute
7	Product_Heigth	number(8,4)			Y		Attribute

Table E.10. Product Table (Continued).

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
8	Product_Weight	number(8,4)			Y		Attribute
9	Product_Color	varchar2(10)			Y		Attribute
10	Product_Sync	boolean					Attribute
11	Product_Picture	varchar2(20)			Y		Attribute

Table E.11. Price Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	Product_Code	varchar2(5)	Y			Product	Concatenated Key
2	Customer_Code	varchar2(5)	Y			Customer	Concatenated Key
3	Uprice	number(8,2)					Attribute
4	Ulaborprice	number(8,2)					Attribute
5	Price_Lastupdate	date					Attribute

Table E.12. Purchase Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	PO_No	varchar2(8)	Y	Y			Primary Key
2	PO_Date	date					Attribute
3	PO_Status	char(3)					Attribute
4	Supplier_Code	varchar2(5)	Y			Supplier	Attribute
5	PO_Tamount	number(8,2)					Attribute
6	PO_Vatpct	integer					Attribute
7	PO_Vat	number(8,2)					Attribute
8	PO_Canceldate	date			Y		Attribute
9	PO_Paymentdate	date			Y		Attribute
10	PO_Faxdate	date			Y		Attribute
11	PO_Deliverydate	date			Y		Attribute
12	PO_Memo	varchar2(255)			Y		Attribute

Table E.13. PurchaseDetail Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	PO_No	varchar2(8)	Y			Purchase	Concatenated Key
2	Material_Code	varchar2(5)	Y			Material	Concatenated Key
3	PO_Ucost	number(8,2)					Attribute
4	PO_Qty	number(8,2)					Attribute
5	PO_Amount	number(8,2)					Attribute

Table E.14. Quotation Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	Quotation_No	varchar2(8)	Y	Y			Primary Key
2	Quotation_Date	date					Attribute
3	Quotation_Validdate	date					Attribute
4	Quotation_Canceldate	date			Y		Attribute

Table E.14. Quotation Table (Continued).

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
5	Quotation_Status	char(3)					Attribute
6	Customer_Code	varchar2(5)	Y			Customers	Attribute
7	Quotation_Material	boolean					Attribute
8	Quotation_Tamount	number(8,2)					Attribute
9	Quotation_Vatpct	integer			Y		Attribute
10	Quotation_Vat	number(8,2)			Y		Attribute
11	Quotation_Payterm	integer			Y		Attribute
12	Quotation_Shipmentcost	number(8,2)			Y		Attribute
13	Quotation_Memo	varchar2(255)			Y		Attribute

Table E.15. QuotationDetail Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
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Table E.15. QuotationDetail Table (Continued).

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	Quotation_No	varchar2(8)	Y			Quotation	Concatenated Key
2	Product_Code	varchar2(5)	Y			Product	Concatenated Key
3	Quotation_Qty	integer					Attribute
4	Quotation_Uprice	number(8,2)					Attribute
5	Quotation_Amount	number(8,2)					Attribute

Table E.16. Supplier Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	Supplier_Code	varchar2(5)	Y	Y			Primary Key
2	Supplier_Company	varchar2(100)	Y	Y			Attribute
3	Supplier_Addr	varchar2(100)					Attribute
4	Supplier_Addr_Soi	varchar2(50)					Attribute

Table E.16. Supplier Table (Continued).

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
5	Supplier_Addr_Street	varchar2(50)					Attribute
6	Supplier_Addr_District	varchar2(50)					Attribute
7	Supplier_Addr_Zone	varchar2(50)					Attribute
8	Supplier_Addr_Province	varchar2(50)					Attribute
9	Supplier_Addr_Zipcode	varchar2(6)					Attribute
10	Supplier_Person	varchar2(50)			Y		Attribute
11	Supplier_Phone	varchar2(15)					Attribute
12	Supplier_Fax	varchar2(15)			Y		Attribute
13	Supplier_Mobile	varchar2(15)			Y		Attribute
14	Supplier_Payterm	integer *			Y		Attribute

Table E.17. Supply Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	Supply_No	varchar2(8)	Y	Y			Primary Key
2	Material_Code	varchar2(5)	Y			Material	Attribute
3	Purchase_No	varchar2(8)			Y	Purchase	Attribute
4	Job_No	varchar2(8)			Y	Job	Attribute
5	Supply_Date	date					Attribute
6	Supply_Type	byte					Attribute
7	Supply_Qty	integer					Attribute

Table E.18. Voucher Table.

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
1	Voucher_No	varchar2(8)	Y	Y			Primary Key
2	Customer_Code	varchar2(5)	Y			Customer	Attribute

Table E.18. Voucher Table (Continued).

No.	Field Name	Field Type	Index	Unique	Nullable	Foreign Key to Table	Key Type
3	Invoice_No	varchar2(8)	Y		Y	Invoice	Attribute
4	Voucher_Date	date					Attribute
5	Voucher_Shiptype	byte					Attribute
6	Voucher_Location	varchar2(255)					Attribute
7	Voucher_Payterm	integer			Y		Attribute
8	Voucher_Shipmentcost	number(8,2)			Y		Attribute
9	Voucher_Vatpct	integer			Y		Attribute
10	Voucher_Vat	number(8,2)			Y		Attribute
11	Voucher_Tamount	number(8,2)					Attribute
12	Voucher_Receiptdate	date			Y		Attribute
13	Voucher_Receiptcash	boolean			Y		Attribute
14	Voucher_Receiptinfo	varchar2(100)			Y		Attribute



APPENDIX F

DATA DICTIONARY

Table F.1.1. Data Dictionary for the Entity.

Data name	Full Name	Description	Source Data Input
allocation_qty	Allocation Quantity	Quantity of material usage per unit of product	Allocation Screen
co_amount	Customer Order Amount	Total amount in baht currency of the ordered product	Customer Order Screen
co_custref	Customer Order Customer Reference	Reference document number from customer, which is related to this order	Customer Order Screen
co_date	Customer Order Date	Date which customer placed the order	Customer Order Screen
co_material	Customer Order Material	Type of shipment, either delivery or self-service	Customer Order Screen
co_memo	Customer Order Memorandum	Memorandum of customer order	Customer Order Screen

Table F.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
co_no	Customer Order Number	Unique identifier of customer order	Customer Order Screen
co_nqty	Customer Order Net Quantity	Remaining quantity of ordered product, which is adjusted after job assignment	Customer Order Screen
co_oqty	Customer Order Order Quantity	Quantity of the ordered product	Customer Order Screen
co_shipdate	Customer Order Shipment Date	Planned date of shipment	Customer Order Screen
co_shipmentcost	Customer Order Shipment Cost	Cost of shipment from factory to defined location	Customer Order Screen
co_shipmentloc	Customer Order Shipment Location	Shipment location	Customer Order Screen

Table F.1.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
co_shiptype	Customer Order Shipment Type	Type of shipment, either delivery or self-service	Customer Order Screen
co_status	Customer Order Status	Status of customer order. (ORD = ordered, CFM = confirmed, MAT = material waiting, WIP = production, CPL = completed, CAN = cancel)	Customer Order Screen
co_uprice	Product unit price	Unit price or ordered product	Customer Order Screen
cost_lastupdate	Cost Last Update	Date of changing material unit cost	Costing Screen
customer_code	Customer Code	Unique identifier of customer	Customer Screen
customer_company	Customer Company	Company name of customer	Customer Screen
customer_addr	Customer Address	Address of customer	Customer Screen

Table F.1.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
customer_addr_district	Customer Address District	District of address	Customer Screen
customer_addr_province	Customer Address Province	Province of address	Customer Screen
customer_addr_soil	Customer Address Soi	Small street of address	Customer Screen
customer_addr_street	Customer Address Street	Street of address	Customer Screen
customer_addr_zipcode	Customer Address Zipcode	Postal code of address	Customer Screen
customer_addr_zone	Customer Address Zone	Zone of address	Customer Screen

Table F.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
customer_fax	Customer Fax	Fax number	Customer Screen
customer_mobile	Customer Mobile	Mobile phone number	Customer Screen
customer_payterm	Customer Payment Term	Default number of days of credit payment	Customer Screen
customer_person	Customer Person	Name of contact person	Customer Screen
customer_phone	Customer Phone	Phone number	Customer Screen
customer_shipmentcost	Customer Shipment Cost	Default amount charge for shipment	Customer Screen
invoice_amount	Invoice Amount	Total amount of invoice	Invoice Screen
invoice_date	Invoice Date	Issued date of invoice	Invoice Screen
invoice_memo	Invoice Memorandum	Memorandum of invoice	Invoice Screen

Table F.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
invoice_no	Invoice Number	Unique identifier of invoice	Invoice Screen
invoice_paid	Invoice Paid	Payment status of invoice	Invoice Screen
invoice_paiddate	Invoice Paid Date	Payment date of invoice	Invoice Screen
job_date	Job Date	Date of job assignment	Assignment Screen
job_employee	Job Employee	Name of employee to be assigned	Assignment Screen
job_lastupdate	Job Last Update	Date of changing the details of job assignment	Assignment Screen
job_no	Job Number	Unique identifier of job assignment	Assignment Screen
job_qty	Job Quantity	Quantity of product assigned to job assignment	Assignment Screen
job_status	Job Status	Status of job assignment (ASS = assigned, MAT = material received, INV = inventory)	Assignment Screen
material_code	Material Code	Unique identifier of material	Material Screen
material_desc	Material Description	Detailed description of material	Material Screen

Table F.1.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
material_name	Material Name	Name of material	Material Screen
material_picture	Material Picture	File name of material picture	Material Screen
material_sref	Material Supplier Reference	Material reference document from each supplier	Costing Screen
material_utype	Material Unit Type	Unit type of material	Material Screen
po_amount	Purchase Order Amount	Amount in bath currency of ordering material in Purchase Order	Purchase Screen
po_canceldate	Purchase Order Cancellation Date	Cancellation date of Purchase Order	Purchase Screen
po_date	Purchase Order Date	Issuing date of Purchase Order	Purchase Screen

Table F.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
po_deliverydate	Purchase Order Delivery Date	Estimated date of receiving the material.	Purchase Screen
po_faxdate	Purchase Order Faxed Date	Date of sending fax to supplier	Purchase Screen
po_memo	Purchase Order Memorandum	Memorandum of Purchase Order	Purchase Screen
po_no	Purchase Order Number	Unique identifier of Purchase Order	Purchase Screen
po_paymentdate	Purchase Order Payment Date	Payment date of Purchase Order	Purchase Screen
po_qty	Purchase Order Quantity	Quantity of ordering material in Purchase Order	Purchase Screen

Table F.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
po_status	Purchase Order Status	Status of Purchase order (NEW = new, FAX = faxed , CFM = price confirmed, RCV = material received, CAN = cancel, PAY = paid)	Purchase Screen
po_tamout	Purchase Order Total Amount	Total amount in bath currency of Purchase Order	Purchase Screen
po_ucost	Purchase Order Unit Cost	Unit cost of material in Purchase Order	Purchase Screen
po_vat	Purchase Order VAT	VAT amount in bath currency of Purchase Order	Purchase Screen
po_vatpct	Purchase Order VAT Percentage	Percentage of VAT	Purchase Screen

Table F.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
price_lastupdate	Price Last Update	Date of changing product unit price	Pricing Screen
product_code	Product Code	Unique identifier of product	Product Screen
product_color	Product Color	Color of product	Product Screen
product_desc	Product Description	Description of product	Product Screen
product_height	Product Height	Height measurement of product	Product Screen
product_length	Product Length	Length measurement of product	Product Screen
product_name	Product Name	Name of the product	Product Screen
product_picture	Product Picture	Picture of product	Product Screen
product_sync	Product Sync	Synchronized of product	Product Screen
product_utype	Product Unit Type	Unit type of product	Product Screen
product_weight	Product Weight	Weight measurement of product	Product Screen
product_width	Product Width	Width measurement of product	Product Screen

Table F.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
quotation_amount	Quotation Amount	Amount in bath currency of ordering product listed in quotation	Quotation Screen
quotation_canceldate	Quotation Cancellation Date	Cancellation date of quotation	Quotation Screen
quotation_date	Quotation Date	Issuing date of quotation	Quotation Screen
quotation_material	Quotation Material	Flag to identify material supplier, either client or factory	Quotation Screen
quotation_memo	Quotation Memorandum	Memorandum of quotation	Quotation Screen
quotation_no	Quotation Number	Unique identifier of quotation	Quotation Screen
quotation_payterm	Quotation Payment Term	Number of days for credit payment	Quotation Screen

Table F.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
quotation_qty	Quotation Quantity	Quantity of ordering product listed in quotation	Quotation Screen
quotation_shipmentcost	Quotation Shipment Cost	Cost of shipment to customer's location	Quotation Screen
quotation_status	Quotation Status	Status of quotation (NEW = new, FAX = faxed, ORD = ordered, CAN = cancel)	Quotation Screen
quotation_tamount	Quotation Total Amount	Total amount in bath currency of quotation	Quotation Screen
quotation_uprice	Quotation Price	Unit price of ordering product listed in quotation	Quotation Screen
quotation_validdat	Quotation Valid Date	The latest date which the quotation is valid	Quotation Screen
quotation_vat	Quotation VAT	VAT Amount in bath currency of quotation	Quotation Screen
quotation_vatpct	Quotation VAT Percentage	Percentage of VAT, which is applied to the quotation	Quotation Screen

Table F.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
supplier_addr	Supplier Address	Address of supplier	Supplier Screen
supplier_addr_district	Supplier Address District	District of address	Supplier Screen
supplier_addr_province	Supplier Address Province	Province of address	Supplier Screen
supplier_addr_soil	Supplier Address, Soi	Small street of address	Supplier Screen
supplier_addr_street	Supplier Address Street	Street of address	Supplier Screen
supplier_addr_zipcode	Supplier Address Zip Code	Postal code of address	Supplier Screen
supplier_addr_zone	Supplier Address Zone	Zone of address	Supplier Screen

Table F.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
supplier_code	Supplier Code	Unique identifier of supplier	Supplier Screen
supplier_company	Supplier Company	Company name of supplier	Supplier Screen
supplier_fax	Supplier Fax Number	Fax number	Supplier Screen
supplier_mobile	Supplier Mobile Phone	Mobile phone number	Supplier Screen
supplier_payterm	Supplier Payment Term	Default number of days of credit for payment	Supplier Screen
supplier_person	Supplier Person	Name of contact person	Supplier Screen
supplier_phone	Supplier Phone	Telephone number	Supplier Screen
supply_date	Supply Date	Date of material transaction	Purchase Screen and Assignment Screen

Table F.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
supply_no	Supply Number	Unique identifier of supply transaction	Purchase Screen and Assignment Screen
supply_qty	Supply Quantity	Quantity of material, either check-in or check-out	Purchase Screen and Assignment Screen
supply_type	Supply Type	Transaction type, either check-in (1) or check-out (0)	Purchase Screen and Assignment Screen
ucost	Unit Cost	Material unit cost	Costing Screen
ulaborprice	Unit Price of Labor	Product unit price without material	Pricing Screen
uprice	Unit Price	Product unit price with material	Pricing Screen
voucher_date	Voucher Date	Issuing date of voucher	Shipment Screen
voucher_location	Voucher Location	Shipment location declared in voucher	Shipment Screen

Table F.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
voucher_no	Voucher Number	Unique identifier of either shipment voucher or tax invoice	Shipment Screen
voucher_payterm	Voucher Payment Term	Number of days recorded as account receivable	Shipment Screen
voucher_receiptcash	Voucher Receipt Cash	Flag to declare the customer makes cash payment against the voucher	Shipment Screen
voucher_receiptdate	Voucher Receipt Date	Date of issuing receipt related to the voucher	Shipment Screen
voucher_receiptinfo	Voucher Receipt Information	Information about payment against the voucher	Shipment Screen
voucher_shipmentcost	Voucher Shipment Cost	Shipment cost declared on the voucher	Shipment Screen

Table F.1. Data Dictionary for the Entity (Continued).

Data name	Full Name	Description	Source Data Input
voucher_shiptype	Voucher Shipment Type	Type of shipment declared on the voucher	Shipment Screen
voucher_tamount	Voucher Total Amount	Total amount in bath currency of the voucher	Shipment Screen
voucher_vat	Voucher VAT	VAT amount in bath currency of the voucher	Shipment Screen
voucher_vatpct	Voucher VAT Percentage	Percentage of VAT used on the voucher	Shipment Screen

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

Data Flow name	Description	Source	Destination
assigned material status	Status of job assignment, which allocates the material and ready for production	Production Process	Jobs (D12)

Table F.2. Data Dictionary for Data Flow Diagram (Continued).

Data Flow name	Description	Source	Destination
billing data	Information related to the billing invoice	Shipment Process	Invoices (D14)
bill invoice	Document for collecting money from customer	Invoices (D14)	Customer
complete status data	Status of product order, which states completeness of production	Production Process	Orders (D9)
confirmation for order	Confirmation for production, related to the placed order	Customer	Orders (D9)
confirmed order	Product Order, confirmed by customer	Manage Order Process	Manage Material Process
confirmed status data	Information related to confirmation details	Customer	Orders (D9)
customer data	Stored information related to customer	Customers (D1)	Manage Order Process
customer order	Product Order, placed by customer	Customer	Orders (D9)
inventory status data	Status of job assignment, which is finished and ready for shipment	Production Process	Jobs (D12)

Table F.2. Data Dictionary for Data Flow Diagram (Continued).

Data Flow name	Description	Source	Destination
invoice status data	Information related to the billing invoice and status of shipment vouchers	Shipment Process	Vouchers (D13)
job data	Stored information related to job assignment	Jobs (D12)	Production Process
job with inventory status	Job assignment which has status “INV”, which means assigned product in stock and ready for shipment	Jobs (D12)	Shipment Process
material allocation data	Information related to material usage per unit of product	Products (D2), Materials (D3)	Allocations (D4)
material data	Stored information related to material	Material (D3)	Manage Order Process
material market price	The latest market price of material, classified by supplier	Supplier	Costs (D6)
material price acquisition	Enquiry from factory against suppliers for the latest market price of material	Manage Material Process	Supplier

Table F.2. Data Dictionary for Data Flow Diagram (Continued).

Data Flow name	Description	Source	Destination
material price data	Stored information related to material price	Costs (D6)	Manage Material Process
material tax invoice	Official document for material shipment issued by either customer or supplier	Customer and Supplier	Orders (D9), Purchases (D10)
material status data	Status of product orders, which states the material waiting	Manage Material Process	Orders (D9),
material transaction	Record of material inventory	Manage Material Process	Supplies (D11)
new material data	Information about material, needed for the product produced by the factory	Supplier	Materials (D3)
new or updated customer data	Information about the customer, who contacted the factory	Customer	Customers (D1)
new job data	Information about the job assignment in production line	Production Process	Jobs (D12)

Table F.2. Data Dictionary for Data Flow Diagram (Continued).

Data Flow name	Description	Source	Destination
new or updated material allocation data	Information about material usage per unit of Product	Manage Order Process	Allocations (D4)
new or updated material price data	Market price of material issued by supplier	Supplier	Costs (D6)
new or updated order data	Information about the order, placed by the customer	Customer	Orders (D9)
new or updated product price data	Unit price of product, which reflects the current unit cost of material	Manage Order Process	Prices (D7)
new or updated purchase data	Information of all purchasing issued by factory	Manage Material Process	Purchases (D10)
new or updated quotation data	Information about quotation issued by the factory	Manage Order Process	Quotations (D8)

Table F.2. Data Dictionary for Data Flow Diagram (Continued).

Data Flow name	Description	Source	Destination
new or updated supplier data	Information about suppliers, who contacted the factory	Supplier	Suppliers (D5)
new product data	Information of new registered product	Customer	Products (D2)
order data	General information about the product order, placed by the customer	Orders (D9)	Manage Material Process
order with confirmed status	Placed orders, which already have confirmation from the customer	Orders (D9)	Manage Material Process
order with material status	Placed orders waiting for material from the suppliers	Orders (D9)	Production Process
order with unassigned status	Placed orders waiting for production	Orders (D9)	Production Process
payment	Payment from customer	Customer	Shipment Process

Table F.2. Data Dictionary for Data Flow Diagram (Continued).

Data Flow name	Description	Source	Destination
payment data	Information related to payment information, i.e. check's details	Customer	Vouchers (D13)
payment status data	Status of Billing Invoice, which records the payment	Shipment Process	Invoices (D14)
product acquisition	Request from customer related to the product	Customer	Customer (D1), Products (D2), Materials (D3)
product data	Stored information related to product	Products (D2)	-
product price	Price of ordered product	Prices (D7)	Customer
product price data	Stored information related to a unit price of product	Prices (D7)	Manage Order Process
product ready for shipment	Notification of product information, which is kept in stock and ready for shipment	Production Process	Shipment Process

Table F.2. Data Dictionary for Data Flow Diagram (Continued).

Data Flow name	Description	Source	Destination
purchase data	Stored information related to purchasing	Purchases (D10)	Manage Material Process
purchase order	Official document for ordering material	Purchases (D10)	Supplier
quotation	Official document for quoting product price	Quotation (D8)	Customer
quotation data	Stored information related to quotation	Quotation (D8)	Manage Order Process
receipt	Official document for payment declaration	Vouchers (D13)	Customer
shipment data	Information related to the product, which is delivered to the customer	Jobs (D12)	Vouchers (D13)
shipment data with credit	All shipment vouchers, which has credit payment	Vouchers (D13)	Shipment Process
shipment data without payment	All shipment vouchers, which has no payment information	Vouchers (D13)	Shipment Process
shipment status data	Status of job assignment, which is already shipped	Shipment Process	Jobs (D12)

Table F.2. Data Dictionary for Data Flow Diagram (Continued).

Data Flow name	Description	Source	Destination
shipment voucher	Shipment voucher, excluding VAT	Vouchers (D13)	Customer
supplier data	Stored information related to supplier	Suppliers (D5)	Manage Material Process
tax invoice	Shipment voucher, including VAT	Vouchers (D13)	Customer
unassigned order	Product orders, which are not assigned to the production line	Manage Material Process	Production Process
unassigned status data	Status of product orders, which states production in waiting	Manage Material Process	Orders (D9),
unconfirmed order data	Details of order, placed by customer, which has not received confirmation	Orders (D9)	Customer
updated remaining quantity	Remaining quantity of ordered product from selected order	Production Process	Orders (D9)

Table F.3. Data Dictionary for Data Process of Context Diagram.

Code	Data Process Name	Description
0	Made-To-Order System	The information system, which manages processes starting from receiving product order from customer, purchasing the material, producing the final product and shipment to customers.

Table F.4. Data Dictionary for Data Process Level 0.

Code	Data Process Name	Description
1.0	Manage Order	Activities related to registering new products, handling customer inquiry and processing customers' orders.
2.0	Manage Material	Activities related to material purchasing.
3.0	Production	Activities related to assignment in production lines and inventory.
4.0	Shipment	Activities related to preparing shipment, including document generation.

Table F.5. Data Dictionary for Data Process Level 1.

Code	Data Process Name	Description
1.1	Manage New Product Acquisition	Activities related to registering new product, and new material if needed. Also maintaining customer information if there is any update in details.
1.2	Calculate Material Usage	Activities related to recording material allocation per unit of product.
1.3	Calculate Product Price	Activities related to costing of material and pricing of product.
1.4	Generate Quotation	Activity related to printing process of quotation.
1.5	Receive Order	Activities related to maintaining records of customer order, including recording of new order and modification of status.
2.1	Verify Material Requirement	Activities related to identifying material source.
2.2	Calculate Material Requirement	Activities related to identifying material and number of material per total number of products.
2.3	Order Material	Activities related to purchasing material from suppliers, including material price enquiries, recording material market price, creating and printing purchase order, and

Table F.5. Data Dictionary for Data Process Level 1 (Continued).

Code	Data Process Name	Description
		maintaining the status of purchase order transaction after faxing it to customer.
2.4	Receive Material	Activities related to maintaining the status of material received according to pending purchase orders.
3.1	Assign Work to Employee	Activities related to assigning unassigned customer orders to employees in the production line.
3.2	Checkout Material	Activities related to checking out material according to the assigned amount of product.
3.3	Produce Product	Activities related to maintaining status of job assignment in the production line.
4.1	Prepare Shipment Voucher	Activities related to preparing shipment voucher and tax invoice according to pending product inventory.
4.2	Prepare Billing Invoice	Activities related to preparing bill of invoice according to unpaid tax invoice.
4.3	Prepare Receipt	Activities related to preparing receipt according to paid tax invoice.



APPENDIX G
SCREEN DESIGN



Figure G.1. Login Screen.



Figure G.2. Main Menu Screen.

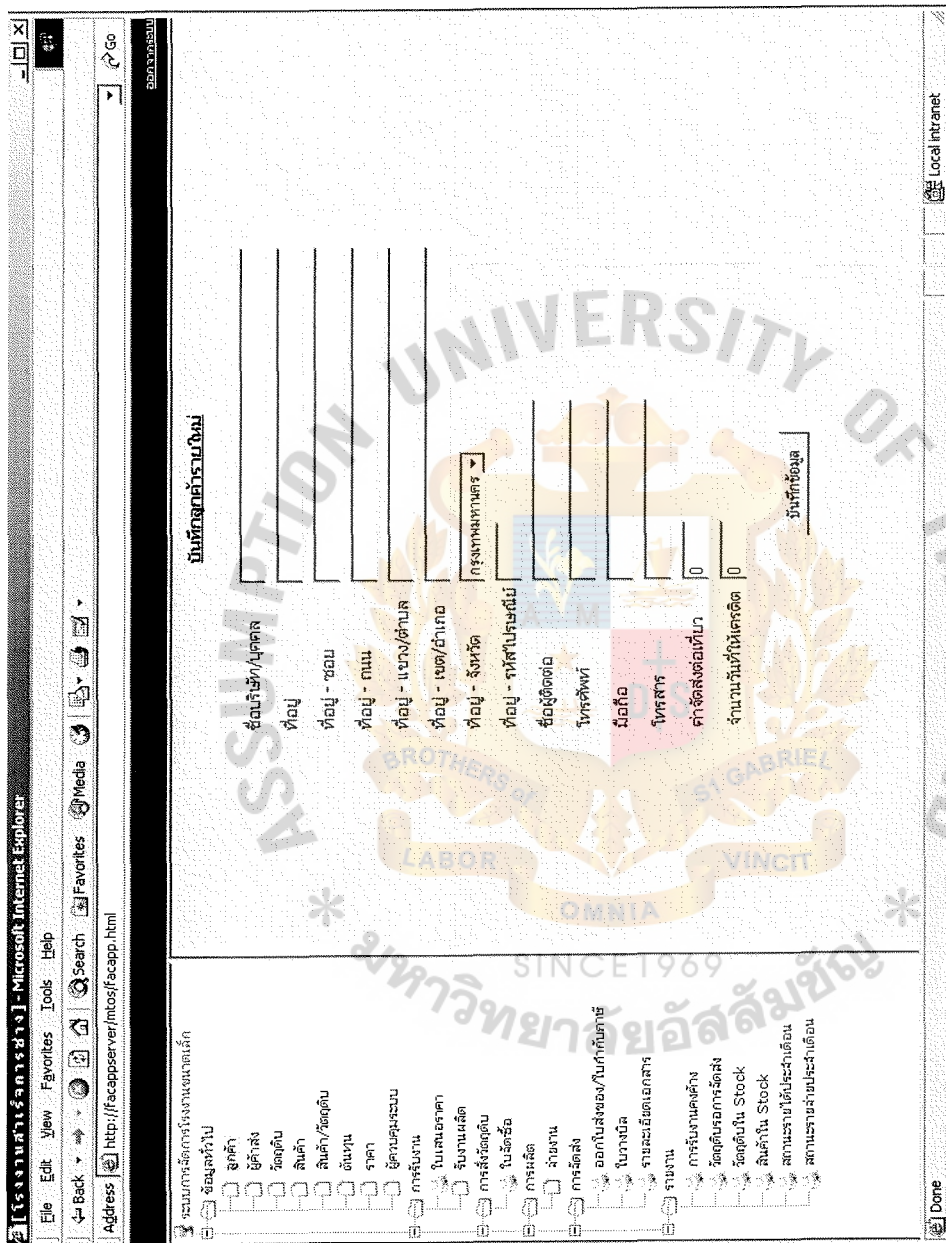


Figure G.4. Customer Input Screen.

Figure G.9. Material Main Screen.

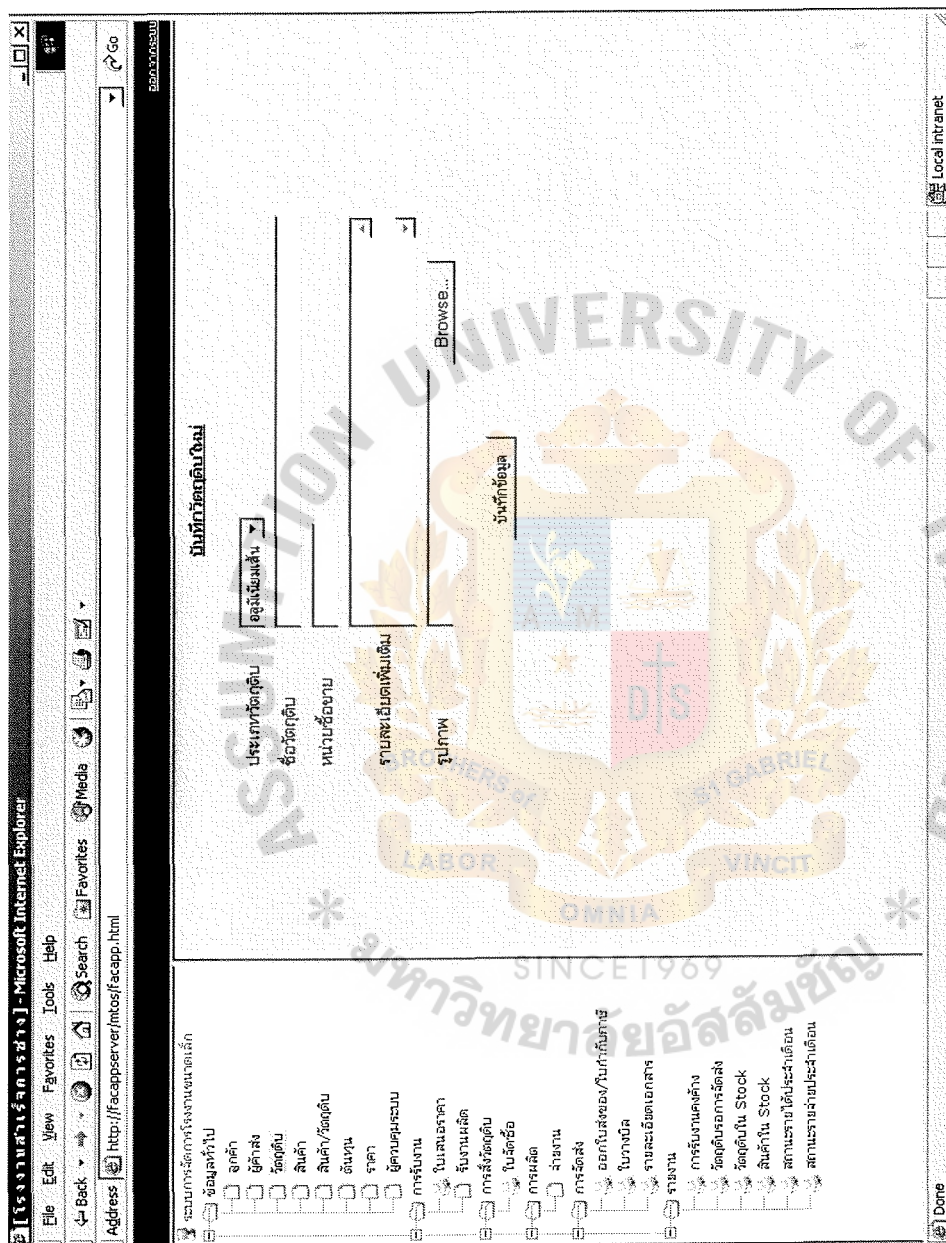


Figure G.10. Material Input Screen.

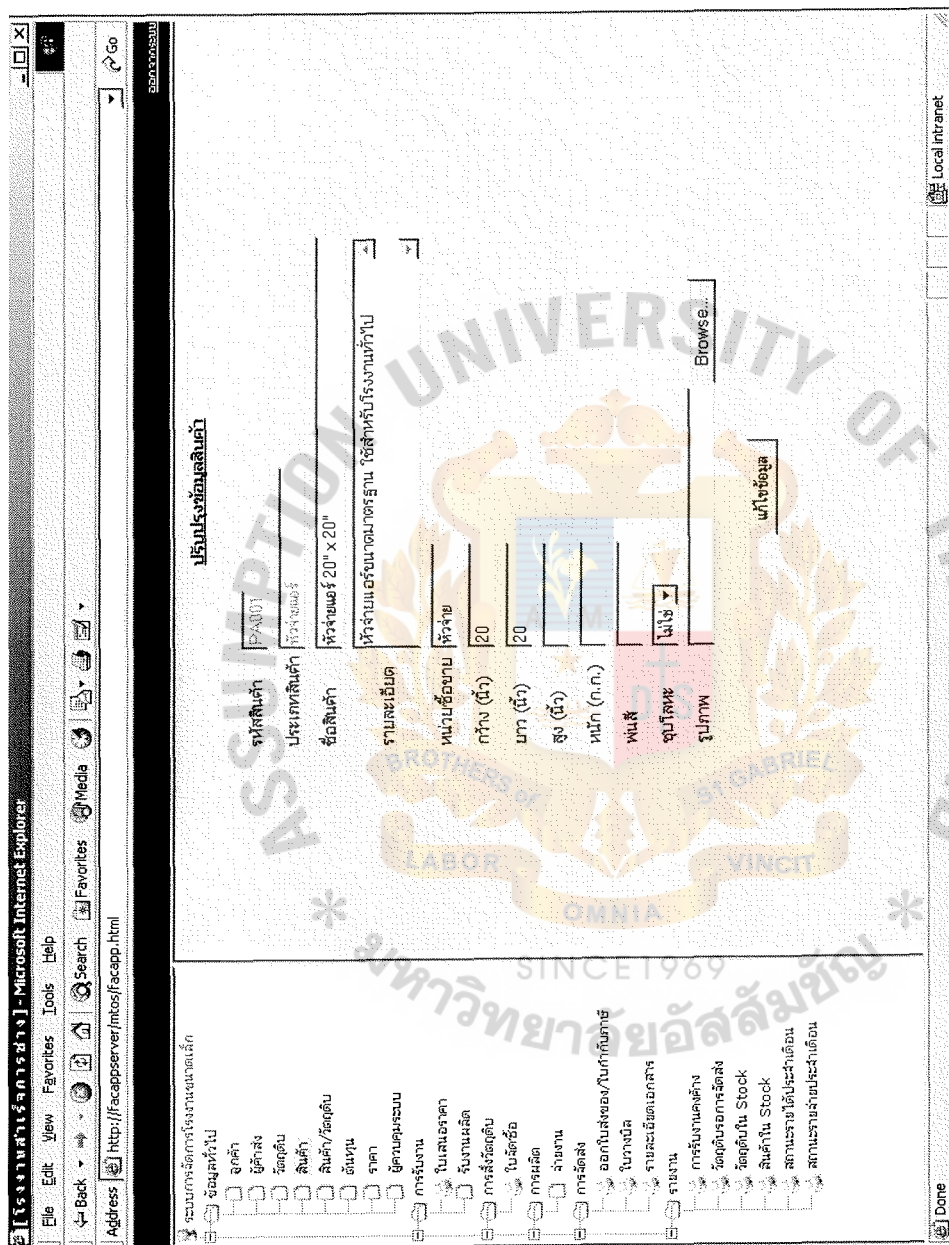


Figure G.14. Product Edit Screen.

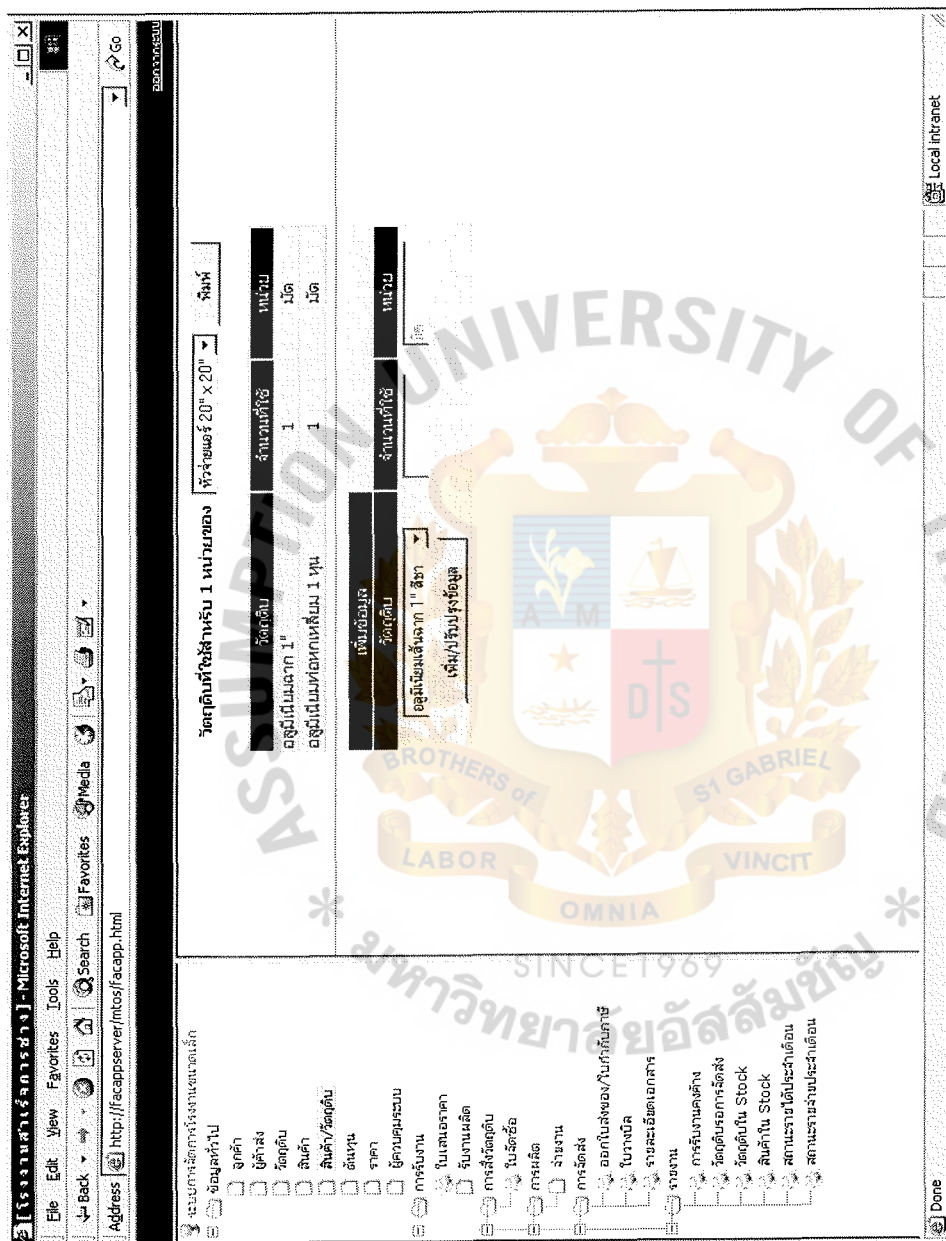


Figure G.15. Material Allocation Screen.

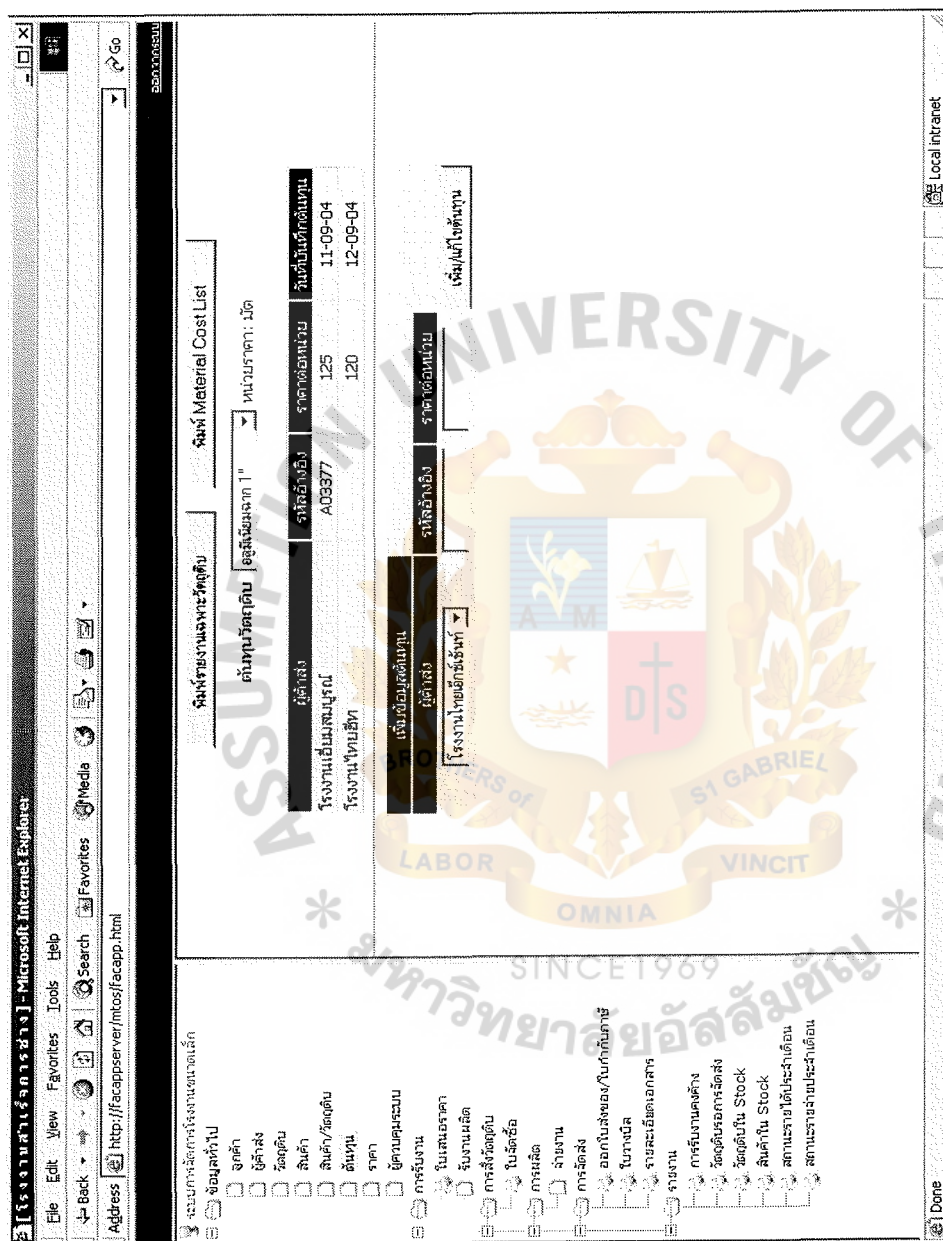




Figure G.23. Order Main Screen.

2 [โรงงานสำหรับการช่าง] - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Search Favorites Media

Address http://facappserver/mtos/facapp.html

ระบบการจัดการโรงงานขนาดเล็ก

- ข้อมูลทั่วไป
 - ลูกค้า
 - ผู้ค้าส่ง
 - ผู้ซื้อ
 - สินค้า
 - สินค้า/วัสดุ
 - ต้นทุน
 - ราคา
 - ผู้ควบคุมระบบ
- การรับงาน
 - ใบเสนอราคา
 - รับงานผลิต
 - การส่งวัสดุ
 - ใบจัดซื้อ
 - การผลิต
 - รายงาน
 - การจัดส่ง
- ออกใบส่งของ/ใบกำกับภาษี
 - ใบกำกับ
 - รายละเอียดเอกสาร
 - รายงาน
- การรับงานคลัง
 - วัสดุรับรอการจัดส่ง
 - วัสดุเก็บใน Stock
 - สินค้าใน Stock
 - สถานะงานได้ประจำเดือน
 - สถานะงานล่าช้าประจำเดือน

ขอย่อยใบราคาใบเสนอราคา

อ้างอิงเลขที่ใบเสนอราคา 000-40001

วันที่ส่งเอกสาร 13 กันยายน 2004

กำหนดส่ง 30 กันยายน 2004

ลูกค้า C0001 ส. ใหญ่

สินค้า P2A001 หน้ากระดาษ 20" x 20"

ผู้ซื้อ/ผู้ขาย 2125

ราคา 25

จำนวนที่ส่ง 53125

จำนวนเงิน

อ้างอิงเลขที่เอกสารของลูกค้า

จัดส่งสินค้า

สถานที่ส่งสินค้า

ค่าจัดส่งต่อหน่วย

รายละเอียดเพิ่มเติม

วันที่จัดส่ง

Done Local Intranet

Figure G.25. Order Input, Using Quotation, Screen.

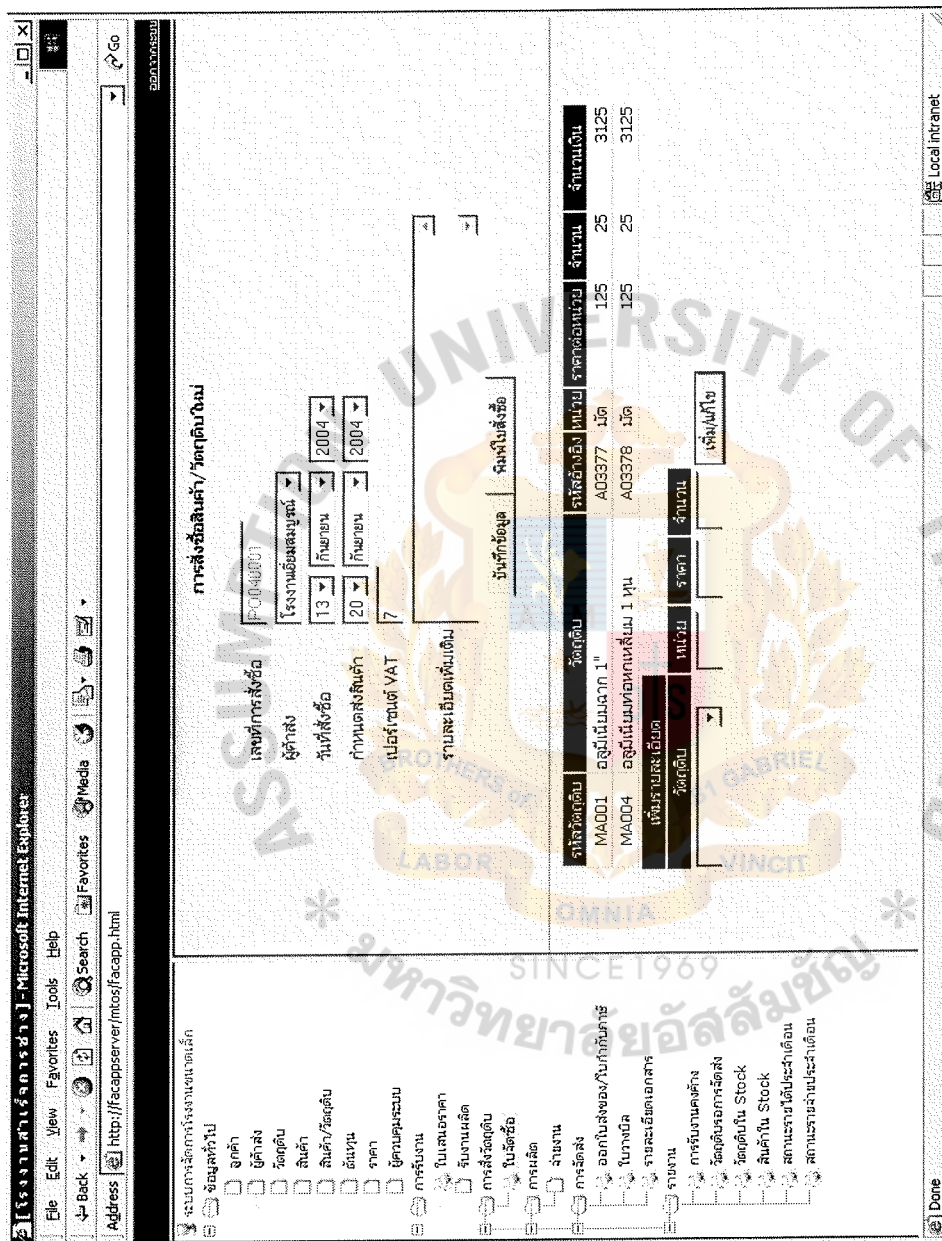


Figure G.29. Purchase Order, use Allocation, Screen.

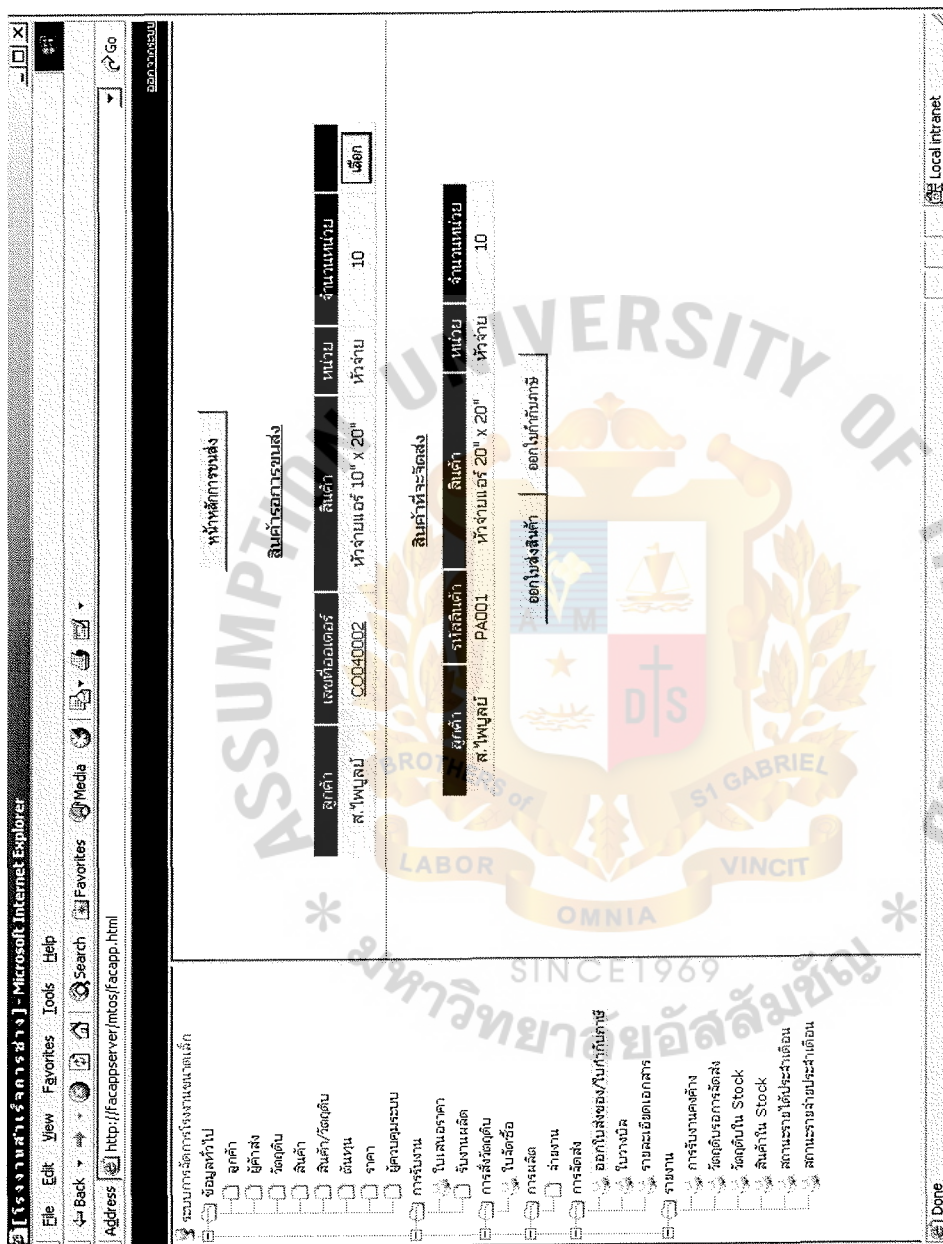


Figure G.35. Pre Shipment Screen.



Figure G.36. Shipment Main Screen.

Figure G.42. Shipment Detail Screen.



Figure G.46. Pending Order Report Screen.



Figure G.49. Product Stock Report Screen.



Figure G.51. Expense Report Screen.



APPENDIX H
OUTPUT DESIGN

สำเนาใบเสนอราคา

13/10 หมู่ 6 ต.สุขุมวิท 105 แขวงบางนา เขตบางนา กรุงเทพฯ 10260
โทร/แฟกซ์: 0-2748-6480 - 2, 0-2393-0467
หมายเลขใบแจ้งหนี้ผู้เสียภาษี 1 00 7 75693 8

ใบเสนอราคา
QUOTATION

หน้า 1/1

ชื่อลูกค้า NAME C0001	ชื่อลูกค้า NAME ส.โพธิ์สุ	เงื่อนไขการชำระเงิน TERM OF PAYMENT 15 วัน	เอกสารเลขที่ DOCUMENT NO. QU-04-0001
ที่อยู่ ADDRESS 75 สุขุมวิท 103 บางนา บางนา กรุงเทพฯ 10260	ค่าขนส่ง SHIPMENT COST 0 บาท/เที่ยว	วันที่ส่งมอบเอกสาร EFFECTIVE DATE 20/09/2004	วันที่ DATE 13/09/2004
รายการ DESCRIPTION PA001 หัวจ่ายแอร์ 20" x 20"	หน่วย UNIT TYPE หัวจ่าย	จำนวน QTY 25	ราคาหน่วยละ UNIT PRICE 2,125.00
			จำนวนเงิน AMOUNT 53,125.00
			รวมเงิน GRAND AMOUNT 56,843.75
ราคารวม TOTAL AMOUNT 53,125.00			ภาษีมูลค่าเพิ่ม 7.0% VAT 3,718.75
รวมเงิน GRAND AMOUNT 56,843.75			
ผู้เสนอราคา อนุมัติโดย		ใบเสนอราคานี้จะมีผลใช้บังคับเมื่อมีลายเซ็น ของผู้เสนอราคาและผู้รับจากทางบริษัทผู้รับจ้าง ราคาและรายละเอียดทั้งหมด ที่กำหนดในเอกสารนี้จะมีผลใช้ บังคับจนวันสิ้นสุดของเอกสารตามที่กำหนดข้างบน	

Figure H.1. Quotation.

สำเนาการช่าง

13/10 หมู่ 6 สุขุมวิท 105 แขวงบางนา เขตบางนา กรุงเทพฯ 10260
โทร/แฟกซ์: 0-2748-6480 - 2, 0-2393-0467
หมายเลขประจำตัวผู้เสียภาษี 1 00 7 75693 8

ใบสั่งซื้อสินค้า
PURCHASE ORDER

หน้า 1/1

ชื่อผู้สั่งซื้อ NAME S0020 โรงงานเชื่อมสมบูรณ์	เงื่อนไขการชำระ TERM OF PAYMENT 7 วัน	เอกสารเลขที่ DOCUMENT NO. PO-04-0001
ที่อยู่ ADDRESS 12/20 นิคมบางพลี ซอย 7 บางพลี สมุทรปราการ 10550	วันจัดส่งสินค้า DELIVERY DATE 20/09/2004	วันที่ DATE 13/09/2004
สถานที่ส่งสินค้า SHIPMENT ADDRESS สำนักงานช่าง 13/10 สุขุมวิท 105, บางนา กรุงเทพฯ	คำสั่งเอกสาร ORDER NO. CO040001	

รายการ DESCRIPTION	หน่วย UNIT TYPE	จำนวน QTY	ราคาหน่วยละ UNIT PRICE	จำนวนเงิน AMOUNT
MA001 อลูมิเนียมจาก 1" (A03377)	มัด	25	125	3,125.00
MA004 อลูมิเนียมท่อหกเหลี่ยม 1 หนบ (A03378)	มัด	25	125	3,125.00

รวม TOTAL AMOUNT 6,250.00
ภาษีมูลค่าเพิ่ม 7.0% VAT 437.5
รวมเงิน GRAND AMOUNT 6,687.50

ยืนยันราคา และรายละเอียดตามรายการข้างบนนี้
Confirmed for all order & conditions stated above
ลงชื่อ SIGNED
วันที่ DATE

ผู้สั่งซื้อสินค้า
อนุมัติโดย

ใบสั่งซื้อสินค้านี้ จะมีผลบังคับใช้เมื่อมีลายเซ็นของผู้สั่งซื้อสินค้า
และผู้ยื่นใบสั่งซื้อจากทางโรงงานสำหรับการช่าง
ราคาและรายละเอียดทั้งหมด ที่กำหนดในเอกสารนี้มีผลบังคับใช้
เป็นระยะเวลาสองวันทำการ นับแต่วันออกเอกสาร
กรุณาเซ็นรับรองและประทับลายเซ็นโรงงานเพื่อยืนยันการสั่งซื้อสินค้า

Figure H.2. Purchase Order.

ใบส่งสินค้า

SHIPMENT VOUCHER

(ลูกค้า)

หน้า 1/1

สำหรับส่ง

13/10 หมู่ 6 ต.ชุมพล 105 แขวงบางนา เขตบางนา กรุงเทพฯ 10260

โทรเลข: 0-2748-6480 - 2, 0-2393-0467

หมายเลขประจำตัวผู้เสียภาษี: 1 00 7 75693 8

เอกสารเลขที่

SV-04-0001

วันที่

11/10/2004

รายการ	หน่วย	จำนวน	ราคาหน่วยละ	จำนวนเงิน
DESCRIPTION	UNIT TYPE	QTY	UNIT PRICE	AMOUNT
PA001 ห้างจ่ายแอร์ 20" x 20"	หิ้วจ่าย	40	2,000.00	80,000.00
รวม			รวม	80,000.00

ได้รับของตามรายการข้างบนนี้ถูกต้องเรียบร้อยแล้ว

Received goods stated above in good order & conditions

ลงชื่อ SIGNED

วันที่ DATE

ผู้ส่งสินค้า

ผู้รับเงิน

... เอกสารนี้สามารถใช้แทนใบเสร็จรับเงินได้

Figure H.3. Shipment Voucher.

สำเร็จการช่าง

13/10 หมู่ 6 สุขุมวิท 105 แขวงบางนา เขตบางนา กรุงเทพฯ 10260
โทร/แฟกซ์: 0-2748-6480 - 2, 0-2393-0467
หมายเลขประจำตัวผู้เสียภาษี 1 00 7 75693 8

ใบวางบิล
BILL INVOICE
(ลูกค้า)

หน้า 1/1

ชื่อลูกค้า NAME	C0001 ส.ไพบุลย์	เอกสารเลขที่ DOCUMENT NO.	BI-04-0001
ที่อยู่ ADDRESS	75 สุขุมวิท 103 บางนา บางนา กรุงเทพฯ 10260	วันที่ DATE	16/10/2004

รายการ DESCRIPTION	วันที่ ISSUE DATE	วันครบกำหนดจ่าย DUE DATE	จำนวนเงิน AMOUNT
IN-04-0001	30/09/2004	15/10/2004	40,927.50
IN-04-0004	01/10/2004	16/10/2004	18,190.00
ห่านมีนแก้วพันธุ์หนึ่งร้อยสิบเจ็ดบาทห้าสิบสตางค์		รวมเงิน TOTAL AMOUNT	59,117.50

ผู้รับเอกสาร _____ วันที่ _____	ในกรณีมีการแก้ไขใด ๆ กรุณาแจ้งกลับทางโรงงานภายในสามวันทำการ นับแต่วันที่รับเอกสาร
------------------------------------	--

Figure H.5. Bill Invoice.

สำเนาการช่าง

13/10 หมู่ 6 ต.ชุมวิท 105 แขวงบางนา เขตบางนา กรุงเทพฯ 10260
โทร/แฟกซ์: 0-2748-6480 - 2, 0-2393-0467
หมายเลขประจำตัวผู้เสียภาษี: 1 00 7 75693 8

ใบเสร็จรับเงิน
RECEIPT
(ลูกค้า)

หน้า 1/1

ชื่อลูกค้า C0001 ช.ไพบุณย์ NAME 75 สุขุมวิท 103 บางนา บางนา กรุงเทพฯ 10260 ที่อยู่ ADDRESS อ้างถึงเอกสาร IN-04-0001 / BI-04-0001 DOCUMENT NO			เอกสารเลขที่ RV-04-0001 DOCUMENT NO. วันที่ 16/10/2004 DATE	
รายการ DESCRIPTION	หน่วย UNIT TYPE	จำนวน QTY	ราคาหน่วยละ UNIT PRICE	จำนวนเงิน AMOUNT
PA001 ห้างจ่ายแอร์ 20" x 20"	ห้างจ่าย	10	2,125.00	21,250.00
PA012 ห้างจ่ายแอร์ 10" x 20"	ห้างจ่าย	10	1,700.00	17,000.00
รวมเงิน TOTAL AMOUNT ภาษีมูลค่าเพิ่ม 7.0% VAT				38,250.00
รวมเงิน GRAND AMOUNT				2,677.50
				40,927.50
ผู้รับเงิน		ใบเสร็จรับเงินฉบับนี้ จะสมบูรณ์ต้องมีลายเซ็นผู้รับเงิน และผู้มอบอำนาจ และได้เรียกเก็บเงินตามเช็ค หรือได้รับเงินเข้าบัญชีครบถ้วนแล้ว		
ผู้มอบอำนาจ		ม.มส.ช.ไทย เลขที่ ม.ม. 0087/754 มีวันหมดอายุ 30/10/04		

Figure H.6. Receipt.

วัตถุดิบสำหรับ : (PA001) หัวจ่ายแอร์ 20" 20" x 20"

รหัสวัตถุดิบ	วัตถุดิบ	หน่วย	จำนวน
MA001	อลูมิเนียมฉาก 1"	มัด	1
MA004	อลูมิเนียมท่อหกเหลี่ยม 1 หุน	มัด	1
MO001	ลวดเชื่อมโลหะ	กล่อง	1

Figure H.7. Material Allocation Report.

ต้นทุนวัตถุดิบ : (MA001) อลูมิเนียมฉาก 1"

รหัสผู้ค้าส่ง	ผู้ค้าส่ง	รหัสอ้างอิง	หน่วย	ราคา	วันที่บันทึก
S0002	โรงงานเอี่ยมสมบูรณ์	A03377	มัด	125	11-09-04
S0003	โรงงานไทยสีท		มัด	120	12-09-04

Figure H.8. Material Cost Report.

List ต้นทุน: 17-10-04

รหัสวัตถุดิบ	วัตถุดิบ	ผู้ค้าส่ง	หน่วย	ราคา	วันที่บันทึก
MA001	อลูมิเนียมฉาก 1"	โรงงานไทยสีท	มัด	120	12-09-04
MA002	อลูมิเนียมฉาก 1" สีขา	โรงงานไทยสีท	มัด	120	12-09-04
MA003	อลูมิเนียมท่อกลม 2 หุน	โรงงานเอี่ยมสมบูรณ์	มัด	160	14-09-04
MA004	อลูมิเนียมท่อหกเหลี่ยม 1 หุน	โรงงานเอี่ยมสมบูรณ์	มัด	125	14-09-04
MA005	ตัวที 1" x 1"	โรงงานเอี่ยมสมบูรณ์	มัด	250	14-09-04
MA006	ตัวที 1" x 1" สีขา	โรงงานเอี่ยมสมบูรณ์	มัด	300	14-09-04
MM001	เหล็กแผ่น 1 มิล	ไทยโลหะกิจเจริญ	แผ่น	700	02-10-04
MO001	ลวดเชื่อมโลหะ	รุ่งแสง	กล่อง	300	01-09-04
MO002	สีฟันขาว	รุ่งแสง	กระป๋อง	450	12-09-04
MO003	สีฟันดำ	รุ่งแสง	กระป๋อง	450	12-09-04
MW001	ไม้ขัดหนา 1 เซนติเมตร	รุ่งแสง	แผ่น	800	11-10-04

Figure H.9. Material Cost List.

ราคาสินค้า : (PA001) หัวจ่ายแอร์ 20" x 20"

รหัสลูกค้า	ลูกค้า	หน่วย	ราคา	ราคาค่าแรง	วันที่บันทึก
C0001	ส.ไพบุลย์	หัวจ่าย	2125	1000	11-09-04
C0004	สยามดีจิ้น	หัวจ่าย	2120	1000	11-09-04
C0005	สยามเครื่องแอร์	หัวจ่าย	2120	1000	12-09-04

Figure H.10. Product Price Report.

List ราคา: 17-10-04

ประเภทสินค้า	รหัสสินค้า	สินค้า	หน่วย	ราคา	ราคาค่าแรง	วันที่บันทึก
หัวจ่ายแอร์	PA001	หัวจ่ายแอร์ 20" x 20"	หัวจ่าย	2125	1000	11-09-04
หัวจ่ายแอร์	PA002	หัวจ่ายแอร์ 18" x 18"	หัวจ่าย	2010	1000	11-09-04
หัวจ่ายแอร์	PA003	หัวจ่ายแอร์ 16" x 16"	หัวจ่าย	1900	1000	11-09-04
หัวจ่ายแอร์	PA004	หัวจ่ายแอร์ 14" x 14"	หัวจ่าย	1800	1000	11-09-04
หัวจ่ายแอร์	PA005	หัวจ่ายแอร์ 20" x 12"	หัวจ่าย	1700	1000	11-09-04
หัวจ่ายแอร์	PA006	หัวจ่ายแอร์ 20" x 10"	หัวจ่าย	1670	1000	11-09-04
หัวจ่ายแอร์	PA007	หัวจ่ายแอร์ 10" x 20"	หัวจ่าย	1500	1000	11-09-04
ตัวตี	PT001	ตัวตียาว 1" x 1"	มัด	250	180	12-09-04
ตัวตี	PT002	ตัวตียาว 1" x 1" สีขา	มัด	350	180	12-09-04
ตัวตี	PT003	ตัวตียาว 1" x 1" ปีกนก	มัด	340	140	12-09-04
ตัวตี	PT004	ตัวตีสั้น 60 cm.	มัด	120	50	12-09-04
เหล็ก	PM001	เกือกม้าเล็ก 10"	ชิ้น	170	80	13-09-04
เหล็ก	PM002	เกือกม้ากลาง 12"	ชิ้น	190	80	13-09-04
เหล็ก	PM003	เกือกม้าใหญ่ 14"	ชิ้น	230	100	13-09-04
เหล็ก	PM004	คันท่อนผูกพื้น	อัน	120		13-09-04
สแตนเลส	PM005	ป้ายบอกทาง 10'	กล่อง	4000		12-09-04
สแตนเลส	PM006	ป้ายสินค้า Orange	กล่อง	5000		12-09-04

Figure H.11. Product Price List.

รายงาน ออเดอร์ดังกล่าว

วันที่ 20/09/04

ลูกค้า	เลขที่ออเดอร์	สินค้า	จำนวนที่สั่ง	วันที่สั่ง	สถานะ	กำหนดส่ง
ส.ไพบุลย์	CO040001	หัวจ่ายแอร์ 20" x 20"	20	13/09/04	อยู่ในการผลิต	30/09/04
ไทยแข่งธง	CO040020	เกือกม้าเล็ก 10"	10	15/09/04	รอวัตถุดิบ	30/10/04
ไทยแข่งธง	CO040021	เกือกม้าใหญ่ 10"	10	15/09/04	รอวัตถุดิบ	30/10/04

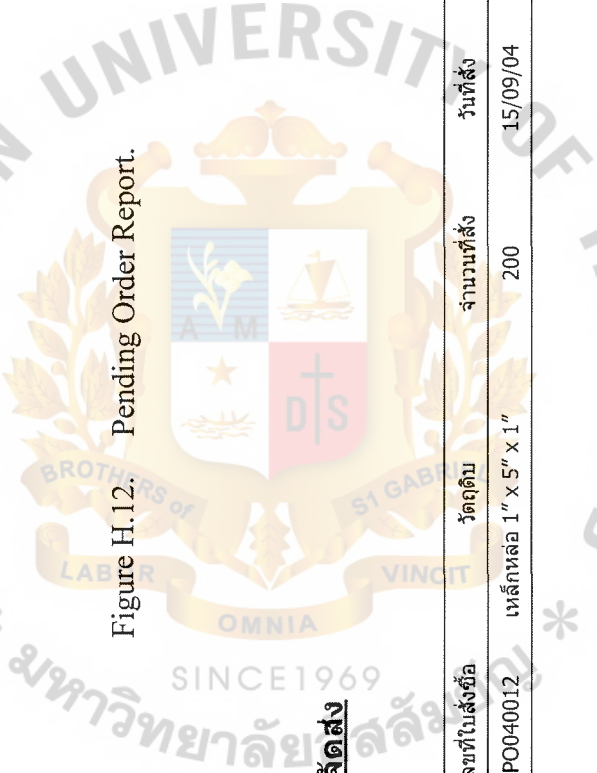


Figure H.12. Pending Order Report.

รายงาน วัตถุดิบรอการจัดส่ง

วันที่ 20/09/04

ผู้ค้าส่ง	เลขที่ใบสั่งซื้อ	วัตถุดิบ	จำนวนที่สั่ง	วันที่สั่ง	สถานะ	กำหนดส่ง
โรงงานเหล็กกิจเจริญ	PO040012	เหล็กหล่อ 1" x 5" x 1"	200	15/09/04	ยืนยันราคา	21/09/04

Figure H.13. Pending Material Report.

รายงาน วัตถุดิบใน Stock

วันที่ 30/09/04

ลูกค้า	เลขที่ใบสั่งซื้อ	วัตถุดิบ	จำนวนที่เหลือ
ส.ไพบุลย์	PO040007	อลูมิเนียมฉาก 1"	10
ส.ไพบุลย์	PO040008	อลูมิเนียมท่อนกเหลี่ยม 1 ทุน	5
สยามดีจีน	PO040007	อลูมิเนียมฉาก 1"	20

Figure H.14. Material Stock Report.

รายงาน สินค้าใน Stock

วันที่ 20/09/04

ลูกค้า	เลขที่ออเดอร์	สินค้า	จำนวนที่รอการจัดส่ง
ส.ไพบุลย์	CO040001	หัวจ่ายแอร์ 20" x 20"	10
สยามดีจีน	CO040005	ตัวที่ยาว 1" สีขา	50
สยามดีจีน	CO040006	ตัวที่สั้น สีขา	200

Figure H.15. Product Stock Report.

รายได้ประจำเดือนตุลาคม 2004

ลูกค้า	เลขที่ใบส่งของ/ใบกำกับภาษี	จำนวนเงิน	กำหนดจ่าย	สถานะ
ส.ไพบุลย์	IN040001	38250	15/10/04	เช็ค
	IN040004	17000	16/10/04	เช็ค
	IN040005	20000	20/10/04	วางบิล
สยามดีจีน	SV040001	80000	11/10/04	เงินสด

Figure H.16. Revenue Report.

รายจ่ายประจำเดือนตุลาคม 2004

ผู้ค้ำส่ง	เลขที่ใบสั่งซื้อ	จำนวนเงิน	สถานะ
โรงงานเอี่ยมสมบูรณ์	PO040001	38250	จ่ายแล้ว
ไทยซีทเอ็กซ์เชนจ์	PO040002	17000	ยืนยันราคา
ไทยอลูมิเนียม	PO040003	80000	แฟกซ์

Figure H.17. Expense Report.



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