1996

Customer Feedback Information System for Quality Improvement

Ke Wang
Eastern Illinois University

THESIS REPRODUCTION CERTIFICATE

TO: Graduate Degree Candidates (who have written formal theses)

SUBJECT: Permission to Reproduce Theses

The University Library is receiving a number of requests from other institutions asking permission to reproduce dissertations for inclusion in their library holdings. Although no copyright laws are involved, we feel that professional courtesy demands that permission be obtained from the author before we allow theses to be copied.

PLEASE SIGN ONE OF THE FOLLOWING STATEMENTS:

Booth Library of Eastern Illinois University has my permission to lend my thesis to a reputable college or university for the purpose of copying it for inclusion in that institution's library or research holdings.

May 17, 86
Date

I respectfully request Booth Library of Eastern Illinois University not allow my thesis to be reproduced because:

_____

_____

_____

_____ _____

Author Date

Customer Feedback Information System for Quality Improvement

(TITLE)

BY

Ke Wang

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

Master of Science

IN THE GRADUATE SCHOOL, EASTERN I LLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

1996

YEAR

I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING
THIS PART OF THE GRADUATE DEGREE CITED ABOVE

5/16/96
DATE

5/17/96
DATE

THESIS COMMITTEE MEMBERS

5/8/96

Ping Liu, Ph.D., P.E., C.Q.E and C.S.I.T. — Date
Professor
Thesis Advisor
School of Technology

9 May 96

Clifford E. Strandberg, Ed.D. — Date
Professor
Graduate Coordinator
School of Technology

5-8-96

Mahyar Izadi, Ph.D. and CMfgE — Date
Professor
School of Technology

ABSTRACT

Title of the thesis: **Customer Feedback Information System for Quality Improvement**

This research addressed the basic needs for an effective customer feedback information system and the database technology to develop the system. It discussed the system concept and configuration of a typical customer feedback information system, database management technology, programming flow charts, program functions and capabilities. A proposed customer feedback information system consists of customer data inputs, database management system and outputs to various departments in an organization. With a user-friendly interface, database management system serves as an information management tool. It can process the feedback from customers and use the information in decision making. Thus, customer feedback can be promptly and effectively used to make corrective actions by manufacturing and service departments. The idea of continuous improvement can be effectively carried out to meet and exceed customers' satisfactions and expectations.

ACKNOWLEDGMENT

I would like to take this occasion to express my sincerest appreciation and deepest gratitude to Dr. Ping Liu for the opportunity to conduct this research and for his guidance and wisdom throughout the thesis writing process. I would like to thank Dr. Myhyar Izadi and Dr. Gene Strandberg for their advisement and encouragement throughout the research and thesis writing process.

I am very grateful to the members of my research group, Zhongyu Chen, Jinshan Song, Yanze Li, and James McKirahan for their assistance and comraderie.

I would also like to thank Ms. Mandy Woodward for her helping in my thesis writing.

I wish to acknowledge the School of Technology, and the Graduate School for the assistance they provided during this work.

Finally, I would like to acknowledge my sincerest appreciation to my wife Shuijun Fu, my father Linbin Wang, my mother Lingxuan Wu, and my sister Wei Wang. Their encouragement, support, patience, and strength were essential to the success of this research.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

Introduction

In the competitive global economy, every organization needs to continuously improve the quality of its products and services to meet the needs of ever sophisticated customers. Prompt response to customer feedback is a critical step toward achieving the world class quality.

Evans and Lindsay (1993) indicated that "quality begins with the consumer." Costumer demands and constant technological changes have opened new and highly competitive markets. In the 1950s and 1960s, consumers purchased goods and accepted their quality without any question. However, the market competition, foreign product import, and the development of their higher quality in their products prompted consumers to examine their purchasing decisions more carefully. Today, consumers demand high quality and reliability in goods and services at a fair price. The quality of products and services can no longer be taken for granted. Even industries that enjoyed a monopoly over domestic products now must face the competition of foreign products. More than ever industrial companies realize that quality is vital to their survival.

1.1 Statement of the Research

To constantly improve the quality of products and services, it is imperative to understand customers' needs and expectations. To achieve this objective, an effective feedback and decision making system is necessary so that customers' feedback can be promptly collected, processed and responded. This research will study a customer feedback information system, including system concept and design approach, data analysis, decision making, user interface design and program implementation. Customer feedback data were managed with a centralized database. The analysis results were used to make recommendations regarding corrective actions for various departments in an organization. In this way, an organization can continuously make effective improvement on its products and services according to customers needs and expectations.

1.2 Significance of the Research

All activities associated with quality improvement must put customers in the principal position. Both manufacturing and customer service divisions should focus on fulfilling the needs and expectations of customers. A series of processes including design, manufacturing, and service, begin with

customer needs and expectations and end with what the customer sees and believes concerning the quality of the product. Managers must continuously understand customers' needs and provide products and services that meet those needs (Shores, 1992).

All product and service attributes that create perceptions of quality will increase customer satisfaction. Besides the technical characteristics of a product, customers have other needs and expectations throughout the product life cycle. First, before the sale, customers have clear and unambiguous specifications. These specifications must relate to the application for which the product is intended. Second, delivery information must be reliable. The product should be received when promised and the shipment should contain everything expected and needed to use the product. Operating and setup instructions must be clear and complete. Third, the product should be user-friendly and function as expected without defects. As the product ages, maintenance must be easy and economical. Factory and service center repairs should be handled promptly. Finally, spare parts should be available at reasonable cost over the life of the product (Bragar, 1992).

To understand customer requirements and expectations, and to improve customer satisfaction, customer feedback is very critical. An effective

customer feedback system is an essential part of the quality information system in an organization so that customers' feedback can be promptly responded. Thus, customer satisfaction and expectation can be continuously monitored and measured (Ward, 1994a). A typical closed-loop customer feedback system is illustrated in Figure 1. In this system, customer feedback is continuously collected and processed in the information system. After processing and analyzing, recommendations are promptly forwarded to various departments within an organization, including R&D, design, manufacturing, vendor relations, sales, and services.

1.3 Definitions

For this research, the following definitions are used.

Management Information System (MIS). An information system that provides information including routine summary and reports for managing an organization. MIS is sometimes used to refer to all the computing systems in an organization that support management.

Customer Feedback Information System (CFIS). A system that can process feedbacks from customers and use the information in decision

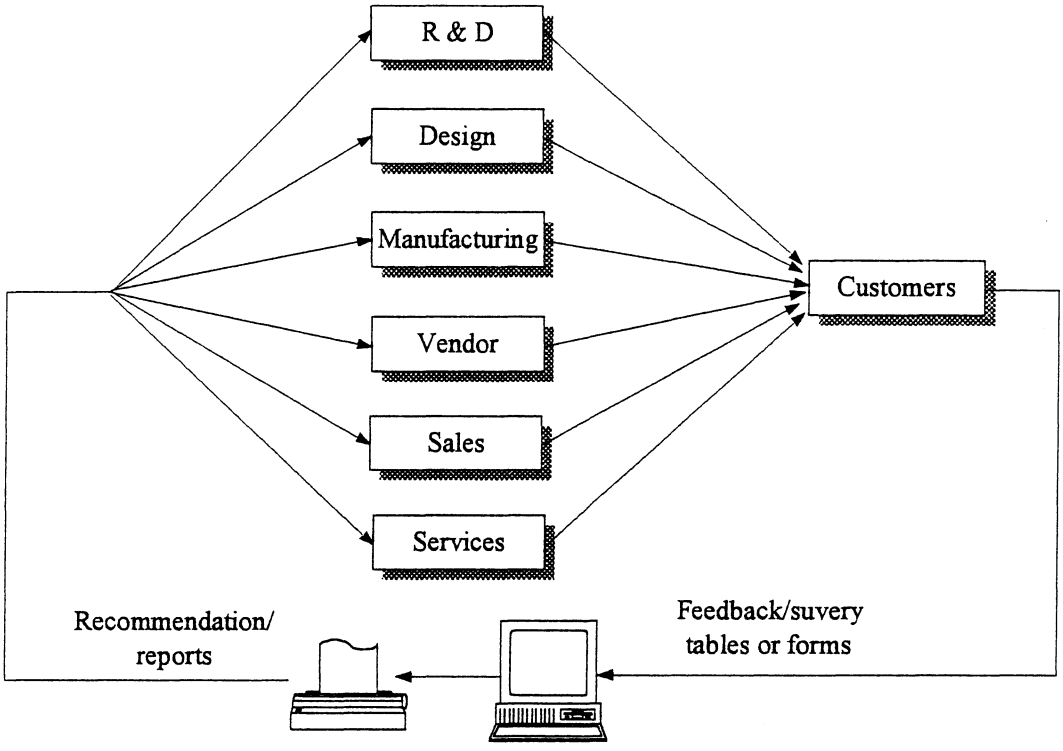

Figure 1. Closed-loop customer feedback system

making.

Information. Processed data that is organized, meaningful, and useful.

Relational Data Base Management System (RDBMS). A set of programs that are used to define, process, and administer the database and its applications. RDBMS treats data as if they were stored in two-dimensional tables. It can relate any data in one table to data in another table as long as the two tables share a common data element through a relational expression.

Database. A collection of files stored in a particular format and accessed through a computer.

Database File. A collection of records stored in a table or in a particular file structure.

Record. A collection of fields.

Field. The smallest unit of data in a database.

Data. Data is defined as recorded facts or figures.

Keyword. A data item (data value or data name, field value or field name) used to locate a record effectively.

Data Integrity. A collection of data has integrity if the data is logically consistent.

Flowchart. Graphic representation of operational sequences in a

program or the flow of data through a sequence of processes and procedures.

Closed-Loop System. A system with feedback for control. The output of the system is used to loop back and modify the input of the system.

Object Linking and Embedding (OLE). A set of features supported by Microsoft Windows operating system that allow embedding or linking data from one Windows application with another application.

1.4 Assumptions

This system is assumed to be used by companies in manufacturing or services. After the customer information system is completed, the system will be of general purpose for quality monitoring, measuring, and reporting. It will be suitable for various management levels in an organization.

1.5 Limitations and Delimitations

During designing, programming, and debugging the system, it was difficult to obtain factual data for data base. Thus, data about customers, products, and vendors were created in two-dimensional tables. Assumed data were used to simulate different environments for programming, debugging, and improving the system.

In this research, the structure of customer, product, and vendor tables, such as descriptions of field type, width, decimal, and so on, were defined and constructed. In order to test search efficiency of the program, each table contained at least several hundred records during debugging.

In this research, the system was developed under Windows 3.0 or higher operating environment and FoxPro for Windows.

CHAPTER 2

Review of Literature

Fifteen years ago, companies put major focus on producing products of competitive design with new technique. Customers were eager to buy and to pay premium prices for the products with new features. Decision makers idealized that innovative features of a product could be turned into benefits, which would help them increase productivity or cut costs. The only thing end users knew was that the product looked great and promised to improve the way they did business (Lyons & Alexander, 1993).

Today, customers do not perceive products as unique. They look for good design and name recognition, but purchase products based on price, quality, and assurance of service. Customers are concerned with not only product features, but also information about product improvement. They refuse to undertake the cost, time delays, or inconvenience of mistakes made by the manufacturer or vendors (Lyons & Alexander). Under this situation, organizations began to pay more attention on the customer feedback about their products and services. They established various information systems to collect, archive, and process customer feedback, and send analysis reports to the management level. These organizations realized that access to customer

information was essential to the success of their quality improvement.

Bragar (1992) indicated that customer-focused quality improvement was the key to survival for many organizations in the competitive worldwide market of the '90s, and a feedback information system was an essential component of its success.

Ward (1994b) indicated customer satisfaction must be continuously monitored and measured. Customers were satisfied only when their requirements were consistently met. In his study, Ward emphasized that if an organization wanted to remain competitive in the market, it must meet these requirements in a timely and cost-effective manner.

Orme, Parsons, and McBridge (1992) stated that organizations must invest time, effort, and money to learn what their customers wanted and expected. They also pointed out that there were three major reasons to establish a system. First, an organization should eliminate the duplication of research efforts and time, hence, reduce costs. Secondly, an organization should ensure that information about customers, products, and services is properly collected and interpreted throughout the organization. Thirdly, an organization should provide decision makers access to better and more reliable quality information. Therefore, they constructed a customer

information system (CIS)-a model for collecting, archiving, and accessing customer information in a health care organization. In their research, Orme *et al.* discussed the concepts how to establish and manage a customer database and how to collect, archive, and access customer information. They believed the organizations that have begun a quality improvement program would understand the advantages of setting up a customer feedback information system. These organizations will discover that the system will make the quality transformation easier by improving the efficiency of project teams and by providing managers access to more information to make important decisions. In all business activities including manufacturing and service, organizations that manage information more efficiently than competitors can meet their customers' expectations better. As they consistently satisfy all of their customers' expectations, these organizations will be better prepared to survive and prosper future competition (Orme *et al*).

Orkin, Bogetz, Frase, and Fox (1992) stressed the importance of quality information system for quality and utilization management in ambulatory surgery. They believed managing quality and utilization was essential for the success of an ambulatory surgery facility. The information system became a critical element for quality and utilization management. In

their research, Orkin *et al.* viewed patients as their customers and divided patient data including patient satisfaction into six categories. The data were maintained in a relational database on a microcomputer network (Macintosh Apple Talk) in the facility for use by hospital staff in evaluating and improving the quality of care and service. Designing an information system for quality and utilization management emphasized making meaningful information available with the least effort. They indicated that their quality and utilization management activities must continuously satisfy the "monitoring and evaluation" paradigm and continuous quality improvement programs. The system must also prepare for a future in which patient outcomes will be increasingly important as the number and complexity of procedures and patients continue to grow (Orkin *et al.*).

Wind River Systems (1996) demonstrated its commitment to customer satisfaction through its high quality Customer Support Service. Staffed by dedicated software support engineers, Customer Support provides timely, accurate responses to customer inquiries. They also convey customer feedback to engineering department ensuring that products of Wind River continue to meet customer needs. All customer contacts are tracked using WRS' on-line Customer Support database. The customer's telephone and fax

numbers, shipping and email addresses, and system configuration data are automatically linked in from the WRS customer database (Wind River Systems).

CHAPTER 3

Methodology

3.1 Description of Customer Feedback Information System (CFIS)

In this research, a customer feedback information system (CFIS) was established to effectively measure the quality of products and services. The major technique includes a database management system, which records all relevant information on customers, products and vendors, and structured program design. The system can analyze customer feedback, continually assess their needs and expectations, and recommend corrective actions to various departments in an organization.

A structure of a typical customer feedback information system is illustrated in Figure 2. The system consists of five modules, including data collection, data operation, evaluation and analysis, decision making, and reporting. Customers' data are collected through various channels such as customer surveys, registration, correspondence, communications, returned goods, and so on. Data input can be accomplished using keyboard, bar-code scanner, automatic reader, or other input devices. Data management operations include appending, browsing, deleting, indexing, searching, sorting, and updating. These operations can make data easily retrievable.

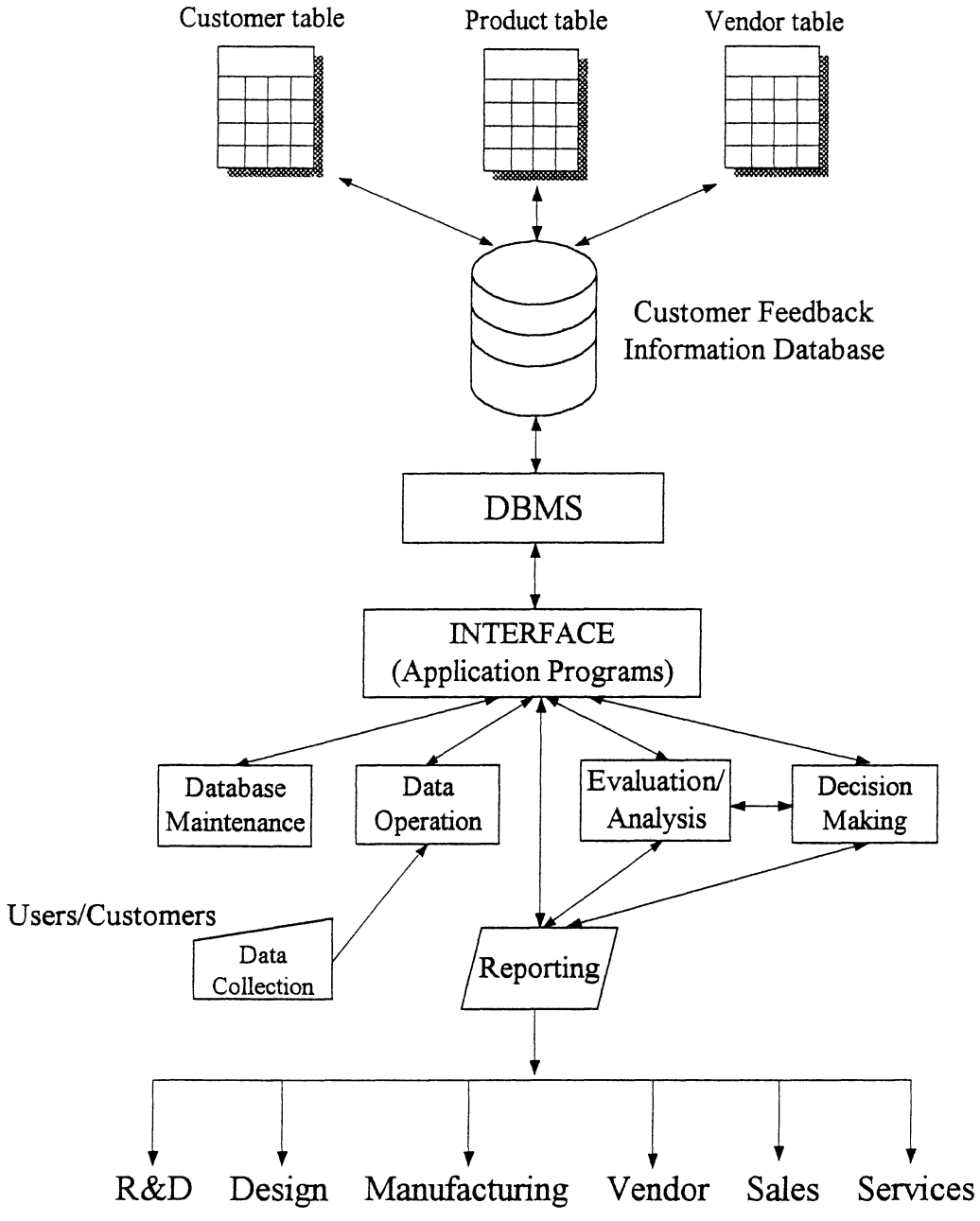

Figure 2. Structure of customer feedback information system.

Customers' data can be evaluated by various statistical tools such as control chart, bar diagram, Pareto chart, and so on. Data reporting sends corrective action recommendations to various departments, for example, research and development, design, manufacturing, sales, shipping, and customer services.

3.2 Structure of Database

In the customer feedback information database, three two-dimensional basic tables were defined and constructed. These are customer table, product table, and vendor/manufacturer table. The three tables are independent in structure, but they can be related to each other. By keyword, common field or relational expression, new tables can be derived from the basic tables.

3.2.1 Customer table

The customer table includes such fields as customer name, address, phone number, and customer comments as shown in Table 1. Besides the basic information about customers, customer table records data associated with customers' purchasing and returning activities. Customer satisfaction levels can be evaluated through customers purchasing history and pattern.

Table 1. Structure of customer table

Record:Field	Type	Width	Decimal
Customer code	Character	5	
Name	Character	20	
Address	Character	30	
City	Character	15	
State	Character	2	
Zip	Character	10	
Contact	Character	20	
Phone	Character	12	
Fax	Character	12	
E-mail	Character	15	
Comment	Memo		
Purchased item	Character	10	
Purchase date	Date	8	
Returned item	Character	10	
Return date	Date	8	
Rating score	Numeric	2	

The field of rating score records customer's evaluation for the quality of products.

3.2.2 Product table

The basic structure of product table is shown in Table 2. The product table records product code, description, category, cost, unit price, manufacturer/vendor code, quality ratio, and related information. The recommendation field records the evaluation result and decisions made. In the product table, five scale fields and Customer Satisfaction Index (CSI) field were defined. Scale fields record the degree of satisfaction for the product customer purchase. Scale 5 means very satisfied, scale 4 satisfied, scale 3 not applicable, scale 2 dissatisfied, and scale 1 very dissatisfied.

3.2.3 Vendor table

As shown in Table 3, the vendor table records vendor code, name, telephone number, address, product code, and product name. In this table, relevant product data can also be included.

In the customer feedback information system, a product table is a bridging table. It includes common fields such as product code and

Table 2. Structure of product table

Record:Field	Type	Width	Decimal
Product code	Character	10	
Description	Character	30	
Category	Character	10	
Stock	Numeric	6	
Price	Numeric	8	2
Cost	Numeric	8	2
Quantity	Numeric	6	
Sale	Numeric	10	2
Vendor code	Character	10	
Vendor name	Character	30	
Recommendation	Memo		
Scale5	Numeric	3	
Scale4	Numeric	3	
Scale3	Numeric	3	
Scale2	Numeric	3	
Scale1	Numeric	3	
CSI	Numeric	4	1

Table 3. Structure of vendor table

Record:Field	Type	Width	Decimal
Vendor code	Character	10	
Vendor name	Character	35	
Address	Character	30	
City	Character	15	
State	Character	2	
Zip	Character	10	
Contact	Character	20	
Phone	Character	12	
Fax	Character	12	
E-mail	Character	15	
Product code	Character	10	
Description	Character	30	

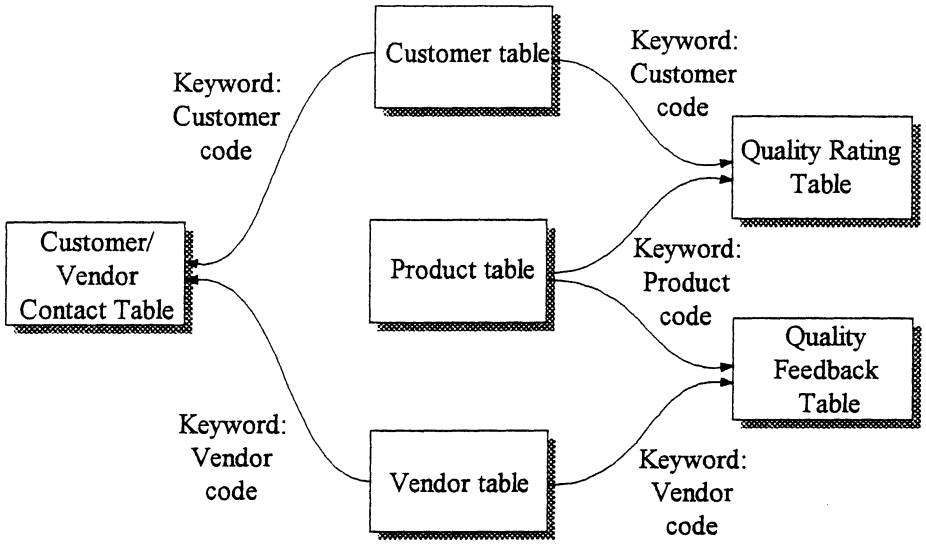

Figure 3. The relation between three basic tables and derived tables

vendor/manufacturer code for linking customer and vendor/manufacturer table. In a product table, using product code as the keyword, customers' purchasing and returning activities can be searched and summarized. Similarly, using vendor/manufacturer code as a keyword, related information about vendor/manufacturer can be accessed.

With the three basic tables, other tables can be easily created as shown in Figure 3. Through keywords or common fields, new tables such as quality rating score table, quality feedback table, customer/vendor contact table, and many other tables can be derived.

3.3 Design of Customer Feedback Information System(CFIS)

In design of the system, the following steps are involved: planning and programming environment, designing a user-friendly interface between database and users, mechanisms for control, report design, customer satisfaction summary, and realization of object linking and embedding.

3.3.1 Planning and programming environment

Two major factors must be considered in this step. The first one is the flow of the data, which is related to data structure and data relation. Due to

the entry of thousands of records about customers, products, and vendors in the customer feedback information system, storage of the same data in multiple records or tables will be redundant and lead to waste computer resources, especially the storage space. In addition, it also causes complicated problems for data management such as poor data integrity and extra computer processing time required to retrieve these redundant records. To avoid this problem, only three basic tables were created. These tables contained primary data required by the system and key words as a linkage between tables. A derived table can be created through keywords such as customer code, product code, vendor code, and relational, or logical expression.

Programming environment is another factor that should be considered in designing a database management system. Currently, there are many database management systems (DBMS) available. In this research, Microsoft FoxPro, a relational database system was used as the DBMS of the customer feedback information system. FoxPro is an ideal tool for developing applications for cataloging, tracking, and processing information. Like most other database management systems, FoxPro allows the system to work with various types of data, such as numbers and character strings. Data can be

stored in tables, arrays, variables, and files. FoxPro provides a rich set of query language commands and functions that can be written in a program to perform data querying and processing. The advantage of the query language is that it has flexibility for application development and it is easy to use. FoxPro provides a self-contained programming language that has more than one hundred commands and functions. Moreover, FoxPro has a charting software, Microsoft Graph. Microsoft Graph can insert charts directly into application's report or document as they appear on the screen. FoxPro also provides a user-friendly interface consisting of menus, windows, and dialogs.

3.3.2 Design of a user-friendly interface

An application is the user's interface with the database. Ideally, an application should provide an easy-to-use interface for users to make requests with valid and accurate data(Kroenke and Dolan, 1988). In the system, most data were entered to the database through a keyboard and displayed on a CRT terminal. Availability of a user-friendly interface will significantly reduce users' burden. With the interface, users no longer need to master the environment of FoxPro and query language commands. All menus including submenus were designed in Windows format. Users can easily establish a

relational or logical expression to complete their desired operations by clicking mouse on pop-up menus, push buttons, radio buttons, or spinners.

3.3.3 Mechanisms for control

The customer feedback database is a valuable information resource. Once the database has been accessed, processing the database must be controlled. Such controls are primarily intended to reduce the inadvertent errors. Menus and pop-up windows are two forms of mechanisms for processing control. Figure 4 shows a two-level menu structure used by the customer feedback information system. In main menu, a user is given the operational options of DATABASE, RECORD, ANALYSIS, REPORT, and EXIT. If the DATABASE item is chosen, DATABASE submenu is displayed. Users can choose OPEN, CLOSE, BROWSE, SORT, or Pack operations to process the table. If users choose RECORD item in the main menu, the RECORD submenu is displayed. Users can GOTO, LOCATE, APPEND, CHANGE, REPLACE, DELETE, or UNDELETE records in a customer table, product table, or vendor table. All optional items are represented in icons. The structure of the menu and the allowed options provide one important means of processing control.

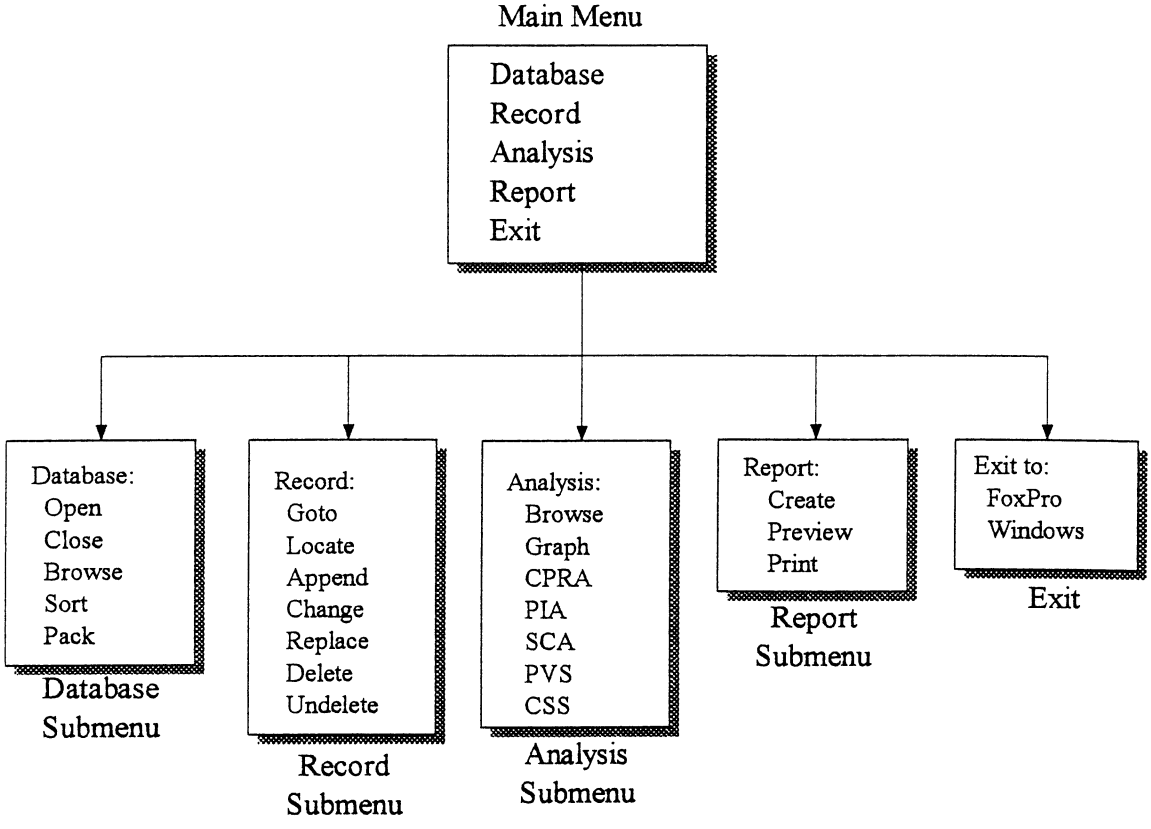

Figure 4. Menu structure

The other mechanism for processing control is pop-up window. A pop-up window can be placed in the screen, with full or decreased size. In a submenu, if a processing option is chosen, associated pop-up window is defined and displayed. Users can choose options in a pop-up window. After desired operations are completed, users can exit the window. Because pop-up windows can be nested, it can make the system levels clear.

3.3.4 Report design

Printed reports, graphs, and charts represent the major output from the CFIS. The readability of any reports is very important in the system design since they present the results of analysis and decisions to be carried out. Figure. 5 shows various report formats, including tables, summary, and graphs. Graphic functions present data using pie, bar, or line charts.

In design of a report, flexibility of the report was considered. In order to help users easily create and revise the report format according to their needs, all report formats can be created, revised, and previewed dynamically. In the REPORT pop-up window, users can click CREATE, MODIFY, or PREVIEW push bottom to choose different operation. In

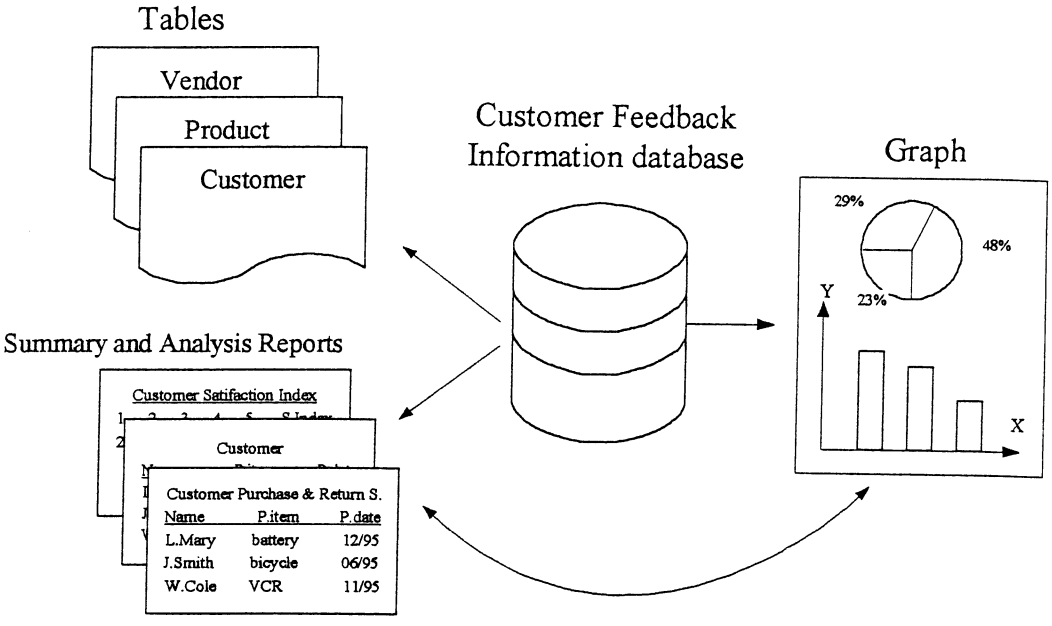

Figure 5. The integrity of data

the report creating submenu, a new report format can be created easily by selecting different fields, system functions, system variables, font size, page number, report title, and footer, and arranging them in the desired position. Moreover, a bitmap file can be merged into the report to enhance satisfied output effect. After creating a report format, users can also preview the report. The result displayed on a monitor will be the same as the report to be printed out. If the report format is not satisfied, revising operation can be invoked to modify the format until satisfied results are achieved. To complete above operations, system commands such as CREATE REPORT, PREVIEW REPORT, and MODIFY REPORT will be used.

In the ANALYSIS pop-up window, customer purchase, return pattern, quality rating score, products or vendors information can be accessed and analyzed. The results of analysis can be printed out according to key word or relational expression.

3.3.5 Customer satisfaction summary (CSS)

In analysis process, customer satisfaction summary was used to show the satisfaction degree of products customers purchased or returned. In the CSS report, product name, code, rating scales and Customer Satisfaction

Index (CSI) are included. In rating scale columns, a five-point scale was used. Scale 1 means very dissatisfied, scale 2 dissatisfied, scale 3 not applicable, scale 4 satisfied, and scale 5 very satisfied. An example for customer satisfaction rating scale is shown in Table 4.

Table 4. Customer satisfaction index summary table

Product		**Rating Scale**						
Code	**Description**	**1**	**2**	**3**	**4**	**5**	**Total**	**CSI**
A1434	Ayers diatonic	4	2	10	23	47	86	89.0
A1574	Amble cyril	8	18	12	78	97	213	83.1
A1738	Auto bushel	2	3	6	25	66	102	92.1
A1815	Apart snipe	7	7	2	72	89	177	87.8
A2330	Achievers nally	10	8	12	7	10	47	46.5
A3028	Adieu divider	1	4	7	44	107	163	93.9

Using the five-point scale, data for dissatisfaction and satisfaction are interpreted. Then, CSIs are calculated for each product using the following formula:

$$CSI = \frac{(\ No.\ of\ Scale\ 4\ +\ No.\ of\ Scale\ 5\ )}{(\ No.\ of\ Total\ -\ No.\ of\ Scale\ 3\ )} \times 100$$

For instance, product A1738 receives 66 very satisfied scores, 25 satisfied scores, 6 not applicable scores, 3 dissatisfied scores, and 2 very dissatisfied scores. Thus, its CSI is 92.1. Motorola Inc. has defined the following scale to interpret the results of the quality: 100 to 95=best in quality, 94 to 90=very good, 89 to 80=acceptable, and 79 to 70=needs improvement (Vora, Harthun, & Kingen, 1993). Different companies may establish their own rating score standards according to their products and services.

3.3.6 Realization of object linking and embedding (OLE)

In the customer feedback information system, the task of graphic processing is submitted to Microsoft Graph. Thus, how to realize object linking and embedding (OLE), or to combine text with graph to produce quality analysis reports was one of the tasks in the system. Object linking and embedding (OLE) is a set of features supported by Microsoft Windows operating system that allows users to embed or link data from one Windows application into another application. OLE objects can be stored and displayed in fields of general type in a database table. Once an object is stored in a general field, the object can be displayed or edited into tables,

screens, or reports. In the system, if GRAPH push button is clicked in the ANALYSIS pop-up window, the system will work under Microsoft Graph environment. In Microsoft Graph environment, different graph such as pie chart, bar chart, or line chart can be chosen to display on the screen or printed report. The charts of analysis results can be stored in the general field of relevant database file by clicking SAVE AS push button. After the operation is completed, the system returns to the quality information system environment.

CHAPTER 4

Results: Program Descriptions

4.1 System Requirement

4.1.1 Hardware requirement

The customer feedback information requires an IBM 80386SX or higher hardware system. It requires a mouse, a printer, and 6 megabyte RAM if virtual memory is set to none or 4-megabyte RAM if virtual memory is set to temporary or permanent. It is recommended that a VGA or higher resolution monitor should be used. The hard disk should have at least 100 megabyte storage space.

4.1.2 System software requirement

CFIS requires Microsoft Windows version 3.0 or higher running in 386 enhanced mode. The system can also run under Windows 95.

4.2 System Functions Descriptions

CFIS was written using FoxPro commands and functions to realize the interface between DBMS and users. The program is divided into main program, subprogram, and procedures in structure according to their different

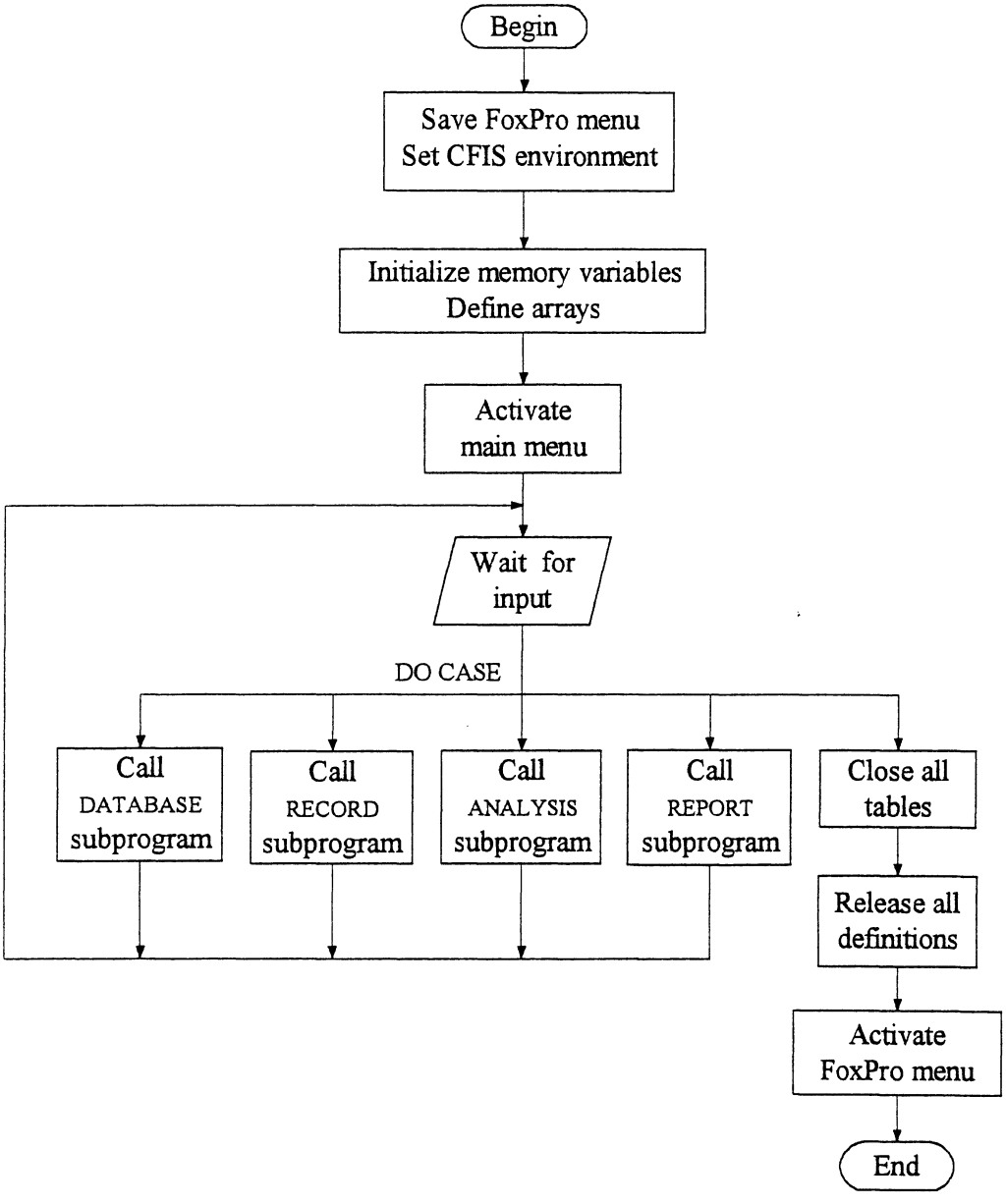

Figure 6. Flowchart of CFIS main program

functions. The main program is divided into three sections. A flowchart of CFIS main program is shown in Figure 6. The first section is initialization, which sets up CFIS environment, initializes global variables, and defines arrays. In this section, SET SYSMENU SAVE was programmed to save FoxPro environment when users exit from CFIS environment and FoxPro window can be restored. Four arrays need to be defined. The field names of three basic tables and logical operators are stored in these arrays for pop-up lists displaying. The main menu definition section defines, establishes, and displays main menu and waits for users' choice. The third section controls the flow of program according to users' choice. DO CASE conditional statement was used to execute a set of commands based on a logical condition. It controls the flow and invokes associated procedures. In the system, there are four major procedures to complete database maintenance, records operations, data analysis, and reports output. They are implemented by DATABASE, RECORD, ANALYSIS, and REPORT subprogram. In main window, users can start one of the four subprograms by clicking on relevant push button. Users can also terminate CFIS and exit to FoxPro environment or Microsoft Windows environment. All definitions and setting about windows, variables, and arrays will be released. In order to make the

program more concise, many macro substitutions were used. In the program, an ampersand & represents a macro substitution if it appears in the front of a memory variable.

4.2.1 DATABASE subprogram

DATABASE subprogram consists of a series of procedures to complete operations such as OPEN, CLOSE, BROWSE, PACK, or SORT. These operations are used to manipulate tables in database. The flowchart of DATABASE subprogram is shown in Figure 7.

In the OPEN or CLOSE procedure, users can open or close a data table based on their needs. If a table has been opened, other database can not be opened until the opened table is closed. The OPEN or CLOSE windows will give relevant prompts to users.

BROWSE is used to browse the opened table which has opened. In order to prevent inadvertent data modification in a table, all fields are frozen during browsing, so that users can not make any modifications to the table. In the BROWSE window, users can activate a pop-up to move record pointer to any position in the opened table.

PACK procedure permanently removes all records marked for deletion

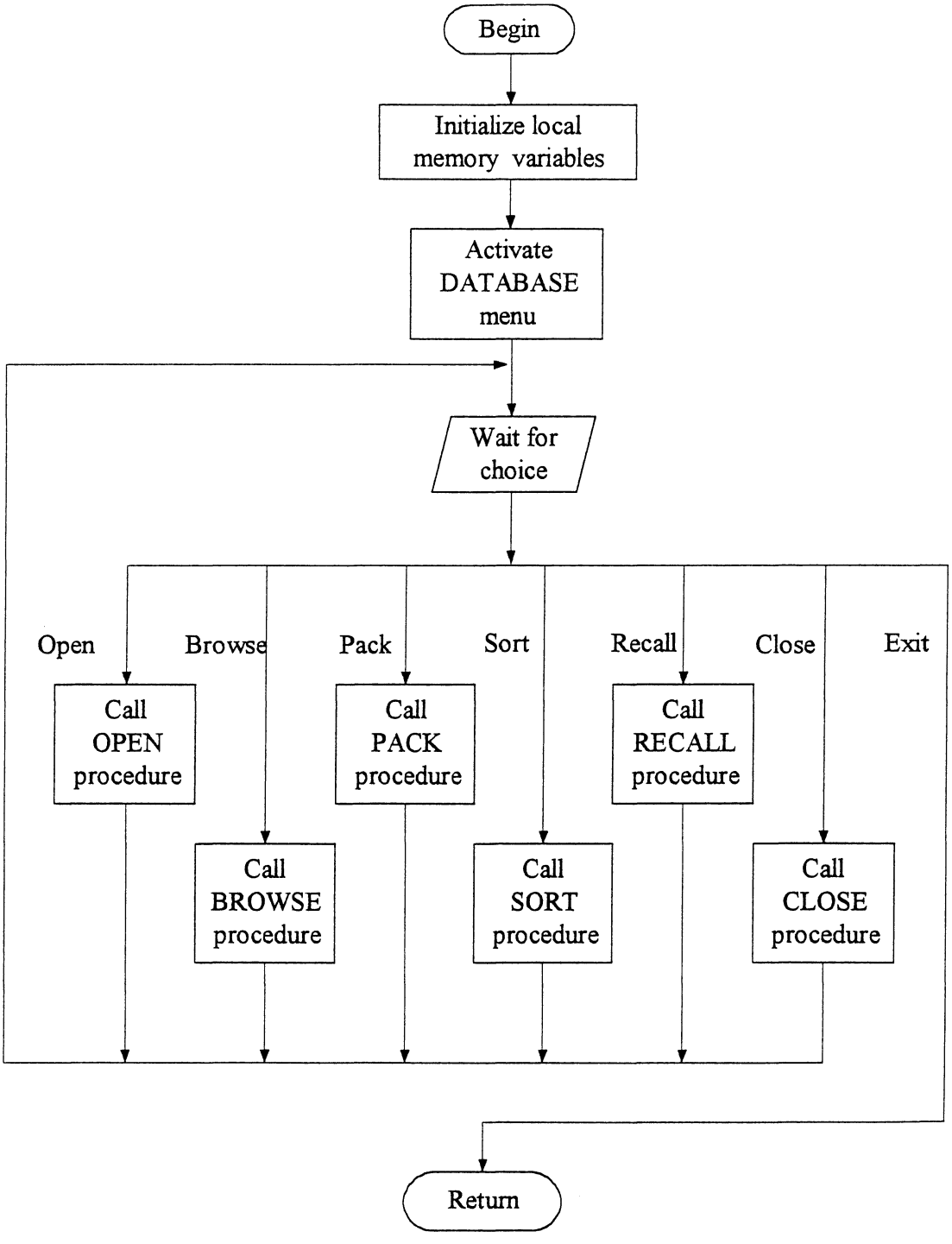

Figure 7. Flowchart of DATABASE subprogram

in the current table. Before packing, warning information is displayed. SORT is very useful in maintaining the order of table. It sorts records in the current table and outputs the sorted records to a new table.

In SORT windows, users can specify a sort order such as ASCENDING or DESCENDING and select four fields for sorting at same time. After specifying fields and sort orders, the SORT procedure will rearrange records to a temporary table, delete current table, rename temporary table to the original table name, and then open sorted table. Above operations are transparent and convenient to users.

4.2.2 RECORD subprogram

RECORD subprogram includes APPEND, CHANGE, DELETE, GOTO, LOCATE, UNDELETE, and REPLACE procedures to perform operations such as adding, changing, selecting, deleting, and positioning records. The flowchart of RECORD subprogram is shown in Figure 8. The subprogram controls the flow of these procedures. After users choose RECORD by clicking mouse in main menu, main program will start execution of RECORD subprogram.

APPEND procedure enables users to add records to the end of the

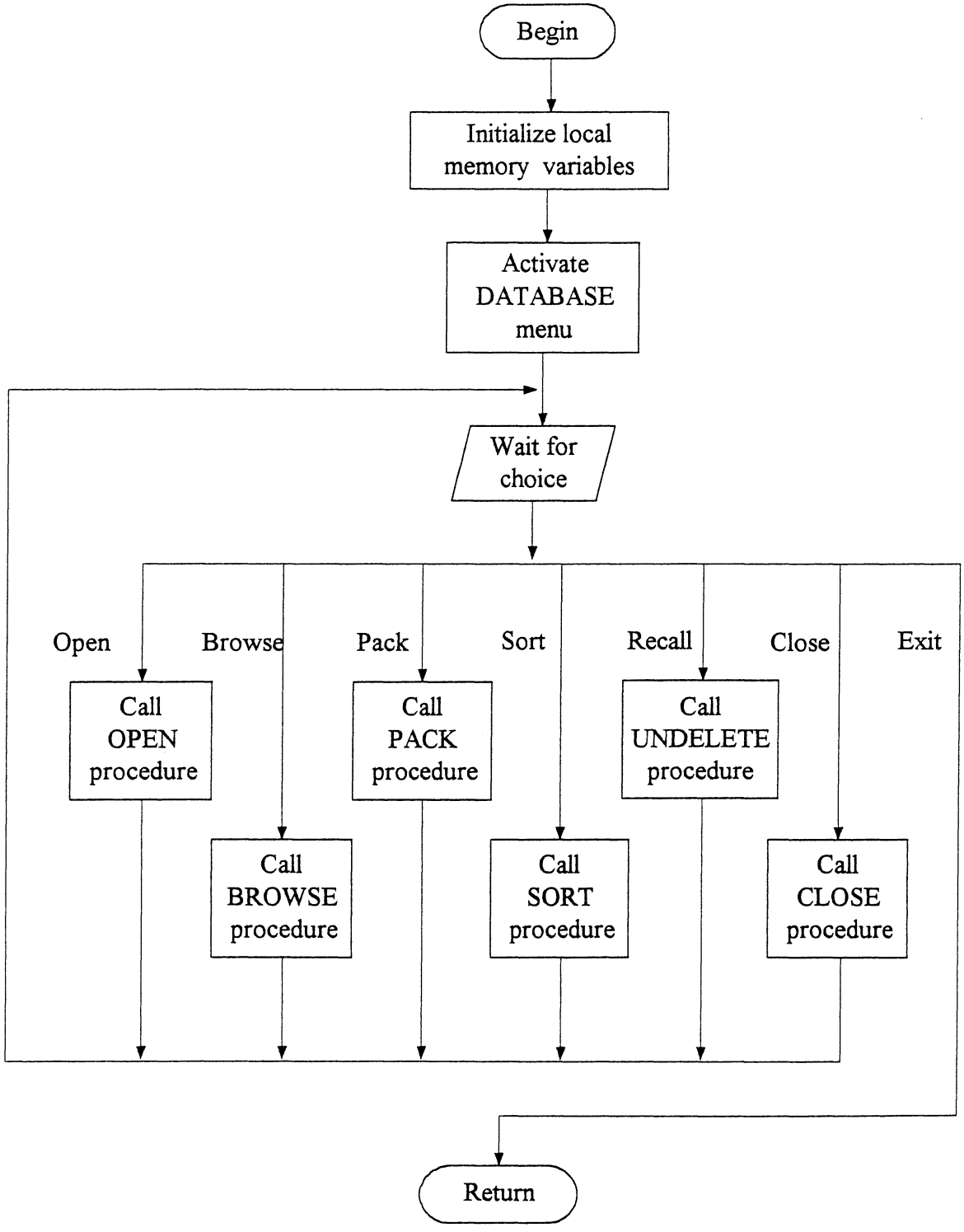

Figure 8. Flowchart of RECORD subprogram

current table. For example, if users want to add new records to customer table, they can enter the data according to associated prompts such as CUSTOMER_CODE, NAME, ADDRESS, TELEPHONE NUMBER, COMMENT. Users need also enter the data of products they purchase or return including PRODUCT CODE, PURCHASE_DATE, RETURN_DATE, and RATING SCORE. After entering purchase or return information, the procedure will search product table in the second work area automatically to check the product data. If the data is not existing, a small prompt window will be activatived and displayed. Users can decide to append a new record about the product to product table according to their desire. If users want to append a new record , the procedure will switch to the second work area from current work area, activative the second APPEND window, and allow users to enter the data of the product to the product table. After users finish data entering, the procedure will return to original work area, users can continuously enter data into next field in customer table. When users click ADD or BACK push button, procedure will add rating score given by customer to the relative rating scale fields in a product table.

CHANGE allows users to edit fields or records in the selected table

within CHANGE window. User can move cursor from field to field or from record to record to edit data. Since CHANGE is a full screen editor and supplies many functions for editing, CHANGE command was written directly in program.

GOTO procedure positions the record pointer on the specified record number in a table. Users can specify positioning range such as TOP, BOTTOM, RECORD NUMBER, or NEXT and activate FOR window to establish a logical expression for positioning.

Usually, LOCATE command sequentially searches the table for the first record that matches a given logical expression. In CFIS, LOCATE procedure can find out all records according to positioning range and logical expression and copy them to a temporary table. After users access the search result, the temporary table will be released.

DELETE procedure defines DELETE window and allows users move the pointer to the desired record. Users can make a deletion mark on the records and the keyword such as CUSTOMER_CODE, PRODUCT_CODE, or VENDOR_CODE will be displayed in red color. If users change mind and want to erase marks for deletion, they can simply move record pointer to the desired record, and click UNDELETE push button in DELETE window.

If users want to erase deletion marks for all records which have deletion marks, users can return to main menu, go to DATABASE submenu, and choose UNDELETE operation.

REPLACE procedure replaces data in a field with the value in an expression. Before starting REPLACE operation, users must specify field, replacing scope, and logical expression. After users click REPLACE push button, all record which match the logical expression will be replaced. When users click BACK push button, the procedure will return to RECORD subprogram.

4.2.3 ANALYSIS subprogram

ANALYSIS subprogram consists of Customer Purchase and Return Analysis (CPRA), Product Information Analysis (PIA), Sale and Cost Analysis (SCA), Product and Vendor Summary (PVS), and Customer Satisfaction Summary (CSS) procedures. The flowchart of ANALYSIS is shown in Figure 9. CPRA is based on customer table. PIA, SCA, and CSS are performed from the product table. These procedures are controlled by ANALYSIS subprogram. The subprogram will activate or deactivate relevant push buttons according to opened table.

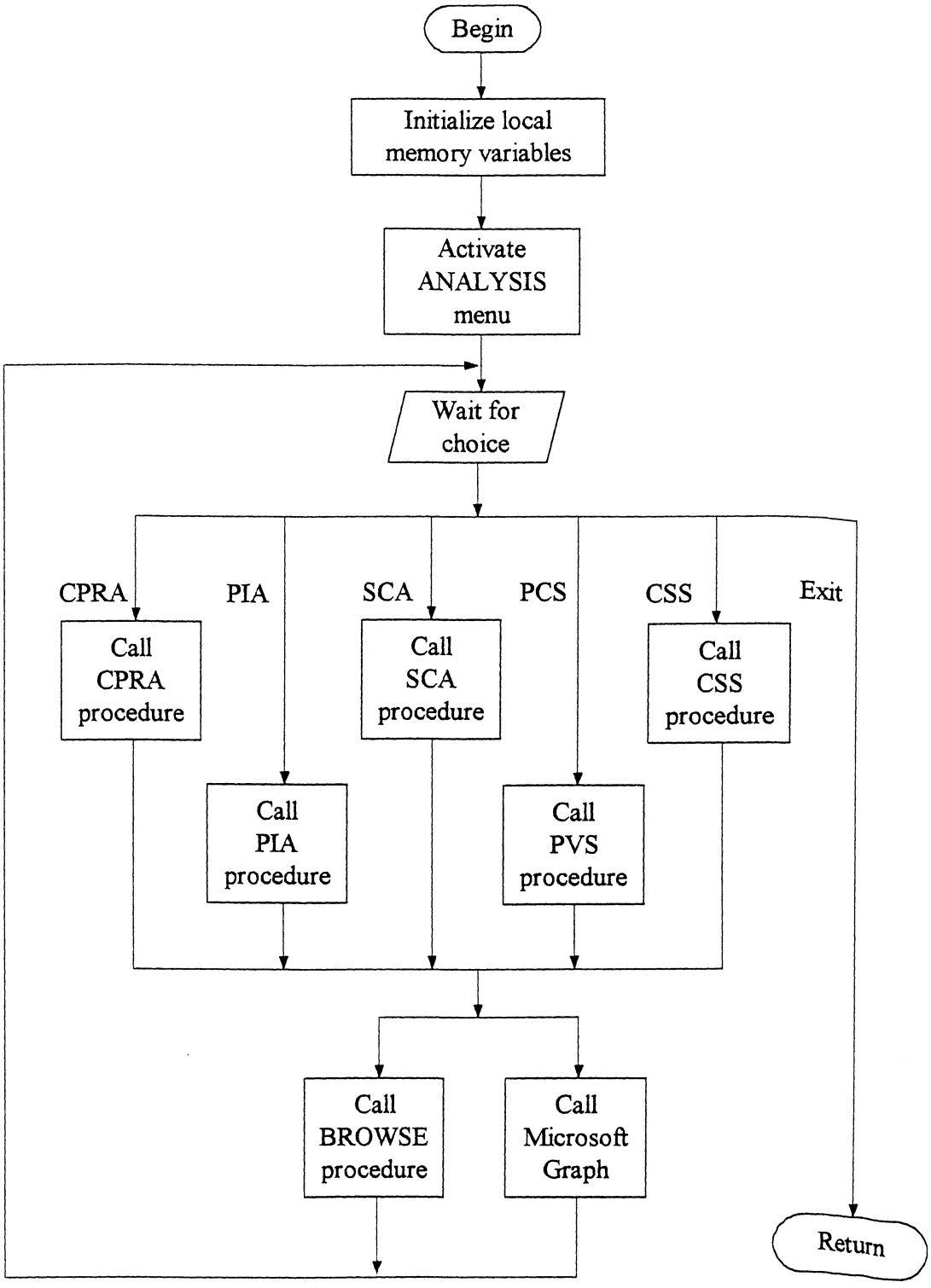

Figure 9. Flowchart of ANALYSIS subprogram

The function of CPRA procedure is to analyze customers' purchase and return pattern in a specified duration. Users can know how many products are bought and returned by customers through statistical operation. In CPRA window, users need to specify the beginning date and the ending date for statistical operation by moving spinners. The statistical results will be stored in a temporary table. Users can click BROWSE or GRAPH push button to list the content of the temporary table or to generate graphs. In the Graph window, users can choose one of twelve graphic formats to display statistical results, and then click SAVE AS push button to save the graph. The graph will be appended to the temporary table automatically. After returning from Graph environment, users will receive a report that combines text with graph by clicking PRINT push button. CPRA report is especially useful to sale and service departments. From the report, managers can understand total sales, total return, and proportion of return to sale and finally take appropriate measures.

PIA is a procedure that calculates sold quantity and returned quantity of a product. Because PRODUCT_CODE is common field in customer table and product table, the relation can be established through the field. In PIA, current opened table should be product table. The procedure will search

customer table opened in the second work area through key words to complete statistics. After entering PIA window, users need to click PRODUCT NAME check box to select a product in the product pop-up list, click SOLD or RETURN check box, and then specify the period. After statistic operation is completed, BROWSE push button or GRAPH push button can be activated. Users can browse the results or go to Microsoft Graph environment to generate graph and click SAVE AS push button to save the graph. The graph will be appended to a temporary table automatically. After returning from Graph environment, users can click PRINT push button to print PIA report. An example of product sold and return analysis report is shown in Figure 10.

The function of SCA procedure is to analyze sale and cost of a product. It supplies a summary report that reflects monthly sale volume and cost of a product to the managers of sale department.

CSS procedure is used to analyze customer satisfaction according to customer rating scales. The rating scales are given by customers for the products they purchase and return. The customer satisfaction index will be calculated using Customer Satisfaction Index (CSI) formula. In the CSS

Product Sold/Returned Report

Description: Adequate pile **Code:** A1953

Vendor/Manu.: Azimuth

Date:	**Sold:**	**Returned:**
04/95	3	0
05/95	4	2
06/95	2	0
07/95	3	0
08/95	4	0
09/95	4	0
10/95	5	0
11/95	4	0
12/95	3	0
01/96	3	0
02/96	5	2
03/96	3	0
04/96	2	0
TOTAL:	45	4

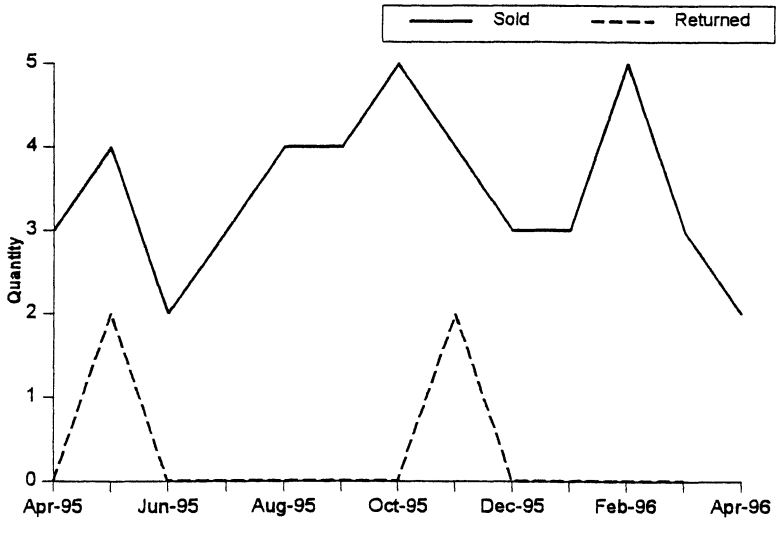

Figure 10. Example of product sale/return analysis report

window, after users specify product, rating scales and customer satisfaction index about the product will be displayed. Users can click LIST push button to list CSI of all products, or click PRINT push button to print CSI report.

4.2.4 REPORT subprogram

The function of REPORT procedure is to generate various reports and print data report in tables in a desired format. The flowchart of REPORT is shown in Figure 11. In the system, there are fourteen format files with FRX extension were defined. Information such as text, pictures, fields, lines, or rectangles about the reports is stored in these format files. Users can create other report formats according to their needs. In the REPORT window, if users click CREATE push button to create a new report format, REPORT procedure will invoke Report Layout Window. Users can design their own report formats. After a report format design is completed, users can click PREVIEW, or MODIFY push button to view or modify it. The procedure will execute REPORT command with PREVIEW clause to display the format, or invoke Report Layout Window and let users to modify it.

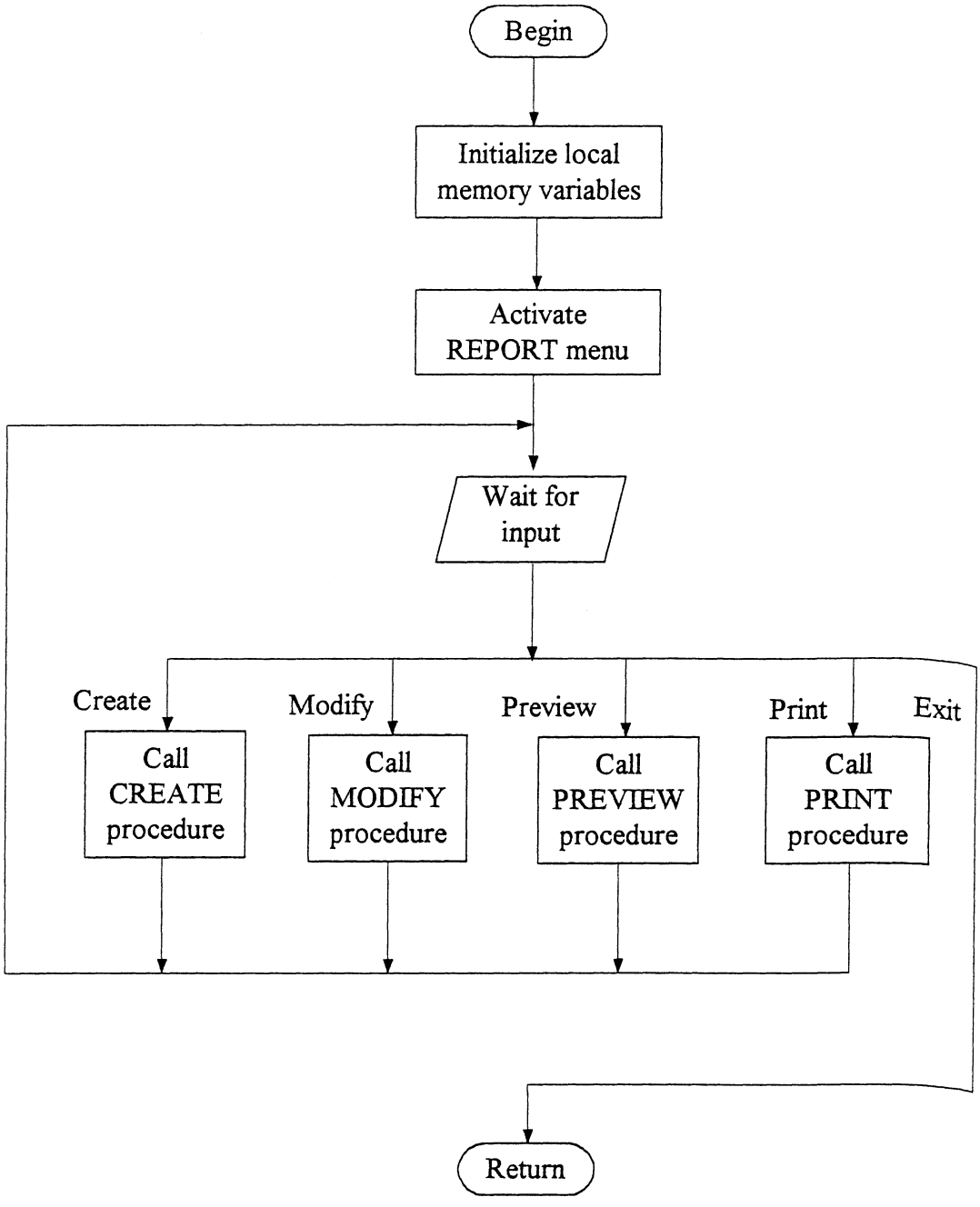

Figure 11. Flowchart of REPORT subprogram

Table 5 summaries all the relevant files described above including file name, description and corresponding table for the operation. For example, to perform analysis on "customer purchase and return pattern," structure describing file "analyse0.frx" will be invoked to generate a report with working table.

Table 5. List of report format files

File Name	Description	Working Table
analyse0.frx	customer purchase and return pattern	temporary table
analyse1.frx	product sold and return quantity report	temporary table
analyse2.frx	sale and cost analysis report	temporary table
analyse3.frx	vendor and product analysis report	temporary table
customer0.frx	customer information report	customer table
customer1.frx	customer list	customer table
customer2.frx	customer purchase and return list	customer table
product0.frx	product information report	product table
product1.frx	product list	product table
product2.frx	product and vendor list	product table
product3.frx	customer satisfaction summary	temporary table
vendor0.frx	vendor information report	vendor table
vendor1.frx	vender list	vendor table
vendor2.frx	vendor summary report	vendor table

CHAPTER 5

Summary

The following conclusions were made according to the research on customer feedback information feedback system.

1. Customer feedback information feedback system is an effective tool to collect, access, summary, and respond customers' feedback for continuously improving quality of products and services of an organization.

2. Closed loop feedback system is emphasized to constantly improve quality by promptly responding customers' needs and expectations.

3. The customer feedback system includes functions of data input, storage, database maintaining, processing, analysis and reporting.

4. The system uses FoxPro and Windows environment for data management. Microsoft Graph is connected to produce graph for report output.

5. Limited number of data tables are used to maintain data integrity and reduce redundancy. Users can create their own tables and report formats for analysis and summary reports according to their needs.

CHAPTER 6

Recommendations for Further Study

The following recommendations for further study were made according to the research and development of customer feedback information system:

1. Because a lot of feedback data come on the customer survey written forms, an enhancement would be text scanning rather than manual data entry. More efficient equipment of data entry should be applied to the CFIS. The equipments can include light pen, bar code scanner, touch screen, and image scanner.

2. Distributed database processing is a technique in which the execution of procedures and the retrieval, updating, analysis of data occur across two or more independent computers, so distributed database application system should be considered in the further research of CFIS.

REFERENCES

Bragar, J. (1992). The customer-focused quality leader. Quality Progress, 5 (May), 51-53.

Evans, J. R., & Lindsay, W. M.(1993). The Management and Control of Quality (2nd ed.). St. Paul, MN: West Publishing Company.

Kroenke, D. M. & Dolan, K. A. (1988). Database Processing--Fundamentals, Design, Implementation (3rd ed.). New York, NY: Macmillan Publishing Company.

Lyons, M. C. & Alexander, J. A. (1993). Distributors in many industries learn a lesson about customer service. Quality Progress, 26 (November), 109-114.

Orkin, F. K., Bogetz, M. S., Frase, D. R., & Fox, C. S. (1992). An information system for quality and utilization management in ambulatory surgery. The Journal of Ambulatory Care Management, 15 (4), 24-29.

Orme, C. N., Parsons, R. J. & McBride, G. Z. (1992). Customer information and the quality improvement process: developing a customer information system. Hospital & Health Services Administration, 37 (2), 197-212.

Shores, A. R. (1992). Improving the quality of management systems.

Quality Progress, 26 (6), 53-57.

Ward, J. A. (1994a). Continuous process improvement. Information Systems Management, 11 (Spring), 74-76.

Ward, J. A. (1994b). Meeting customer requirements-first time, every time. Information Systems Management, 11 (Summer), 75-78.

Vora, M. K., Harthun, S. M., & Kingen, R. G.(1993, November). ASQC certification committee practices what it preaches. Quality Progress, 26 (11), 99-103.

Wind River Systems. (1996). Customer Support. *http://www/wrs.com/*