THE ROLE OF MANAGEMENT ACCOUNTING INFORMATION ON CONTINUOUS IMPROVEMENT

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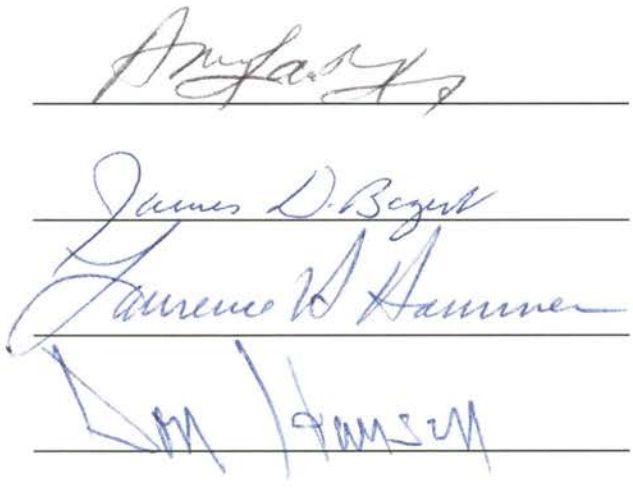

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CHAPTER I

INTRODUCTION

This study investigates the changes that are made in the management accounting information system when continuous improvement is adopted. The study also examines the changes in internal performance that occur after the adoption of continuous improvement. Section 1.1 provides the background for the study. Section 1.2 presents the motivation of the study. The objectives of the study are provided in Section 1.3. Finally, Section 1.4 describes the organization of the study.

1.1 Background

Reaction to intense global competition has brought about a shift in the operation paradigm. In order to remain competitive, firms have substituted an operation improvement paradigm for the more traditional cost minimization paradigm. The popular term for the operation focus is

continuous improvement. Continuous improvement firms create an organizational culture and structure that encourages constant efforts to eliminate waste. Continuous improvement has many elements, four of them are: employee empowerment, strict attention to quality of conformance, process improvement, and activity based management.

Elimination of waste by employee empowerment-- A continuous improvement culture is established by involving all employees in improvement efforts through frequent communication by upper management of continuous improvement goals and the encouragement of active involvement of all employees in the achievement of the goals. American Express has improved its service to its external customers by taking an internal customer/supplier view of its internal operation. Performance of each employee is measured by his/her ability to serve his/her internal customer. In addition, employees are rewarded for developing better ways for providing exceptional service (Denton [1995]).

Elimination of waste by strict attention to quality of conformance-- Continuous improvement makes use of the *zero defects* approach to quality of conformance or the more

exacting *robust quality model*. Under the zero defects approach, efforts are made to prevent defects or to correct them before they go further in the process (Daniel and Reitsperger [1991]). An even more stringent approach to quality is the robust quality model. The robust quality model focuses upon achievement of complete perfection by designing products and processes to eliminate variability among outputs (Taguchi and Clausing [1992]). Ford used a zero defects/robust quality model approach to design its successful Taurus model. Using suggestions solicited from Ford employees and potential customers the Taurus design team was able to design the car and its production process so that the resulting Taurus was both easy to build and pleasing to customers (Bowles and Hammond [1991] p. 50).

Elimination of waste by process improvement-- Two methods of process improvement are *re-engineering* and *benchmarking*. Re-engineering involves simplifying processes to make them faster and cheaper. For example, IBMs credit subsidiary simplified its credit process by replacing its multi-step credit approval process with a one-step approval process which makes use of an internally developed credit

approval software package. Under the new system IBM Credit reduced its credit approval time from seven days to four hours (Hammer and Champy [1993] p. 36).

A firm benchmarks by modeling its processes after successful processes used by other firms (Bemowski [1991]). For example, Xerox attributes half of a 10% warehousing and materials handling productivity gain to its benchmarking of L.L. Bean's superior warehousing operation (Bowles and Hammond [1991] p. 19).

Elimination of waste by activity based management (ABM)-- ABM uses activity based information (ABI) to eliminate waste and manage costs by providing information about the activities consumed to perform processes. Ditch Witch used ABI to determine when quality problems occurred during its cylinder production process. Using this information the firm could eliminate the quality problems, decrease its cycle times, increase the productivity of the production process and realize a reduction in cost due to the lower scrap and rework rates (Thomas and Mackey [1994]).

1.2 Motivation

A recent survey found that 93 percent of the 500 largest firms in the US are pursuing some type of operation improvement or waste elimination program to improve their internal operations (Powell [1995]). Although, the goals of continuous improvement are to improve firm performance by improving the firm's operation, there has been very little systematic inquiry into whether the adoption of continuous improvement actually acts to improve internal firm performance. Ittner and Larcker [1995] used a subjective assessment of quality performance to measure Total Quality Management performance, and Selto, Renner and Young [1995] used one firm's measures of internal performance to examine its Just-in-Time/Total Quality Control performance. Weaknesses of each study had to do with the measures that were used to assess internal performance (i.e., subjectivity (Ittner and Larcker [1995]) and measurement error (Selto, Renner and Young [1995])). This study extends previous work by examining the effects of the adoption of continuous improvement programs on internal performance using objective measures of internal performance.

In addition, this study examined three management accounting issues: information provided, information demand and information use. Information provided is concerned with identifying the types and distribution of information that are furnished by the firm's formal management accounting information system. This type of investigation is useful for making inferences about the impact that management accounting information has on firm performance. Information demand has to do with information needs that are currently being met, as well as those that are not. Information use is concerned with the relationship between job responsibilities and information needs that support the job responsibilities. Inquiry into these issues provides insight that is useful for making practical recommendations about the design of management accounting information systems. The current literature makes recommendations about management accounting information systems that are based upon the analysis of the types of information that firms are currently providing to their decision makers. Inquiry into information demand and use would add to this literature by providing additional insight into the information users' perceived information needs.

Empirical evidence supports the notion of an association between operating conditions and management accounting information system design. The evidence has shown that positive associations exist between the adoption of operation improvement strategies, zero defects (Daniel and Reitsperger [1991]), employee empowerment (Banker, Potter and Schroeder [1993]), flexible manufacturing (Abernathy and Lillis [1995]), and total quality management practices (Ittner and Larcker [1995]) and the information provided. However, little has been done to investigate information demand and use in the continuous improvement setting. This study examined the changes in the management accounting information system related to the adoption of continuous improvement activities.

1.3 Objectives of the Study

This study used the contingency theory approach to examine two issues. First, the relationship between continuous improvement programs, management accounting information provided, and internal firm performance was examined using a cross-sectional sample of firms. Data were gathered by questionnaire survey and were analyzed using

bivariate correlations. Second, the implications of the adoption of continuous improvement on the information demand and use issues were examined using the longitudinal case study research approach. The data that were collected and the methods of analysis were guided by the following three research questions.

Does the implementation of continuous improvement programs improve internal performance?

Are the measures that are used to assess continuous improvement performance consistent with the continuous improvement goals?

How does the firm's management accounting information system change in response to the implementation of continuous improvement programs?

This study provides insight into the manner in which management accounting information is used to support continuous improvement, as well as, the impact of continuous improvement on internal firm performance.

1.4 Overview

This study is arranged as follows. Chapter 2 describes the prior research that examines the continuous improvement-management accounting information system relationship.

Chapter 3 develops the framework for the study and discusses the research questions and hypotheses. Chapters 4 and 5 describe the methodologies that were used for the cross-sectional study, and the case study. The results of each study are presented in Chapters 6 and 7. Chapter 8 summarizes the results, discusses the limitations, and provides suggestions for extensions of the study.

CHAPTER II

REVIEW OF THE LITERATURE

Evidence shows that the demand for information and the design of the management accounting information system are associated with management performance (Gul and Chia [1994]). However, a limited number of studies focus on (1) the relationship between the modern operation improvement program and internal firm performance, and (2) the association between operation improvement programs and the demand for information. Section 2.1 summarizes the studies that are concerned with the operation improvement-performance relationship. Section 2.2 summarizes the studies that examine the demand for information in the continuous improvement environment. Section 2.3 presents the limitations of these studies.

2.1 Operation Improvement/Performance Studies

The *contingency theory* is used for the examination of questions about organizational structure[1] (Otley [1980] and Drazin and Van de Venn [1985]). Many contingency theory studies aim to identify the associations between organizational structure factors in order to make normative recommendations about organizational structure (Daniel and Reitsperger [1991] and Gordon and Narayanan [1984]). Other contingency studies examine the relationships between organizational structure factors and performance (Gul and Chia [1994], Abernathy and Guthrie [1994], and Gupta and Govindarajan [1984]). The organizational structure-performance relationship is called *fit*. The assumption of the fit relationship is that higher levels of congruence between the organizational structure variables are associated with higher levels of performance. These studies use high levels of performance as the decision

[1]The organizational structure variables are the internal and external operating context, organizational design, which includes the distribution of decision making rights and the formal communication network, and the characteristics of the management accounting information system.

criteria to make normative recommendations about the organizational structure factors. The studies summarized in this section examine the fit relationship between the organizational structure factors that are pertinent to the goals of continuous improvement and companies' performance.

2.1.1 Abernathy and Lillis [1995]

The purpose of this study was to examine fit in the flexible manufacturing system (FMS) setting. FMSs are concerned with the coordination among functions that supports quick changeovers in the manufacturing process to accommodate rapidly changing customer demand. Structured interviews with general managers of 42 Australian manufacturing firms were used to gather the data for this study. Fit was assessed among three organizational structure variables: the level of flexible manufacturing strategy, the level of cross-functional communication, and the information used for measurement of FMS performance for control purposes. Flexible manufacturing strategy was measured by percentage of non-standard production. Cross-functional communication was measured by a variable called

integrative liaison devices[2]. To measure the information variable, the respondents were asked to rate a list of information items by the level of their importance for operation control purposes. The list of information items included efficiency (financial) and non-efficiency (non-financial) performance measures. The performance measure used to assess fit was the respondents' subjective assessments of their firms' performance relative to the performance of the firm's competitors.

Bivariate correlations were used to examine the associations between flexibility strategy, organizational design and performance. The results showed that the level of flexibility was negatively related to the demand for efficiency based measures. It can be inferred from this result that the firms used performance measures that fit the manufacturing flexibility goals. Also, the degree of cross-functional communication was shown to be positively associated with the degree of manufacturing flexibility and

[2]Integrative liaison devices are organizational design attributes that facilitate communication among functions, for example, use of cross-functional teams for problem solving.

these factors were both positively related to firm performance. These results give support to the belief that the operational strategy has an impact upon both information used for performance evaluation (i.e., non-financial information) and organizational design (i.e., the network of formal communication). The results also support a positive association between organizational structure congruence and firm performance.

2.1.2 Ittner and Larcker [1995]

This study tested the assertion that there is an advantage to having a management control system (SYS) that supports Total Quality Management (TQM). The associations between SYS and specific[3] TQM strategies, that were operationalized by canonical variables, and firm performance

[3]Specific TQM strategies and SYSs were identified using canonical correlations. The two sets of canonical correlations that are obtained from the canonical correlation procedure are the canonical variables. The procedure consists of identifying significant correlations within and between two sets of variables (in this case TQM and SYS). In this study the resulting sets of canonical variables were used to operationalize the specific TQM strategies and management accounting control systems (SYS).

were examined. The sample used for the study was selected from a population of successful Canadian, German, Japanese and US automobile and computer manufacturers, assemblers and suppliers. Data were obtained by surveys and interviews with management personnel[4]. The Malcolm Baldrige Award criteria[5] were used to develop the TQM variables. SYS variables had to do with the use of modern operation program reporting and performance evaluation.

One set of canonical variables contained training, teamwork, and soliciting employee suggestions (TQM factors), and the use of scientific problem solving, and the use of non-financial and team-based measures of performance evaluation (SYS factors). The second set of canonical variables included the establishment of a quality assurance

[4]A major weakness of this study is that the data used were survey data collected by a management consulting firm for some other purpose than to examine the hypotheses to be tested.

[5]The Malcolm Baldrige award recognizes with awards firms that are concerned with achieving long term survival by making quality of operations improvements. The award criteria have to do with implementation of quality programs and organizational design factors that support the programs (Zairi, Letza and Oakland [1994 p. 39]).

position, and supplier evaluation (TQM factors), and the use of benchmarking, the integration of strategic planning, and process improvement (SYS factors). Fit was measured by the respondents' self-assessments of their firms' quality performance, and an objective measure of performance, ROA[6].

The data were analyzed using generalized least squares regression on the sets of categorical TQM and SYS variables, and performance (i.e, ROA and Quality). The TQM variable was separated into three equal groups (i.e., low, medium, and high) using the 33 and 66 percentiles of the canonical variable scores, and the SYS variable was separated into two equal groups (i.e., low and high) using the 50th percentile of the canonical variable scores. The two basic models[7] that were tested were: (1) Current performance regressed on the current TQM and SYS categories and the interaction[8]; and

[6]ROA was pre-tax return on assets.

[7]Four control variables were also used: country, industry product groups (i.e, cars or computers), union activity, and the number of employees.

[8]Another variation of this model included three-year lagged performance variables.

(2) Current performance regressed on three-year lagged TQM and SYS variables and the interaction. Positive significant interactions are believed to represent the synergistic effect that is obtained when continuous improvement programs are supported by the information system.

The regression results provided mixed support for the presence of an interaction effect of the TQM and SYS canonical variables on performance. Specifically, the results using the first model, suggest that the highest returns (both ROA and quality) are earned during the early stages of implementation of TQM. The highest levels of both ROA and quality were found at low and medium TQM levels and high SYS levels. Surprisingly, the lowest levels of performance occurred at high levels of TQM and SYS. The second model showed similar results for ROA, indicating that a lag does exist between the implementation of continuous improvement programs, and improvements in performance. None of the second model regressions using quality performance; however, were significant.

2.1.3 Selto, Renner and Young [1995]

This study considers fit in a Just-in-Time/Total Quality Control (JIT/TQC) setting. It examines the associations between organizational structure (i.e., managerial control, and workgroup coordination) within and between workgroups[9] on workgroup performance. This study took place on-site at a division of a Fortune 500 computer firm. Data pertaining to managerial control, and workgroup coordination, and job satisfaction[10] were obtained by using the authors' adaptation of the *organizational assessment instrument (OAI)* questionnaire[11]. The workgroup control

[9]Workgroups are autonomous groups of employees that are responsible for the production of a single product or product line.

[10]Job satisfaction was used as a measure of workgroup performance.

[11]The organizational assessment instrument (OAI) questionnaire is used to measure the contingency theory constructs. It was developed in Van de Ven and Ferry [1980]. The original questionnaire measures the context and management control contingency factors. The authors adapted it to their particular study by eliminating the context questions and adding management control questions that measured JIT/TQC constructs.

variable was measured by the levels of horizontal and vertical communication and conflicts within workgroups. The managerial control variable was measured by the level of task difficulty and variability of the process that is being performed, worker dependency on the supervisor, worker dependency on the workgroup, worker authority, and job standardization. The current study also considered the association between the workgroup control variables and performance because much of the investigation at the case study centers around the investigation the user's attitudes toward the continuous improvement process and the management accounting system and their suggestions for improvement.

The questionnaire was administered to 19 managers and 406 direct labor employees that represented 31 production workgroups. The performance measures used were the firm-generated routine measures of workgroup performance that were gathered during the quarter during which the study was conducted. These objective performance measures were developed by the firm's management specifically to monitor the firm's JIT/TQC goals of cost reduction, quality, and speed - they were: cost (i.e., the ratio of actual to standard workgroup costs), yield (i.e., percentage of good

units produced), defects (number of defects for the quarter), and cycle time. However, upon the receipt of the data, the authors found that all of the measures were not provided for every workgroup that was examined. Also, it was determined that some of the performance information that was provided had not been measured according to the specifications that were provided to the researchers. To mitigate these data problems, factor analysis was used on the information that was obtained to compute a single performance measure that was called *workgroup effectiveness*. In addition, a second measure of performance, job satisfaction, was obtained from the OAI. Finally, two covariates, were used to control for the factors that were believed to impact workgroup performance, but that were beyond the control of the workers or the managers. They are: the number of engineering changes; and the number problems discovered with the processes during the time of the study.

Fifteen regressions were run for each of the two performance measures (i.e., work group effectiveness and job satisfaction). The regressions consisted of two-way combinations of the workgroup coordination, and the

managerial control variables (3 factors *5 factors = 15 combinations) and the interactions between them. Essentially, the regression results showed that the firm was not following the modern operation program. The modern operation program would have been evidenced by significant positive interaction terms, indicating that the firm was coordinating its operation improvement goals with the proper mix of managerial control and organizational design factors (i.e., employee empowerment). However, while the majority of the regressions were significant, only three of the interactions between the managerial control and the organizational design variables were significant. These results provide limited support for the normative recommendations about the congruence that is needed between managerial control and employee empowerment (i.e., low managerial control and high employee empowerment). The study also makes clear the need for the use of reliable measures of internal performance to assess fit.

2.2 Continuous Improvement-Information Demand Studies

Normative recommendations suggest that the adoption of the modern operation improvement program calls for the

provision of a wider range of information to a wider group of decision makers than is generally found in the more traditional operation program (Kaplan and Cooper [1992] and Blanchard [1995]). The two studies summarized in this section are concerned with investigating the types of information that are provided in the modern operation environment.

2.2.1 Daniel and Reitsperger [1991]

The purpose of this study was to identify associations between the goal-centered zero defects strategy and the demand for goal directing quality information. Data was collected by a questionnaire survey. Respondents were managers of large Japanese consumer electronic and automotive firms. To measure the zero defects variable eight questions were used. The questions assessed the respondents' attitudes toward various beliefs about methods of quality control. The information variable was used to determine the type of information: unit- or cost-based, that was most used by the decision makers in the zero defects environment. The respondents were asked whether and how often they received reports of scrap, rework, reject and

machine downtimes. Each of these measures of quality were expressed in unit and cost terms, for example, the number of units of scrap, and scrap costs; so that it could be determined whether unit- or cost-based quality information was used.

Bivariate correlations were used to identify positive associations between each of the eight measures of attitudes about quality control methods and the two forms of the items of information. Results showed that among the sample of firms those that followed zero defects strategies believed that both cost and unit information are useful. This study provides evidence in support of the assumption that the adoption of the modern operation program effects the demand for information.

2.2.2 Banker, Potter and Schroeder [1993]

This study investigated the TQM/JIT practice of providing lower level workers with quality and productivity information. In addition, the impact of the provision of

the information on employee empowerment and job satisfaction was examined.

Data were collected by a questionnaire survey. The respondents were 362 line workers from 40 US manufacturing firms. The three dependent variables investigated were quality information, productivity information, and worker job satisfaction. The independent variables used were TQM, JIT, decentralization and teamwork. Regression results showed that each of the dependent variables was positively related to the independent variables. It can be inferred from the results that firms that are involved in the modern operation program provide information to lower level workers and that the information has a positive impact on job satisfaction.

2.3 Limitations of the Current Literature

The review of the current literature shows the following weaknesses: (1) the use of inappropriate performance measures to assess the achievement of the continuous improvement goals; (2) a failure to examine the changes in the management accounting information system due to the adoption of the modern operation improvement program;

and (3) the relationship between the information provided and used, and information demand has been ignored.

2.3.1 Measures of Internal Performance

Studies have examined associations between modern programs, organizational structure, and measures of external firm performance (i.e., subjective measure of respondent firms' performance relative to competitors (Abernathy and Lillis [1995]) and ROA (Ittner and Larcker [1995])). Changes in external performance may be only partially caused by the achievement of continuous improvement goals. Other factors, such as changes in customer demand or market competition, will also affect external performance. Therefore, even though both Abernathy and Lillis [1995] and Ittner and Larker [1995] obtained significant results, the results provide only weak support for the hypothesized modern program-organizational structure-fit relationship because of the confounding factors.

In addition, Otley [1980 p. 419-421] explains the importance of the selection of the appropriate performance measures to assess fit in accounting information contingency studies. He suggests that "externally imposed standards" of

firm performance (i.e., ROA (Ittner and Larcker [1995] and competitiveness (Abernathy and Lillis [1995])) may be too far removed for the organizational objectives described by the goals and support systems that are being examined in the contingency studies. This argument leads one to believe that the appropriate performance measures should be carefully chosen by their ability to represent the achievement of the organizational goals being examined. In the case of continuous improvement the appropriate measures of fit would have to do with operations improvements in efficiency, productivity, quality and cost reduction. Though Ittner and Larcker [1995] assessed fit using quality performance as an internal measure. It was a self-assessment of the respondent firms' quality performance relative to their competitors. While this operation performance measure is appropriate to the assessment of continuous improvement performance, it is subject to *leniency bias*. Leniency bias occurs when the respondents' desire to provide a favorable answer causes them to give higher ratings than are warranted by the actual conditions (Nunnally [1978] p. 599). An objective measure of performance (i.e., one calculated using quantitative

outcomes of operations) is appropriate because it is less subject to leniency bias.

The performance measurement issue is addressed in both parts of the current study. Objective measures of internal performance are used to assess fit in the cross-sectional study of the fit relationship between continuous improvement programs and management accounting information. In addition, the case study investigates the individual firms' assessment of their continuous improvement performance. Specifically, various measures used to assess continuous improvement performance by the case study firm are examined. Also, the reliability of these measures for assessment of the achievement of continuous improvement goals is investigated by comparing the firms' assessments of their internal performance to alternative normative performance measures.

2.3.2 Management Accounting Information System

Changes in the management accounting system-- The prior research described in the above review of the literature consists of point-in-time studies of the continuous improvement-information-performance relationship. These results describe the conditions that were present during the time of the study. They are limited in that they provide only the means to make inferences about whether the adoption of continuous improvement had actually caused any changes to be made in the management accounting information system, and whether the changes in information had any impact on the resulting improvements in performance.

Other interesting analyses of the continuous improvement-management accounting information-performance issue would address questions about the causal relationship (Otley [1980]). Specifically, this study used the longitudinal case study approach to investigate whether the adoption of continuous improvement has any impact upon the types of information that are provided by the management accounting information system. The results provide insight

into the role of management accounting in the support of the continuous improvement effort.

The uses of management accounting information-- There are three separate information issues to examine: (1) information that is desired; (2) information that is provided by the management accounting information system; and (3) information that is used. Banker, Potter and Schroeder [1993] examined the information provided issue. They investigated whether firms were providing information to lower level workers. Daniel and Reitsperger [1991] and Abernathy and Lillis [1995] examined the information demand issues. However, none of these studies investigated the information provided and demand issues as they relate to the uses of information.

This study addressed each of the three information issues. The cross-sectional study investigated which types of operations information were provided by the management accounting information system in addition to how the information was being used for operation improvement. The case study examined all three issues by investigating the changes that have taken place in the management accounting information system that are needed to support continuous

improvement. Also, the information demand and use issues were investigated by surveying the users of information.

CHAPTER III

FRAMEWORK, HYPOTHESES AND RESEARCH QUESTIONS

This chapter develops the contingency theory-based framework that is used in the study. Figure 3.1 provides a representation of the framework. Section 3.1 explains the goals and objectives of continuous improvement and several of the individual continuous improvement programs. Section 3.2 discusses the impact that the adoption of continuous improvement programs should have on internal performance. Section 3.3 discusses the influence that the adoption of continuous improvement has on the demand for information. Section 3.4 provides a discussion about the impact that information has on the achievement of continuous improvement goals. The hypotheses to be tested with the cross-sectional study are explained in Section 3.5. Section 3.6 discusses the research questions that are addressed by the case study.

3.1 Continuous Improvement Strategies

The goal[12] of continuous improvement programs is the elimination of *waste* in operations (Turney and Reeve [1990]). A working definition of waste is any activity[13] or process[14] that does not contribute to the achievement of any of the firm's objectives. The elimination of waste in operations is desirable for two reasons. First, the elimination of waste in operations provides the means to achieve an operation that is more controllable and therefore responsive to the achievement of the firm's competitive

[12]Two terms that may appear to be used interchangeably are *goals* and *objectives*. Objectives are general descriptions of the firm's mission. Goals are individual projects whose outcomes can be measured. Specifically, the objective of continuous improvement firms is to provide high quality products at competitive prices by finding ways to improve the processes and activities of the operation to make them more dependable and efficient. The continuous improvement programs support the firm's objective by helping it to achieve the operation improvement goals.

[13]Activities are items of work. Examples are machining and assembling parts.

[14]A processes is a sequential sets of activities that provides an output or outcome that fulfills an objective (Booth [1995]).

objectives[15] (Turney and Reeve [1990] and Nolan and Provost [1990]). Current thinking is that firms are more able to fulfil their objectives when they stop wasting time and effort on activities that do not serve those objectives. Second, the elimination of waste is an indirect method of cost reduction. When waste activities are identified and eliminated the associated costs also are eliminated (Letza and Gadd [1994]).

The waste elimination efforts of continuous improvement programs focus upon the reduction of inefficiencies that are contained in *processes* and poor *quality of conformance*. Several continuous improvement programs are concerned with either process improvement or increasing quality of conformance. Other continuous improvement programs take more comprehensive views of operation improvement by focusing on both process improvement and quality of conformance. Finally, there is a continuous improvement program called *employee empowerment*. It is the practice of actively encouraging employees to

[15]Competitive firms are generally concerned with providing good customer service, which includes selling high quality products at competitive prices.

become involved in the continuous improvement effort.

Process Improvement Programs-- Processes are series of activities or functions that the firm must perform to provide goods and services to its customers[16](Burkett [1995], McNair [1990],Turney and Reeve [1990]] and Wruck and Jensen [1994]). The continuous improvement program, *re-engineering*, is used to make processes faster and less expensive by simplification. Processes targeted for re-engineering are analyzed to identify and find ways to eliminate non-essential or waste activities (Hammer [1990] Hammer and Champy [1993], and Roberts [1994]).

Another continuous improvement process improvement program that is used to reduce waste in processes is *benchmarking*. A firm benchmarks by modeling certain of its processes after best practices[17] processes. Benchmarking has three basic steps. First, the current state of the

[16]For example, production runs of individual products or order processing.

[17]Best practices are processes or functions used by competitor or non-competitor firms that are widely believed to be worthy to be copied (Bemowski [1991] and McNair and Leibfried [1992]).

process to be benchmarked is examined. Its weaknesses and the inter-dependencies that exist between it and other processes are then identified. Next, a field study at the selected firm to examine the best practice process is performed. A plan is formulated to implement a best practices process that takes into consideration the benchmarking firm's specific needs and inter-dependencies. Finally, the modified best practices process is developed and implemented (Bemowski [1991], Whiting [1991] and McNair and Leibfried [1992]).

Quality of conformance programs-- Quality of conformance is the degree to which an output[18] meets its design specifications. There are many continuous improvement programs that are concerned with the goal of improving quality of conformance. One example of a continuous improvement quality of conformance strategy is *zero defects*. Under zero defects mistakes are corrected when they occur during the production process by workers.

[18]Outputs are defined as any intermediate or final goods or services.

This increases the probability that the final output will be defect free (Daniel and Reitsperger [1991]).

Comprehensive improvement programs-- Other continuous improvement programs attack both waste in processes and poor quality of conformance. The goal of the *robust quality model* is to determine ways to produce output that conforms very closely to product design specifications. This is accomplished by paying attention to quality of conformance issues during the initial stages of product development and process design (Taguchi and Clausing [1990]). *Quality circles* are teams of lower level workers who meet regularly to solve production problems and to brainstorm about new ways to improve the operation (Bowles and Hammond [1991] and Wruck and Jensen [1994]). The *value engineering* and *value analysis*[19] programs are integrated approaches to product and process design (McDowell [1994]). Value engineering and value analysis (McDowell [1994]) concentrate on product development and re-development using essentially the same

[19] Value engineering focuses upon the initial stages of new product development and value analysis is used to improve the process and design of already existing products (McDowell [1994]).

procedures as the robust quality model uses for product and process design. These programs use cross-functional teams of design engineers, and marketing and production personnel to select the most efficient combination of product attributes and production processes so that the firm maintains a portfolio of products that are desirable to customers.

Employee Empowerment-- It is widely believed that success at continuous improvement depends upon cooperation from employees (Bowles and Hammond [1991], Juran [1989], and Wruck and Jensen [1994]). *Employee empowerment* is the popular term used for the employee relations approach that involves encouraging all employees to actively participate in the continuous improvement effort. The basic elements of employee empowerment are training, teamwork and decentralized decision making. Training includes communicating continuous improvement goals to employees to inform them about the firm's continuous improvement objectives and to explain to them the role that they play in the continuous improvement effort. Training in scientific

problem solving[20] and teamwork skills is also important to continuous improvement (Wruck and Jensen [1994]). Teamwork is very important to operation improvement, for example, *quality circles* are teams of lineworkers[21] that meet regularly to solve quality or other operation problems and to consider ways to improve the operation. Taguchi and Clausing [1990] describe how cross-functional teams composed of engineers are used in the simultaneous product and process design activities of the robust quality model. Finally, decentralized decision making is widely used in continuous improvement firms. In many cases workers are assigned their own small spheres of influence where they are given the power to make decisions guided only by the values prescribed by the firm's continuous improvement objective

[20]The method of scientific problem solving involves the formulation of theories and hypothesis testing. It can be used for process improvement and cost reduction (Wruck and Jensen [1994]).

[21] Lineworkers are laborers that are directly involved in turning raw materials and component parts into finished goods.

(Ettorre [1995], Wruck and Jensen [1994], Mefford [1989], Denton [1995], and Wellins and Murphy [1995]).

3.2 Continuous Improvement and Internal Performance

Operation improvement is measured on three dimensions: *productivity*, *efficiency*, and *quality* (Turney [1993]). Productivity is the level of efficiency of the use of inputs to make output. Efficiency is the speed at which goods are produced, and services are provided. Quality of goods or services is the level of acceptable output that is produced. Each of the continuous improvement programs that was discussed in Section 3.1 is concerned with making improvements in operations on one or more of these dimensions. For example, new product development and process design using the robust quality model should impact productivity, efficiency and quality performance. Also, the benchmarking of processes at world-class firms, will allow firms to improve a process or activity that will increase the productivity and/or efficiency of its operation.

3.3 The Impact of the Adoption of Continuous Improvement on Information Demand

The demand for information is affected by the adoption of continuous improvement in two ways: (1) the types of information that are needed; and (2) the distribution of information.

Types of information-- Information is most valuable to decision makers when it provides support for the firm's current goals and objectives (Kaplan and Cooper [1992]). The more traditional management accounting information systems are designed to support the more traditional goal of cost control. Traditional systems use the cost assignment methods that are required for external reporting. They provide reports on items such as price and usage variances for labor and materials. While this information is useful in the continuous improvement setting, it should be supplemented with information that provides support for the achievement of operation improvement goals. For example, process improvement planning and decision making that is used in benchmarking, re-engineering, value analysis, value engineering, and the robust quality model require disaggregated and detailed information about activities and

processes (Wruck and Jensen [1994] and Turney and Reeve [1990]). Detailed and dissaggregated information about operations is useful for understanding the cause and effect relationships in operations, which is necessary for proper identification of problems and opportunities for operation improvement (Daniel and Reitsperger [1991], McDowell [1994], and Thomas and Mackey [1994]). In addition, performance measures that are developed to measure the changes in productivity, efficiency and quality of operations are useful in the ongoing evaluation of the operation improvement effort.

Distribution of information-- In the continuous improvement setting information is used as a tool to promote employee understanding and participation in the firm's continuous improvement effort. The information is used to make the workers aware of the firm's operation improvement goals and to explain to them their role in the achievement of the goals. Information (i.e., communication of the firm's continuous improvement plans and goals, and internal performance reports) is also used by continuous improvement firms to promote ownership of the continuous improvement effort (Blanchard [1995]). In more traditional settings

information is closely controlled, the belief being that there is an adversarial relationship between management and workers and the less communication that passes between them the better. However, more progressive approaches to employee relations favor providing information to workers in order to create an atmosphere of trust and cooperation. In this more open environment workers are inspired to actively participate in the firm's continuous improvement efforts. In addition, what is generally considered to be proprietary information is useful to workers who participate in such operation improvement activities as quality circles (Banker, Potter and Schroeder [1993]).

3.4 The Use of Operation Information for Continuous Improvement

Information, in particular, operation information, that is provided by the management accounting information system supports the continuous improvement effort in several ways. First, operation information provides the means to identify actual opportunities for operation improvement. Traditional systems provide, for example, cost variance reports. Large unfavorable variances may indicate that operation problems

exist, but this information generally provides no insight into where the problems are, or what might be done to correct them whereas detailed operation information does. Second, performance measures that are developed using the firm's productivity, efficiency, and quality goals will provide the means to adequately monitor operation improvement projects, and to signal the need for adjustments in improvement plans. Finally, measuring performance in terms of productivity, efficiency, and quality has the advantage of directing workers toward these operation improvement goals. Managers and workers focus on improving the outcomes that the firm measures (Kaplan and Norton [1992]).

3.5 The Research Hypotheses

Sections 3.1 and 3.2 discussed the continuous improvement programs and the ways that they are used to achieve the operation improvement goals. The programs focus on changing operations in such a way that they become more productive and/or efficient, and/or provide increased quality of conformance of the outputs. The adoption of these programs should have the desired effect of improving

internal performance. Therefore, the first hypothesis tested is stated as follows:

> **H_1 Internal performance is positively related to the implementation of continuous improvement programs (i.e., process improvement, quality of conformance, comprehensive, and employee empowerment programs).**

Sections 3.3 and 3.4 discussed the impact that the adoption of continuous improvement has on the demand for information and the way that the information supports continuous improvement. The information that is needed to pursue continuous improvement is information that provides insight into the operation, including information about the productivity and efficiency of processes, and the quality of outputs. Traditional management accounting information systems provide information about operation performance in relation to pre-determined standards (i.e., variances); however, this information provides little or no insight into the causes of operation problems or the areas in the operation where effective operation improvements might be made. It is expected that the operation improvement decisions that are made at firms that have management accounting information systems that provide operation

information in addition to, or instead of the more traditional management accounting information will be more effective in the improvement of operations than the operation improvement decisions that are made at firms whose management accounting systems do not provide operation information. Also, it is expected that the more effective operation improvement decisions made at these firms will result in greater improvements in internal performance than at firms where these decisions are made without this information. Therefore, the second hypothesis tested in this study is stated as follows:

> **H_2 Improvements in internal performance are positively related to information, and/or uses of information that support continuous improvement.**

3.6 The Research Questions

This study used the longitudinal case study approach at a continuous improvement firm to examine the research questions that were first presented in Chapter 1. First, many firms have adopted continuous improvement (Cheatham and Cheatham [1996]; however, there is still some confusion about whether continuous improvement is effective for

operation improvement (The Economist [1992]). This study investigated the changes in internal performance that occur after the adoption of continuous improvement by examining the behavior of two of the performance measures that are used by the firm to track its internal performance after the implementation of continuous improvement programs. The analysis was guided by the first research question, which is stated as follows:

> **Does the implementation of continuous improvement programs improve internal performance?**

Section 3.2 discusses the relevant measures of operation performance (i.e., productivity, quality and efficiency), and 3.3 discusses the use of traditional versus operation information in the evaluation of continuous improvement performance. This study examined alternative measures of internal performance to determine whether they are more useful in the evaluation of the firm's operation improvement performance. The investigation was guided by the following research question:

> **Are the measures that are used to assess continuous improvement performance consistent with the continuous improvement goals?**

Finally, Section 3.3 describes the desired impact that the adoption of continuous improvement should have on the firm's management accounting information system. It is expected that the adoption of continuous improvement should cause the firm to provide operation information in addition to, or in place of, other more traditional management accounting information in order to support its operation improvement goals. The investigation of the changes in the firm's management accounting information system was guided by the third research question, which is stated as follows:

> **How does the firm's management accounting information system change in response to the implementation of continuous improvement?**

Summary-- This chapter has explained the contingency theory-based framework that was used to address the three research questions that are addressed in this study. First, the framework, the constructs, and the relationships between them were described. Next, the hypotheses were developed. Finally, a discussion about the motivation for further inquiry into the research questions was provided.

CHAPTER IV

METHODOLOGY - CROSS-SECTIONAL STUDY

This chapter describes the data collection procedures that are used to test the hypotheses stated in Chapter 3. Data were collected by mail questionnaire survey. The prior contingency theory-management accounting information system literature provides support for this method of data collection (Ittner and Larcker [1995], Daniel and Reitsperger [1991], and Abernathy and Lillis [1995]). The major advantage of mail questionnaire surveys is that they give the researcher the ability to survey a large, diverse sample at a relatively low cost. Weaknesses of mail surveys have to do with low response rates that may lead to non-response bias. To mitigate the possibility of non-response bias in the current study, the recommendations for successful mail questionnaire surveys that are provided by Salant and Dillman [1994] were followed closely in the

design of the questionnaire, and the mailing procedures. This chapter is arranged as follows. Section 4.1 describes the sample selection. Section 4.2 describes the questionnaire, and the survey procedures that were used. The variables are discussed in Section 4.3.

4.1 Sample Selection

This study investigated the continuous improvement program implementation, and internal performance of manufacturing firms. Manufacturing firms were selected because they have a rich set of operation processes that are open to operation improvement efforts. Also, according to the findings of Powell [1995 pp. 22 and 23] service firms have less experience with continuous improvement adoption than manufacturing firms. Since the current study is concerned with examining the continuous improvement effort, the sampling will be limited to manufacturing firms, because there is a greater probability that the surveyed firms will have implemented continuous improvement.

The majority of contingency studies investigate the organizational structure-performance relationship at the strategic business unit level (Hofer [1975]). Strategic

business units (another appropriate term is division) are the semi-autonomous units of large- or medium-sized parent firms. At strategic business units there is limited variability in the products that are made, the production processes, and the managerial philosophies, which have a significant influence on the culture of the firm. These characteristics make strategic business units the appropriate sampling units for contingency studies because it is believed that the observed organizational structure variables will adequately describe conditions throughout the unit. In addition, the internal performance data that are used for the current study are normally collected at this level of operation.

The initial sample consisted of small publicly owned US manufacturing firms. Small manufacturing firms were sampled instead of strategic business units because the information that was needed for mailing the questionnaires was available on a computerized data base (i.e., Compact Disclosure). Strengths of this approach to sample selection include:(1) small manufacturing firms display many of the characteristics of strategic business units (i.e., consistency of application of the strategy, organizational

design, management accounting information, narrow range of products and processes); and (2) a sample of small firms would provide the variation within the sample that would facilitate an adequate analysis of the variables. There are two weaknesses of this method of sample selection. First, it is possible that small firms may not have adopted continuous improvement because it is quite time consuming and expensive. However, nineteen of the twenty firms that responded to the study, and several others that were contacted by telephone, indicated that they were involved in some way with continuous improvement. Second, small firms may be reluctant to provide internal performance information, which would have the effect of lowering the survey's response rate. This was the case in this sample of firms. Only three of thirteen responses from the sample of small firms provided the internal performance data that was requested.

The initial sample selection used three search terms. Manufacturing firms were selected using the primary SIC codes (i.e., the range between 2200 and 3999). Small size was defined as having between 800 and 1200 employees and between $10 and $100 million in sales. This search yielded

290 firms. Of this sample forty-seven firms had to be eliminated because the names of their controllers or treasurers were not provided.

After the first and second mailings to the initial sample, another sample, which consisted of thirty Oklahoma firms that had more than 500 employees was selected.[22] This sample was chosen for two reasons. First it was believed that surveying this sample would increase the survey's response rate because many of the surveyed firms' maintain affiliations with the University, and were expected to want to support its research (this sample had a 23.3% response rate (seven responses of thirty possible)). Second, the majority of the Oklahoma sample were strategic business units of large US firms. This sample was identified using the 1994 Oklahoma Manufacturers Register.

[22]Firms with five hundred employees were selected because using the same criteria that was used for the larger sample would have yielded a set of only 5 firms.

4.2 The Questionnaire and the Survey Procedures

The questionnaire has seven pages including the cover page. It was divided into five parts. There is one part for each of the four variables (i.e., continuous improvement strategy, employee empowerment, management accounting information and internal performance). The fifth part asked for background information about the firm. Early drafts of the questionnaire were pre-tested with the controller of the case study firm. The questionnaire is provided in Appendix A.

The initial mailings to both samples included a cover letter, the questionnaire, and a bulk mail return envelope. The envelopes and the cover letters were addressed to the controllers (or treasurers if no controller was listed for the US sample) of the potential respondent firms. Controllers and treasurers were selected as the ideal respondents because they are responsible for internal reporting and the measurement of internal performance. Also, they should be familiar with their firm's operation improvement efforts. Second mailings, and in some cases third mailings, which included a new cover letter, a

replacement questionnaire and a return envelope were made to the non-respondents.

4.3 The Variables

Four variables are used to examine the hypotheses. The questions that were asked in the questionnaire were controlled to model the expected lag that exists between implementation of continuous improvement and improvements in internal performance. Specifically, the independent variables, which are continuous improvement strategy, employee empowerment, and the characteristics of the management accounting information system, are measured for the years 1991 to 1994 and internal performance, the dependent variable, is measured for the years 1993, 1994 and 1995.

4.3.1 Continuous Improvement Programs and Internal Performance

The continuous improvement strategies and programs, which include employee empowerment, that are examined focus upon the achievement of quality, efficiency, and productivity goals. Continuous improvement performance was

measured using internal performance variables that correspond to the goals.

Continuous improvement programs-- The questionnaire provides a list of continuous improvement programs. This list was adopted from the lists used by Ferdows and DeMayer [1990] and Banker, Potter and Schroeder [1993], Abernathy and Lillis [1995], which were used to identify various operation improvement factors.

Each of the strategies was measured on two dimensions; (1) the emphasis that is being placed on the strategy, and (2) the average length of time since implementation of the individual continuous improvement programs. The respondents were asked to indicate the programs that were being pursued by their firms and the year (i.e., before 1991, 1991, 1992, 1993 or 1994) of their implementation. The emphasis upon continuous improvement was measured by the number of programs that had been implemented. Firms that have adopted more programs are believed to place more emphasis on continuous improvement. These firms should show greater improvements in internal performance than firms that have adopted fewer programs. This method of measuring the emphasis upon a strategy or goal was used by Ferdows and

DeMayer [1990]. Ferdows and DeMayer [1990] investigated the associations between operation goals, and the achievement of internal performance goals. A respondent firm was classified as pursuing a particular goal (i.e., product quality, cost reduction, operation flexibility, and the reduction in the product development times) when it had adopted the programs that focus upon achieving that particular goal.

The average time since implementation of each of the continuous improvement programs was used as an additional method of capturing the time lag effect. Firms that have been involved in continuous improvement for a longer period of time should show greater improvements in internal performance than firms that have been involved for a shorter time[23].

Employee empowerment-- Training, teamwork, and decentralization were used to measure employee empowerment.

[23]Powell [1995] investigated the differences between the correlations between subjective measures of total quality management performance and total quality management organizational structure variables in long (more than four years) and short term TQM firms. Long term TQM firms had nine out of twelve possible significant positive correlations, while the short term TQM firms had only four significant positive correlations.

To measure the levels of training, the respondents were asked to indicate the types of continuous improvement training that were being provided to management and non-management personnel[24]. The percentages of non-management and management personnel involved in team decision making were used to measure the teamwork dimension of employee empowerment. Decentralization was measured with four 1-7 Likert scale questions. Each of these organizational design attributes have been successfully measured in prior studies (i.e. training (Banker, Potter and Schroeder [1993]) and Ittner and Larcker [1995]), use of cross-functional teams (Banker, Potter and Schroeder [1993] and Abernathy and Lillis [1995]), and decentralization (Gordon and Narayanan [1984], Chenhall and Morris [1986] and Gul and Chia [1994]). Each factor was coded so that high values of the employee empowerment variable indicate a strong emphasis. The employee empowerment variable should be positively associated with improvements in internal performance because of the importance of employee participation in the

[24] Non-management personnel were defined as the employees that were directly involved in providing the firms' goods and services. Management personnel supervise the non-management personnel.

successful achievement of continuous improvement (Banker, Potter, and Schroeder [1993]).

Internal Performance-- Internal performance was measured with annual performance data. The measure of quality performance was the respondent's calculation of scrap costs. Scrap costs were defined as the cost of defective outputs. To assess efficiency performance the respondents were asked to provide the average throughput time for their firm's major product. Throughput time was defined for the respondents' as the time that it takes for raw materials and component parts to be converted to finished goods. Improved quality and efficiency performance are indicated by decreasing values of the performance measures.

Productivity performance was assessed using several commonly used measures of productivity. These measures were computed by the researcher using the raw internal performance data that were provided by the respondents. The measures and the equations used to compute them are provided in Table 4.1.

Evidence of improvements in productivity performance is obtained with increasing values of the performance measures.

Finally, to make the internal performance measures comparable within the sample, percentage changes between 1993 and 1994, and 1994 and 1995 were used in the analysis of the data and the hypothesis testing.

4.3.2 Management Accounting Information Systems

Two dimensions of the information variable were measured: the types of information that is provided by the management information system; and the uses that are made of the information. To measure the information provided dimension, respondents were asked to indicate which of the items on a list of operation-type information were provided by their firms' management accounting information systems. The list of operation information was compiled using the recommendations of Cooper [1988 and 1989], Kaplan and Cooper [1992], and Turney and Reeve [1990]. Each of these papers describes the types of information that are useful in the support of operation improvement.

The relationship between the achievement of operation improvement goals and operation information should be positive because the operations information supports the continuous improvement effort. The information variable was

coded so that more information provided indicated a more sophisticated management accounting information system. This method of the measurement of the sophistication of a management accounting information system has been used by Gul and Chia [p. 415 1994]. Gul and Chia [1994] investigated the associations between the non-financial and disaggregation attributes of the information that was provided by the respondent firms' management accounting information system and managerial performance.

The uses of information dimension of the information variable was measured by asking the respondents how the information was being used for operation improvement. The list of possible uses of information for operation improvement was compiled from recommendations for uses of information in the modern operation improvement program made by Turney [1993], Shepherd [1995], Letza and Gadd [1994], Pare [1993], and Johnson [1988]. Investigation of the uses that are made of information is important to the study of the impact that information has on the improvements in performance, because information must be used by decision makers in order to have an effect upon the achievement of goals and improvements in performance. However, no prior

study has examined the relationship between the use of information and improvements in performance.

Summary-- This chapter has explained the methodology that was used to perform the cross-sectional study. In Section 3.1, the sample selection procedures were described. In Section 3.2 the data collection methods using a mail questionnaire survey were discussed. Section 3.3 described the dependent variable, internal performance, and the independent variables: continuous improvement, employee empowerment, and information variables; and the methods that were used to measure them. Also, the predicted relationships between internal performance and the independent variables were provided.

CHAPTER V

METHODOLOGY - THE CASE STUDY

This chapter describes the methodology that is used to address the research questions. The research strategy and its appropriateness to the objective of the research question are discussed in Section 5.1. Section 5.2 discusses the typology of case studies and the rationale for the current study's use of the single site, holistic design. The case study site is described in Section 5.3. The data collection methods are outlined in Section 5.4. Finally, the data validity issues are discussed in Section 5.5.

5.1 The Research Strategy

The research questions deal with the examination of internal performance improvement within a continuous improvement setting, and the impact that the adoption of continuous improvement has upon the management accounting information system. The use of a methodology that consists

of gathering cross-sectional data and hypothesis testing was rejected for the following reason. Cross-sectional studies of the relationship examined in the literature review (Chapter 2) are investigations of the associations between organizational structure variables and performance at a point in time. The use of this methodology would not allow the examination of the changes in internal performance over time, and the causal relationships between the adoption of continuous improvement programs and changes in the management accounting information system that are directed by the research questions of this study as first stated in Chapter 1.

The research questions are addressed in this study using the longitudinal case study approach. Yin [1994 p. 13] defines a case study as the systematic examination of actual phenomena within a specified context. Case studies provide the means to address the "how" or "why" questions and to investigate causal relationships. In addition, Otley [1980] suggests that because the influence of management accounting information is very subtle and difficult to isolate and measure in event-type studies, contingency studies of the role of management accounting information on

firm performance should take a more longitudinal view of the objects of study. Taking a longitudinal view of the firm's continuous improvement experience would provide more information and provide the means to investigate the complex interrelationships that exist between the management accounting information systems and other organizational structure factors as they interact to impact firm performance.

Finally, the case study research program is appropriate when the researcher has little control over the events and outcomes that are being examined (Yin [1994] p. 8). This was certainly the case in the current study where the researcher could only take the role of an observer.

Recently the case study research approach has been identified as a viable research program for the study of management accounting issues (Bruns and Kaplan [1987]). Bruns and Kaplan [1987] describe the case study research program's role in the management accounting research as follows.

> Because management accounting information is created to, plan, coordinate, motivate, and evaluate activities of complex organizations, research in the field must start with an excellent understanding of the management accounting process in actual organizations...

> management accounting systems *must* be studied in the settings where they have been developed and where they function. (p. 1 and 2).

Three examples stand out as illustrations of case study research that has contributed significantly to the body of management accounting research. Kaplan and Cooper [1992] and Cooper [1988 and 1989] used case studies performed at manufacturing firms to generate the *activity based costing theory*. The *balanced scorecard approach*[25] was developed during the course of consulting assignments with firms that were revising their performance evaluation methods (Kaplan and Norton [1992]). More recently, Cooper [1994] used case studies of Japanese manufacturing firms to develop the theory of the *confrontation strategy*[26].

[25]The balanced scorecard is a method of performance evaluation that uses multiple measures of performance that are chosen in conjunction with the formulation of the objectives of the firm. It is useful to the achievement of the firm's objectives because it directs attention to the objectives and provides a means of direct measurement of the achievement of the objectives.

[26]Cooper [1994] used a multiple site case study to examine competitive behavior of Japanese firms. Confrontation strategy is a proactive competitive strategy that a firm may choose to adopt when it believes that it can gain a competitive advantage with the following criteria--product profitability and customer demand for product attributes and product quality. Cooper examined how the

5.2 The Typology of Case Studies

Yin provides a typology of the case study research designs and a methodology for the selection of the appropriate research design (Yin [1994] p. 38-44). Table 5.1 provides Yin's typology.

Case studies can be performed at multiple or single sites. The choice of a single site, or multiple sites has to do with the objectives of the research questions. The multiple-site case study research program is useful in the refinement of theory. It is analogous to performing multiple experiments using what is called *replication logic*[27] (Yin [1994] pp. 45-46). Replication logic is used as the basis for the selection of sample case study sites. Sites are selected because the researcher believes that they will produce results that are predicted by the theory being refined. The cases in which the theory was unable to correctly predict the outcomes present opportunities for the

case study firms made the decision to adopt the strategy and the methods that they used to pursue it.

[27]Replication of a case study is achieved when similar results are obtained at other case study sites using the same research program.

researcher to identify other relevant variables or relationships in order to refine the existing theory or to devise a new one.

Single site case studies are appropriate in studies when the research questions direct the study to the examination of phenomena and events that have taken place in a unique setting. Another reason to perform a single site case study is to test currently held beliefs or theory. This study used the single site case study design. The research questions deal with the examination of phenomena and events that take place in a unique setting. In particular the changes in the management accounting information system, and the changes in internal performance in a continuous improvement setting were investigated.

The choice between a holistic or embedded case study design is determined by the objectives of the research question. In some instances addressing the research question involves the examination of the discernable sub-units which are present at the case study site(s). This is the embedded design. An example of this approach is Selto, Renner and Young [1995]. That study examined the influence of continuous improvement organizational structure factors

on group performance of 31 of the manufacturing workgroups in an electronics firm. The holistic approach is appropriate when the research questions direct the study to take a more global view of the case study site. As discussed in the next section, the site examined for this study has taken a whole-facility approach to its continuous improvement effort. Therefore, this study used the holistic approach. The continuous improvement experience of the firm taken as a whole was examined.

5.3 Data Collection

5.3.1 Site Selection

The ideal research site is a manufacturing firm that has implemented continuous improvement for at least five years. The 5-year time constraint was set because of continuous improvement, and operation improvement's nature as long-term endeavors. It is more likely that changes in the management accounting system will have been made and that improvements in internal performance will have been

realized in a firm that has been involved in continuous improvement for at least 5 years[28].

The site that was chosen is a strategic business unit of a large manufacturer of marine motors. Initial contact was made by telephone with the controller of the firm. The firm readily agreed to participate in the study. Subsequently, three one-hour get-acquainted meetings were held. The content of the meetings included discussions about the firm's continuous improvement goals and practices, a plant tour and the viewing of a video which documented the firm's recent history. Additional structured interviews, archival evidence (i.e., annual reports, 10Ks, and newspaper and magazine articles), and the researcher's observations were used to get an understanding of the firm and to collect data to address the research questions. Internal performance data from the firm's records was provided by the firm, and the firm completed the questionnaire that was used in the cross-sectional study.

[28]Powell [1995] found that significantly more total quality management programs had been implemented in firms that had adopted continuous improvement for more than four years.

5.3.2 The Research Site

The research site (called the *firm*) is the subsidiary of a parent that specializes the manufacture of marine motors. The firm has approximately 1,000 employees. The non-management employees are not unionized. The current facility is located in the Southwest US. It began its operation in 1975. The organizational charts for the firm and its corporate and division parents are provided in Figures 5.1 and 5.2.

The parent of the firm is headquartered in the Great Lakes area. It began its operation in 1938. It employs over 7500 people at several subsidiaries that are located in various US locations and Canada. Each subsidiary is responsible for the manufacture, sale and service of its own line of marine motors. In 1961 a vertical merger was executed when the parent (hereafter called the *division*) of the firm was purchased by a much larger firm[29] (hereafter called the *corporate parent*). At that time of the purchase

[29]The corporate parent has three billion in sales and more than 20,000 employees.

the corporate parent was extensively diversified. It had four distinct divisions: technical, medical, recreation, and marine motors. It has since divested itself of the medical division and now concentrates its efforts on the manufacture of recreational equipment (i.e., bowling, roller skating and golfing equipment), boats[30], boat motors, and camping equipment.

In 1995 the firm was promoted to strategic business unit status. The new status was conferred upon the firm to allow it to exercise more freedom of creativity and innovation in the design, manufacture and distribution of its products and to pursue its continuous improvement efforts. Its customer base consists of boat builders and marine dealerships. The firm maintains a large customer service department to provide service after the sale and replacement parts to its customers.

[30]In 1986 the corporate parent purchased two established boat manufacturing companies and developed two new ones of its own.

5.3.3 The Product and the Manufacturing Process

Marine motors have two parts. The engine, which provides power, and the sterndrive. The sterndrive directs the power, propelling and steering the boat. Each of the two parts of the motor is assembled, packed and shipped separately. The two parts are put together when the motor is installed in a boat. The firm is currently producing more than fifty models of marine motors that are combinations of thirty-one models of engines and six models of sterndrives[31].

The manufacture of engines and sterndrives is essentially an assembly process. This facility uses a *flow* process, small batches of each model are produced every day. Figure 5.3 provides a diagram of the manufacturing area.

Many of the component parts used in the assembly process are aluminum castings that are produced in-house in the *diecast* department. In this department, batches of

[31]The firm is heavily involved in research and development. It is responsible for many of the innovations that have been made in the boat motor industry. It has also developed the aluminum alloy used in its in-house casting and a special priming-painting procedure used for corrosion protection.

castings are made in casting machines using a firm-developed aluminum alloy and pre-formed molds. Most of the completed castings are cleaned and then finished in the *machining* department. In many cases the completed parts are painted before they are assembled[32]. Component parts are also purchased from outside suppliers. In the receiving department incoming component parts are received, inspected and bar-coded. They are then sent to the inventory warehouse. Finished goods and component parts that are produced in-house are also stored in the inventory warehouse. Most of the departments are connected by automated material handling systems and self-guided cars that are controlled by bar codes. Forklifts and forklift drivers are used to move materials that are not handled automatically.

5.3.4 Continuous Improvement

Continuous Improvement-- In 1990 the entire corporation adopted continuous improvement after consulting with Motorola, the first Malcolm Baldrige award winner. The

[32]Painting is important to waterproofing and to preventing corrosion.

driving motivation for the adoption of continuous improvement at the division level arose out of its desire to focus upon increasing its financial performance by increasing customer service and improving the firm's products. At the time of the implementation of continuous improvement the division believed that it was weak in these areas.

In addition, at the time of the corporate-wide implementation of continuous improvement this firm and its sister subsidiaries were suffering from depressed sales, a holdover from the 80s recession. Also, demand for their product had decreased because of the luxury tax that was being levied on recreational boats. The firm realized the need to produce a product that was reasonably priced and high quality enough to induce people to make purchases in spite of the economy and the taxes.

Yet another motivation for the adoption of continuous improvement involves the enactment by the Environmental Protection Agency of new, very strict emissions regulations for marine engines. These regulations take effect in 1997. While compliance with them leads to the production of motors that are more desirable to the customer, the manufacturing

costs, which affect the selling prices of the motors, increase. To reduce those costs not affected by the emissions regulations, the firm believes that the reduction of operating costs by the use of continuous improvement methods is the most appropriate strategy for it to take.

Employee empowerment-- In accordance with the continuous improvement philosophy the firm involves its employees in its continuous improvement effort. Training in teamwork skills and scientific problem solving is being provided to both management and non-management personnel. About 30% of management and non-management personnel are involved in teamwork efforts to develop operation and process improvement ideas. In addition, the use of teamwork is promoted at the corporate level. A corporate-wide program has been implemented that is used to exchange operation improvement ideas among divisions. The program involves friendly competition within and among the divisions. Teams from each division compete to present their operation improvement ideas to a corporate quality committee. The selection process proceeds as follows. At the individual firm level, teams of workers submit documentation of their operation improvement projects to

their facility's quality director[33]. Teams present to the production staff, which chooses the team or teams that it would like to have represent the firm at the division level. Since the projects have already been implemented at the firm and are considered to be successfully contributing to the firm's continuous improvement effort, the selection of the *best* presentations has to do with teamwork, project selection, the analysis techniques and remedies that were used, the results of the project, its internalization, and the presentation. The selection process is then repeated at the division level and the smaller set of best presentations continue on to present to the corporate continuous improvement committee. In October 1996 two of the firm's teams were chosen at the division level to represent the division at the corporate competition to be held later in 1996[34].

Finally, the firm pays bonuses to the employees on a scale that is based upon the achievement of the firm's

[33]At this point, each project has already been implemented at the team's facility.

[34]Two of the firm's teams presented at the corporate event in 1995.

predetermined quality, productivity, cost reduction and safety goals. Posters providing graphs which track operational performance and describe the terms of the bonuses are displayed prominently throughout the facility. This is done to keep the employees focused on the performance goals of the firm.

This firm represents an *extreme or unique case* for the study of continuous improvement implementation (Yin [1994 p.39-40]). It shows at least three of the characteristics of the continuous improvement philosophy. First, the continuous improvement effort has upper management support (Ittner and Larcker [1995]). Second, it concentrates on process improvement, rather than, for example cost reduction (Wruck and Jensen [1994]). Third, it has adopted the practice of employee empowerment (Banker Potter and Schroeder [1993]). Extreme cases provide the opportunity to observe the phenomena of interest because the researcher is sure that the particular phenomena are present at the site. In this situation, the firm displays the characteristics of a continuous improvement firm. It was expected that close inspection of the firm using the case study approach would

provide insight into the causal relationships between the adoption of continuous improvement and the demand for information that supports continuous improvement. It was also expected that the case study site would provide an opportunity to examine the improvements in internal performance that result from continuous improvement efforts because (1) it has been involved in continuous improvement for more than 5 years and has enough time to adjust, and (2) it has adopted many of the recommended continuous improvement policies and practices that are recommended for success at continuous improvement.

5.4 Data Collection

5.4.1 The Respondents

The primary face-to-face interview respondents for the study were the division controller and the manufacturing controller of the firm. The division controller has held that position for six years. He is responsible for the accounting function and financial reporting for the firm. He is also very actively involved in the continuous improvement effort. The manufacturing controller provides

financial support to the manufacturing and materials functions. Their duties make each of these individuals logical sources for information about the firm's continuous improvement efforts. In particular, the division controller is responsible for the information services function.

In addition, *users* of management accounting information were surveyed. The surveys were distributed by the controller with instructions from the researcher about potential respondents. Supervisors and managers of the manufacturing, marketing, inventory/purchasing, engineering functions, and human resources were surveyed. The respondents' titles and job descriptions are provided below.

The Production function--

1) The *director of manufacturing* oversees and directs all aspects of the manufacturing function. His/her duties include supervising production, budgeting, and implementing process improvements.

2) The *administrative assistant to the director of manufacturing* is responsible for monitoring the manufacturing function and providing updated information

about production and capital budgets to the director of manufacturing.

3) The *director of quality* is responsible for directing the firm's quality objectives.

4) The *production coordinator* is directly responsible for production scheduling and quality control.

5) The *coordinator of the diecast department* oversees the firm's casting operation, which includes production and quality control, cost containment, and worker safety.

6&7) Two *area managers* are in charge of the operation of designated areas within the manufacturing process.

8) The *safety and environmental control manager* is responsible for supervising the manufacturing and non-manufacturing support functions concerned with solid waste removal and hazardous waste treatment and control.

The Marketing function--

1) The *director of marketing* oversees all of the marketing activities.

2) The *marketing manager* in charge of the long range planning for the development of new foreign and domestic markets.

The Inventory/Purchasing function--

1) The *purchasing manager* is in charge of the purchase of all of the non-product related goods and services.

2) The *director of materials* is responsible for the purchase of the product related goods (i.e., raw materials and component parts) and services.

3) The *materials manager* is concerned with monitoring the consumption of raw materials and component parts that are used in production. He/she is also in charge of the materials component of production scheduling, raw materials inventory control and materials handling, and shipping and receiving.

4&5) Two *buyers* who deal directly with suppliers for raw materials procurement. They are also responsible for providing quality assurance for purchased goods.

6) The *finished goods inventory manager* is responsible for monitoring the internal movement of finished goods, and for tracking shipments to customers.

The Engineering function--

1) The *director of engineering* oversees product design and validation, and budgeting for the engineering function.

2) The *product design engineer* directs the product design teams. He/she also provides product design change support to the manufacturing function.

3) The *administrative assistant* to the director of product design engineering assists the director of engineering. He/she also provides the reports that are used by the design engineers.

4) The *quality engineer* supervises the product inspection lab. He/she collects and summarizes quality data for use in product quality improvement decisions.

5) The *product development manager* oversees the development and implementation of the firm's production plans. He/she is also concerned with new product development.

6) The *engineering group manager* is responsible for the management of the product development groups. He/she is responsible for the budgeting and cost control of the product development activities.

7) The *senior manufacturing engineer* provides engineering support to the machining function. He/she is also responsible for capital spending decisions for machines and for forecasting machine utilization.

The administrative function--

1) The human resources manager provides general administrative support for the personnel of the firm.

5.4.2 Data Collection Procedures

Data were collected by interviews, surveys, and from observation and archival sources. The actual data collection procedures followed a sequential process and the process consisted of the following five steps.

Step 1: Preliminary interviews were conducted with the controller and the manufacturing controller to gain and understanding of the site's continuous improvement activities, its accounting system and its employee practices. (A summary of the questions that were asked during the interviews are provided in Appendix B.)

Step 2: Internal performance data were provided by the firm. The data obtained were analyzed by plotting internal performance versus monthly time periods and calculating bivariate correlations between the time periods and internal performance.

Step 3: Questions about the changes in the management accounting information system were developed for the controller and other users of the information[35] (i.e., the information user survey). (These questions are provided Appendix C.)

Step 4: Three follow-up interviews with the primary respondent were conducted to discuss the questions developed in Step #3 and to distribute the user surveys.

Step 5: The information user surveys were given to the controller for distribution to the potential respondents to the survey.

[35]The information user survey that was initially prepared by the researcher was edited by the division controller and the manufacturing controller. They changed some of the original wording so that it would by more familiar to the respondents. For example, the term, *accounting information system* was changed to the *information system*. Also, in one question the word *information* was changed to *reports and information* because the users are more familiar with the act of receiving reports about their performance. Finally, *continuous improvement* is changed to *the improvement process*. This is the phrase that is used at the firm to describe its continuous improvement effort. These processes are described in Chapter VII, which provides the results of the case study.

5.5 Quality of Research Issues

The quality of research is judged by the tests of validity (i.e., construct, internal, external), and reliability. Yin [1994] provides overviews of the four tests and offers suggestions about the ways that the threats to each of the tests can be addressed by the design of the case study research program.

Construct validity-- Construct validity is concerned with the proper specification and measurement of the study's constructs. The greatest threat to construct validity in case study research occurs because of the exploratory nature of case studies, which means that many of the constructs cannot be operationalized in advance. The resulting specifications of the constructs may lack credibility because it may appear to the reader that the constructs are only the subjective judgements or observations of the researcher rather than clearly defined, objective, measurable variables. Yin [1994] suggests several approaches to data collection which help to mitigate the threats to construct validity. The ones used by this study are *triangulation* and soliciting the input from *key*

informants. Triangulation involves gathering evidence about the same phenomenon or outcome from more than one source. For the current study, questions about changes in the management accounting information system are asked to both the controller (i.e., the information provider) and the users of information. This method of examination provides a comprehensive view of the demand and use of information that is needed to support continuous improvement. Also, it mitigates the effects of *researcher bias*. Researcher bias occurs when the researcher unintentionally endeavors to find support for his or her pre-conceived conclusions (Eisenhardt [1989] p. 546).

Key informants (i.e., a subset of case study interviewees) reviewed the researcher's findings. In their review of the case study findings, they notice and point out any misconceptions or mistakes that the researcher made in her interpretation of the data. The primary respondent reviewed the writeup of the study results.

Internal validity-- Internal validity is a major concern of case studies. It is concerned with the correct identification of the causal relationship between the

independent and dependent variables (Yin [1994] p.35). Cause and effect relationships are not generally observable and so must be inferred. In order to strengthen the credibility of the inferences the researcher must address any threats to internal validity by ruling out all alternative explanations and by making sure that no spurious relationships exist. In the current study the major threat to internal validity occurs in the relationship between continuous improvement efforts and improvements in internal performance. Other possible factors (i.e., uncertainty of supply, changes in product mix, engineering changes in product designs, union activity at other firms that adversely affects the attitudes of the firm's workers toward their particular work situations, etc.) that could affect internal performance were explored in order to make a distinction between the changes in internal performance due to the continuous improvement effort and changes in internal performance due to other factors.

External validity-- The external validity of a study has to do with the generalizability of its results to other situations (Yin [1994] p. 35-36). Taken individually, case studies have little external validity because by their

objectives and design these studies are context specific. However, detailed descriptions of the case study site's operation provide information that should be useful to other firms that have similar circumstances and face similar problems (Bruns and Kaplan [1987] p. 6).

Reliability-- Reliability refers to the degree to which the study is repeatable. A study is repeatable when the documentation of the data collection procedures provided is detailed enough to allow another researcher to perform the same study at the same site and arrive at the same conclusions. The reliability of a study gives its results credibility because the documentation and description of the procedures serves to minimize the possibilities of errors in interpretations and researcher bias. The primary objectives of this chapter are to provide the rationale for the case study research process and explanations of the procedures that were followed to make the study repeatable.

Bruns and Kaplan [1987] discuss two additional factors for judging the quality of case or field study research in management accounting in particular-- choice of subject matter, and practicality of the results. They write:

> A good research question [suitable for the case study method] has significance to the community of users of the research and/or makes a significant contribution to the explanation of the uses of management accounting information, demands for information, or the effects that management accounting information has upon management issues. The choice of subject is particularly useful when the analysis is of phenomena associated with management issues that have not been previously described or explained (pp.5-6).

This study makes an attempt to identify a connection between changes in the management accounting information system, and improvements in internal performance in a continuous improvement setting. To date very little evidence has been collected about this relationship.

Summary-- This chapter provided a discussion of the means by which the research questions were addressed. Case study research, including, its strengths, types and its appropriateness to this part of the study were discussed. A description of the research site, the respondents, and the methods of data collection were provided. Finally, the attributes of quality case and field studies in management accounting research were discussed.

CHAPTER VI

RESULTS OF THE CROSS-SECTIONAL STUDY

This chapter presents the results of the cross-sectional study. Non-parametric bivariate correlations were used to test the hypotheses. The tests provide limited support for the hypothesized relationship between internal performance and the continuous improvement programs. In addition, a comparison was made between individual firms to further examine the relationship between information and internal performance. The results show that firms that provide more information show greater improvements in internal performance than the firms that provide less information. Section 6.1 describes the mail questionnaire survey and the response. Section 6.2 provides a summary analysis of the data that were obtained from the questionnaire. Section 6.3 provides the results of the tests of the hypotheses.

6.1 The Mail Survey Response

In total two hundred seventy-three firms were included in the initial mailing. Six of the mailings were returned by the post office, as these firms no longer existed. One firm wrote to say that it had gone into liquidation. Three potential respondents declined to participate. Twenty questionnaires were returned. This is a response rate of 7.6% (20/263). The most likely reason for this low response rate is the request that was made for internal performance data. In many cases this information is viewed as proprietary by firms and is not generally released to outsiders. Also, it may have been difficult for the respondents to easily obtain the information since data from past operating periods (i.e., 1993-1995) was requested. These possible reasons for the low response rate are supported by the fact that six of the respondents indicated on the questionnaires that they could not provide the information because it was either proprietary or not available to them. In addition, one firm provided internal performance information for only 1994 and 1995. The information provided on this questionnaire could not be used

in the data analysis. The inconsistent samples (i.e., 6 firms for 1993-1994 and 7 firms for 1994-1995) could not be used to make comparisons between the changes in 1993-1994 and 1994-1995 performance. Consequently, six of the twenty responses were usable for the study's statistical analyses.

Non-response bias-- Non-response bias occurs when the individuals who respond to the survey display certain characteristics that are unrelated to the research question that skew the data and the results of the study (Salant and Dillman [1994] pp. 20-21). It can be expected that the firms that responded to the mail survey have had some success with continuous improvement, and feel comfortable with discussing their experiences, while non-respondents have had either no experience, or no success with operation improvement programs and would rather not discuss their experiences. If this scenario actually describes the sample, the results would be skewed toward positive relationships between the independent variables and internal performance because of the sample firms' strong emphasis on continuous improvement and the fact that they have obtained improvements in internal performance. To explore this possibility, several of the firms that did not respond were

contacted by telephone. Each of these firms indicated that at least some aspects of continuous improvement were being successfully pursued at their facility[36]. Therefore, it can be assumed that a significant portion of the sample, which includes both those firms that responded and those that did not, was involved in some way with continuous improvement. This leads to the conclusion that the involvement in continuous improvement was not a differentiating factor between responding and non-responding firms.

Finally, the possibility of non-response bias toward positive outcomes was investigated by examining the industry distributions of the sample and the set of usable responses. It is possible that the characteristics of certain industries (i.e. innovative industries like electronics) may be more open to the modern operation program of continuous improvement, which would cause the firms of these industries to have a greater response rate than the other industries that are not so heavily involved in the modern operation program because they are happy to discuss their experience.

[36]Several of the firms that were contacted said that there was a company policy not to respond to questionnaire surveys of the type used for this study.

Table 6.1 provides a comparison by industry groupings of the response to the survey.

The table shows that only two industry groups- metals and electronics[37], are represented in the usable sample. Further analysis of the responding firms, showed that they are involved in either the production of transportation equipment or the production of electronic machinery. The concentration in these two business areas limits the generalizability of the study's results to these particular manufacturing business types.

6.2 Analysis of the Data

6.2.1 Characteristics of the Responding Firms

The median number of products or product lines produced by the sample of firms is 10. One firm produces only two products and another produces 50. The majority of firms devotes at least 75% of their manufacturing facilities to the production of the major products. Also, each firm

[37]Textiles (two firms) and rubber, leather, and stone and clay (one firm) also responded; however they were not included in the six-firm sample because they did not provide internal performance information.

holds at least 50% of the market share for its major product. The length of time that each facility has been in operation ranges from 7 to 33 years (median 21 years). Only two firms are unionized (25% of the workforce). Four of the six firms use standard costing. Two firms use target costing and two other firms use activity based costing in addition to standard costing. Two of the firms were not using any of these three costing systems.

6.2.2 Summary Analysis of the Independent Variables

This section discusses the characteristics of each of the independent variables that were described in Section 4.3. Table 6.2 provides summary statistics of the independent variables. Table 6.3 provides the raw data that were obtained from each of the six firms for each of the independent variables.

Number of continuous improvement programs-- This variable measures the emphasis that is placed on continuous improvement by each firm. It is measured by the number of programs that the responding firm has implemented. It is assumed that the more emphasis that is placed on continuous

improvement by the firm, the greater the impact on improvements in internal performance. Refer to Table 6.2. The number of continuous improvement programs ranged between 15 and 1 (out of a possible 15). The median number of programs that were implemented was 10. Table 6.4 provides a list of categories of programs that are relevant to the continuous improvement philosophy: employee empowerment/teamwork, quality, process-product design, programs to increase efficiency and productivity, and the average number of firms that are involved in each category of program.

Table 6.4 shows that the firms are most heavily involved in programs that involve employee empowerment practices; of three possible employee empowerment programs (i.e., quality circles, cell manufacture and just-in-time) three firms have adopted three, and two firms have adopted two. Quality programs are the next most widely adopted; of the two possible quality programs (i.e., zero defects and statistical process control) three firms have adopted both programs and two firms have adopted one. Less emphasis by the sample firms has been placed on programs that are used to improve product/process design (i.e., value engineering,

value analysis, robust quality model, computer aided design) and efficiency and productivity (i.e., benchmarking, re-engineering, programs to reduce setup times or cycle times, vendor lead time reduction, outside linking). Three firms adopted three of the four possible process/product design programs and two firms adopted six of the six productivity and efficiency programs.

Time since implementation of the continuous improvement programs-- This variable measures the length of time that the firms have been involved in continuous improvement. It was measured by taking the average of the total number of years since the firms' implementation of individual continuous improvement programs. It is assumed that the longer a firm has been involved in continuous improvement the greater the chances that the program will have had a positive impact on internal performance. The continuous improvement survey questions asked about program implementation that occurred before 1991 and during 1991, 1992, 1993, and 1994. Table 6.5 provides a summary of the implementation dates of the firm's continuous improvement program adoption.

Three of the firms have staggered the adoption of the continuous improvement programs that they have implemented. One of the firms indicated that all of the programs that were being used at its facility were implemented before 1991. One firm did not become involved in continuous improvement until 1994.

Employee empowerment-- Employee empowerment includes providing training, using teamwork and delegating decision making authority to lower level workers. These employee practices are suggested by the current literature as a means to encourage employees to participate in the firm's continuous improvement effort. Therefore, it is assumed that higher levels of employee empowerment are associated with greater improvements in internal performance. The employee empowerment variable was measured with the sum of the scores of the components of the variable. Table 6.6 provides the coding procedure that was used to measure the employee empowerment variable, and Table 6.7 provides the scores that were earned by each firm.

The training component of employee empowerment was measured by asking the respondents to indicate which types of training programs (i.e., the firm's quality principles,

scientific problem solving and teamwork skills) were provided to its employees. At the minimum, each of the firms provided training in the firm's quality principles to its employees. Teamwork was measured by the percentage of management and non-management personnel that had been involved in team decision making. All but one (ob #6) of the firms provided training in team decision-making skills and scientific problem solving. Also, in traditional settings, management personnel participate to some degree in team decision making (i.e., meetings); however, in continuous improvement, non-management personnel are included in team decision making because they have direct knowledge of the operation, and they are responsible for carrying out the operation improvement plans (Banker, Potter and Schroeder [1993] and Wruck and Jensen [1994]). One firm (ob #2) involves a higher percentage of its non-management personnel in teamwork activities, while three firms (obs #4, #5 and #6) have higher percentages of management personnel involved in teamwork. Two firms (obs #1 and #3) have equal percentages of management and non-management personnel that are involved in teamwork.

Decision making was used to measure the degree to which the firms have given decision making rights to non-management personnel. The two highest scoring firms (obs #3 and #5) each scored 5 or more (on a 7-point Likert scale - large scores mean a greater degree of employee empowerment) on questions about giving employees wider ranges of job responsibilities (i.e., responsibility for quality control and wide ranges of job responsibilities). However, only observation #3 scored higher than a 3 on the question about giving non-management employees greater operating decision making power.

Information provided by the management accounting information system-- This variable is used to determine the amount of information that is provided by the sample firms' management accounting information systems that is useful for operation improvement decision making, such as quality performance information, process information, customer information, and information sharing among functions. It is expected that when the firm's decision makers have access to operation information, they are more informed about the details of the operation. This will facilitate more effective operation improvement decisions and planning,

which will support the firm's achievement of its operation improvement goals. Table 6.8 provides a summary by the information categories (i.e., quality, process, customer and information sharing) of the information provided variable and Table 6.9 provides the responses of the six firms.

Four of the firms' management accounting information systems provide information about processes and operations (i.e., cycle times, downtime, process by activity, excess capacity). Process and operation information is important to operation improvement because it provides opportunities to identify the places where operations can be improved and the means to monitor changes in performance due to the changes that are made (Thomas and Mackay [1994]). All six of the firms' management accounting information systems provide unit-based (i.e., scrap rates, rework rates and defect rates) and cost of quality information. This information is important both as an operation improvement goal directing tool, and as a means of monitoring quality performance. Five of the firms indicated that information sharing among functions is practiced within the firm. Finally, only one of the firms' management accounting information systems provides information about customer

costs and activities. Information about customers, and customer service and costs are important to the continuous improvement effort because the ultimate goal of continuous improvement is to improve customer service (Kaplan and Norton [1992]).

Information uses-- The information use variable is used to assess how the information that is provided by the management accounting information system is used by the decision makers to make operation improvement decisions. It is expected that firms that have recognized the need to use information about operations to make operation improvement decisions will show greater improvements in internal performance than firms that do not (Daniel and Reitsperger [1991]).

To measure this variable the respondents were asked whether information was used to pursue six operation improvement processes. Table 6.10 provides the responses that were obtained for the information use variable from each firm.

Five of the firms use the information provided by the management accounting information system for process design,

process re-design and cost reduction. Only two firms use information for product design; however four firms use information for product re-design. One firm (ob #6) is not currently using information for any of the six purposes.

6.2.3 Summary of the Dependent Variables

Each of the six firms provided incomplete performance information. This means that each of the hypotheses was tested with less than six observations. Percentage changes in the internal performance variables are used in the statistical analysis. They are calculated using the following equation.

$$\frac{Y_{ix} - Y_{iy}}{Y_{iy}}$$

Here

i = 1-5 - labor productivity, cost of goods manufactured productivity, manufacturing overhead productivity, efficiency and quality performance.

and

x and y = 1993 and 1994 or 1994 and 1995.

Productivity performance-- A list of the productivity measures and the equations that were used to calculate them was provided on Table 4.1. These productivity values were calculated by the researcher using the internal performance information that was provided by the questionnaire respondents. Improvements in productivity are evidenced by increasing positive values of the percentage changes. Table 6.11 provides the values for productivity performance for the years 1993-1995 for each of the firms that provided the information that was needed to calculate the productivity measures.

The sample firms show mixed results for productivity performance. Panel A of Table 6.11 provides the labor hour productivity (Y1) values that were calculated using the equation[38]. Panel A1 provides the percentage changes for the time periods 1993 to 1994 and 1994 to 1995. Only one

$$\frac{Y_{ix} - Y_{iy}}{Y_{ix}}$$

[38]Here i= 1-5 for labor productivity, cost of goods manufactured productivity, manufacturing overhead productivity, efficiency, and quality performance
and
x and y = 1993-1994 and 1994-1995.

firm (observation #5) shows positive changes for both time periods; however the magnitude of the change in labor hour productivity for the 1994 to 1995 time period is smaller than the change from 1993 to 1994. The other two firms (observations #1 and #4) show decreases in labor hour productivity. Labor hour productivity is perhaps the most reliable measure of productivity because it is a purely non-financial measure and cannot be confounded by the inevitable changes in labor costs.

Panel B of Table 6.11 provides the cost of goods manufactured productivity measures (Y2). Panel B1 provides the changes in cost of goods manufactured productivity for the time periods 1993 to 1994 and 1994 to 1995. One firm (observation #2) showed significant increase in labor hour productivity (from .7% to 14.07%). In addition, observation #5 showed positive changes (56% to 1.9%), while observation #4 showed a positive change followed by a negative change. Observation #1 shows deteriorating cost of goods manufactured productivity (-.7% to -2.5%).

Panel C provides the measures of manufacturing overhead productivity (Y3). Panel C1 provides the percentage changes in manufacturing overhead productivity for the time periods 1993 to 1994 and 1994 to 1995. Observation #2 shows the greatest increase (from 7.29% to 29%), while observation #5 showed positive changes, and observation #4 shows a positive change followed by a negative change. Observation #1 shows a positive change followed by a negative change (12.9% to -6.6)

Observation #2 shows the most consistent improvements in productivity performance (increasing percentages for manufacturing and cost of goods sold productivity). This firm has implemented thirteen of the fifteen possible continuous improvement programs. Also, the majority of the programs (ten) were implemented after 1992.

Efficiency performance-- Efficiency performance is measured by the throughput time of the firm's major product. Throughput times were provided by the respondent firms. Decreasing values of throughput are evidence of increases in efficiency performance. In addition, it is a non-financial measure and therefore not susceptible to the effects of cost increases. Table 6.12 provides the values that were

supplied by the firms for throughput times of their major products (Panel A) and the percentage changes in these measures (Panel A1). The sample firms all show improvements in efficiency performance for the 1993-1995 period that range between 62.5% to 11.7%. However, the Industry Week "1996 Best Plants" award winners have shown an average of 50% improvements in a similar efficiency performance measure, *order-to-ship lead times* (Sheridan [1997]). Only one firm (ob # 5) showed an improvement in its efficiency performance (62.5%) that was comparable to that of the "Best Plants" firms.

Quality performance-- Quality performance is measured as the total cost of defective outputs (called *reject cost*) of the firm's major product[39]. Improvements in quality performance are evidenced by decreases in the total cost of rejected outputs. This measure is susceptible to measurement error because it is not completely clear to the researcher how the firms actually measured this cost, even though a definition of the variable was provided on the questionnaire. For example, the case study firm measures

[39]This definition of the quality measure was provided on the questionnaire.

its reject costs as the standard labor content of scrapped units. Other firms may have included materials and allocated overhead costs.

Table 6.13 provides the reject cost data that was provided by the firms (Panel A) and the percentage changes in reject costs for the periods 1993-1994 and 1994-1995 (Panel A1). Observation #3 shows the only consistent improvement in quality performance, quality costs decreased from 1215 to 760 to 560 thousand dollars (Panel A), which are improvements of 37.4% and 26%. Observation #1 shows an improvement in quality performance in the 1994-1995 period (Panel A1). There was a 39% increase in reject cost in the 1993-1994 period and a 4.8% decrease in reject cost in the 1994-1995 period.

6.3 The Test of the Hypotheses

The hypotheses investigate the relationships between the changes in the five performance measures for two time periods (1993-1994 and 1994-1995) and the continuous improvement, employee empowerment, and management accounting information variables.

Bivariate non-parametric *rank correlations* using the *T* statistic were used to test the hypotheses (Conover [1980] pp.252-255).

Rank correlations-- Rank correlations are used when the data provided by the sample are not normally distributed, which is the case in this sample. The univariate tests normality of the dependent and independent variables showed that none of them were normally distributed.

The underlying assumption of rank correlations is that the ranks of the observations of two correlated variables are similar. To perform the test, observations of each variable are ranked as directed by the hypothesis being tested. The T-statistic is calculated using the following equation.

$$T = \sum_{i=1}^{n} [R(X_i) - R(Y_i)]^2$$

Here $R(X_i)$ and $R(Y_i)$ are the ranks of each of the observations of the two variables that are being compared. Large values of T indicate dissimilar rankings, which means that the variables are not correlated in the manner stated by the hypothesis.

The values of the independent variables that were used to rank the observations were the values of the variables that were provided on Tables 6.2 and 6.3. The internal performance values that were used to determine the ranks in the statistical analysis are expressed as percentage changes in performance. These are the values that are reported on Tables 6.11, 6.12 and 6.13.

Test of Hypothesis 1-- Hypothesis 1 examines the relationships between internal performance and continuous improvement programs and employee empowerment. Hypothesis 1 is tested in two parts. In the first part, the associations between internal performance and the number of continuous improvement programs and the time since the implementation of the continuous improvement programs and internal performance are tested. The bivariate correlation results of the test are provided on Table 6.14. Neither the correlations between number of programs that were implemented, nor the time since implementation and the internal performance variables were significant.

In the second part, the association between employee empowerment and internal performance is tested. The results of the bivariate correlation tests are provided on Table

6.15. Employee empowerment is shown to be significantly correlated to cost of goods manufactured and manufacturing overhead productivity for the 1993-1994 period, but not the 1994-1995 period. Possible explanations for why employee empowerment not be significantly related to the two performance measures may have to do with the effects of rising costs that occurred during the 1994-1995 period that the firms were not able to mitigate with cost reducing operation improvements.

Test of Hypothesis 2-- Hypothesis 2 examines the relationship between management accounting information and internal performance. The results of the bivariate correlation analyses are provided in Table 6.16. No significant relationships were found.

Further analysis of the relationship between the information and internal performance variables-- A more detailed analysis of the impact of information on operation improvement was performed by comparing the changes in internal performance of high- and low- information score firms. Each firm provided incomplete internal performance data so one pair of firms was used to compare productivity performance, and another pair of firms was used to compare

quality and efficiency performance. Table 6.17 shows the pairs of firms that were compared on each performance measure. The information scores for each firm are also provided.

None of the firms that were compared in this analysis showed consistent changes in internal performance (i.e., increasing or decreasing) for the two periods (i.e., 1993-1994 and 1994 and 1995) that were examined in the tests of the hypotheses so the performance measures that were compared were the percentage changes for the entire period (i.e., 1993-1995). Comparing these percentage changes simplified the comparisons, which made the results easier to understand.

The percentage changes were calculated using the following equation.

$$\frac{Y_{i1995} - Y_{i1993}}{Y_{i1993}}$$

Here i = 1-5 - labor productivity, cost of goods manufactured productivity, manufacturing overhead productivity, efficiency and quality performance.

Table 6.18 provides the comparisons of the performance measures of the high information score firms to the low information score firms. The table shows that the high information firms out-performed the low information firms. In particular, on productivity performance (i.e, Y1, Y2, Y3), the high information firm showed increases in productivity performance, while the low information firm showed decreases in labor hour productivity and cost of goods manufactured productivity and only a relatively small (5.4% compared to the high information firm's change of 167.7%) increase in manufacturing overhead productivity. For efficiency performance (i.e., Y4), the high information firm showed a percentage increase in performance for the period of 41.5%, while the low information firm showed a smaller percentage increase of 25%. Finally, the high information firm showed a 53.9% percentage increase in quality performance (i.e. Y5), while the low information firm's quality performance deteriorated by 33%.

Summary-- Limited statistical support was obtained for the positive relationship between continuous improvement implementation and internal performance that was examined by

hypothesis 1. The results show a positive relationship between employee empowerment and internal performance.

In addition, the test for the positive relationship between information and internal performance that was examined by hypothesis 2 showed no significant relationships. However, further analysis of the information-internal performance relationship was performed by comparing individual firms that scored high and low on the information provided and information use variables. In each case the high information firms showed more favorable changes in internal performance than the low information firms. These results provide evidence that management accounting information does, indeed, positively impact internal performance. Future, studies will require many more observations than were used in the current study in order to adequately examine this relationship.

CHAPTER VII.

RESULTS OF THE CASE STUDY

This chapter discusses the results of the case study that was used to investigate the three research questions. The response to the information user survey is discussed in Section 7.1. The firm's continuous improvement processes are discussed in Section 7.2. Section 7.3 discusses the answers that were obtained for the first two research questions. The first research question **-Does the implementation of continuous improvement programs improve internal performance?-** was examined by analyzing two of the case study firm's plant-wide internal performance measures. The second research question **-Are the measures that are used to assess continuous improvement performance consistent with the continuous improvement goals?-** was answered by analyzing two other measures of plant-wide internal performance that are suggested by the case study firm's goals for operation improvement. Section 7.4 discusses the answers to the third

research question -**How does the management accounting information system change in response to the implementation of continuous improvement?** To answer this question, the information issues: information provided, information demand, and information use were investigated by surveying information users and by interviewing the controller of the case study firm.

7.1 Response to the Information User Survey

Fifty copies of the two-page information user survey were given to the controller of the firm with instructions to distribute them to managers of the marketing, inventory/purchasing, manufacturing, engineering and human resources functions. Forty-five questionnaires were distributed. Postage paid envelopes were also provided. Twenty-five questionnaires were returned. This is a response rate of 55% (25/45). Twenty-four of the questionnaires were useable. One questionnaire was returned with only one page. Table 7.1 provides a summary of the response to the information user survey by function. In addition, the actual number of managers for each function

are provided[40]. In all cases the response rates of the survey and actual distribution of managers are dissimilar. For example, the manufacturing response was 33% (8/24) compared to 47.7 (32/67) percent possible. A method of assessing bias in the response is to compare early and late responses for certain attributes that may impact the results (Do, Kim and Shim [1996]). The questionnaires were received by the researcher in two groups. The first group had nineteen[41] questionnaires and the second had six. The eighteen early responses were compared with the six later responses on: (1) the function of the respondents; and (2) the answers that were given to the information questions. No discernable differences between the two sets of responses were identified.

7.2 Continuous Improvement

The basic units of the firm's continuous improvement effort are called *continuous improvement processes*. These

[40]The total managers per function are estimates that were determined from the firm's list of cost center managers and cost center coordinators.

[41]One questionnaire was not usable.

processes are on-going projects that are administered by cross-functional teams or committees that are composed of management and non-management employees. Some of the firm's continuous improvement processes are described below.

(1) The bonus committee-- The bonus committee is responsible for administering the bonus program that was discussed in Section 5.3.4.

(2) Formal work projects-- The firm maintains permanent cross-functional teams of employees whose purposes are to solve various operation problems or to find ways to improve existing processes. *Ad hoc* problem solving committees are also used.

(3) The internal auditing function-- Internal auditing is a division-wide activity in which various management and non-management personnel are trained to provide performance auditing services to the other firms of the division. The internal audit activity provides a two-fold benefit to the firm. First, the firm benefits from having objective assessments of its continuous improvement projects by evaluators that will maintain confidentiality. Second, a

synergistic effect is obtained with the exchange of operation improvement ideas within the division.

(4) The product development process-- The product development process is concerned with product re-design and new product development. The team membership includes design engineers and an accounting support person that provides cost information.

(5) The material sourcing process-- This process is concerned with improving the firm's procurement function. For example, one of the materials sourcing processes that has recently been implemented simplifies small purchase procurement[42].

Table 7.2 provides a summary of the respondents' participation by their function in the continuous improvement processes that were described above. The table shows that the continuous improvement processes are cross-functional. For example, five engineers are involved in materials sourcing, and the two marketing managers are involved in product development.

[42]This team project will be discussed in Section 7.4.1.

Relevant input into the assessment of the firm's continuous improvement performance includes the respondents' perceptions of the usefulness of the firm's continuous improvement processes. Table 7.3 provides a summary of the respondents assessments of each process' role in the achievement of the firm's continuous improvement goals. The formal work projects, materials sourcing, and the bonus plan processes received the highest ratings (14, 12, and 11 significant influence ratings). This may be due to the fact that outcomes of these particular processes impact all employees of the firm. That is, all managers are concerned with receiving materials and supplies in a timely manner, and everyone is concerned with their bonuses. The product development and internal audit processes received the lowest ratings (a total of 16 and 14 minor or no influence ratings). The low ratings for these processes may have something to do with the inability of the respondents to see any direct positive outcomes that are connected with these processes.

Finally, thirteen of the information user survey respondents provided suggestions for ways in which the firm

could improve its approach to continuous improvement. Out of these suggestions four themes emerge.

(1) Focus-- Nine of the respondents recommended that the firm narrow its focus to a few (one respondent suggested six) well-specified projects. Along this same line of thinking, two respondents suggested that the firm lengthen its time frame for success and spend adequate amounts of time on a project before switching to other projects.

(2) Communication-- Two respondents expressed the need for more comprehensive publication of the firm's continuous improvement goals and objectives. Many of employees are not aware of the projects the are currently being pursued and of the projects that are in line to be implemented. Increased promotion of the firm's continuous improvement goals would facilitate ownership among the employees of the firm's continuous improvement effort because they would have more of an idea of what was happening.

(3) Accountability-- Four respondents suggested that the firm require continuous improvement teams to develop more reliable measures of their projects' performance. They

believe that it would increase the accountability for the success or failure of projects.

(4) Risk taking-- One respondent suggested that the firm take more decisive action and risks in its continuous improvement effort, in his/her words the firm should "start walking the talk."

7.3 Analysis of the Firm's Internal Performance

7.3.1 Measurement of Plant-Wide Performance

Two of the performance measures that the firm has used since before its adoption of continuous improvement are total plant hourly efficiency (TPHE), a productivity measure, and scrap labor dollars as a percentage of total labor dollars (SCRAP), a measure of quality. Table 7.4 provides the equations that are used by the firm to calculate each of the performance measures.

These two internal performance measures are traditional labor efficiency standard costing measures. Further discussion about the performance measures and the rationales that were given for using them are provided below.

Total Plant Hourly Efficiency (TPHE)-- TPHE is calculated by dividing the standard labor hours for good output by the actual labor hours used to produce good output. This traditional measure reflects the firm's emphasis on efficient labor utilization. According to the division controller this measure is used as both a means to direct the employees' efforts toward efficient labor utilization and for the assessment of continuous improvement performance.

Scrap Labor Dollars as a Percentage of Total Labor Hours (SCRAP)-- SCRAP is calculated by the standard labor cost of scrapped parts divided by standard labor cost of good output. According to the division controller, this performance measure is used to direct the workers' attention to searching for and correcting defects in the work in process as early in the production process as possible.

Use of TPHE and SCRAP at the plant level-- TPHE and SCRAP are calculated monthly at the cost center level. The information is provided to cost center managers and cost center coordinators as monthly variance reports (i.e.,

actual vs target[43] values of the performance measures) of TPHE and SCRAP on the particular cost centers that they direct. The variance reports are supposed to be used by the managers and coordinators to monitor their cost center's performance. The reports are also used to show the coordinators and managers how their cost center's performance impacts the performance of the whole plant.

7.3.2 Analysis of the Changes in TPHE and SCRAP

This sub-section provides the analysis of the data and answers to the first research question **-Does implementation of continuous improvement programs improve internal performance?** Figures 7.1, 7.2 and 7.3 provide plots of output, TPHE, SCRAP vs consecutive months for the time period that covers 1991 through 1996. Three items of interest emerge on examination of these plots. First, the output plot shows seasonality in its yearly production. TPHE also decreases at this time. The decrease in TPHE during the slow production times is probably the result of

[43]The target values are cost center targets that are determined by the bonus plan targets.

of its method of calculation. At these particular times there are fewer direct labor hours assigned to a decreased amount of good units of output. SCRAP also shows a decrease during low production times. One reason for this result is that there are probably fewer opportunities to make mistakes when fewer units are being produced. Other possible explanations for the decrease in SCRAP during the low production times include: (1) a change in the standard labor rate; (2) a change in the labor mix (i.e. inexperienced versus experienced workers) of the production force; and (3) change in the labor usage standards.

The other two items of interest have to do with behavior of TPHE and SCRAP. Figures 7.2 and 7.3 show that the variability of TPHE appears to have decreased during the time period, 1994 through 1996, and the variability of SCRAP appears to have increased. A decrease in the variability of these measures may indicate that the firm has been able to make its production process more stable. Stability in processes is desirable because it means that the firm has more control over its operation. This also means that it is easier to plan changes and to predict the effects of changes in the process outcomes when operations are improved (Nolan

and Provost [1990]). To investigate whether the variability of the performance measures did indeed change, Levene's test for the homogeneity of variances was performed. Levene's test compares the variances of two samples, in this case the periods - 1991 through 1993 and 1994 through 1996, by determining whether the variations around the means of the two samples are significantly different. Table 7.5 provides the results of the Levene's test. Neither of the internal performance measures shows a significant change in variability. The standard deviation of TPHE has decreased (from 3.5635 to 2.6135), which means that it is moving in the right direction. However, the variances of TPHE for the two time periods are not significantly different (p-value .7354). The standard deviation of SCRAP has increased (from .4214 to .4866), an undesirable change. However, the variances between the two periods are not significantly different (p-value .2185).

Finally, examination of Figures 7.2 and 7.3 shows that there have been no significant increases in productivity and quality performance as measured by TPHE and SCRAP for 1991 through 1996. However, the changes in the internal performance measures appear to be more favorable during 1994

through 1996. Figures 7.4 and 7.5 are plots of TPHE and SCRAP for the time periods 1991 through 1993, and 1994 through 1996. These plots show that TPHE has definitely moved to a higher range of values, while SCRAP has moved to a lower range of values in the 1994 through 1996 time period[44]. Bivariate correlations between TPHE and SCRAP, and the consecutive time periods were calculated to determine whether the internal performance as measured by these particular measures has improved. Table 7.6 provides the bivariate correlations between TPHE and SCRAP and the consecutive months for the two time periods. The bivariate correlations for TPHE show that it has improved during 1994 through 1996. The correlation is negative, but not significant (-.1103), indicating an overall decrease in productivity performance during 1991 through 1993; however, the correlation is positive and significant (.5306) for 1994 through 1996.

In addition, some evidence of a favorable change in SCRAP was obtained. During the 1991 through 1993 period the bivariate correlation was positive and significant (.4698),

[44]Both are desirable relationships between time and internal performance.

which indicates unfavorable quality performance. However, during 1994 through 1996 the bivariate correlation shows the correct sign, but it is not significant (-.1394). These results support Ittner and Larcker [1996], which found that a lag exists between implementation of operation improvement programs and changes in performance. The firm implemented continuous improvement in 1990 but improvements in internal performance did not become evident until four years later in 1994.

7.3.3 Suggestions for Other Measures of Plant-Wide Performance

This sub-section discusses the data analysis and the answers to the second research question **-Are the measures that are used to assess continuous improvement performance consistent with the continuous improvement goals?** by analyzing two labor usage measures of internal performance.

Productivity performance-- The firm's productivity measure, TPHE, compares expected to actual labor usage. We have seen that the mean of TPHE for the period 1991 through 1996 is .48. TPHE is also increasing for the firm.

This means that the values of TPHE provide information and the motivation to improve performance because the firm is not currently working to its standard.

Another measure of productivity that would be useful to the firm would provide information about the consumption of labor to produce output, without regard to pre-determined labor standards. A measure that was calculated by dividing the number of units produced (i.e., good units produced) by total labor hours would be useful in that it would tell the firm about the labor content of each unit of output. Also, it would focus the users of the information toward finding more innovative ways to decrease labor usage. In addition, it is a simple comparison of output to input, which is not dependent on the firm's estimates of standard labor usage and standard labor costs.

Labor productivity (number of units of good output divided by total labor hours) was calculated using the data that was provided by the firm. Figure 7.6 is a plot of labor productivity for the time periods 1991 through 1993,

and 1994 through 1996. The plots show that the variability of labor productivity appears to be smaller during 1994 through 1996; however labor productivity may have worsened. Levene's test was used to test for the homogeneity of variances for the two time periods, Table 7.7 provides the results. The standard deviation decreases from .0049 to .0037 and the variances are significantly different to the .1 level (.0984). From this result, it may be inferred that the firm has increased the control that it has over its consumption of labor. In addition, to determine whether labor productivity has increased for the firm, bivariate correlations were computed between labor productivity and time for the two time periods (i.e., 1991 through 1993 and 1994 through 1996). The bivariate correlation results are presented on Table 7.8. Both time periods show not-significant results. However, the negative correlation coefficient indicates that productivity as measured by labor productivity has deteriorated.

Summary-- The analyses of TPHE and labor productivity show an interesting result. TPHE has increased over time. This indicates that the firm is showing increased

conformance to its standards. However, the measure of its consumption of labor to produce output (i.e., labor productivity) shows an unfavorable trend. That is, over time more labor is being consumed to produce each unit of output. The decrease in labor productivity is easily explained. According to the controller, recent design changes have increased the labor content of many of the motors. Therefore, the unfavorable trend is probably just a reflection of the design changes. However, labor productivity would still be useful to the firm, especially in view of its interest in reducing the waste of labor. The firm could calculate labor productivity for the individual motors. This dissaggregated information would be useful because it would provide the firm with information about the changes in, or problems with labor usage on the individual motor level. It would help the firm to prioritize its labor waste reduction efforts.

Quality-- Another measure of quality called *SCRAP*labor hours* was calculated. SCRAP*labor hours is calculated by multiplying SCRAP, a unitless measure of the percentage of standard labor costs that are spent on scrapped outputs,

times the actual labor hours that have been used. This is a measure of the total labor hours that were spent to produce scrapped outputs. It should also be useful because of the interest that the firm has in reducing the waste of labor. SCRAP*labor hours can be used to track reductions or increases in the labor that is spent to make scrap over time.

Figure 7.7 provides a plot of SCRAP*labor hours for the periods 1991-1993 and 1994-1996. Examination of the plots shows that SCRAP*labor hours appears to have increased over time as has its variability. The results of the Levene's test are provided on Table 7.9. The standard deviation increased by 13103.67 (from 24284.16 to 37387.83), and the variances are significantly different to the .01 level (p-value .0085). This result provides limited evidence that quality performance is becoming more difficult for the firm to control. However, the bivariate correlations between SCRAP*labor hours and time (Table 7.10) provide evidence that overall, quality performance using this measure of quality has improved. The bivariate correlation of SCRAP*labor hours during 1994 through 1996 is negative but it is not-significant (-.2006).

Summary-- The preceding analysis shows another interesting result. According to the firm's labor efficiency measure of quality performance (i.e., SCRAP) the firm shows no appreciable improvement in quality performance. However, the measure of the labor used to make scrap (i.e., SCRAP*labor hours) shows the there is an improvement in quality performance. That is, the amount of labor that is used to make scrap is trending downward.

Material use-- Currently, the firm provides materials price and usage variance reports to the inventory/purchasing managers. The two components of materials cost are aluminum for castings and purchased component parts. Scrapped aluminum parts are generally remelted and remolded, and non-conforming component parts are either reworked at the firm or returned to suppliers. However, since 80% of the firm's product costs are for materials, it may want to consider monitoring its consumption of material more closely. For example, the firm could track the consumption of materials by calculating scrap rates in the diecast[45] department by dividing pounds of good output

[45] The diecast department was first described in Section 5.3.2.

by the total pounds of aluminum that were used[46]. If this measure was calculated by individual castings and by the individual casting machines, it would provide information that could be used to identify the places where the casting process could be improved. This would also be useful information to compile in the machine shop, where scrapped parts represent the waste of materials in addition to labor (currently measured by TPHE) and machine time. According to three information user survey respondents, information of the type just described is collected independent of the management accounting system. In addition, three other managers, who are not collecting the information themselves, mentioned that they would like to have this type of information. A more formal system for collecting this data would save the managers time that they could use for running their cost centers. Finally, the firm may want to determine the cost of remelting an remolding scrapped aluminum parts as it is possible that the cost to do this is not insubstantial.

[46]A correction would have to be made for normal or acceptable waste in the diecasting process.

7.4 Management Accounting Information Issues

In this section the impact that the firm's adoption of continuous improvement has had on the information provided by the firm's management accounting information system is discussed in order to answer the third research question **-How does the management accounting system change in response to the implementation of continuous improvement programs?** In addition, this section discusses the responses to the information user survey in terms of the information issues: information provided, information demand, and information use. Finally, a summary of the recommendations for additional information that were suggested by the information users on the survey is provided.

7.4.1 Changes in the Management Accounting Information System

Product costing-- The adoption of continuous improvement has had only a small effect upon the types of information that are provided by the management accounting information system. For example, the firm continues to use standard costing for product costing. Overhead is applied using standard direct labor hours. The only change that has

been made in the firm's product costing since the implementation of continuous improvement has to do with the the allocation of general administrative costs to products. Until four years ago accounting and human resources costs were not included in product costs because no apparent connection between these costs and production could be identified. However, as the firm became more aware of its operation, it was able to identify causal relationships that allow it to reliably allocate these costs to its products.

Continuous improvement projects-- The greatest impact that the adoption of continuous improvement has had on data collection and performance measurement has come from the implementation of individual continuous improvement projects. The firm requires the individual teams that create and implement projects to also devise a set of measures and targets that are used to track the progress of the project once it is implemented.

A non-manufacturing example of an improvement project is the change that was made in the small purchases procurement process. The goal of this project was to reduce the purchasing function's workload. Before the

implementation of this project, all purchasing followed the usual authorization, ordering, receiving, and in-house delivery procedures. The new system provides purchasing identification numbers to certain employees, which they use to deal directly with the suppliers. The project plan also provides methods for the monitoring and control of the new ordering process. The project team listed the following as benefits of the plan: (1) expedition of the receipt of purchased items; (2) reduction of the workload at the procurement function; and (3) expedition of invoice payments in order to take advantage of early payment discounts. The project is being evaluated by tracking the decreases in the time that it takes for an employee to place an order and receive an order. It is assumed that decreases in ordering time are evidence that the three goals of the project are being met.

7.4.2 Information Provided from Formal Sources

As was discussed in Section 7.3, TPHE and SCRAP and the other internal performance measures that are used in the bonus plan are calculated at the cost center level and are provided to cost center managers and coordinators. With the

exception of the human resources manager, each of the respondents indicated that he/she receives these reports. This information is used by cost center managers and coordinators to determine whether their cost centers' performance is in accordance with the firm's expectations.

In some cases additional information is provided to certain managers. Several of the respondents indicated that they receive additional reports that provide specific information about their function. For example, the director of materials and the materials manager (the purchasing/inventory function) are provided with weekly materials price and usage variance reports. Also, two engineers mentioned that they receive monthly updates on the materials sourcing process because they are involved in this particular continuous improvement process.

The respondents were asked about their feelings about the adequacy to their needs (i.e., satisfied, neutral or dissatisfied) of the information that is currently being provided to them by the firm's management accounting information system. Table 7.11 provides the responses. Seventy-one percent (17/24) of the respondents are neutral toward or dissatisfied with the information provided by the

firm's management accounting information system. The purchasing/inventory managers are more satisfied with the information that is provided to them (4 of 6 purchasing/inventory managers), while the manufacturing managers are the least satisfied (5 of 8 manufacturing managers). This finding may be due to the fact that the inventory/purchasing managers receive more regular reports and the manufacturing managers must collect much of the information that they need. In addition to the formal reports mentioned, the firm maintains a database that provides cost data to the managers. Two managers mentioned that they find this system to be very user-unfriendly.

7.4.3 Information Provided from Informal Sources

The respondents to the information user survey were asked whether and how often they use information that is not provided by the firm's management accounting information system. A summary of the response is provided on Table 7.12.

As expected from the previous discussion about the information users' satisfaction with the information that is provided by the management accounting information system,

three of the six purchasing/inventory managers never use information from informal sources and all of the manufacturing managers use information from informal sources.

The respondents described several informal sources of information: (1) six manufacturing managers and an engineer collect quality (i.e., scrap and rework) data directly from the shop floor; (2) one engineer obtains information from the firm's parent; (3) another engineer uses information that is provided by vendors; and (4) five of the respondents obtain information from other functions by seeking out the people who have the information that they need.

7.4.4 Uses of Information

Six of the information users described how they use the information that they obtain from the formal management accounting information system and from informal information sources to do their jobs. Two manufacturing managers use process data about machine downtimes, scrap, rework to identify, and solve the production and quality problems that occur in their areas. Two buyers use the firm's long term business plans to make long-term purchasing decisions. They

also compile information about the firm's suppliers in order to select the ones that provide the best products and customer service. One marketing manager uses information about product quality that he/she uses during his/her interactions with customers. This information, which he/she obtains from various other managers, includes information about product durability and warranty rates to use in his/her conversations with customers. The other marketing manager uses information about production plans, budgets, and targets to plan new market strategies and other strategic planning.

7.4.5 Suggestions for Additional Information to be Provided to the Information Users of the Firm

Six themes emerge about additional information and reports from the suggestions that were provided by the respondents to the information user survey.

Non-financial data-- Several respondents from the manufacturing and engineering functions indicated that non-financial information that includes unit-based information about machine downtime, and scrap and rework rates would be helpful to them in their efforts to improve the way that

jobs are performed in their cost centers. A marketing manager explained that information about product quality, which includes information about product durability and warranty claims by individual product would provide him/her with more knowledge about the products that would help him/her in dealing with customers and making sales. A purchasing/inventory manager requests the means to obtain information about inventory aging and obsolete inventory.

Costs associated with actions-- Three of the respondents that requested non-financial operation information also indicated that being able to associate the cost to the firm of the certain decisions would be helpful to them for prioritizing their operation improvement efforts. One manufacturing manager suggested that the firm provide the means to calculate the costs that are tied to inefficiencies due to poor planning; for example downtime due to delays in the arrival of component parts and the costs of being reactive rather than proactive.

Trends-- Two respondents suggested that a useful supplement to the variance reports that they now receive would be trend reports that show the changes in the

performance measures over time for their particular cost center[47].

Timely information-- Three respondents described how more timely or even real-time information would be more helpful to them in making their day to day decisions. They do not find the variance reports that they currently receive to be helpful in their real-time decision making.

Progress reports on the individual continuous improvement projects-- Most of the respondents requested periodic information about the continuous improvement projects that were currently being implemented within the firm. They also suggested that more effort should be expended to devise adequate performance measures for operation improvement projects, which they believe would make project teams more accountable for the success of their projects.

Summary-- This chapter presented the results of the case study in which the three research questions were addressed. The first research question **-Does the**

[47]Trend reports of this type are provide at the plant-wide level as part of the publication of the bonus plan.

implementation of continuous improvement programs improve internal performance?- was investigated by analyzing the behavior over time of two of the standard labor cost efficiency internal performance measures that are currently being used by the firm (i.e., TPHE (productivity) and SCRAP (quality)) for the six years after the firm's implementation of continuous improvement programs. First, Levene's test was performed to determine whether the variation in each performance measure had decreased during the last half of the 6-year period. The Levene's test on TPHE showed that its variance has decreased (a favorable change); however the difference in the variances between the two periods is not significant. The Levene's test on SCRAP showed that its variance has increased (an unfavorable change); however, the change was not significant. Second, bivariate correlations between time and monthly values of the performance measures were calculated. The second-period bivariate correlations indicate a positive association (a favorable result) between time and TPHE and a negative association (a favorable result) between time and SCRAP. In summary, with the exception of the increase in variability of SCRAP, the results of the investigation of the first research question

show that according to the firm's measures its internal performance has improved.

The second research question **-Are the measures that are used to assess continuous improvement performance consistent with the continuous improvement goals?-** was addressed by analyzing two labor usage measures of internal performance using the Levene's test and bivariate correlations. These measures were calculated by the researcher using performance data that was provided by the firm. Labor productivity was calculated by dividing good output by total labor hours. The Levene's test showed a significant decrease in the variance of labor productivity; however, the bivariate correlation for the second time period showed an unfavorable change that is explained by design changes. The measure of quality performance (i.e., SCRAP*labor hours) was calculated by multiplying the firm's quality measure, SCRAP, times total labor hours. This is a measure of the number of labor hours that were spent on scrapped outputs. SCRAP showed a significant unfavorable increase in variability; however, the bivariate correlation in the second time-period showed that it is decreasing over time (an improvement). These results indicate that the firm shows a favorable change in

quality performance in the amount of labor used to make scrap and an unfavorable change in productivity performance. Finally, with the exception of labor productivity, the firm's and the researcher's measures of internal performance are consistent. The usefulness of the researcher's internal performance measures to the firm were also discussed- SCRAP*labor hours, and labor productivity that was calculated by individual product would help the firm to assess its usage of labor. Finally, suggestions for assessing materials usage were provided. For example, the firm could measure scrap or defective outputs at the individual cost centers levels (i.e., diecast and machining department) in order to identify where scrap problems occur.

The third research question **-How does the management accounting information system change in response to the implementation of continuous improvement programs?-** addressed three information issues: information provided; information demand; and information uses. This question was answered by interviewing the firm's controller and by surveying various managers (i.e., information users). In regard to information provided, it was determined that the only significant change in the types of information that are

collected have to do with the assessment of the individual operation improvement projects. The teams are required to develop relevant measures to assess their projects contribution to the continuous improvement effort.

In regard to information demand, it was determined from the responses to the information user survey that many of the firm's information users are not entirely satisfied with the information that is provided to them by the firm's formal management accounting information system. The respondents' suggestions were compiled and recommendations were made about additional information that could be made available to the information users. These suggestions included formal reporting of non-financial data, and updates on the continuous improvement processes. Finally, six of the information user survey respondents described how they use information from formal and informal sources to do their jobs. For example, process and quality information is used at the manufacturing function to improve the operation at the cost center level, and buyers at the purchasing function use the firm's long-range production plans, and information about suppliers in order to make effective purchasing decisions.

CHAPTER VIII

SUMMARY AND CONCLUSION

8.1 Summary of the Findings

This study developed a contingency theory-based framework to examine management accounting information issues and internal performance in the continuous improvement environment. The study was conducted in two parts. In the first part of the study, a cross-sectional study of manufacturing firms using a mail questionnaire survey was performed to investigate the relationships between changes in internal performance, and continuous improvement, employee empowerment and management accounting variables. Non-parametric bivariate correlation results showed a significant positive relationship between employee empowerment and productivity performance. In addition, the comparisons of changes in the internal performance of high and low information firms provided evidence that higher

levels of information are associated with larger improvements in internal performance.

The second part of the study used the single site case study research method to investigate the continuous improvement experience at a strategic business unit of a large manufacturing firm. Three research questions were investigated. The first research question **-Does the implementation of continuous improvement programs improve internal performance?-** was answered by analyzing two of the firm's standard labor cost efficiency measures. Bivariate correlations between the measures and time showed that productivity performance (standard labor cost for good output divided by actual labor hours, called TPHE) has improved, while quality performance (standard labor cost for scrapped outputs divided by standard labor cost for good output, called SCRAP) has shown no appreciable change.

The second research question **-Are the measures that are used to assess continuous improvement performance consistent with the continuous improvement goals?-** was answered using the same analysis on two labor consumption measures because the firm is interested in reducing the waste of labor.

Bivariate correlation results showed that productivity performance (output divided by total labor hours, called labor productivity) has deteriorated. However, this unfavorable result is explained by product design changes. Quality performance (SCRAP multiplied by total labor hours, called SCRAP*labor hours) has shown an increase. In addition, the variability of the productivity measure has shown a significant decrease, while that of the quality measure has shown a significant increase. The results show that these measures would provide additional information to the firm about changes in its internal performance.

The third research question -**How does the firm's management accounting information system change in response to the implementation of continuous improvement?**- was answered by interviewing the controller, and by surveying cost center managers at the firm. The investigation focused on three information issues: (1) information provided, (2) information demand; and (3) information use.

Information provided-- The majority of the managers receive monthly variance reports for the cost centers that they manage (TPHE and SCRAP are included). However, the most significant changes in performance measurement has

taken place at the individual operation improvement project level. Relevant performance measures are developed during the time that the projects are conceived.

Information demand-- Many of the managers indicated that they are not completely satisfied with the information that they receive from the management accounting information system because some information that they would like to have is not provided. In some cases they are able to obtain this information from other sources, in other cases they go without the information that they want. Their suggestions for additional reports were summarized. These suggestions included the development of a formal mechanism for collecting and reporting unit-based quality information.

Information uses-- Several of the managers described how they use information to do their jobs. For example, cost center managers at the manufacturing function regularly collect process and quality information to make operation improvement decisions within their areas.

8.2 Methodological Contributions of the Study

Two questionnaires were developed for this study. First, a questionnaire was developed for the cross-sectional study to operationalize the continuous improvement setting by measuring the continuous improvement program, employee empowerment and management accounting information constructs. Second, an information user questionnaire survey was developed for the case study to investigate information provided, information demand, and information use in the continuous improvement setting.

In addition, this study used objective internal measures of performance to assess continuous improvement performance (i.e., labor productivity, cost of goods manufactured productivity, manufacturing overhead productivity, throughput times, and scrap costs). Objective measures of performance are the preferred measures of continuous improvement performance because they measure the achievement of the immediate operation improvement goals (Otley [1980]). The prior literature uses external performance (i.e., Ittner and Larcker [1995]) and subjective assessments of performance (i.e., Ittner and Larcker [1995]

and Abernathy and Lillis [1995]) to assess continuous improvement performance. These performance measures are not direct measures of operation improvement performance. Selto, Renner and Young [1995] used objective measures of internal performance; however, the data, which were supplied by the firm, were believed to contain measurement error. This study used internal performance information to calculate productivity measures. In order to obtain reliable information definitions were supplied to the questionnaire respondents for the quality and efficiency measures, and productivity performance was calculated by the researcher using raw data that was provided by the respondents.

Finally, this study examined the information provided, information demand, and information use issues using the information user survey. Using the information obtained from the survey responses, recommendations about the types of information (i.e., unit-based quality information, real-time information, and performance trends) that decision makers in continuous improvement settings need to have were made.

8.3 Limitations

8.3.1 Limitations of the Cross-Sectional Study

The most obvious limitation of the cross-sectional study was the small sample size. The sample size limited the statistical analysis of the data to non-parametric bivariate correlations. A more complete analysis would include an investigation of the interaction effects of the independent variables on internal performance using multiple regression analysis. In addition, only two industry groups (electronics and metals) were represented by the sample. This limits the generalizability of the results.

Another limitation of the study has to do with possible measurement error in each of the dependent and independent variables. The data were compiled and reported by the respondents to the mail questionnaire survey. Although, the researcher took care to make each of the questions readily understandable by pre-testing, the data and information that were obtained may have contained some errors. This is especially true for the internal performance data that was requested. Since the respondents

would have had to look up this information, they may have made mistakes or just provided best-guess estimates.

8.3.2 Limitations of the Case Study

Case studies exhibit several inherent weaknesses. First, the phenomena of interest that are examined at single site case studies are affected by many factors, such as firm culture or employee perspectives, that are specific to the site. This limits the generalizability of the case study to other firms. However, future studies that use the research program that was developed for this study (i.e., performing a multiple-site case study) will facilitate the refinement of the relevant variables and provide additional understanding about their relationships in the continuous improvement environment.

8.4 Suggestions for Future Research

Several of the findings of this study suggest interesting directions for future research. First, two of the firms that were examined in the cross-sectional study have adopted both continuous improvement and activity based costing. These firms also showed the greatest improvements

in internal performance. Current literature suggests that activity based costing and activity based analysis provides a useful framework for identifying opportunities for operation improvement. Prior literature that examines activity based analysis in the continuous improvement setting generally examines the decision makers' attitudes towards the activity based information systems that are used in their firms (e.g.,Swenson [1995] and Do, Kim and Shim [1996]). Further studies of the continuous improvement experience would examine the factors that lead continuous improvement firms to choose to adopt activity based management. Also, systematic inquiry to determine whether activity based management actually allows continuous improvement firms to show greater improvements in performance could be performed.

Second, this study used objective measures of internal performance to examine continuous improvement performance instead of subjective judgments about internal performance or external performance measures. The continuous improvement philosophy makes the assumption that improvements in internal performance actually lead to improvements in external performance; or else why improve

operations[48]? Eventually, a methodology may be developed to obtain reliable evidence that would provide insight into the causal relationship between improvements in internal and external performance[49].

Third, as mentioned above, many of the case study firm's information users' information needs are going unmet. Further investigation into the information demand and use issues would provide insight into how management accountants could expand their role in ways that would increase their value as information providers.

[48]It is of course possible that firms have to adopt continuous improvement just to survive.

[49]For example, the internal performance measures used in this study could be used as the independent variables in regressions on external performance measures. (Dr. A. Blakely at Western Michigan suggested this analysis.)

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APPENDIXES

APPENDIX A -
THE CROSS-SECTIONAL STUDY QUESTIONNAIRE

Appendix A - Cross-Sectional Study Questionnaire

Section I. Improvement Programs

Continuous Improvement is the umbrella term for modern operation improvement programs. This section asks for information about the continuous improvement programs that were implemented in your firm during the years 1991-1994. Please indicate the continuous improvement programs that were implemented by your firm by checking the boxes that represent the year that each program was implemented.

Continuous Improvement Program	before 1991	1991	1992	1993	1994
Zero defects					
Quality circles					
Just-in-Time					
Robust Quality Model					
Statistical Process Control					
Benchmarking					
Process simplification by re-engineering					
Cell Manufacture					
Value Engineering					
Value analysis					
Vendor Lead Time Reduction					
Outside Linking					
Programs to reduce setup/changeover times					
Computer aided Design					
Product Re-Design to reduce cycle times					

Appendix A, cont. - Cross-Sectional Study Questionnaire

Section II. Organizational Design

A firm's organizational design describes the manner in which it carries out its day to day operations and employee practices.

Employees can be divided into two broad categories: *Non-management* personnel are those employees who are directly involved in providing the firm's good or service. *Management* personnel direct the non-management personnel.

Training

Please indicate the types of training that were provided to management and non-management personnel during the years 1991-1994 by putting checks in the appropriate boxes.

Type of training	Non-Management Personnel	Management Personnel
Training in the firm's quality principles.		
Training in problem-solving.		
Training in teamwork skills.		

Teamwork

What percentage of non-management personnel were involved in cross-functional team decision making during 1991-1994? (Circle the range that applies)

0% below 25% 25 to 49% 50-75% above 75%

Appendix A, cont. - Cross-Sectional Study Questionnaire

What percentage of management personnel were involved in cross-functional team decision making during 1991-1994? (Circle the range that applies)

0% below 25% 25 to 49% 50-75% above 75%

Decision Making

Please answer the following questions about decision making in your firm during the years 1991-1994.

At what organizational level were most operating decisions made? (Please circle the number that most closely represents the conditions in your firm.)

Management levels 1 2 3 4 5 6 7 Non-management levels

Who assured compliance with quality standards?

The quality assurance group 1 2 3 4 5 6 7 The person performing the job.

Non-management personnel were given a broad range of tasks.

disagree 1 2 3 4 5 6 7 agree

Non-management personnel were given planning responsibility.

disagree 1 2 3 4 5 6 7 agree

Appendix A, cont. - Cross-Sectional Study Questionnaire

Section III. The Management Accounting Information System

The *management accounting information system* of a firm is the system or set of sub-systems used to collect, store, process and provide information for decision making. The management accounting information system includes the various costing system used by the firm.

During 1991-1994 what types of cost systems were used (check yes or no for used or not used)

Standard costing	yes ( )	no ( )
Activity based Costing	yes ( )	no ( )
Target costing	yes ( )	no ( )

Please indicate whether the information provided by your firm's management accounting information system was used for the following items by checking the boxes that apply.

process design	process re-design	product design	product re-design	value engineering	cost reduction

Appendix A, cont. - Cross-Sectional Study Questionnaire

What types of information were provided by your firm's management accounting information system during 1991-1994? (Indicate yes or no for provided or not provided)

Non-financial data-defect rates	Yes ( )	No ( )
Non-financial data-scrap rates	Yes ( )	No ( )
Non-financial data-rework rates	Yes ( )	No ( )
Cost of quality data	Yes ( )	No ( )
Data about cycle times	Yes ( )	No ( )
Data about machine downtime	Yes ( )	No ( )
Customer-generated costs	Yes ( )	No ( )
Customer-generated cost drivers	Yes ( )	No ( )
Activities measured at the process level	Yes ( )	No ( )
The means to identify excess capacity	Yes ( )	No ( )
The means to use charges to control the use of internal services.	Yes ( )	No ( )
The means to share information among manufacturing and non-manufacturing functions.	Yes ( )	No ( )

Appendix A, cont. - Cross-Sectional Study Questionnaire

Section IV. Performance Information

This section asks for internal performance data. Please provide as much of this information as possible (e.g. dollar costs, machine hours, direct labor hours)

Performance Data	1993	1994	1995
Total labor cost	$	$	$
Total labor hours			
Total manufacturing overhead cost	$	$	$
Total cost of goods manufactured	$	$	$
Total machine hours			
Total reject cost*	$	$	$
Average throughput** time for your firm's major product			
# units produced of your firm's major product			

* Rejects are defective outputs

** Throughput time is the time that it takes for raw materials to be converted to finished product

Appendix A, cont. - Cross-Sectional Study Questionnaire

Section V. Background Information

Please answer the following questions about your firm for the time period 1991-1994.

How many different products were manufactured at this facility?_____

In the space provided, describe the major product manufactured at this facility during 1991-1994?

_____

_____

_____

What portion of total manufacturing at this facility was devoted to your major product during 1991-1994?

below 25% 25 to 49% 50-75% above 75%

What was the percentage of market share held by your major product during 1991-1994?

below 25% 25 to 49% 50-75% above 75%

At this facility, what percentage of the firm's employees were unionized during 1991-1994?

0% below 25% 25 to 49% 50-75% above 75%

In what year did operations at this facility begin?_____

APPENDIX B - THE CASE STUDY INTERVIEW QUESTIONS

Appendix B - Case Study Interview Questions

These questions were asked at interviews with the primary respondents (i.e. the information providers).

Part 1.

Background questions:

1. What is your position? Please describe your duties.

2. Number of employees in management (non-management) positions. Number of employees in manufacturing (non-manufacturing) positions.

3. Is market share-declining, increasing, steady?

4. What is the organizational chart at this location?

5. What is the organizational chart at the corporation level?

6. Describe the manufacturing process.

Part 2 - Continuous Improvement

1. What caused the firm to adopt continuous improvement?

2. What are your firm's continuous improvement goals?

3. What was the cost of the continuous improvement effort?

4. Overall, are you comfortable with the progress that has been made with continuous improvement?

5. On what do you base your beliefs about the progress?

Continuous Improvement Performance

1. What performance measures are used to evaluate the firm's continuous improvement goals? How is each measure calculated? Why was each measure chosen?

2. Would you provide the monthly values of the measures that are used to evaluate continuous improvement performance for the years 1990 to the present?

3. Please explain why each of the performance measures mentioned in #2 was chosen.

4. Would you provide the monthly values of direct labor hours, direct labor costs, cost of goods manufactured, overhead costs and scrap or reject costs, and the numbers of units produced and throughput times of your major product for the years 1990 to the present?

Internal reporting

1. How did product quality reporting change after the adoption of continuous improvement?

2. Describe the existing system for gathering and reporting product quality information.

3. How did operations efficiency (e.g. productivity, speed, work in process control, cost control, and variance) reporting change after the adoption of continuous improvement?

4. Describe the existing system for gathering and reporting operations efficiency information.

5. What were the percentages of the materials, labor and overhead costs of your major product before the adoption of continuous improvement? Have these percentages changed since the adoption of continuous improvement?

6. How did your product costing system change after the adoption of continuous improvement?

APPENDIX C - THE INFORMATION USER SURVEY QUESTIONS

Appendix C - Case Study Survey Questions

These questions were used to survey the information users the case study site.

SURVEY
Use of Accounting Information

1. To what extent are you involved in the following continuous improvement processes? (Check each box that applies)

Process	Leadership role	Actively Involved	Aware of	not aware of	other
Product Development					
Materials procurement					
Formal work projects					
ISO 9000					
Internal audit					
bonus plan					
others*					

* please explain

Appendix C, cont. - Case Study Information User Survey Questions

2. For the last 2 years, how effective do you believe these continuous improvement processes have been in the improvement of the firm's operation?

Process	Significant Influence	Minor Influence	No Influence
Product Development			
materials procurement			
Formal work projects			
ISO 9000			
internal audit			
the bonus plan			
others*			

*please explain

3. Describe your ideas for the improvement of the firm's continuous improvement efforts? (Please use the back page if you need more space to write)

4. Are you satisfied with the information that is provided to you by the management accounting information system with respect to the evaluation of the continuous improvement process (as identified in question 1)?

SATISFIED NEUTRAL DISSATISFIED

5. Please describe some of the types of reports and information that you frequently use that is provided by the management accounting information system that enable you to evaluate the effectiveness of the continuous improvement process. (Please use the back page if you need more space to write)

Appendix C, cont. - Case Study Information User Survey Questions

6. What other items of information which are not currently provided by the management accounting information system would help you in performing your job with respect to the continuous improvement process? (Please use the back page if you need more space to write)

7. During the week, how many times do you use information that is not provided by the management accounting information system to perform your job with respect to the continuous improvement process? (Circle one)

never once each week once each day more than once each day

8. From where do you currently obtain this information? (Please use the back page if you need more space to write)

Background information

9. What is your position at the firm?

10. Please provide a description of your duties. (Please use the back page if you need more space to write)

APPENDIX D - TABLES

Table 4.1.

Summary of the Productivity Measures

Productivity measure	equation
labor hour productivity	$\frac{\text{\# of units}}{\text{labor hours}}$
overhead cost productivity	$\frac{\text{\# of units}}{\text{manufacturing overhead cost}}$
total cost productivity	$\frac{\text{\# of units}}{\text{cost of goods manufactured}}$

*The number of units of output of the firm's major product that was produced for each year 1993, 1994 and 1995.

Table 5.1.

Yin's Typology of Case study design
(Source: COSMOS Corporation)

	Single Site	Multiple Sites
holistic (single unit of analysis)	Type 1	Type 3
embedded (multiple units of analysis	Type 2	Type 4

Table 6.1

Industry Classifications of
the Survey Responses

Industry Group	Respond	Did not respond		Total
		refused	not returned	
Food and fiber	2	0	42	44
Chemicals and Drugs	0	0	10	10
Rubber, Leather, and Stone and Clay	1	1	17	19
Metals	8	2	70	80
Electronics	9	0	91	100
Miscellaneous	0	0	10	10
Total	20	3	240	263

Table 6.2

Summary Statistics of the Independent Variables

Variable	range	mean	high value	low value	s.d.
Number of Continuous Improvement Programs	0-15	8.66	15	1	5.08
Years of Implementation*	3->7	4.5	>7	3	1.37
Employee Empowerment	6-44	26.5	32	20	5.2
Information Provided	0-12	7.5	12	1	3.78
Uses of Information	0-6	4	6	1	1.89

*respondents were asked about the length of time that the continuous improvement programs had been in place.

Table 6.3

Raw Scores for each Observation

Variable	ob #1	ob #2	ob #3	ob #4	ob #5	ob #6
Number of Continuous Improvement Programs	6	13	10	7	15	1
Years of Implementation*	7	4.6	3.7	5.4	6.7	3
Employee Empowerment	20	26	32	28	32	21
Information Provided	6	10	9	8	8	1
Uses of Information	3	4	4	6	6	0

*respondents were asked about the length of time that the continuous improvement programs had been in place.

Table 6.4

The Number of the Continuous Improvement Programs that have been Adopted by the Firms by Category

Program Category	ob #1	ob #2	ob #3	ob #4	ob #5	ob #6
Employee Empowerment*	3[1]	3	2	2	3	0
Quality Programs**	1	2	1	2	2	0
Product-Process Design***	1	3	3	0	3	0
Efficiency and Productivity ****	1	6	4	3	6	1
Total Programs Adopted	6	13	10	7	15	1

[1] number of programs

* quality circles, just-in-time, cell manufacture

** zero defects, statistical process control

*** value engineering, value analysis, robust quality model, computer aided design

****benchmarking, re-engineering, programs to reduce setup times or cycle times, vendor lead time reduction, outside linking

Table 6.5

Summary of the Times that
each Firm Implemented its
Continuous Improvement Programs

Observation # / Year of Implementation	ob #1	ob #2	ob #3	ob #4	ob #5	ob #6
before 1991	6[1]	1	1	3	13	0
1991	0	3	0	2	0	0
1992	0	3	1	1	2	0
1993	0	6	1	0	0	0
1994	0	1	7	1	0	1
	6	13	10	7	15	1

[1] number of programs that were implemented in that year

Table 6.6

Details of the Employee Empowerment Variable

Component of the Employee Empowerment Variable	Question	Points Possible
Training	-three questions -1/0 for yes/no -training for non-management and management personnel	6
Teamwork	-two questions -five percentage ranges 0% to 100% - non-management and management personnel that are involved in teamwork.	10
Decision Making	-four-seven point Likert scale questions	28
Total score Possible		44

Table 6.7

Scores for the Components of the Employee Empowerment Variable that were Earned by each Firm

Observation # / Employee Empowerment Component	ob #1	ob #2	ob #3	ob #4	ob #5	ob #6
Training	6[1]	6	6	6	6	1
Teamwork	4	7	6	9	7	6
Decision making	10	13	20	13	19	14
Total	20	26	32	28	32	21

[1] Employee empowerment score

Table 6.8

Summary of the Information Categories
of the Information Provided Variable

Information Provided Category	Points Possible
Quality*	4
Process**	4
Customer***	2
Information**** Sharing	2
Total Points Possible	12

* defect rates, rework rates, scrap rates, cost of quality
** cycle times, downtime, process by activity, excess capacity
*** customer costs, customer cost drivers
**** ease of information sharing, chargeouts to control the use of services

Table 6.9

Scores Earned by the Firms
on the Information Provided Variable

Observation # / Information Category	ob # 1	ob # 2	ob #3	ob #4	ob #5	ob#6
Quality	2	4	4	4	3	1
Process	4	4	4	2	4	0
Customer	0	0	2	0	0	0
Information Sharing	1	2	2	2	1	0
Total	6	10	12	8	8	1

Table 6.10

The Responses to the
Information Use Variable

Observation # / Information Use	ob # 1	ob # 2	ob #3	ob #4	ob #5	ob#6
Process Design	1[1]	1	0	1	1	0
Product Design	0	0	0	1	1	0
Process-Re-design	1	1	1	1	1	0
Product-Re-design	0	1	1	1	1	0
Value Engineering	0	0	1	1	1	0
Cost Reduction	1	1	1	1	1	0
Total	3	4	4	6	6	0

[1] 1-used, 0-not used

Table 6.11 - Productivity Performance

Panel A - Y1 - Labor Hour Productivity
Calculated Values

	1993	1994	1995
ob #1	.6908	.6873	.6821
ob #4	.0812	.0879	.0813
ob #5	.0278	.0523	.063

Panel A1 - Y1 - Labor Hour Productivity
Percentage Changes

	1993-1994	1994-1995
ob #1	-.005	-.007
ob #4	.0825	-.075
ob #5	.88	.204

Table 6.11, cont. - Productivity Performance

Panel B - Y2 - Cost of Goods
Manufacturing Productivity
Calculated Values

	1993	1994	1995
ob #1	.304	.3017	.294
ob #2	.009	.009	.0112
ob #4	1.846	1.927	1.635
ob #5	.00198	.00039	.0003

Panel B1 - Y2 - Cost of Goods
Manufacturing Productivity
Percentage Changes

	1993-1994	1994-1995
ob #1	-.007	-.025
ob #2	.007	.1407
ob #4	.043	-.153
ob #5	.56	.0194

Table 6.11, cont. - Productivity Performance

Panel C - Y3 - Manufacturing Overhead Productivity
Calculated Values

	1993	1994	1995
ob #1	2.091	2.362	2.205
ob #2	.0576	.0618	.080
ob #4	.00578	.006	.005
ob #5	.00059	.0011	.00158

Panel C1 - Y3 - Manufacturing Overhead Productivity
Percentage Changes

	1993-1994	1994-1995
ob #1	.129	-.066
ob #2	.0729	.29
ob #4	.038	-.167
ob #5	.966	.362

Table 6.12

Panel A - Efficiency Performance
Y4 - Throughput Times

	1993	1994	1995	Change in Performance
ob #2	6 wks	4 wks	3 wks	increase
ob #3	32.5 wks	27.15 wks	19 wks	increase
ob #4	12 days	12 days	10 days	increase
ob #5	8 days	8 days	3 days	increase
ob #6	171 hours	143 hours	128 hours	increase

Panel A1 - Efficiency Performance
Y4 - Throughput Times
Percentage Changes

	1993-1994	1994-1995
ob #2	-.33	-.25
ob #3	-.16	-.3
ob #4	0	-.167
ob #5	0	-.625
ob #6	-.16	-.117

Table 6.13. Quality Performance

	1993	1994	1995
ob #1	458	641	610
ob #2	1864	2319	491[50]
ob #3	1215	760	560
ob #4	696	603	553

Panel B - Quality Performance
Y5 - Reject Cost
Percentage Changes

	1993-1994	1994-1995
ob #1	.39	-.048
ob #2	.244	.788
ob #3	-.374	-.26
ob #4	-.13	.08

[50]Observation #2 makes medical equipment. Since each unit produced is very expensive, improvements quality performance will result in large changes in scrap costs.

Table 6.14

T Statistics[1]
Test of Hypothesis 1
Continuous Improvement Programs

Independent Variables / Internal Performance	Number of Programs Implemented		Average Time Since Implementation	
	93-94	94-95	93-94	94-95
Y1	54 n=3	56 n=3	30.5 n=3	27.5 n=3
Y2	26 n=4	24 n=4	24.5 n=4	28.5 n=4
Y3	26 n=4	22 n=4	24.5 n=4	23.5 n=4
Y4	42 n=5	18 n=5	60.5 n=5	21 n=5
Y5	30 n=4	20 n=4	6.5 n=4	14.5 n=4

*marks the relationships that are significant at p<.05
**marks the relationships that are significant at p<.1

n = the number of observations that were available to test each relationship.

Y1-labor hour productivity
Y2-cost of goods manufactured productivity
Y3-manufacturing overhead productivity
Y4-throughput times
Y5-reject costs

[1]T-statistics were calculated using this equation:

$$T = \sum_{i=1}^{n} [R(X_i) - R(Y_i)]^2$$

Table 6.15

T Statistics[1]
Test of Hypothesis 1
Employee Empowerment

Independent Variable / Internal Performance	Employee Empowerment	
	93-94	94-95
Y1	10.25 n=3	16.25 n=3
Y2	4.25** n=4	17.25 n=4
Y3	4.25** n=4	12.25 n=4
Y4	32.5 n=5	7.5 n=5
Y5	33.25 n=4	22.25 n=4

* marks the relationships that are significant at p<.05
** marks the relationships that are significant at p<.1

n=the number of observations that were available to test each relationship.

Y1-labor hour productivity
Y2-cost of goods manufactured productivity
Y3-manufacturing overhead productivity
Y4-throughput times
Y5-reject cost

[1] T-statistics were calculated using this equation:

$$T = \sum_{i=1}^{n} [R(X_i) - R(Y_i)]^2$$

Table 6.16

T Statistics[1]
Test of Hypothesis 2

Independent Variables / Internal Performance	Information Provided		Information Uses	
	93-94	94-95	93-94	94-95
Y1	3.5 n=3	6.5 n=3	26 n=3	34 n=3
Y2	17.5 n=4	10.5 n=4	16.25 n=4	34.25 n=4
Y3	17.5 n=4	15.5 n=4	16.25 n=4	29.25 n=4
Y4	27.5 n=5	22.5 n=5	49 n=5	17.5 n=5
Y5	51.25 n=4	40.25 n=4	26.5 n=4	15.5 n=4

* marks the relationships that are significant at p<.05
** marks the relationships that are significant at p<.1

n=the number of observations that were available to test each relationship.

Y1-labor hour productivity
Y2-cost of goods manufactured productivity
Y3-manufacturing overhead productivity
Y4-throughput times
Y5-reject costs

[1]T-statistics were calculated using this equation:

$$T = \sum_{i=1}^{n} [R(X_i) - R(Y_i)]^2$$

Table 6.17. Summary of the High and Low Information Firms Whose Performance was Compared

Performance Measures	High Information Firm provided/uses	Low Information Firm provided/uses
Productivity - Y1 Y2 Y3	ob #5 8/6[1]	ob #1 6/3
Efficiency - Y4	ob #3 14/4	ob #6 1/0
Quality - Y5	ob #3 12/4	ob #1 6/3

[1] Information provided and use scores

Y1-labor hour productivity
Y2-cost of goods manufactured productivity
Y3-manufacturing overhead productivity
Y4-throughput times
Y5-reject costs

Table 6.18

Analysis of Changes in Performance
of the Firms that Scored Highest and Lowest
on the Information Provided and Information Used Variables

Internal Performance Variable	High Information Firm	Low Information Firm	Greatest Improvement
Y1	⇑ 1.266[1]	⇓ -.012[3]	high information firm
Y2	⇑ .59[1]	⇓ -.033[3]	high information firm
Y3	⇑ 1.677[1]	⇑ .054[3]	high information firm
Y4	⇑ -.415[2]	⇑ -.25[4]	high information firm
Y5	⇑ -.539[2]	⇓ .33[3]	high information firm

[1] High Scoring firm ob #2
[2] High Scoring firm ob #3
[3] Low Scoring firm ob #1
[4] Low Scoring firm ob #6

Y1-labor hour productivity
Y2-cost of goods manufactured productivity
Y3-manufacturing overhead productivity
Y4-throughput time
Y5-reject costs

Table 7.1

Summary of the Response to the Information User Survey

Function	Response	Total Possible
Marketing	2	10
Purchasing/ Inventory	6	10
Manufacturing	8	32
Engineering	7	9
Human Resources	1	6
Total	24	67

Table 7.2

Summary of the Number of Managers by Function that are Involved in Each of the Firm's Continuous Improvement Processes

Function/ Process*	(1)	(2)	(3)	(4)	(5)
Marketing	0	1	0	2	0
Purchasing/ Inventory	3	6	4	3	6
Manufacturing	7	6	4	4	3
Engineering	2	4	2	5	5
Human Resources	0	0	1	1	1

* (1) - Bonus plan, (2) - Formal Work Projects, (3) - Internal Audit, (4) - Product Development, and (5) - Materials Sourcing

Table 7.3

Respondent's Beliefs about the
Usefulness of each
Continuous Improvement Process in
Achieving the Firm's
Continuous Improvement Goals

Process	Significant Influence	Minor Influence	No Influence
Bonus Plan	11	7	1
Formal Work Projects	12	10	0
Internal Audit	7	12	4
Product Development	8	12	2
Materials Sourcing	14	7	1

Table 7.4

Internal Performance Measures
that are used by the Firm
to Assess Plant-Wide Internal Performance

Performance Measure	Equation
Total Plant Hourly Efficiency (TPHE)	standard* labor hours for good output** / actual labor hours
Scrap Labor Dollars as a Percentage of Total Labor Hours (SCRAP)	standard labor cost of scrapped output / standard labor cost for good output

* The standards are reviewed and revised periodically
** good output are goods that are finished and transferred to finished goods inventory.

Table 7.5

Results of Levene's Test
for Homogeneity of Variance of the Time Periods
1991 through 1993 and 1994 through 1996
for TPHE and SCRAP

	TPHE	SCRAP
Standard Deviation 1991 through 1993 (mean)	3.5635 (44.12)	.4214 (1.36)
Standard Deviation 1994 through 1996 (mean)	2.6135 (48.50)	.4866 (1.48)
p-value for H0: The variances are equal	.7354	.2185

Table 7.6

Bivariate Correlations for TPHE and SCRAP
for the Time-Periods
1991 through 1993 and 1994 through 1996

	Bivariate Correlations	
	TPHE	SCRAP
1991 through 1993	-.1103	.4698*
1994 through 1996	.5306*	-.1394

* significant to the .05 level

Table 7.7

Summary of the Levene's Test for Equal Variances
for Labor Productivity
for the Time-Periods
1991 through 1993 and 1994 through 1996

	Labor Productivity
Standard Deviation 1991 through 1993 (mean)	.0049 (.1163)
Standard Deviation 1994 through 1996 (mean)	.0037 (.1118)
p-value for H_0: The variances are equal	.0984

Table 7.8

Bivariate Correlations
Labor Productivity
for the Time-Periods
1991 through 1993 and 1994 through 1996

	Bivariate Correlations
1991 through 1993	.0248
1994 through 1996	-.4027

* significant to the .05 level

Table 7.9

Summary of the Levene's Test for Equal Variances
for SCRAP*Labor Hours
for the Time-Periods
1991 through 1993 and 1994 through 1996

	SCRAP*Labor Hours
Standard Deviation 1991 through 1993 (mean)	24284.16 (63664.47)
Standard Deviation 1994 through 1996 (mean)	37387.83 (98665.24)
p-value for H_0: The variances are equal	.0085

Table 7.10

Bivariate Correlations
for SCRAP*Labor Hours
for the Time-Periods
1991 through 1993 and 1994 through 1996

	Bivariate Correlations
1991 through 1993	.4655*
1994 through 1994	-.2006

* significant to the .01 level

Table 7.11

Summary of the Information User Survey Question:
How Satisfied are you with the Information that
is provided by the firm's
Management Accounting Information System?

	Level of Satisfaction			Total
Function	Satisfied	Neutral	Dissatisfied	
Marketing	0	1	1	2
Purchasing/ Inventory	4	1	1	6
Manufacturing	2	1	5	8
Engineering	1	4	2	7
Human Resources	0	0	1	1
Total	7	7	10	24

Table 7.12

Summary of the Information User Survey Question:
How frequently do you use information that is **not** provided by the firm's
Management Accounting Information System?

	Frequency of Use				
Function	Never	Once Each Week	Daily	Several Times a Day	Total
Marketing	0	1	1	0	2
Purchasing/ Inventory	3	0	2	1	6
Manufacturing	1	1	3	1	5*
Engineering	2	2	1	2	7
Human Resources	0	0	1	0	1
Total	6	4	7	4	21*

* Three manufacturing managers did not answer this question.

APPENDIX E - FIGURES

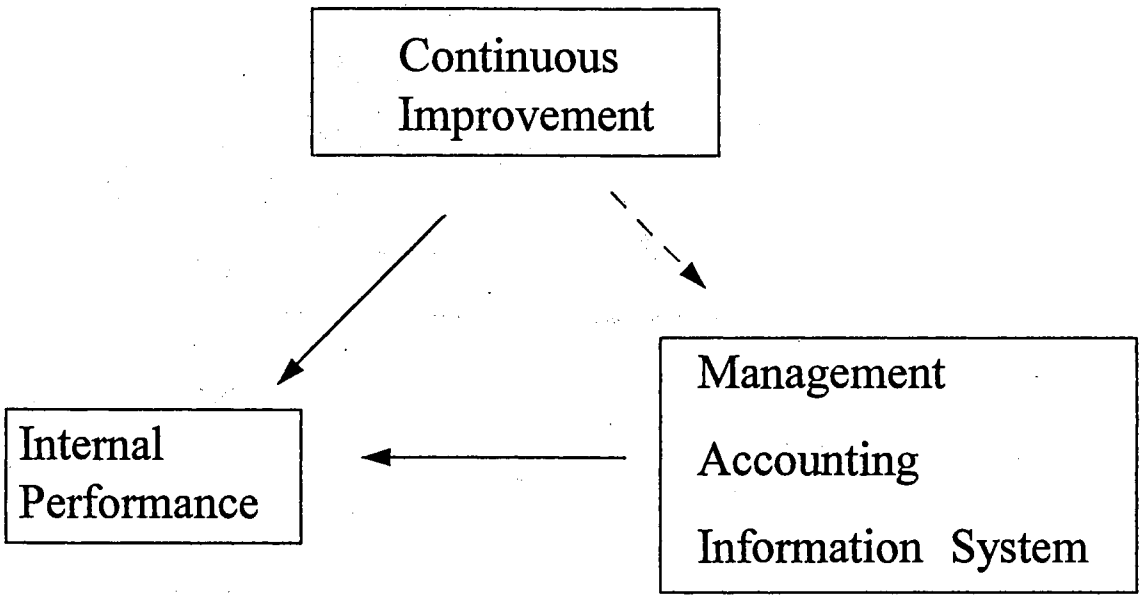


Figure 3.1
Framework of the Study

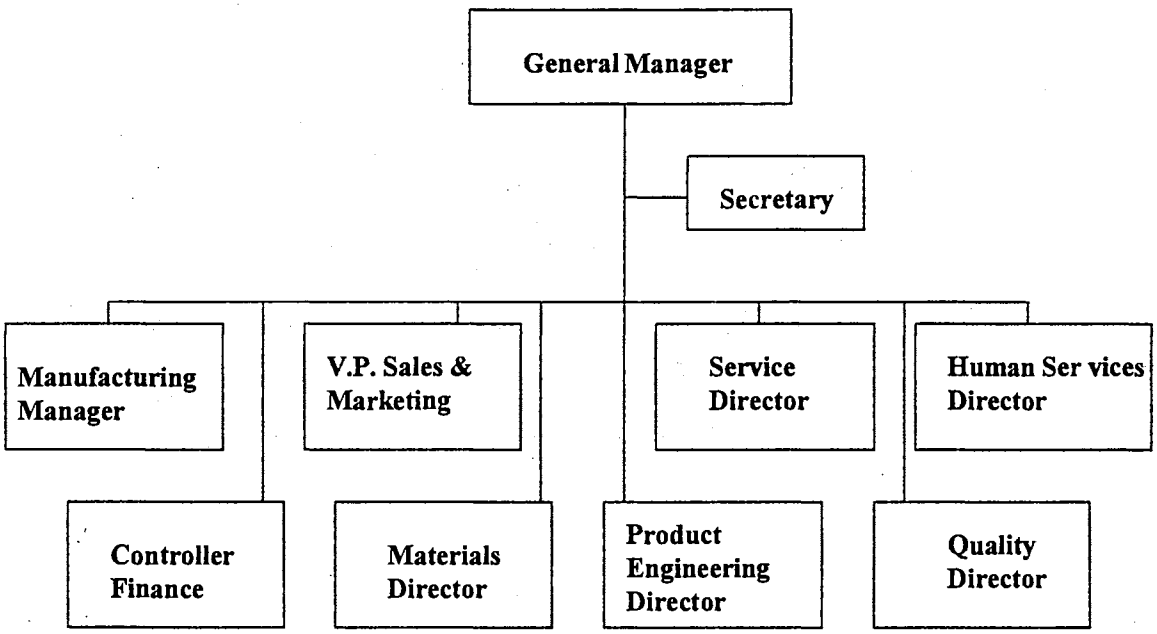
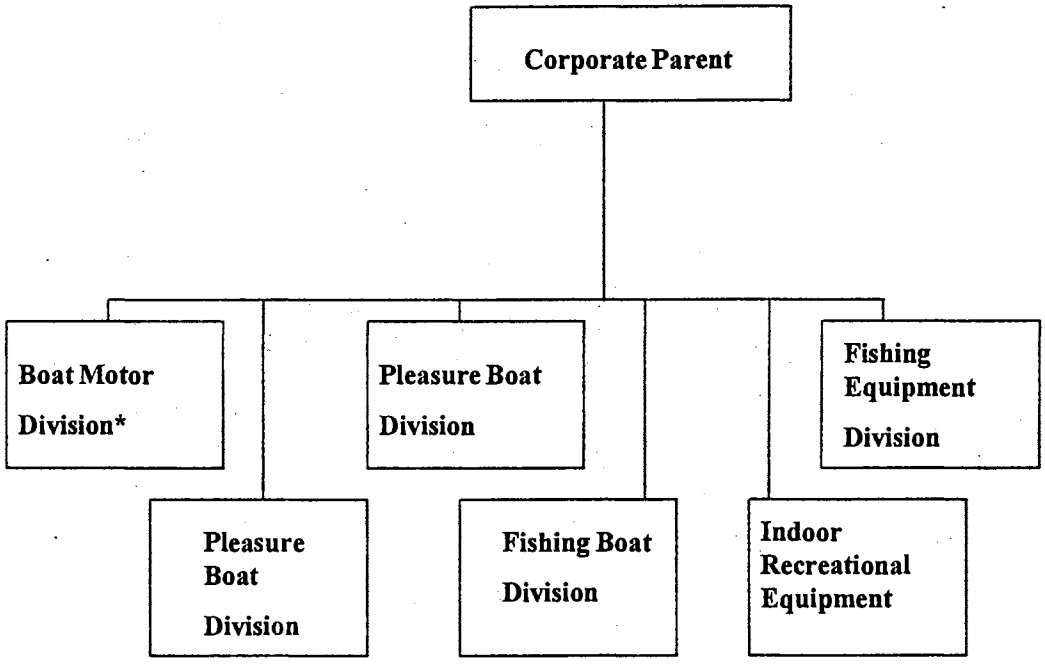


Figure 5.1
Organizational Chart of the Firm



*The Firm is Here

Figure 5.2
Organizational Chart of the Corporation

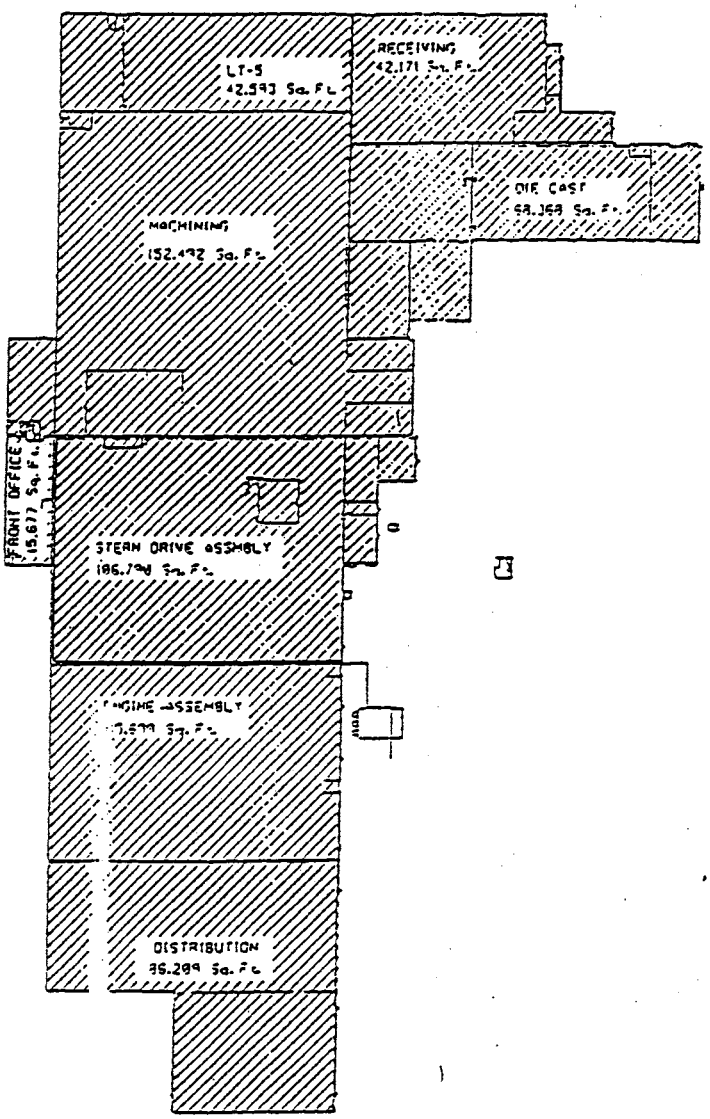


Figure 5.3
Diagram of the Firm's Manufacturing Area

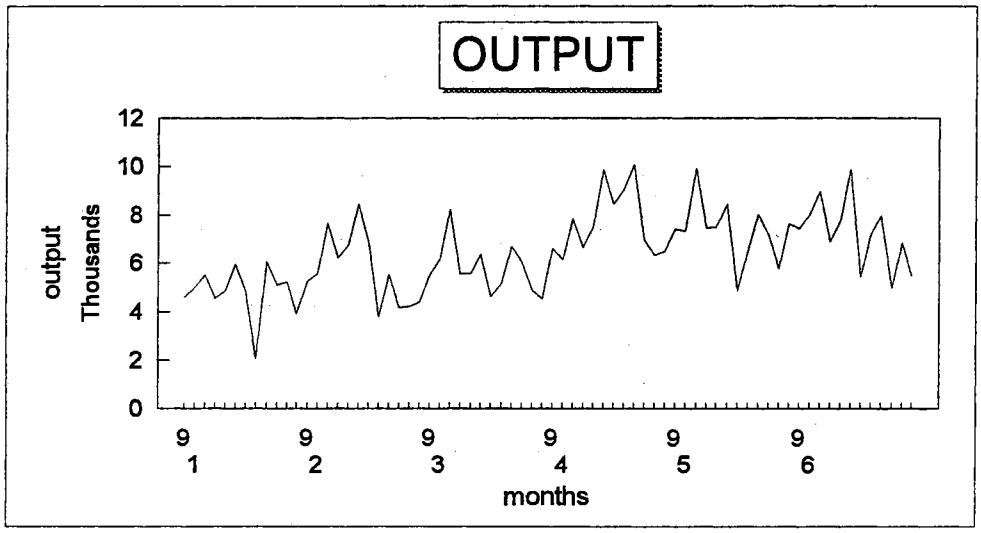


Figure 7.1
Monthly Values of Units of Output for the
Consecutive Time Periods
1991 through 1996

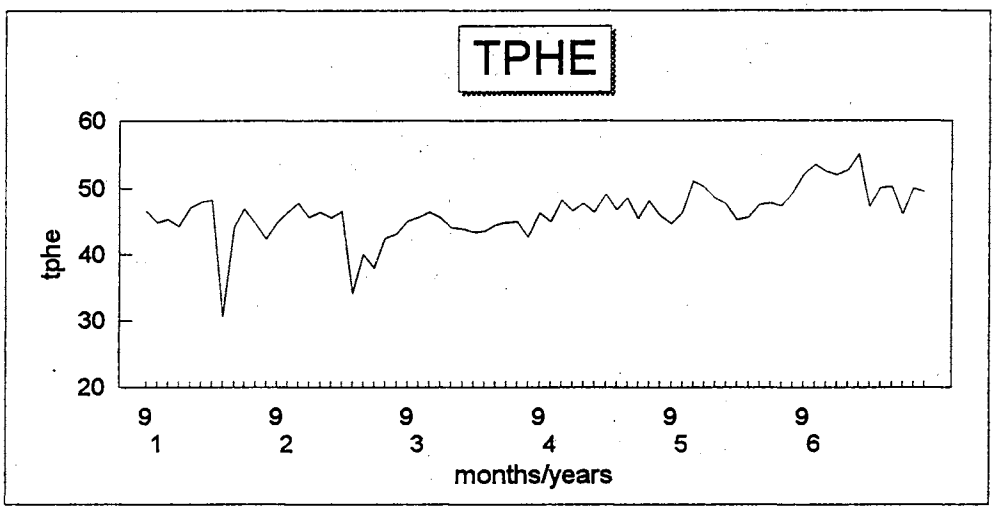


Figure 7.2
Monthly Values of TPHE for the
Consecutive Time Periods
1991 through 1996

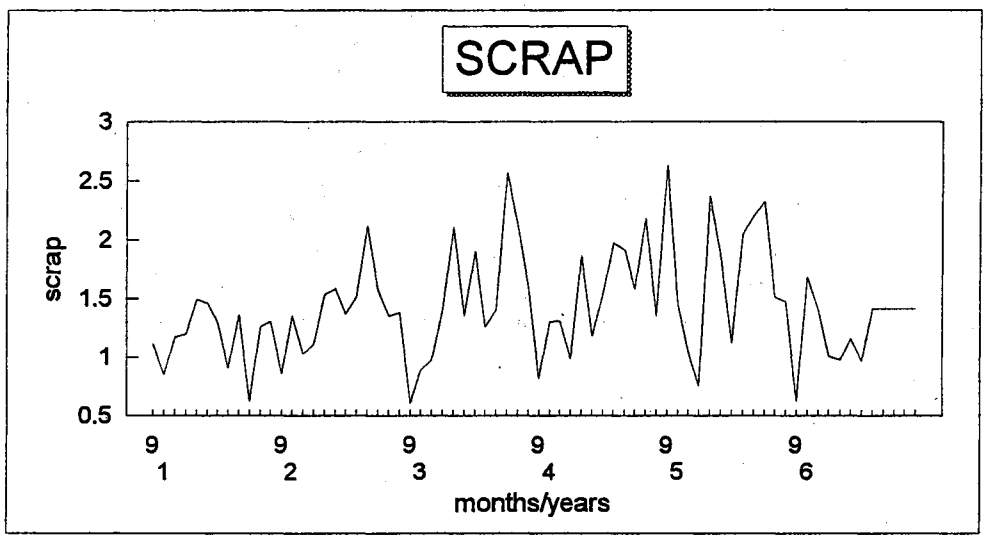
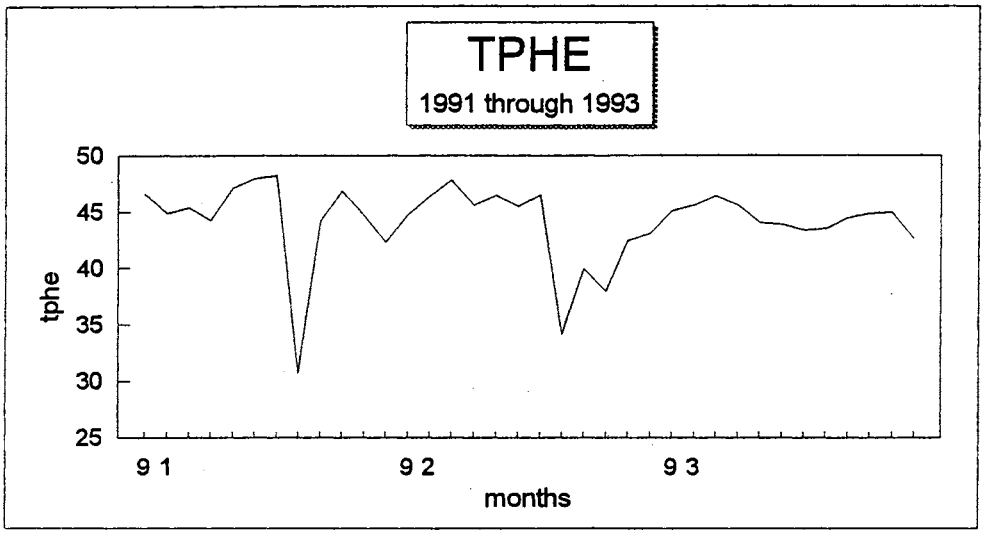


Figure 7.3
Monthly Values of SCRAP for the
Consecutive Time Periods
1991 through 1996



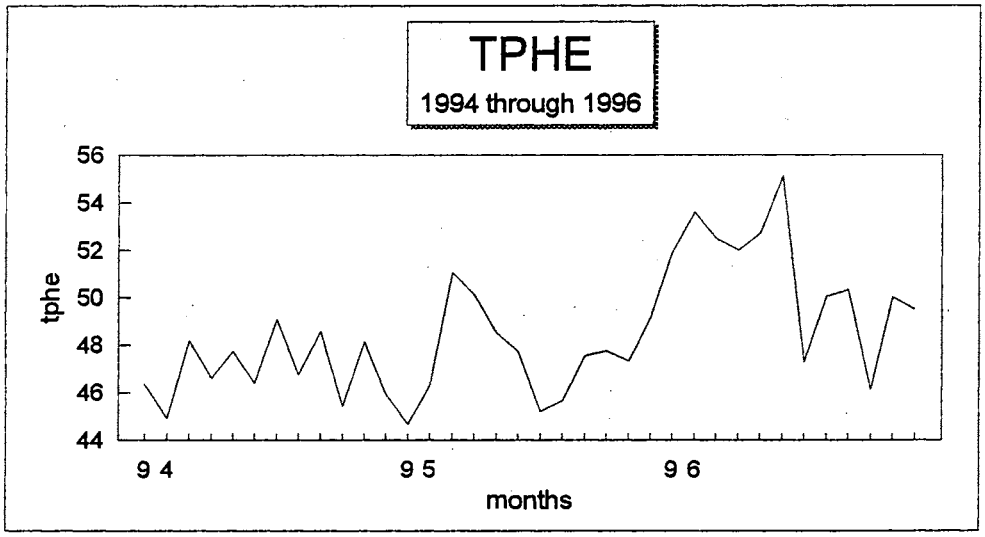
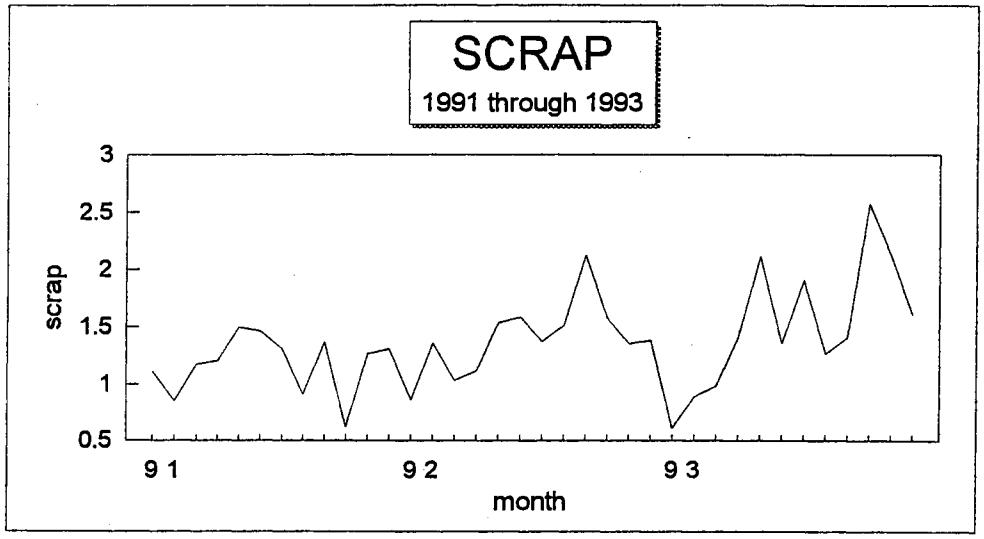


Figure 7.4
Monthly Values of TPHE for the
Consecutive Time Periods
1991 through 1993
and
1994 through 1996



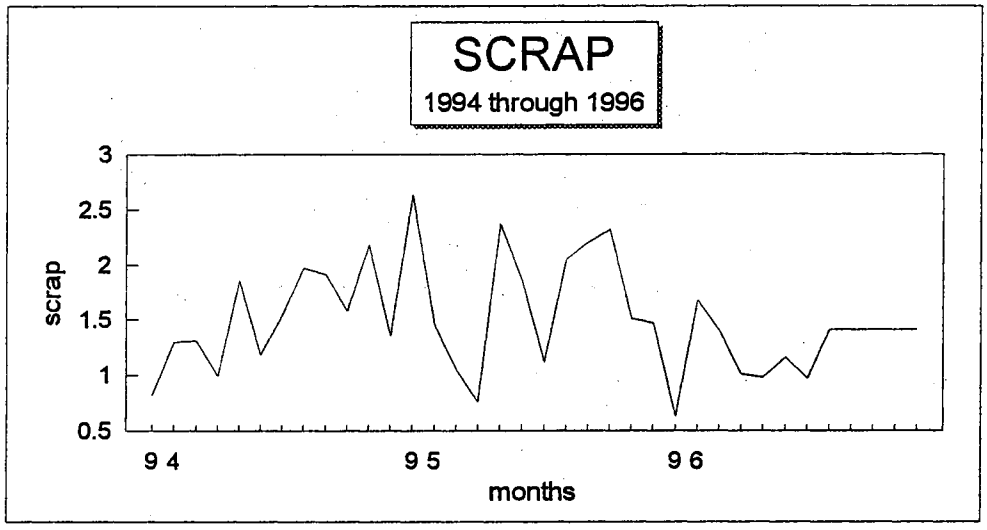
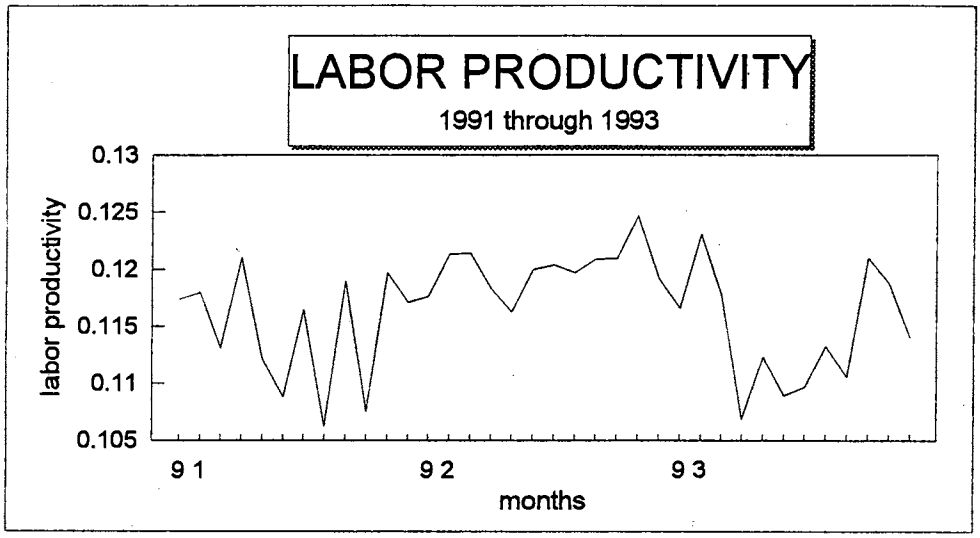


Figure 7.5
Monthly Values of SCRAP for the
Consecutive Time Periods
1991 through 1993
and
1994 through 1996



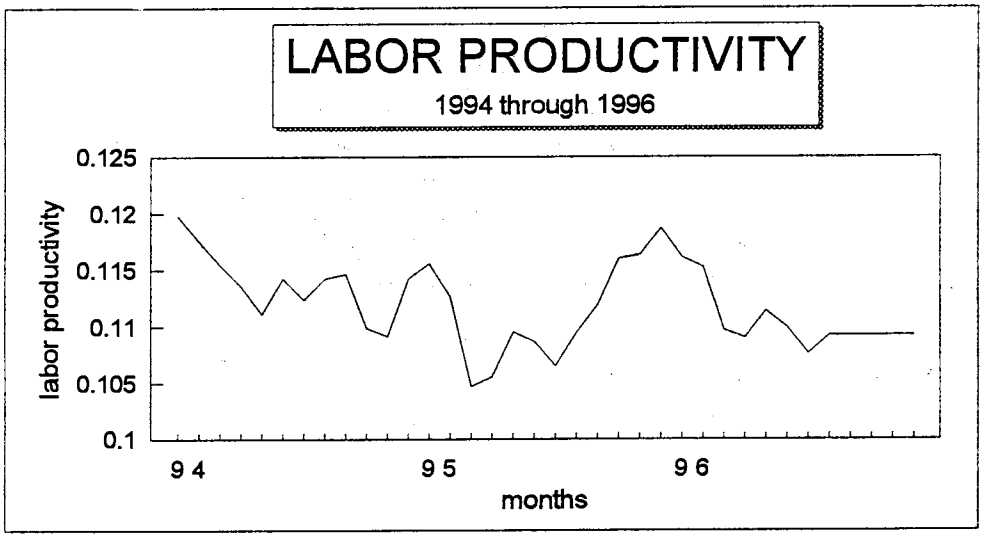
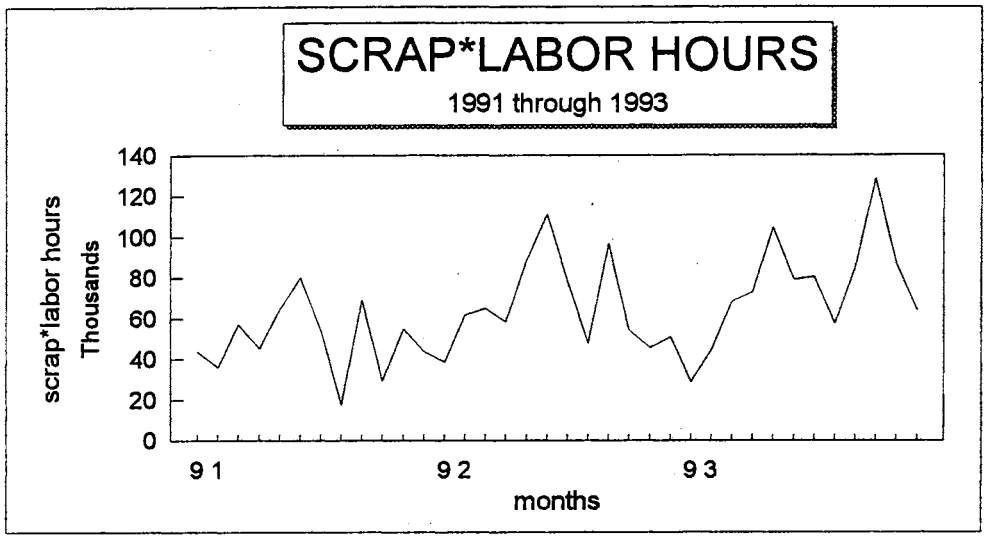


Figure 7.6
Monthly Values of Labor Productivity
vs Consecutive Time Periods



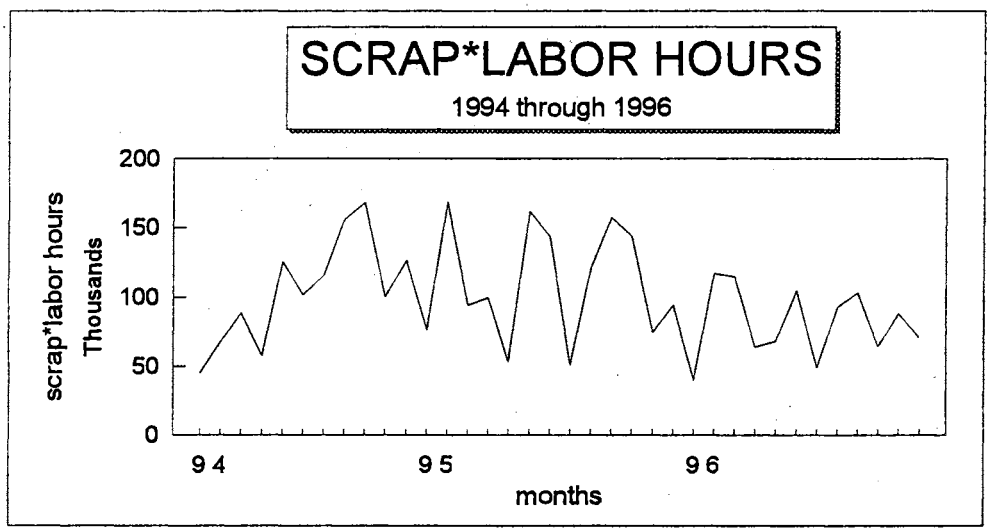


Figure 7.7
Monthly Values of SCRAP*Labor Hours
vs Consecutive Time Periods

APPENDIX F -
INSTITUTIONAL REVIEW BOARD REVIEW FORM

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 03-15-96 **IRB#:** BU-96-013

Proposal Title: THE ROLE OF ACTIVITY BASED INFORMATION ON IMPLEMENTATION OF CONTINUOUS IMPROVEMENT PROGRAMS

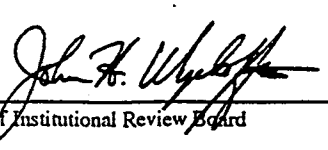
Principal Investigator(s): Amy Lau, Linda Holmes

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING.
APPROVAL STATUS PERIOD VALID FOR ONE CALENDAR YEAR AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Reasons for Deferral or Disapproval are as follows:

Signature:  Date: April 11, 1996

Chair of Institutional Review Board

2

VITA

Linda Holmes

Candidate for the Degree of

Doctor of Philosophy

Dissertation: THE ROLE OF MANAGEMENT ACCOUNTING INFORMATION ON CONTINUOUS IMPROVEMENT

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