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**AN EMPIRICAL STUDY ON QUALITY MANAGEMENT PRACTICES,
ORGANIZATION PERFORMANCE AND SUPPLIERS' SELECTION IN
SOUTHERN MINNESOTA MANUFACTURING FIRMS**

**A THESIS
SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL
OF MINNESOTA STATE UNIVERSITY,
MANKATO, MINNESOTA**

BY

RACHEL Y. AWOKU

**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF**

**MASTERS OF SCIENCE
IN
MANUFACTURING ENGINEERING TECHNOLOGY**

**HARRY C. PETERSEN, CHAIR
CRAIG T. EVERS
GUANGHSU A. CHANG**

APRIL, 2012

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RACHEL Y. AWOKU

**THIS THESIS HAS BEEN EXAMINED AND APPROVED BY THE
FOLLOWING MEMBERS OF THE THESIS COMMITTEE.**

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ABSTRACT

Quality management systems (QMS) have been widely applied successfully by many manufacturing companies to improve their process, increase profits and organizational performance. The most applied of the quality programs are ISO 9001, Total Quality Management (TQM), Just-In-time (JIT), Lean Management and Six Sigma. Although past studies on quality management have identified and studied the implementation of quality management practices, there is little or no research on quality management practices and business performance in Southern Minnesota manufacturing companies. Many researchers have concluded that the implementation of quality management practices has led to significant improvements in companies' business performance while others have established that it does not. In addition, no research has been conducted to identify the factors considered by Southern Minnesota companies in the selection of suppliers to ensure satisfaction from the suppliers. A review of literature on quality management systems and organization's performance was carried out. The major

objective of this study is to develop and propose the conceptual framework and research model of quality management practices implementation in relation to organization performance particularly in Southern Minnesota manufacturing firms. And also to identify the most important factors considered in suppliers' selection in the companies. A survey was conducted involving Southern Minnesota manufacturing companies. The survey aims to investigate the current quality management practices in manufacturing industries in Southern Minnesota. In this study, focus was the relationship between quality management practices and organization performance. The results of the survey conducted on the companies found that implementation of the quality practices affects organizations' performance positively. Also, that the three most important factors considered in supplier selection by the companies is quality, on-time delivery and commitment. This is contrary to much research that has established that three most important factors in suppliers' selection by manufacturing companies are quality, cost and on-time delivery. This study provides useful information for further improvement of quality management practices and the current situation of quality management practices in Southern Minnesota manufacturing industry.

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DEDICATION

This thesis is dedicated to God for always being there for me. To everyone who believes in me. And to everyone who believes that 'Knowledge is Power'.

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CHAPTER ONE

INTRODUCTION

1.1 Background

In today's business world, many manufacturing companies have found themselves in a great competition for survival; this has driven companies to constantly desire to improve the quality of their products and reduce cost. Many of these companies are ready to make drastic changes according to the demands of the market in order to be ahead of their competitors, but there is a constant need for maintenance and continuous improvement of quality management practices. The findings of a recent study state that after implementation of quality systems, many do not improve their processes continuously. It was suggested that companies strive to perform best in quality practices associated with the quality management system implemented (Zu, Fredendall, & Robbins, 2006). While for many other companies, after the implementation of continuous improvement and successfully reducing costs, time and waste while increasing quality, they are now looking at the external factors affecting their processes and production in order to get optimal results.

1.2 Problem Statement

Although quality systems continue to gain popularity and awareness in the United States and abroad, a surprising number of manufacturing companies do not have effective quality systems established. Many critics have proposed that the responsiveness to the importance of implementing effective and efficient quality practices which would give the country more edge in the world market by high quality standard has not been remarkable. There are problems of lost time and increased costs that cannot be regained. Manufacturing industries can lose lots of money as a result of not using significant opportunities to increase the quality of their manufacturing processes and products. Most of these companies are uneasy about the cost of implementing quality practices, that is, preventive costs, appraisal costs and failure costs. The preventive costs provide the tools and training for reducing wastes in manufacturing processes (Rodchua, 2006).

The ability to meet customers' expectations and even exceed these expectations by improvement initiative of excellence is very essential for firms' survival. Manufacturing companies should shift attention from the cost of implementing quality practices and focus on the sustainability, as they stand to gain from these practices. One of the basic aims of adapting a quality process is to consistently improve value to customers (Stamatis, 2004, p. 23). According to a study by Chuck Cox, Master Six Sigma Black belt, for companies that do not conduct ongoing continuous improvement, their costs of quality could be between 20 to 35% of the revenue stream, or equal to the product's

selling price; 25% of such costs can be reduced by half through continuous effort in every year and six months (Anderson, 2011).

Furthermore, companies need to emphasize high quality with their suppliers. Many organizations now select suppliers that have implemented continuous improvement programs, as they know that by the supplier reducing its waste and costs, invariably, the cost of their parts will be less costly and of the best quality. In supplier selection, one of the main factors needed is a good supplier relationship. The existence of a good relationship implies that there is trust and that the supplier may be willing to improve their processes in order to reduce cost of their products when the opportunities arise. This will be a win-win situation for both the supplier and its customer.

There has been extensive research on quality management practices and organization's quality performance, but there is still little known about the effect of quality management practices on companies' business performance in Southern Minnesota, particularly in the manufacturing industry. Those manufacturing companies that have adopted quality management practices need to know which practices are important in improving overall performance. Therefore, the studying of the importance of quality management practices on the quality performance of a company is essential.

1.3 Objectives

This research project attempted to understand the common quality tools and quality practices within Southern Minnesota manufacturing firms and to evaluate the contribution of existing quality systems toward the company's overall performance. Also, an attempt was made to analyze quality as an important factor for suppliers' selection for these companies' suppliers. The primary objectives are to:

- Establish quality practices
- Analyze quality performance
- Analyze factors of suppliers selection for quality products

1.3.1 Establish Quality Practices

This research study made an attempt to establish the quality practices of manufacturing firms in Southern Minnesota. In order to achieve this, data was collected to gain the knowledge of the quality techniques deployed by these firms. Moreover, the data collected was used to assist in measuring the quality performance of the firms. It is important to select an appropriate methodology for this aspect of the research. Detailed information on data collection is expatiated in future sections. A questionnaire was designed to capture the empirical data and establish the existing quality practices.

1.3.2 Analyze Quality Performance

This research study also analyzed the quality performance of manufacturing companies in Southern Minnesota which have adopted a quality program. It was anticipated that this analysis will help in validating whether the implementation of a continuous improvement technique helps in highly satisfactory sales growth and overall organizational performance.

1.3.3 Analyze Factors of Suppliers Selection for Quality Products

In this research study, the factors considered by Southern Minnesota companies were presented and ranked according to their importance to the companies. This helps in establishing which factors of supplier selection are most crucial to these companies in adequately selecting the best suppliers for their parts and raw materials. Supplier selection is important in achieving reduction in cost and delivery time and indirectly improves the quality of products and also the manufacturing costs and lead time (Askoy & Ozturk, 2011, p. 6351). The selection of suppliers is very important in Supply Chain Management (SCM) for the reduction of costs and adequately satisfying customers. Organizations now find it true that in order to satisfy customers, they have to make sure that their suppliers are committed to quality just as they are themselves (Russell & Taylor, 2009, p. 67)

1.4 Research Questions

Based on the objectives of this study and extensive literature review, three main research questions were proposed. There are :

Question 1: What are the quality management practices implemented in Southern Minnesota manufacturing companies?

Question 2: What is the correlation between the quality management practices and organization's performance?

Question 3: What are the factors considered in suppliers' selection by the Southern Minnesota manufacturing companies to ensure high quality standards from suppliers?

1.5 Scope

This research study included the manufacturing firms located in Southern Minnesota only. However, relevant literature that was used came from all around the world to best understand quality systems and techniques. The study was planned to use the appropriate methodology for data collection. Also, limiting factors like time and small sample size determined the level of data collected and prevented a random selection procedure. The sample was in the manufacturing industry, specifically companies with Precision

Manufacturing Association membership. Furthermore, findings may not be generalizable to other forms of businesses aside from manufacturing.

1.6 Methods and Procedures

In order to achieve the goals of this research, the following steps were taken:

- **Develop a Questionnaire:** A questionnaire was developed to capture the required data for this research. The questionnaire was designed to be concise and straightforward. In designing the questionnaire, the objectives of the research were focused so as to capture adequate data from the survey.
- **Determine sample:** The research population consists of manufacturing companies in Southern Minnesota. The list of intended companies for the survey of this research was obtained from the Journal of Minnesota Precision Manufacturing Association Magazine's 2011 Buyer's Guide. The companies contacted were selected based on whether their companies' manufacturing facilities are located in Southern Minnesota.
- **Conduct a Survey:** For this study, an online survey was carried out. This enabled proper and efficient data collection. The copies of the consent form, cover letter and questionnaire were sent through emails to the companies' CEOs, production

managers, engineers and supervisors to notify them about the research and its objectives. This was carried out in an attempt to provide a realistic representation of the organizations.

- **Collect data:** The responses from the survey were received via e-mails. The empirical data was compiled, recorded and stored. The data collected was then preserved and analyzed. It was expected to have the ability to be validated by repeating the survey and to assist in realizing the objectives of the research.
- **Analyze data:** This is a very important aspect of the methodology. The data and responses from participating companies were used as empirically based factors and measures to the quality practices model. This helped to establish the reality of the present quality practices in manufacturing companies in Southern Minnesota.

1.7 Organization

This research report is divided into five chapters. Chapters one and two are the introduction and literature review respectively. The third chapter presents the methodology for data collection to be deployed. Chapter 4 consists of data analysis and the results of the research. Chapter 5 details the conclusion from the research findings.

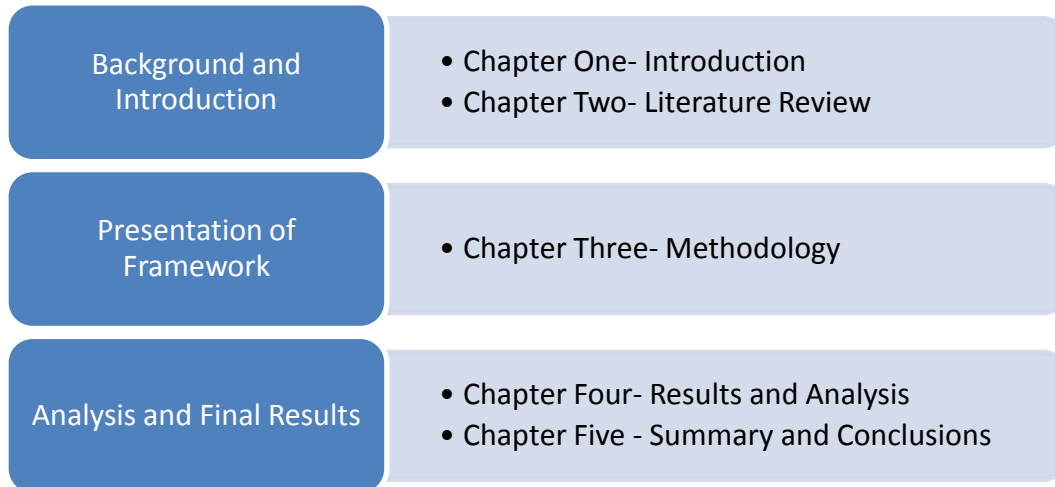


Figure 1.1 Organization of study

CHAPTER TWO

LITERATURE REVIEW

2.1 Background Literature

In both manufacturing and service organizations, the journey of quality has come a long way. In this chapter the overview of quality management is discussed. It traces the history of quality and its present state in the manufacturing industry and describes various findings of researchers and academics. The most commonly deployed quality programs, ISO 9000, TQM and Six Sigma will be discussed. The Six Sigma quality technique is the most recently developed, it brings out the best through existing quality methodologies and improvement practices (Goeff, 2001, p. 6).

2.2 Quality as a Tool

Quality has become a strategic weapon being used by companies. A company with good quality has the tendency to have market share above its competitors. Many manufacturing companies have realized the importance of quality. There are different ways of defining quality. 'Today there is no single universal definition of quality. Some people view quality as performance to standards; others view it as meeting the customer's needs or

satisfying the customers' (Dan & Nada, 2010). In order to ensure total quality in manufacturing, the definition of quality needs to be defined from customers' perspectives. ISO defines quality as *the degree to which a set of inherent characteristics fulfills requirements*. To fulfill requirements is to meet customers' needs and regulatory requirements. Today, the importance of quality is greater than it has ever been. The difference between one organization and another or between one product and another is generally perceived in relation to the product or service of the company. The questions many now ask is what is quality and how does it profit an organization (Goeff, 2001, p. 1).

In manufacturing, quality is best defined in terms of *conformance, performance, reliability, features, durability and serviceability* of a product. Conformance is the degree at which a product's characteristics meet set standards, while performance shows how the product functions efficiently. Reliability is the probability that a device will perform its required functions under stated conditions for a specific period of time. Also, it is important that the products produced have features that would enable their efficient usage and to have durability and be easily repaired.

2.3 Evolution of Quality Methods in Manufacturing

The concept of quality management systems has existed for many decades. In the 1930s, Walter Shewhart at Bell Laboratories inspired the use of statistics to identify 'best

practice' in the USA. This discovery has evolved over many years into control charts and in the US was adopted by manufacturing industries before 1950. During World War II in the 1940s, quality control charts and statistical techniques were deployed to monitor production process and evaluate quality respectively (Goeff, 2001, p. 4). In the 1950s and 1960s, W. Edwards Deming and Joseph Juran saw the importance of pursuing perfection by applying quality principles and techniques to processes and management of organizations. With the U.S dominating world manufacturing, there was no practical interest in quality practices. Deming and Juran were invited to Japan to lecture on statistical quality control (Goeff, 2001, p. 4).

In the 1970s and 1980s, many U.S companies lost market share to foreign competition. Foreign manufacturing companies were producing lower-priced products and better quality. As the West continued to add luxury to products in order to sell at higher prices and increased profits, the East was busy adding quality to products in order to produce items better and cheaper (Goeff, 2001). In order to increase quality awareness, the ISO family standards and Malcolm Baldrige National Quality Award were established in 1987. The Malcolm Baldrige National Quality Award was established to recognize U.S organizations for their achievements in quality and performance, and also to raise awareness about the importance of quality and performance excellence as a competitive edge. The ISO family of 9000 standards represents an international consensus on good quality management practices (ISO, 2011). By this period, many companies also started

adopting the Total Quality Management (TQM) program and significant gains were realized. Others that adopted the program failed as they were not willing to change.

The Six Sigma technique is the latest quality program that is being presently adopted by some large companies (Gooff, 2001,p. 6). Motorola in 1982 developed initial six sigma tools to help to reduce costs and improve quality. This later led to their winning of the Malcolm Baldrige National Quality Award in 1988. In 1995, General Electric also adopted the technique.

Presently in the United States, many manufacturing companies have adapted one form of quality or another. Table 1:1 shows the U.S as one of the top 10 countries with ISO certificates ranked number 9 based on a survey in 2009.

Table 2.1: Top 10 countries for ISO 9001 certificates (Source: ISO Survey 2009)

Rank	Country	No. of certificates
1	China	257,076
2	Italy	130,066
3	Japan	68,484
4	Spain	59,576
5	Russian Federation	53,152
6	Germany	47,156
7	United Kingdom	41,193
8	India	37,493
9	USA	28,935
10	Korea, Republic of	23,400

2.4 Quality Systems in Manufacturing Industries

During the past years, a variety of quality methods have been deployed in the manufacturing industry. The major common methods are; the ISO standards, Total Quality Management (TQM) and Six Sigma. According to Sousa-Poza et al. (2009), the first family of standards issued in 1987 applied to quality management systems and not products. The standards consisted of five quality standards. ISO 9000 and ISO 9004 are guidelines which pertain to the development of quality systems within an organization. The 1987 standards were proposed for quality assurance, which is a means of verifying conformance with procedures rather than the overall process of management. It was condemned for the lack of encouragement for business improvement and no reasonable reference to customer satisfaction (Al-Najjar & Jawad, 2011). After scaling through series of modifications, the latest series of ISO standards is the ISO 9001: 2009; this set of standards stressed, strongly, the role and commitment of top management in the implementation of the standards. In their study, Lamport et al. (2010) stated that, despite the great evidence about the benefits of ISO 9000, it is still debatable as to whether or not the standards improve business performance and profitability. The authors attempted to evaluate empirically the impact of ISO 9000 on the financial performance of a sample of companies in Singapore. The study discovered that there is an association between ISO 9000 certification and the overall financial performance of the companies studied. Though the ISO standards have a final goal, once a certificate has been issued, there is practically no motivation for further improvement by many companies.

Due to attempts to deploy better-quality practices, manufacturing and production procedures have utilized the principles of Total Quality Management (TQM) in achieving practically zero defects. TQM is an integrated management philosophy and set of practices that emphasizes, among other things, continuous improvement, management leadership and commitment, total customer satisfaction, employee involvement, training and education, reducing rework, and closer relationship with suppliers (Powell, 1995). In his book, Goeff (2001) stated that despite the successes of TQM, many companies rely profoundly on standardization approaches, as TQM is too empirical in its application and lacks not only a scientific and firm measure of success, but also a definite goal.

Many firms have adopted the Six Sigma as a tool to increase their performance and strength in the competitive market. The Six Sigma phenomenon has followed the Total Quality Management (TQM) movement as the latest thrust for many companies seeking to improve their performance and effectiveness (Henderson & Evans, 2000, p. 260). TQM is a unique quality methodology that contributes immensely to the Six Sigma approach. One of the main differences between TQM and Six Sigma is that the latter provides the vision, goal and analysis tools needed in continuous improvement.

The Six Sigma is a methodology that reduces costs and improves customer satisfaction by reducing waste in the processes involved in the production of products and services. It uses data, measurements and statistics to identify the vital factors that will help in

decreasing waste and increasing profits and customer satisfaction (Brue, 2006). Over the years, many large companies have implemented the Six Sigma principles and great successes have been recorded. The “Everybody Plays” culture was adopted by General Electric Appliances (GEA), which entails their suppliers participating in GE’s Six Sigma culture (Hendricks & Kelbaugh, 1998, p. 51).

Several organizations that implement Six Sigma have discovered that it is profitable for them to widen the principles to their supply chain (Jiju & Banuelas, 2002, p. 23). Most of these firms had drastic results by simply streamlining their operations, improving quality and eliminating defects. Six sigma can be said to be proactive, as it focuses on changing and improving processes so that less defects and errors arise, rather than reactive; fixing errors after the fact (Harry & Schroeder, 2000, p. 2) . According to Goeff (2001), the Six Sigma approach proclaims the real meaning of quality to be “total customer satisfaction”. And the three keys to achieving total customer satisfaction are; the customer, the process, and the employee. The needs and demands of the customers have to be understood and an efficient business process put into place with competent employees working in daily compliance in order to achieve customer satisfaction.

2.5 Introducing the Six Sigma Business Scorecard

The Six Sigma Business Scorecard was developed by Gupta (2004) and it incorporates proven business improvement practices. It advocates a drastic rate of improvement while

holding the leaders accountable for business success through their dedication and active involvement. Gupta (2004) stated that the Six Sigma Business Scorecard allows the viewing of each business process as a collection of processes which enables the monitoring of the management of each business process using performance measurements (Gupta, 2004, p. 68). Table 2.2 shows the main factors needed to be considered for the successful implementation of the Six Sigma Scorecard. The measurements are crucial tools used to identify opportunities for improvements by monitoring progress and informing the leadership about the state of the business (Gutpa, 2004, p. 100).

Table 2.2: Six Sigma Business Scorecard Measurements

Categories	Objectives	Sample Measurements
Leadership and Profitability (LNP)	Lead company to wellness and profitability	<ul style="list-style-type: none"> • Communication • Inspiration • Profitability
Management and Improvement (MAI)	Drive dramatic improvement	<ul style="list-style-type: none"> • Goal setting • Rate of improvement • Planning for improvement
Employees and Innovation (EAI)	Involve employees intellectually	<ul style="list-style-type: none"> • Recommendations per employee
Purchasing and Supplier Management (PSM)	Reduce cost of goods or service	<ul style="list-style-type: none"> • Total spend/sales • Suppliers defect rate (sigma) • Cost of goods/service sold
Operational Execution (OPE)	Achieve performance excellence	<ul style="list-style-type: none"> • Operational cycle time • Process defect rate (cp, cpk) • Customer defects/total • Sigma level
Sales and Distribution (SND)	Manage customer relationships and generate revenue	<ul style="list-style-type: none"> • New business (\$)/total sales (\$) • Profit margins (%)
Service and Growth (SAG)	Gain competitive advantage and grow	<ul style="list-style-type: none"> • Customer satisfaction • Repeat business (\$)/total sales (\$) • New product or services introductions

In literature, there are few studies that have proposed critical success factors (CSFs) for the implementation of Six Sigma. In a study, Coronado and Antony (2002) empirically investigated critical success factors in UK Small and Medium Enterprises (SMEs) in order to determine the implementation status of Six Sigma in that country. Eleven CSFs

were identified in the study; management involvement and commitment, cultural change, communication, organization infrastructure, training, business strategy, customer satisfaction, employee involvement, buyer-suppliers relationship, training, project management skills, project prioritization and selection. In another study, after a survey research carried out on 100 Slovenian manufacturing companies, it was concluded that the most critical factors for the successful implementation of Six Sigma in Slovenian manufacturing companies are management involvement and participation, employee training, organizational and cultural aspects (Gosnik & Vujica-Herzog, 2010).

El Safty (2011) developed critical success factors from literature of which management engagement, communication, training, monitoring progress are the most critical for implementing Six Sigma in the manufacturing industry in Egypt.

In his book, Gutpa (2004) listed seven elements of the Six Sigma Scorecard which can be said to be critical factors in implementing Six Sigma and used to measure and monitor the Six Sigma processes. These are; leadership and profitability, management and improvement, employees and innovation, purchasing and supplier management, operational execution, sales and distribution and service and growth.

2.6 Suppliers' Selection in the Manufacturing Industry

In many manufacturing firms, the selection of capable suppliers will help reduce waste in terms of quality and time. There is constant emphasis on quality and timely delivery

which has taken outsourcing and supplier selection decisions to an entirely new dimension (Sean, 2006). Suppliers contribute to the overall performance of a supply chain. Poor supplier performance affects the whole chain (Aarkar & Mohapatra, 2006). Therefore, the process of supplier selection is a very important task for the procurement department. Due to the need to have the right materials and parts at the needed time and affordable costs, many organizations have a large supplier base. This on one hand has proven to be a great disadvantage to organizations as they have to sometimes deal with a lot of unreliable suppliers which may have found their way into the pool.

In a competitive manufacturing environment mostly controlled by customers' demands and unrelenting strife to survive in the present harsh economy, there is need for organizations to improve their supply chain and reduce waste by adequately selecting suppliers who are capable and reliable in delivering materials with the required quality on time and at affordable prices. The selection of suppliers is very important in Supply Chain Management (SCM) for the reduction of costs and adequately satisfying customers. Organizations now find it true that in order to satisfy customers, they have to make sure that their suppliers are committed to quality just as they are themselves (Russell & Taylor, 2009, p. 67).

In the process of selection of suppliers, the precise rules are not always well- established. In general, there is a logical way to handle the problem (Askoy & Ozturk, 2011, p. 6532). It was concluded in one study (Dickson, 1966, p. 5) that the most important criteria for

supplier selection are quality, delivery and performance history. In research, there have been many different approaches used for supplier selection. Braglia and Petroni (2000) applied Data Envelopment Analysis (DEA) to measure the efficiencies of suppliers by evaluating nine factors. In order to strategically reduce the number of suppliers and selecting suppliers with greater supply variety, Liu et al. (2000) suggested a simplified DEA model which evaluates the overall performances of a supplier. Sean (2007) proposed the application of imprecise data envelopment analysis (IDEA) for the selection of the best suppliers in the presence of both cardinal and ordinal data. The integration of analytical hierarchy process (AHP) and linear programming was implored by Ghodsypour and O'Brien (1998) in considering both tangible and intangible factors in the selection of suppliers. Another integration of methods was proposed by Ting and Cho (2008); they applied the AHP to select suppliers and also multi-objective linear programming (MOLP) model for optimal allocations of order quantities to the candidate suppliers. Important and critical decision criteria including risk factors for the development of an efficient system for global supplier selection were identified by Chan and Kumar (2007), with the application of fuzzy extended analytic hierarchy process (FEAHP)-based methodology to select suppliers.

2.7 Quality Performance in Manufacturing

With the adoption and implementation of one form of quality management system or the other, there is great enthusiasm among manufacturing industries in the maintenance of

their attained competitive lead. Due to this, many manufacturing companies have been interested in monitoring their quality performance in the overall organization's performance. There are numerous studies that have examined the correlations between quality management practices and various performance measures. For example, a study (Talib et al., 2010) developed and proposed the conceptual framework and research model of TQM implementation in relation to company performance particularly in context with the Indian service companies. It examined the relationships between TQM and a company's performance by measuring the quality performance as a performance indicator. The theoretical model was proposed to help companies to gain a better understanding TQM practices by focusing on identified practices while implementing TQM in their companies.

Different indicators used for measuring organizational performance have been identified from literature. Most of the research (Prajogo and Sohal, 2004; Feng et al., 2006) agree that quality performance and innovation performance are indicators of organizational performance. Others (Lin et al., 2005; Zakuan et al., 2010) stated that employee satisfaction, business results and customer satisfaction are indicators for organizational performance. Research for quality management by Flynn et al. (1994) suggested that the inputs of the framework are quality management practices while quality performance represents outcomes. A study conducted by Jeng (1998) on ISO certified organizations in Taiwan examined the relationships between six quality practices and quality performance. It was found that customer focus was the least of the practices. An

empirical study carried out by Arumugam et al. (2008) on the relationship of TQM practices and quality performance on manufacturing companies in Malaysia through multiple regression and correlation analyses showed that there was partial correlation of the quality practices with quality performance.

The results of a study (Galloway, 2007) indicate that a firm's ability to track the status and financial outcomes of all Six Sigma projects, the maturity of the implementation, the selection of strategically-aligned projects, the integration of Design for Six Sigma (DFSS) into projects, and the breadth of the implementation have a statistically significant impact on subjective and/or objective performance measures. In another research study (Arumugam et al., 2009), it was revealed that the strengths of an organization's quality management implementation lie in customer focus and process management. It was also concluded that there existed a satisfactory level of practices in leadership, strategic planning, human resource development and management. On the other hand, supplier relationship and information and analysis both received only moderate scores. It was suggested that more focus be put on improving supplier quality and relationship management and the information distribution system.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The conceptual model of this study is based on the literature review and was developed to identify quality management practices and explore their correlation to a company's overall performance and profitability by measuring quality performance as a performance indicator. Based on the objectives of the study, a questionnaire was developed which included questions on organizational profile, organizational quality practices, a firm's quality expectations from suppliers, and organizational performance. All these were developed to obtain details in the aspects of customer focus, buyer-supplier relationships, leadership and overall performance.

3.2 Research Hypotheses

To explore the relationship between identified quality management practices, the constructs for the analysis of quality performance were obtained from the literature research of the study. The Six Sigma Scorecard criteria (listed and explained in Chapter Two) were used as the foundation of the constructs of the quality performance analysis.

They were combined with other constructs from literature (Liu et al., 2000; Humphreys et al., 2004) to give a more general analysis of organization's performance and a total of twelve constructs were adopted.

Thus, the constructs adopted as independent variables for analyzing quality management implementation were *leadership-employees communication, on-time delivery, competitive prices, quality products, overall competitive, new businesses, customer satisfaction, new product or service, employee inspiration, assets utilization, employee compensation & profit sharing*. *Sales growth* was adopted as the dependent variable. Based on the empirical research findings from the literature review of this study, the following hypotheses were proposed:

H1: There is a positive effect of quality management practices on quality performance in Southern Minnesota companies.

To capture the relationship between the implemented quality management practices and business performance, the following hypotheses are adopted:

H1₁: There is a positive correlation between leadership-employee communication and business performance

H1₂: There is a positive correlation between on-time delivery and business performance

H1₃: There is a positive correlation between competitive prices and business performance

H1₄: There is a positive correlation between quality products and business performance

H1₅: There is a positive correlation between overall competitive and business performance

H1₆: There is a positive correlation between new businesses and business performance

H1₇: There is a positive correlation between customer satisfaction and business performance

H1₈: There is a positive correlation between new products or service and business performance

H1₉: There is a positive correlation between employee inspiration and business performance

H1₁₀: There is a positive correlation between assets utilization and business performance

H1₁₁: There is a positive correlation between employee compensation/profit sharing and business performance

H2: There is no or negative effect of quality management practices on business performance

H2₁: There is no or negative correlation between leadership-employee communication and business performance

H2₂: There is no or negative correlation between on-time delivery and business performance

H2₃: There is no or negative correlation between competitive prices and business performance

H2₄: There is no or negative correlation between quality products and business performance

H2₅: There is no or negative correlation between overall competitive and business performance

H2₆: There is no or negative correlation between new businesses and business performance

H2₇: There is no or negative correlation between customer satisfaction and business performance

H2₈: There is no or negative correlation between new product or service and business performance

H2₉: There is no or negative correlation between employee inspiration and business performance

H2₁₀: There is no or negative correlation between assets utilization and business performance

H2₁₁: There is no or negative correlation employee compensation/profit sharing and business performance

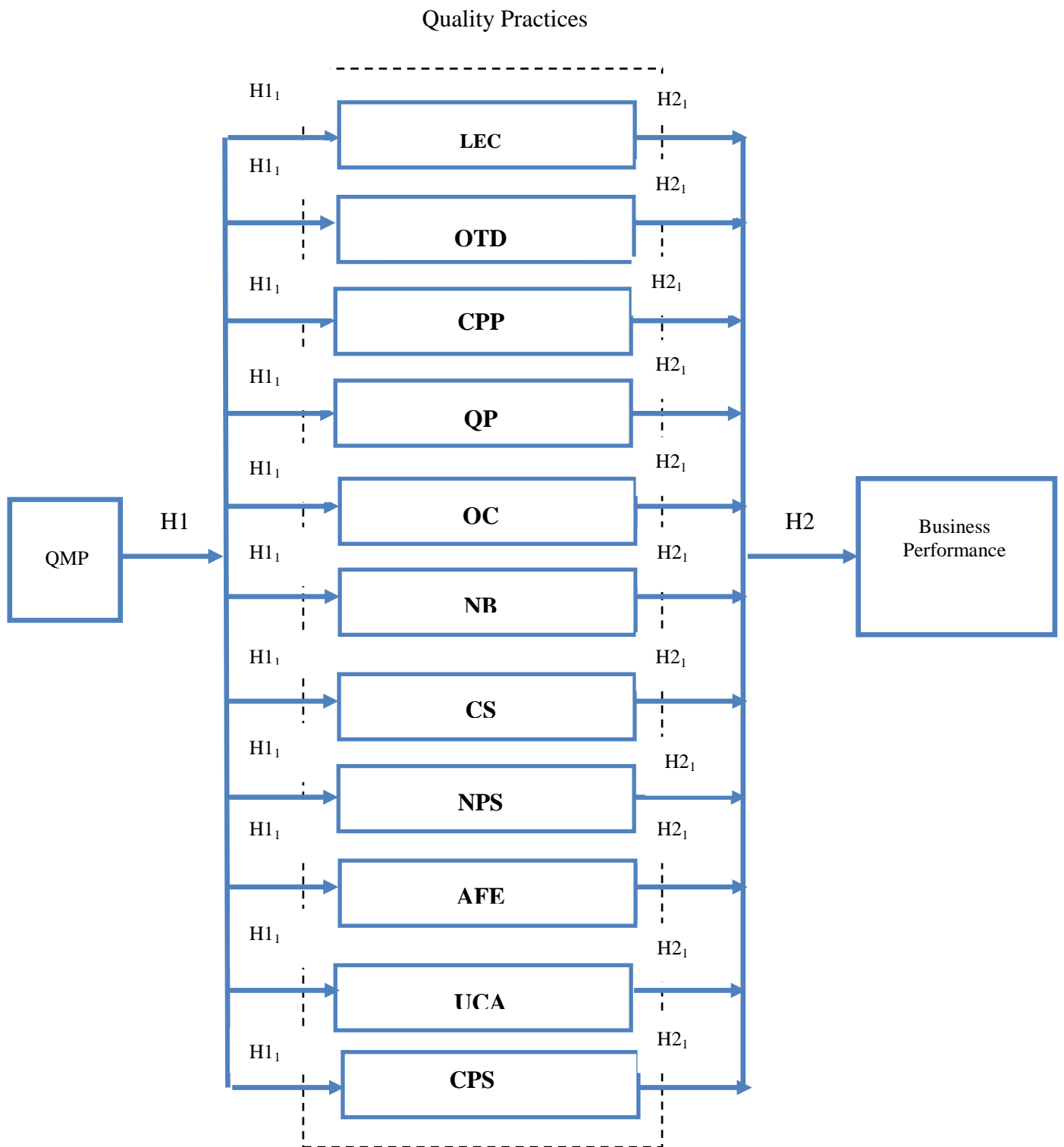


Figure 3.1: Research Framework

3.3 Research Model

From the above hypotheses, the proposed model for the research is developed and displayed in Figure 3.1. The figure shows the constructs of the quality management practices on the left side of the model and the construct for business performance on the right. Though the eleven constructs are regarded as independent variables, there might be some relationships among them. These relationships are however beyond the scope of this study.

3.4 Questionnaire Construction

The first section of the questionnaire was developed to capture the background of the organization and the size of the firm (Appendix B). The second section was intended to establish whether any quality management systems or quality improvement techniques are deployed in the firm and to indicate which ones. For this section the constructs were adapted from a previous study (Bradley, 2006) that established the quality management practices by organizations.

The third section consisted of items that rank factors considered by the firm for suppliers' selection. A five point Likert scale (1= Strongly disagree; 2= Disagree; 3= Neutral; 4= Agree; 5=Strongly agree) was used. Also, respondents are given directions to answer the questions based on the firm's performance over the past two years. This was in

anticipation that quality performance of the companies has been affected by implemented quality practices within the last two years. The constructs were also adopted from the literature research (Li et al., 2011).

In order to measure the overall business performance, the sales growth and annual profit of the respondents were requested (Appendix B). In this study, the company's quality performance was measured by adopting the sales growth as a performance indicator (Talib et al., 2010; Zhang et al., 2000). All the remaining eleven constructs were adopted as independent variables as they are all put in place to increase sales growth and annual profit of the company. The strategic business performance which is the final result of a manufacturing company can be measured in terms of sales and profitability (Zhang et al., 2000). Each construct was measured on a 5-point scale of "1= Never; 2= Seldom; 3= Sometimes; 4= Often; 5= Always" in section IV of the questionnaire.

3.5 Data Collection

The research survey instrument was used to collect empirical data through an online survey to 52 manufacturing companies in Southern Minnesota. The major advantage of an online survey is its lower or no cost compared to other methods. The sample target was manufacturing firms in the 39 southern Minnesota counties (Figure 3.2). Ideally, every company in the population should be questioned especially in a small population, but usually the best that can be done is to take a sample of the population and generalize

the findings to the whole population. (GAO, 1993). The questionnaire was sent to the companies via company's email address and it was requested that respondents who were familiar with the quality programs in their companies answer the survey questions. Attached to the emails sent to the target sample were the cover letter, consent form and the questionnaire (Appendix A).

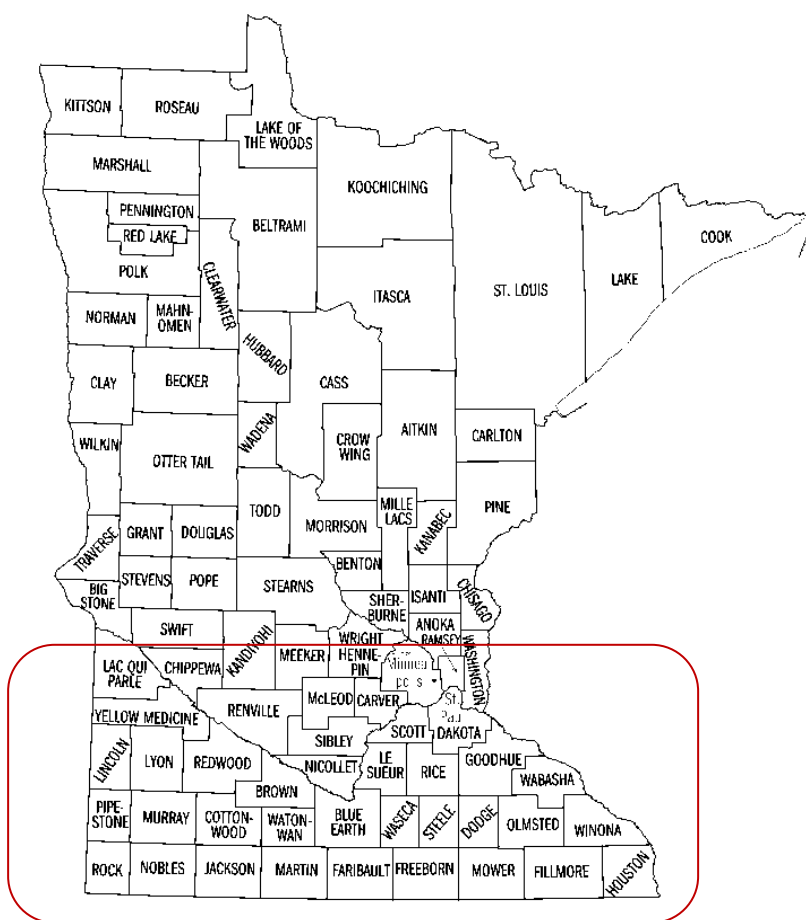


Figure 3.2: Map of Minnesota State showing the sample target

The research respondents consisted of CEOs, Presidents, Vice-Presidents, quality managers, quality engineers and plant managers. The emails were sent to the target

sample. An initial set of e-mails was to the companies and another set was sent as reminders on the participation in the survey.

3.6 Research Response

The number of companies that the emails were sent based on their location and business were 52. A total of 17 companies responded to the survey resulting in an overall rate of 32.6 percent. Because of the limited sample size of these self-selected responses, inferences can be drawn, but not firm conclusions. The survey was conducted via emails as it is generally faster in delivery and cheaper than other methods. It is one of the most appropriate methods of obtaining data from a sample of a population in various locations.

3.7 Discussion

This chapter has explained in detail the methodology deployed for the research to collect and analyze the required data. The construction of the questionnaire was one of the most crucial aspects of this research as it was used for collection of data and information. The target sample was informed of the survey and data was collected from respondents. It is expected that the findings of this survey will assist in identifying the needs for more awareness of the importance of continuous improvement through quality management practices.

CHAPTER 4

SURVEY RESULTS AND ANALYSIS

4.1 Introduction

The data obtained from the respondents of the survey and the survey results are presented in this chapter. The general profile of respondents is first presented. It also presents the quality management practices implemented in Southern Minnesota manufacturing companies. The critical success factors will help to analyze the current level of involvement of these practices.

A closer look at the mean of quality management practices that these responding Southern Minnesota manufacturing companies have scored throughout their firms will help to reveal their current level of involvement in quality management systems. And by analyzing the results, a rough idea on what is lacking in implementation and the potential weaknesses among the companies that need to be focused on will be revealed. Also, a test of significance between the means of the factors of suppliers' selection is carried out to highlight any differences between the factors of selecting suppliers.

Lastly, the overall perception of Southern Minnesota manufacturing companies on success factors is presented. This will help to identify the major setbacks of the firms in the implementation of quality management systems.

4.2 Profiles of Respondents

The respondents for the survey represent various sizes and different manufacturing businesses. The major businesses of the respondents are plastics molding, power generation, machining, metal fabrication and tools. From the survey feedback, the main positions of the respondents were CEOs, Quality managers, Plant managers, Quality engineers and Supervisors. These respondents were contacted as they are in the best position to have the knowledge of the quality practices in their companies. For this study, the companies will be categorized by their sizes. The classifications of the respondents in terms of their sizes are shown in Table 4.1.

Table 4.1: Classifications of the respondents in terms of company size

Category	Size of Industry	Number of Respondents	Percentage %
A	<50 Employees	5	29.4
B	51-200 Employees	8	47.1
C	201-500 Employees	2	11.8
D	501-1000 Employees	0	0
E	>1000 Employees	2	11.8
	Total	17	100

The category with the largest proportion is category B constituting 47.1% of the respondents and has a size between 51 to 200 employees. Category A has 29.4% of the total number of respondents and has less than 50 employees. Categories C and E have the same number of respondents and they represent 11.8% of the respondents and have numbers of employees between 201 to 500 and greater than 1000 respectively. There were no respondents in Category D from the survey. For this study, a small company is defined as a firm with less than 200 employees while a large company is a firm with more than 200 employees.

Table 4.2: The status of Quality Management Practices

Quality Practice	Number of companies	Percentage of total %
ISO 9000	14	82.4
Total Quality Management	4	23.5
Six Sigma	1	5.9
Lean Manufacturing	7	41.2
Just-In-Time	4	23.5
Other	1	5.9
None	1	5.9
Total number of companies	17	

Note: some companies have more than one quality practices

One of the main objectives of this study is to establish the level of involvement of Southern Minnesota manufacturing companies in quality practices. The various types of quality management systems implemented by the respondents are shown in Table 4.2.

These results indicate that there is high awareness of one or more forms of quality practice in the majority of the companies. This also shows that there is a high degree of understanding of the importance of quality practices.

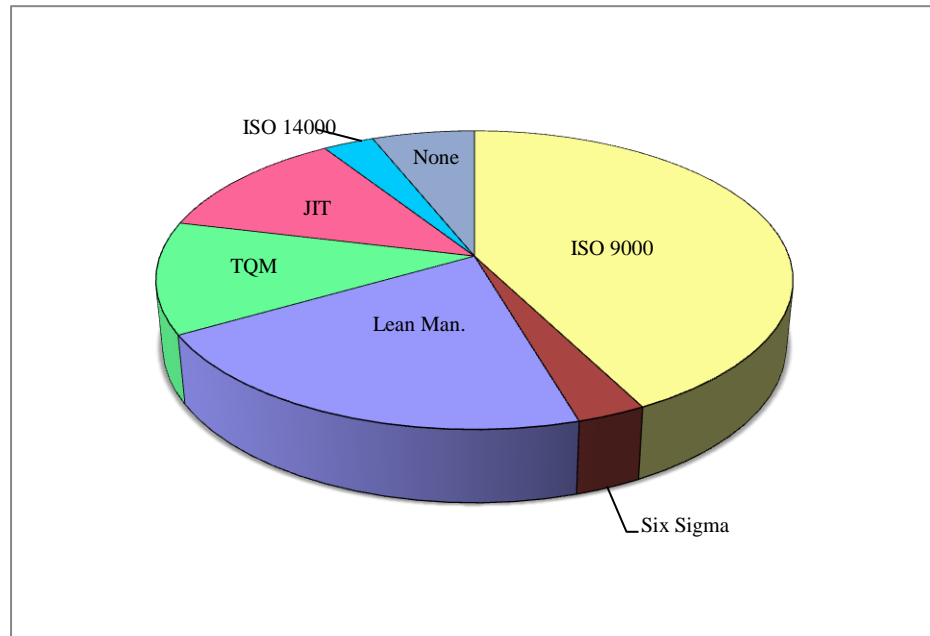


Figure 4.1: The level of implementation of Quality practices

It can be seen that the major common quality management practice is ISO 9000, which is implemented in 14 companies. That represents 82.4% of the respondents. The results indicated that 41.2% of the respondents have TQM implemented. Only 1 of the respondents have implemented the Six Sigma program, while another said they have no quality management practice implemented. Figure 4.1 gives a graphical overview of the level of implementation of quality practices by the respondents.

4.3 The level of Performance of Quality Activities

4.3.1 Descriptive Analysis

In order to examine the degree to which the quality practices are being applied in the companies, their performance was measured by a list of quality features which was included in the questionnaire for the survey. The mean of the level of performance based on the practices of the features are summarized and ranked in Table 4.3. Because the self-selected sample of respondents was relatively small, 17 respondents out of 52 questionnaires, the inferences are suggestive but not definitive.

Table 4.3: Descriptive statistics for quality performance

Rank	Quality attributes	Mean
1	Quality Products	4.47
2	Customer Satisfaction	4.24
3	Competitive Prices	4.12
4	Employees compensation and profit sharing	4.06
5	On-time Delivery	3.94
6	Overall Competitive	3.94
7	New Business	3.94
8	Communication between leaders and employees	3.82
9	Sales Growth	3.77
10	Inspiration for Employees Achievement	3.65
11	Utilization of Assets	3.59
12	New Product or Services	3.41

The three highest quality features with the highest implementation rate were the *quality products*, *customer satisfaction* and *competitive prices*. The highest level of quality

features was *Quality Products* with a mean of 4.47. This shows that the respondents value offering their customers high quality products. This is one of the most important factors that customers seek from their suppliers. This feature of quality is practiced by companies and has been implemented in their daily manufacturing processes. *Customer Satisfaction* had the second highest level of quality features. It can be seen that there is a high utilization of quality activities that enable a high level of customer satisfaction. This also shows that the companies have high interests in meeting their customers' expectations. *Competitive Prices* was ranked as the third highest quality features of the companies. This implies that the companies offer their customers high quality products at competitive prices in order to give customers satisfaction and maximize profit.

The three least level quality features are *Inspiration for Employees Achievement*, *Utilization of Assets* and *New Products or Services*. These can be seen as the least perceived to be achieved by the respondents. Their means 3.65, 3.59, 3.41 respectively are greater than average mean of 2.5 from Likert scale, which means that the respondents often carry out these activities and are considered to be relatively important by the companies though they are ranked the least.

4.3.2 Multiple Regression Analysis

In order to analyze the effect of the eleven constructs on quality performance, a multiple regression analysis was carried out. Once again, because the number of respondents was

relatively small, results are suggestive but not definitive. The eleven constructs were adopted from literature review as the independent variables to evaluate the overall organization performance.

Table 4.4: Regression statistics for quality performance

Regression Statistics	
Multiple R	0.90
R Square	0.80
Adjusted R Square	0.37
Standard Error	0.87
Observations	17

The eleven constructs were adopted from literature review as the independent variables to evaluate the overall organization performance. Sales growth was adopted as the dependent variable. The “R Square 0.80” indicates that 80 percent of the variability in Sales Growth is associated with the eleven constructs. That is, the variance in Sales Growth has been significantly explained by the eleven constructs.

Table 4.5: The ANOVA table for quality performance

	Df	SS	MS	F	Significance F
Regression	11	15.32	1.39	1.86	0.26
Residual	5	3.74	0.75		
Total	16	19.06			

The results presented in Table 4.6 show that Sales Growth is significantly affected by the constructs. Also, the results indicate that the eleven constructs and Sales Growth are highly correlated.

Table 4.6: Results of multiple regression analysis

Model	Coefficients	Standard Error	t Stat	P-value
Intercept	-2.66	3.52	-0.76	0.48
Leadership - Employees				
Communication	-0.46	0.87	-0.54	0.62
On-time Delivery	-0.20	0.86	-0.23	0.83
Competitive Prices	-0.46	0.46	-1.00	0.36
Quality Products	0.34	0.65	0.53	0.62
Overall Competitive	1.02	0.59	1.71	0.15
New Business	0.57	0.63	0.90	0.41
Customer Satisfaction	0.88	0.92	0.96	0.38
New Product or Service	-0.22	0.44	-0.51	0.63
Employees Inspiration	0.82	0.51	1.60	0.17
Assets Utilization	-0.50	0.60	-0.83	0.44
Employees Compensation				
& Profit Sharing	-0.24	0.81	-0.30	0.78

The following model was developed from the results of the multiple linear regression:

$$\text{Business Performance} = -2.66 - 0.46*\text{Communication} - 0.20*\text{On-time Delivery} - 0.46*\text{Competitive Prices} + 0.34*\text{Quality Products} + 1.02*\text{Overall Competitive} +$$

0.88*Customer Satisfaction + 0.57*New Businesses – 0.22*New Product +
 0.82*Inspiration for Employees – 0.50*Utilization of Assets – 0.24*Employees Comp. &
 Profit Sharing

4.4 Suppliers' Selection

One of the main objectives of the research was to establish the factors considered important by the survey respondents in the selection of their suppliers. In this section, the most important factors in the selection of suppliers are investigated and ranked. In the questionnaire for the survey, the respondents were asked to give the importance of each factor and rank them, but only two respondents actually ranked them.

Table 4.7: Ranking of the factors in Suppliers Selection

Factor	Count	Average	Standard deviation	Coeff. of variation	Minimum	Maximum
Quality	17	4.41	1.00	22.75%	1	5
On-time delivery	17	4.12	0.86	20.82%	2	5
Commitment	17	3.71	0.77	20.82%	2	5
Trust	17	3.65	1.17	32.07%	1	5
Location	17	3.59	0.80	22.16%	2	5
Cost	17	3.29	1.05	31.77%	1	5
Involvement in design	17	3.18	0.73	22.91%	2	4
Total	119	3.71	0.99	26.60%	1	5

Due to this, the factors are only by the importance selected by the respondents. The overall mean of the factors in the survey are analyzed, ranked and presented in Table 4.7. The factor with the highest mean is *Quality* with a mean of 4.41 and the second most important is *On-time delivery*, while the least is *Involvement in design* with a mean of 3.17 and the second least important is *Cost* with a mean of 3.29.

CHAPTER FIVE

SUMMARY AND CONCLUSIONS

5.1 Introduction

In this chapter, the results of the analysis of the data collected on the quality practices of Southern Minnesota manufacturing companies and the relationship of these practices are presented and discussed.

5.2 Brief Summary

Although past studies on quality management have identified and studied the implementation of quality management practices, there is little or no research on quality management practices and business performance in Southern Minnesota manufacturing companies. Many researchers have concluded that the implementation of quality management practices has led to significant improvements in companies' business performance while others have established that it does not. In addition, no research has been conducted to identify the factors considered by Southern Minnesota companies in the selection of suppliers to ensure satisfaction from the suppliers. Thus, the main objectives of the study were:

- To establish quality practices
- To analyze quality performance
- To analyze factors of suppliers selection for quality products

The research questions which were proposed to achieve objectives are as follows:

- *What are the quality management practices implemented in Southern Minnesota manufacturing companies?*
- *What is the correlation between the quality management practices and organization's performance?*
- *What are the factors considered in suppliers' selection by the Southern Minnesota manufacturing companies to ensure high quality standards from suppliers?*

In this study, a review of the quality management practices in manufacturing companies was carried out. This started with a literature review on the evolution of quality management in manufacturing companies to quality awards and certificates (ISO certifications and Malcolm Baldrige National Quality Award) to recognize quality performance. Thus, the need to identify quality practices in Southern Minnesota was established.

From the literature review on quality performance, eleven constructs of quality management practices were proposed as independent variables which are important to quality performance: *leadership-employees communication, on-time delivery, competitive prices, quality products, overall competitive, new businesses, customer satisfaction, new product or service, employee inspiration, assets utilization, employee compensation & profit sharing*. The construct proposed for quality performance was *sales growth*. Thus, a research model was developed comprised of 22 hypotheses. A questionnaire was developed in order to achieve the objectives of the study and answer its research questions.

5.3 Conclusions

An online survey was carried out on the manufacturing companies in 39 counties in Southern Minnesota. The sample targets for the survey was chosen based on geographical location and contacted via company email addresses. A total number of 54 companies were contacted and 17 questionnaires were returned with a response rate of 31.5%.

A descriptive analysis of the data collected was carried out. Because the self-selected sample of respondents was relatively small, 17 respondents out of 52 questionnaires, the inferences are suggestive but not definitive. From the analysis, it was found that a majority of the respondents (88.2%) have implemented one or more quality management

practices. The quality management practices implemented are: ISO 900 (82.4%), Lean Manufacturing (41.2%), TQM (23.5%), Just-In-Time (23.5%) and Six Sigma (5.9%).

In order to analyze the correlation of these quality practices on business performance, a research model was developed and hypothesized. A Multiple Regression Analysis was carried out on the data collected in order to test the research model and determine if there is a significant relationship between the implemented quality practices and business performance. From the results, it was found that all the quality practices have positive significant relationship between implemented quality practices and business performance and the null hypothesis was accepted. It was concluded that the practices can be adopted by the implementation of a quality management system in order to achieve high quality products and thereby improve business performance. This finding could help encourage companies that have not implemented any quality management practice to realize the benefits of the practices on their companies' performance. Also, it would encourage continuous improvement in companies which have already implemented a form of quality management system. From testing the research model, the following conclusions were drawn: leadership-employees communication, on-time delivery, competitive prices, quality products, overall competitive, new businesses, customer satisfaction, new product or service, employee inspiration, assets utilization and employee compensation & profit sharing all have positive effects on business performance. There is a need for basic tools and the desire to continuously improve processes by providing guidance and support by skilled professionals and leadership by senior management.

Finally, a descriptive analysis was performed on the limited sample of data collected on factors considered on suppliers' selection by the manufacturing companies. The factors ranked as follows: quality (4.41), on-time delivery (4.12), commitment (3.7), trust (3.65), and location (3.59), and cost (3.29), involvement in design (3.18). The mean score of cost is at a 'good' level as it is above the average score of 3 from the Likert scale. From this analysis, the cost of products is not as important to the companies as quality and on-time delivery of the products, contrary to the literature review that pointed out the three to be the most important in the selection of suppliers by manufacturing companies.

5.4 Research Limitations

There are some limitations on this study. First, the research focused on Southern Minnesota manufacturing companies and the majority of the respondents were small manufacturing companies (SMEs). The results would be more general if large companies had participated. In addition, because participation was voluntary, the sample was self-selecting. Based on this the results of this study may not have represented the whole population but only the group of respondents. Second, the majority of the respondents in the companies were CEOs, so the answers on employee satisfaction may be biased as the employees were not contacted directly for the survey. Third, the customer satisfaction questions were answered by the respondents and not their customers. This may also make the research biased to a degree. Last, the data gathered were self-reported by the

companies contacted. Such data may have been exaggerated by the respondents. Therefore, variations may exist between the results reported in this study and actual results.

5.5 Future Research

Future research is needed for the validation of the research instrument. A larger sample size and broader geographical location will help to generalize the findings of this study. There are other quality practices that can be included in the research framework for business performance that can be used as constructs to find their effects on business performance. For example, supplier management can be included to see how it affects business performance. Also, the data on employees and customer satisfaction can be collected directly from the employees and customers instead of management. Other industries may be studied to ascertain whether the same results can also be applicable to them.

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APPENDIX A

02/20/2012

Dear Respondent,

A Survey on Quality Practices of Manufacturing Companies in Southern Minnesota

This is to request the participation of your company in my thesis research. The information gathered would be used for the completion of my Master's degree in Manufacturing Engineering at Minnesota State University, Mankato, MN. This survey is focused on obtaining information on quality practices of manufacturing companies in Southern Minnesota State and any information gathered is strictly confidential.

During my research, I found out your company is one of the reputable manufacturing companies in Southern Minnesota and got your email from the Precision Manufacturing Magazine, 2011 Buyer's Guide and I would be glad to have you participate in this survey. Please note that you **do not** have to include your company's name in the survey as such information is not relevant to the research. The respondents of this survey would be presented with the results in order to give respondents an overview of the level at which quality practices are deployed by the manufacturing industries in Southern Minnesota State.

Find attached a questionnaire for a survey on the above topic. The completion of this questionnaire would only take a few minutes of your time. I would be glad if this questionnaire is completed and sent to me by the **29th of February 2012**.

I appreciate your time and consideration. I look forward to your response.

Thanks.

Rachel Awoku
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APPENDIX B

Questionnaire

Section I

What is your position?

CEO	<input type="checkbox"/>	Plant Manager	<input type="checkbox"/>	Purchasing Manager	<input type="checkbox"/>	Team Lead	<input type="checkbox"/>	Engineer	<input type="checkbox"/>
Supervisor	<input type="checkbox"/>	Other	<input type="checkbox"/>	Please Specify:					

What is your company's annual profit?

<\$10M	<input type="checkbox"/>	\$10M- \$100M	<input type="checkbox"/>
\$100M- \$500M	<input type="checkbox"/>	\$500M- \$1billion	<input type="checkbox"/>
>\$1billion	<input type="checkbox"/>		

What is the number of employees in your company?

<50	<input type="checkbox"/>	51-200	<input type="checkbox"/>
501-1000	<input type="checkbox"/>	>1000	<input type="checkbox"/>

Section II

What Quality Systems do you have in place? Please select all that may apply.

- Six Sigma
- ISO 9000
- ISO 14000
- Lean Manufacturing
- Just-In-Time (JIT)
- Total Quality Management (TQM)
- Other, please specify:

Section IV

On a scale of 1 to 5, where 1= Never; 2= Seldom; 3= Sometimes; 4= Often; 5= Always.

Please answer the questions in this section.

Based on the last two years of your company, please indicate the level at which the following are carried in your company.

<i>Factors</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
We have efficient communication between leadership and employees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We render on-time delivery to customers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We offer competitive prices of products and service	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We offer high quality products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We have satisfactory sales growth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We are overall competitive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We develop new Business	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We offer customer satisfaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We develop new Product or Services	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We have inspiration for achievement for employees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We have good utilization of companies' assets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We have good employees compensation and profit sharing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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APPENDIX C

Multiple Regression

Dependent variable: Sales growth

Independent variables:

- Communication
- On-time Delivery
- Competitive prices
- Quality Products
- Overall competitive
- Customer Satisfaction
- New Businesses
- New Products
- Inspiration for employees
- Utilization of Assets
- Employees Comp. & profit Sharing

<i>Parameter</i>	<i>Estimate</i>	<i>Standard Error</i>	<i>T Statistic</i>	<i>P-Value</i>
CONSTANT	-2.66	3.52	-0.76	0.48
Communication	-0.46	0.87	-0.54	0.62
On-time Delivery	-0.20	0.86	-0.23	0.83
Competitive prices	-0.46	0.45	-1.01	0.36
Quality Products	0.34	0.65	0.52	0.62
Overall competitive	1.02	0.59	1.71	0.15
Customer Satisfaction	0.88	0.92	0.96	0.38
New Business	0.57	0.63	0.90	0.41
New Product	-0.22	0.44	-0.51	0.63
Inspiration for employees	0.82	0.51	1.60	0.17
Utilization of Assets	-0.50	0.60	-0.83	0.44
Employees Comp. & profit Sharing	-0.24	0.81	-0.30	0.78

Analysis of Variance

<i>Source</i>	<i>Sum of Squares</i>	<i>Df</i>	<i>Mean Square</i>	<i>F-Ratio</i>	<i>P-Value</i>
Model	15.32	11	1.39	1.86	0.26
Residual	3.74	5	0.75		
Total (Corr.)	19.06	16			

R-squared = 80.37 percent

R-squared (adjusted for d.f.) = 37.20 percent

Standard Error of Est. = 0.87

Mean absolute error = 0.38

Durbin-Watson statistic = 2,01622 (P=0.36)