This is to certify that the

dissertation entitled

IDENTIFYING THE DETERMINANTS OF A KAIZEN-SUGGESTION SYSTEM AND ASSESSING ITS IMPACT ON PLANT-LEVEL PRODUCTIVITY: A POOLED CROSS-SECTIONAL AND TIME SERIES ANALYSIS

presented by

Wen-Jeng Lin

has been accepted towards fulfillment
of the requirements for

doctoral degree in philosophy
(Industrial Relations
and Human Resources)

Major professor

Date 4/5/95

IDENTIFYING THE DETERMINANTS OF A KAIZEN-SUGGESTION SYSTEM AND ASSESSING ITS IMPACT ON PLANT-LEVEL PRODUCTIVITY: A POOLED CROSS-SECTIONAL AND TIME SERIES ANALYSIS

BY

WEN-JENG LIN

A DISSERTATION

SUBMITTED TO
MICHIGAN STATE UNIVERSITY
IN PARTIAL FULFILLMENT OF THE REQUIREMENT
FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

SCHOOL OF LABOR AND INDUSTRIAL RELATIONS

APRIL 1995

ABSTRACT

IDENTIFYING THE DETERMINANTS OF A KAIZEN-SUGGESTION SYSTEM AND ASSESSING ITS IMPACT ON PLANT-LEVEL PRODUCTIVITY: A POOLED CROSS-SECTIONAL AND TIME-SERIES ANALYSIS

BY

Wen-Jeng Lin

Kaizen has been viewed as the key to Japanese competitive success. Kaizen-suggestion systems have thus drawn heightened research interest. Unfortunately, however, there is a paucity of studies that have evaluated kaizen-suggestion systems. This paper is one step toward increasing understanding of kaizen-suggestion systems. It serves as an exploratory effort to examine the determinants of suggestions made in the kaizen-suggestion system and the impact of adopted suggestions on organizational effectiveness.

In the determinant level, the empirical results provide initial support that cumulative experience in intangible suggestion making (i.e., those suggestions where dollar savings cannot be estimated), management training and top management participative style played crucial roles in determining tangible suggestion making (i.e., those suggestions where dollar savings can be estimated).

In the outcome level, the findings are that there is an accumulative effect of suggestions successive incremental improvements in productivity, labor efficiency and product quality. A lagged effect exists between suggestion implementation and economic gains. Improvements in

productivity, labor efficiency and quality are not only dependent on the present volume of suggestions accepted but dependent on the past volume of suggestions adopted. However, there is a different pattern of delayed effect over time between tangible and intangible suggestions.

Overall tangible suggestions have longer lag structure than intangible suggestions. That is, economic gain responses to tangible suggestions generally last longer than do response to intangible suggestions. There are also different effects on productivity, labor efficiency and quality between the two types of suggestions. Tangible suggestions have a greater effect on productivity gains and high labor efficiency but have a smaller effect on product quality improvement. In contrast, intangible suggestions have a larger effect on product quality improvement but have a smaller effect on both productivity and labor efficiency improvements.

This study has highlighted the continuous and incremental improvement with what Imai (1986) termed "Japanese competitive success." The effects of tangible and intangible suggestions occur gradually and as a continuous incremental process. Although the improvements are subtle in the short term, when sustained over time, the long term improvements are considerable.

ACKNOWLEDGEMENTS

I wish to express deep appreciation to Dr. Joel Cutcher-Gershenfeld, my mentor and committee chairperson, for his continuous and patient support. He introduced me to the area of Japanese management practices and kaizen-suggestion system. His guidance and scholarly example during the three-year Japan Project--the Seeds of Change--will have a profound impact on my future research and career.

I am also grateful for the guidance received from Dr. Karen Roberts, Dr. Ellen Kossek, Dr. Kevin Ford and Dr. Georgia Chao. I also extend my thanks to Dr. Ed. Montemayor for his help and guidance in using statistical software.

I am greatly indebted to Nippondenso, U.S. Inc. and those who work in the company, Michael Gagnon, Sue Flees, Doug Butler, Roy Roemen and Mark Herzing, for their assistance in providing data and practical guidance for my research.

I also would like to acknowledge all members of the Japanese research team--the Seeds of Change--at the School of Labor and Industrial Relations, Michigan State University. This dissertation emerged out of parallel field research of this research team. Thus this dissertation is an extension of this team's aims and spirit. Special thanks are accorded to Betty Barrett, Takashi Inaba and Arthur Wheaton for their personal advice and encouragement.

Finally, to my parents, wife Ming-Lin, daughters Yen-Ju

and Yi-Jeng I owe the deepest appreciation and gratitude. Their sacrifices have made my education possible.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

CHAPTER ONE

INTRODUCTION AND OVERVIEW

Kaizen has been viewed as the key to Japanese competitive success (Imai 1986; Yasuda 1991; Japan Human Relations Association 1992; Japanese Human Relations Association 1988). As Imai put it:

> Kaizen strategy is the single most important concept in Japanese management--the key to Japanese competitive success,.....,a strategy to cope with the challenges of the 1980s, 1990s, and the beyond.....,Japanese Companies have successfully designed, manufactured, and marketed competitive products using kaizen strategy (1986, pp XXIX-XXXI).

The kaizen-suggestion systems also meet employees' expectations of involvement in organizational decision making (Lawler,1991) because the kaizen-suggestion can serve as a form of communication (Miner 1969; Kossen 1983; French 1984; Klotz 1988) or a form of employee involvement (French 1984; Mattes 1992). In recent years, the topic of Japanese management practices in general and kaizen-suggestion system in particular have received much attention. Unfortunately, however, there is a paucity of studies that have evaluated either the determinants or the outcomes of kaizen-suggestion systems. Research that has been done has either theoretical or methodological weaknesses that may limit understanding of the nature of the kaizen-suggestion system. This dissertation attempts to fill these gaps and make such a contribution.

The concept of a kaizen-suggestion system is not only important in the implications of continuous improvement itself but also has links in the literature on productivity, quality and employee involvement. It is an important phenomena, in part, because of the way it integrates across all three areas. Imai(1986) has suggested that improved productivity and quality are two major outcomes of kaizen activity. Whenever and wherever improvements are made in companies, these improvements are eventually going to lead to improvements in such areas as quality and productivity. Further, a kaizen-suggestion system can serve as a form of communication or a form of employee involvement. The kaizen-suggestion plans give employees opportunities to participate in company matters and decision making.

This chapter provides an introduction and overview of the entire dissertation. The introduction and overview include: (1) the basic concepts of kaizen, suggestion and productivity, (2) why it is of importance to examine the kaizen-suggestion system, (3) aims of the study, (4) the potential limitations of this study, and (5) an outline of the subsequent chapters in the dissertation.

The Basic Concepts of the Kaizen, Suggestion and Productivity

Kaizen

The Japanese term "kaizen" originally came from the

Chinese. The word "kai" means change or correct, whereas "zen" means good or satisfactory. Everything changed from the status quo to a better situation or correction of mistakes or errors means "kaizen."

The Japanese term "kaizen" means continuous improvement in day-to-day life. Imai gives us a clearer picture of the meaning of kaizen in industrial organizations. Imai (1986, p.25) suggests that there is one major difference between kaizen and innovation. Innovation usually calls for a sudden change and this may require a considerable increase in investment. In contrast, kaizen occurs gradually and as a continuous incremental process. Everyone is involved in the process of change since the change process of improvement itself originates through discussions. Therefore, kaizen is an umbrella idea covering most "uniquely Japanese" practices such as suggestion systems, TQC (total quality control), QC circles, TPM (total productive maintenance), just-in-time delivery, zero defects, and productivity improvement. Lillrank and Kano (1989) also provide a precise definition of kaizen that is characterized by 1) improvement that combines both innovation and maintenance, 2) improvement that takes place in small steps, 3) improvement that involves everyone, and 4) improvement that emphasizes the production process (p.28).

One of the most important features of kaizen is process-oriented thinking rather than result-oriented thinking. It does not mean that the results are not important. The logic

here is that once the process is improved, a better result always accompanies it. By emphasizing concern with the work process as much as with the result, a kaizen approach can help management and workers be good problem-solvers when things go wrong and better problem-solvers at other times. Employees under the kaizen concept are concerned with how to get things done, whether it can be done better, and whether other ways have been tried. Once a task is completed, the questioning keeps on going. The focus shifts from what was performed to how it was performed, how it can be done more accurately and more efficiently next time.

A good example of process-oriented management is that in Japanese companies in general and at the research site in this study (Nippondenso, U.S.) in particular, you can find charts and graphs posted all over the place, measuring production, product defects, suggestions adopted, accident rate, training, skill improvement, and so on. Every team and department has its own charts and graphs, which are updated regularly. Team members usually are responsible for creating these charts and graphs.

Employee Suggestion System

As mentioned by Imai, suggestion systems are the centerpieces of kaizen practices. The suggestion system is an integral part of individual-oriented kaizen. It is a vehicle

for carrying out the maxim that one should work smarter, not harder (Imai 1986, pp 110-111).

In Japan, suggestion systems are part of ongoing daily company improvement efforts. The major goals of suggestion systems are how to solve work problems and develop efficient and effective work methods. Some examples are as follows:

Making the job easier and safer

Removing drudgery and nuisance from the job

Making the job more productive

Improving product quality

Eliminating waste in overproduction, transportation, inventory, etc.

Under kaizen systems, employees typically make suggestions on how to solve work problems, develop efficient work methods, or improve working conditions. Each suggestion is taken seriously and is followed up on.

Japanese managers practice kaizen by encouraging constant incremental process improvements. They solicit and reward all suggestions, home runs as well as singles. U.S. companies, on the contrary, primarily look for the home run suggestion, the one-time dramatic event. In addition, the following data provided by the Japan Human Relations Association also can illustrate the difference between Japanese and American suggestion systems:

Table 1-1: The Difference Between Japanese and American Suggestion systems

Japan		United States
1,936,738	# of potential participants	9,194,476
47,926,020	# of suggestions	1,246,749
24.70	# of suggestions per person	0.14
$3.26	prize money per suggestion	$416
$231,770	economic benefit produced per each 100 potential participants	$19,995

Adopted from Rehfeld E. J. (1994). Alchemy of a Leader: Combining Western and Japanese Management Skills to Transform Your Company. New York: John Wiley & Sons. Inc.

A multitude of minor problem-solving suggestions seems to mean much more to employees than a handful of big cost-saving ideas. Besides the different aims of the two systems, Table 1-2 also shows other major differences in core assumptions between kaizen-oriented and traditional suggestion systems.

Table 1-2: Core Assumptions of Kaizen-Oriented and Traditional Suggestion System

Topic	**Kaizen-Oriented Suggestion System Assumptions**	**Traditional Suggestion System Assumptions**
Level	Groups	Individuals
Scale of Involvement	Many	Few
Rewards	Primarily Intrinsic	Primarily Extrinsic
Access to Relevant Data	Complete	Limited
Dedicated Resources	Integral to Everyone's Job Duties (Production Workers, Team Leaders, Facilitator, Skilled Trades, Engineers, etc.) -- Supported by Kaizen Program Coordinators	Integral to Job Duties of Suggestion Program Managers -- Supported by Other Functions When Feasible
Time Horizon	Long-Term	Short-Term

Speed of Implementation	Fast	Slow
Focus/Aim	"hitting singles"	"hitting home runs"
Expected Outcome	Incremental improvements	Redesign events
Integration into Operations	Integral	"Add on"

Adopted from Cutcher-Gershenfeld et al.(1994). Employee Involvement and Kaizen: Understanding Continuous Improvement Through the Harnessing of Knowledge.

Kaizen-Suggestion System

By integrating the two concepts of kaizen and suggestion mentioned above, the kaizen-suggestion system can be defined as a systemwide process designed to achieve continuous incremental improvement in organizations by involving every employee voluntary initiation of a steady stream of suggested changes in daily operations, procedures and policies. This definition helps to distinguish kaizen from other approaches to organizational change and improvement, such as organizational development (OD) and reengineering. Kaizen stands in contrast to traditional OD approaches to change. Organization development is a broad phenomenon involving great diversity of planned interventions, including job redesign, team building, survey feedback, employee involvement and so on. OD is intended to "change the organization in a particular direction, toward improved problem solving, responsiveness, quality of work life, and effectiveness" (Cummings and Worley 1993, p.3). Kaizen also stands in contrast to newer reengineering approaches. Reengineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed (Hammer and Champy, 1993). Reengineering approaches emphasize total rejection of the present system. In contrast, the kaizen system begins with the present situation and transforms it over time through small incremental improvement.

Table 1-3 presents the different features among kaizen, OD and reengineering approaches. It may help us to better understand the nature of different approaches to organization change.

Table 1-3: The Difference Among Kaizen, Organization Development and Reengineering Approaches

	Kaizen	Organization Development	Reengineering
Focus	*Processes *People	*Processes/ Results *Structure	*Results *Strategy
Aims/Impact	Long-Term Payoff	Medium-Term Payoff	Short-Term Payoff
Implementation Time	Extended	Moderate	Quick
Inhibits	Short-Term Cost Savings	Quick Payback	Long-Term Adaptability
Examples	*Suggestion Programs *QCs	*Job Enrichment *Labor-Management Cooperation	*Downsizing *Restructuring

Organizational Productivity

In the last fifty years, the concept of productivity has gradually come to be a key concept in business. Spurred by the international concern, productivity has become a dominant

theme in assessing overall economic, organizational and individual performance.

Productivity means different things to different people. Different perceptions of productivity from an economist's, an industrial/organizational psychologist's and a manager's perspective will be discussed.

Economist's Perspective

Productivity is a function of all of the various inputs to the production function which can be characterized as an input/output relationship[1] (Siegel 1980; Kendrick 1977; Greenberg 1973; Mark 1971; International Labor Office 1969). This efficiency-oriented definition derives from the basic production function, which states that Q = F(K, L), where Q = volume of output, K = capital inputs, L = labor inputs. There are different ways of measuring productivity. The way in which productivity is measured determines the meaning that it

---

[1]Siegel (1980)--Productivity is a family of ratios of (a) quantity of output to (b) quantity of related resource input.
Kendrick(1977)--Productivity is the relationship between output and its associated inputs when the output and inputs are expressed in real (physical volume) terms.
Greenberg (1973)--Measure of relationship between quantity of resources used and quantity of output.
Mark (1971)--Productivity is loosely interpreted to be the efficiency with which output is produced by the resources utilized. A measure of productivity is generally defined as a ration relating output (goods and services) to one or more of the inputs (labor, capital, energy, etc.) which were associated with that output.
International Labor Office (1969)--"The ratio between output and input."

carries. There are two major methods by which productivity is measured: (1) labor productivity, (2) total factor productivity. Basically, labor productivity is the ratio of the quantity of output produced to the labor inputs (Stein 1971; Fourastie 1957). Total factor productivity is the ratio of the quantity of output produced to a weighted combination of the quantities of labor, capital and other resources that produced it (Kendrick 1961; Solow 1957).

Industrial/Organizational Psychologist's Perspective

The literature from the behavioral sciences uses the term productivity quite frequently. The I/O psychologists study human behavior in a variety of forms of organizations and social settings. For many researchers in this field, such performance measures as personnel turnover, absenteeism, accident rates, and grievances are considered productivity criteria as much as measures of production rate or quantity of items produced (Katzell, Bienstock, and Faerstein, 1977). Usage of the term productivity in the more conventional sense, such as labor productivity, physical output per worker, and holding quantity constant (Work in America 1973; Sutermeister 1976), has grown parallel to the more flexible interpretation of the meaning.

Manager's Perspective

For managers, productivity is important as a means of

organizational control. Management theorists argue that the major function of management is the control of productivity. Umstot, Bell, and Mitchel (1976) suggested that "concern for productivity is still the dominant focus of managers" (p.379). Beginning with Drucker (1954), productivity has been proposed as an important element in the development of human resources. This thinking continues today with dual emphasis on productivity and the quality of work life (Hackman and Suttle, 1977).

Importance of the Study

Why Kaizen-Suggestion Systems Meet Today's Need

The Productivity and Quality Problems

Although several factors lead to economic decline, there is general agreement that the productivity level, growth rate, and quality of goods and services can all have a major influence on the national economy in general and industrial organizations in particular. The United States has the lowest productivity growth rate among six major industrialized countries in the past three decades. Table 1-4 combined from two data sources illustrates a long-term trend of productivity growth rate for six selected countries during the recent period 1960 to 1992. In spite of its recent improvement (1991-1992), the lag in productivity growth is putting the United States behind five other industrialized countries.

Table 1-4: Annual Percent Changes in Manufacturing Productivity, 1960-1992.

Year	United States	Japan	Canada	France	Germany	United Kingdom
(Output per hour)						
1960-1990	2.9	6.9	2.9	4.9	4.0	3.7
1960-1973	3.3	10.2	4.5	6.4	5.6	4.2
1973-1990	2.5	4.4	1.7	3.7	2.8	3.3
1973-1979	1.4	5.0	2.1	4.6	4.2	1.2
1979-1990	3.1	4.1	1.5	3.2	2.1	4.4
1988-1989	3.1	4.1	1.5	3.2	2.1	4.4
1989-1990	2.5	3.6	1.3	1.1	4.5	0.9
1990-1991	1.9	4.3	0.6	-.1	3.0	3.9
1991-1992	4.3	-5.0	4.2	2.9	0.5	4.9

Source: (1) Neef A., and Kask, C. (1991). Manufacturing productivity and labor costs in 14 economies. Monthly Labor Review, December, pp 24-37.

(2) Neef A., Nask, C., and Sparks, C. (1993). International comparisons of manufacturing unit labor costs. December. pp 47-58.

Quality is fast becoming one of the competitive issues of the 1980s and 1990s. Increased customer sensitivity gives it new visibility. Pressures for improvement have become intense.

Juran (1981) presented his perception of the relative quality of goods and services produced by the West and those produced by Japan. Prior to World War II, American product quality was regarded as the best, while Japanese product quality was widely regarded as among the worst. During the 1980s this situation was reversed. Japan assumed a leading position in global quality. A 1981 survey supported this observation when it reported that nearly 50 percent of U.S. customers felt the quality of American products had dropped during the previous five years (Binstock, 1981). Another

survey which was conducted in the U.S. and Japan showed similar results. Thirty percent of U.S. customers felt that Japanese consumer products were of better quality than American products, whereas only 21 percent of customers responded that American consumer products were of better quality than their counterpart's. On the contrary, 54 percent of Japanese customers felt that Japanese consumer products were of better quality than American consumer products, while only 16 percent of Japanese customers felt that American consumer products were of better quality than Japanese (Harrington 1991, p.3).

Slower productivity growth coupled with deteriorating product quality has placed the United States at serious competitive disadvantage in global markets.

The Expectations of Employee Involvement in Decision Making

Lawler (1991) argued that employees have developed expectations of participation in organizational decision making due to increasing levels of education and democratic philosophy in society. He argues that employees are increasingly interested in advancing their legal and societal rights to have a say in decisions in the organizations.

The Kaizen-Suggestion System: The Best Answer

As mentioned earlier, kaizen has been viewed as the key to Japanese competitive success (Imai 1986; Yasuda 1991; Japan

Human Relations Association 1992; Japanese Human Relations Association 1988). Imai also argues that improved productivity and quality are two major outcomes of kaizen activity. Whenever and wherever improvements are made in business, these improvements are eventually going to lead to improvements in such areas as quality and productivity. Quality and productivity are usually improved through the elimination of waste[2], cost reduction, the introduction of new and more competitive products, and by using and improving the latest technology. Therefore, the kaizen-suggestion system can meet businesses' needs for productivity and quality improvements.

Kaizen-suggestion systems also meet employees' expectations of involvement in organizational decision making because the kaizen-suggestion can be served as a form of communication (Miner 1969; Kossen 1983; French 1984; Klotz 1988) or a form of employee involvement (French 1984; Mattes 1992). It provides a channel for employees to contribute their ideas. Further, it provides an opportunity for employees to show dissatisfaction with existing practices and procedures. Reuter (1977) indicates the suggestion systems frequently serve as a management safety valve that allows employees to substitute a constructive solution to a problem that otherwise

---

[2]For example, Nippondenso,U.S. and Toyota have identified the seven types of waste: 1) waste from overproduction, 2) waste of waiting time, 3) transportation waste, 4) processing waste, 5) waste of motion, 6) waste from product defects, and 7) waste from inventory. The goal of the kaizen-suggestion system is to eliminate these wastes which are generated in the production processes.

might remain an unspoken complaint or irritation. Kaizen-suggestion systems are also designed to provide a channel for employees to communicate with management and provide an opportunity for employees to share job-related technological and administrative information for suggestion making. Employees who make suggestions are given the responsibility to carry them out and are encouraged, either individually or as a team, to figure out how best to do so. Kaizen-suggestion plans give employees opportunities to participate in company matters and decision making.

Theoretical Issues

In recent years, the topic of Japanese management practices in general and kaizen-suggestion programs in particular have received much attention. Unfortunately, however, there is a paucity of studies that have evaluated either determinant level or outcome level of the kaizen-suggestion system. What research has been done has either theoretical or methodological weaknesses that may limit understanding of the nature of kaizen-suggestion system. Some papers were presented as case studies (Smith 1968; Marmaduke 1946; Greenlaw 1980; Gunch 1991; Matthes 1992; Reuter 1976, 1977). Some studies broadly introduced the benefits of suggestion programs in big organizations (Graf 1982; Wilce 1971). Because of the lack of theoretical or statistical analyses, some important questions about the determinants and

effects of the kaizen-suggestion system remain unanswered.

Measurement/Methodological Issues

Kaizen is culturally based and not easily understood by non-Japanese. The problem is that we always have difficulty understanding how to measure the results of kaizen and what the best indicators of kaizen are. In day-to-day working life, managers speak of the kaizen of organizational performance; workers speak of the kaizen of working conditions; industrial engineers speak of the kaizen of operational efficiency. What are the ultimate indexes that serve as a measure for checking the results in an organization? What kind of index can illustrate for us how things have been improved?

Another issue is measurement problems in suggestion making. Typically, employee suggestion contributions are measured by the volume of suggestions. This reflects the quantity of suggestions rather than the quality of suggestions. For example, the sum of ten "tiny" suggestions may have fewer economic benefits than one "valuable" suggestion. None of the existing studies has differentiated the volume of suggestions from the quality of suggestions. In addition, the differentiation of tangible and intangible suggestions is also important for research. A tangible suggestion is a suggestion for which economic benefits or dollar savings can be estimated. That is, cost reduction results from suggestions that lead to tangible financial

benefits such as savings in labor, material, machine hours, downtime, waiting time and so on. An intangible suggestion is defined as a suggestion where economic benefits or dollar savings cannot be estimated.

Those suggestions involving issues of safety, quality or housekeeping are all typical intangible suggestions. Traditionally, U.S. companies consider only tangible suggestions. Intangible suggestions are a matter of no important. Actually, however, a multitude of minor suggestions may mean much more to the employees than a handful of big ideas. Employees' high level needs can be satisfied and their problem-solving skills can be improved through creation and implementation of numerous intangible suggestions. In addition, a tangible suggestion that may result in huge cost savings for an organization could be generated by employee who has had proficient and rich experiences in making a number of intangible suggestions. That is because cumulative proficiency, rich experiences, skills, and knowledge in making intangible suggestions are useful for the employee to generate tangible suggestions that are usually more difficult to generat and implement than intangible suggestions. None of the existing studies has differentiated tangible suggestions from intangible suggestions. Yet they should not be ignored in kaizen-suggestion research.

Productivity is typically defined as a ratio of outputs to inputs (Siegel 1980; Kendrick 1977; Greenberg 1973; Mark

1971; International Labor Office 1969). Outputs are goods and services produced by an organization. Inputs include labor, capital, materials, and energy. The most common productivity indicators are really measures of labor productivity. It can be regarded as a "hard" measure of organizational performance. However, few of the existing studies either in employee suggestion research or in employee involvement research have adopted a "hard" index of productivity. On the contrary, the use of "soft" measures of productivity in terms of job satisfaction or employee morale in these research areas is prevalent. Much of the research concerned with cost reduction or cost savings claimed for employee suggestion implies productivity improvements. These measurement problems in kaizen, suggestion and productivity should be examined and resolved in a comprehensive study.

Methodology is another issue that is a matter of concern in the existing studies. Cross-sectional analysis is the only method used in employee suggestion research. It raises the following questions. If I assume that a tangible suggestion is associated with employees' experiences and contributions in making intangible suggestions, time is a critical variable. Again, if we assume productivity not only depends on the present volume of suggestions accepted, but depends on past volume of suggestion accepted, time is a crucial factor too[3].

---

[3]More detailed hypotheses will be discussed in chapter three and chapter four.

These assumptions cannot be examined and tested using cross-sectional analysis. The general relationship between tangible suggestions and intangible suggestions as well as the relationship between suggestions and productivity can only be understood via longitudinal analysis. This methodological weakness will be improved in this study.

Aims of the Study

The aim of the study is twofold:

(1) To identify the specific factors that influence the number of adopted suggestions.

(2) To assess the specific ways that suggestions made in the kaizen-suggestion system impact on productivity and other measures of organizational effectiveness.

The first objective of this study is to examine the extent to which situational factors are determinants of adopted tangible and intangible suggestions. This will be done by analyzing the effects of lagged suggestion variables as well as organizational variables. First, what factors determine tangible suggestion contributions. Second, does past intangible suggestion making affect current tangible suggestion making? If yes, what is the lagged effect between adopted tangible suggestions and adopted intangible suggestions. The case of a Japanese-owned company, Nippondenso,U.S., will be used to seek insight into these

questions.

The second objective of this study is to assess the impact of suggestions made in the kaizen-suggestion system on productivity, labor hour inputs, and product quality. While studying the impact of the kaizen-suggestion system, I will take into account other control variables that might also influence organizational performance, such as technology, training, product defects, industrial accidents, absenteeism, organizational structure, etc. Three separate models will be examined to test the joint effects of suggestion variables and other control variables on productivity, labor hour inputs and product quality.

Nippondneso,U.S. (NDUS) has been chosen as the case study site. Two features make it ideal for an examination of systematic situational determinants of employee suggestion contributions as well as their effects on productivity and other measures of organizational effectiveness. First, this dissertation builds on an Michigan State University (MSU) project studying the cross-cultural diffusion of U.S. and Japanese work practices. Three years ago, I started to participate in this project supervised by an international group of scholars based at MSU's School of Labor and Industrial Relations. We began a study of shopfloor work practices in Japanese-affiliated factories in North America[4].

---

[4]This project is supervised by Dr. Joel Cutcher-Gershenfeld (Michigan State University) and Dr. Micho Nitta (University of Tokyo).

The initial stage of this project was completed in 1992 but research processes (e.g., study group meetings, the project-book-writing sessions) continued. Thus this dissertation emerged out of parallel field research, and I take advantage of this three-year ongoing learning experience in Japanese shopfloor work practices. However, because this research project studied Japanese work practices, in general, this study can help us further understand one Japanese work practice, the kaizen-suggestion system, in particular. Second, NDUS was awarded the best employee suggestion program among medium to large size manufacturing companies by the National Association of Suggestion System in 1992. Therefore the kaizen-suggestion system at NDUS can be viewed as a benchmark employee suggestion system in the U.S.. A study of this benchmark employee suggestion system is helpful for us to better understand the nature of other suggestion systems.

Contributions

This paper serves as an exploratory effort to address these research questions by examining the determinants of suggestion made in the kaizen-suggestion system and the impact of adopted suggestions on productivity, labor efficiency and product quality. It is exploratory in the sense that (1) no other study in which a world-class benchmark kaizen-suggestion system has been assessed in this way, and (2) it is based on

a rich body of plant-level data seldom available to researchers to test the strengths of determinants and outcomes of the kaizen-suggestion system. Because of the lack of an adequate theoretical construct for relating these concepts, this paper can only serve for proposition generation rather than formal theoretical testing.

Outline of This Dissertation

Chapter One generally describes the importance of the study, the rationale underlying a number of research aims and the potential contributions and limitations of this dissertation.

Chapter Two discusses the methodology of study which include a description of the research site as well as the background of the kaizen-suggestion system, data source and collection, method of data analysis, and operationalization of variables.

Chapter Three identifies the determinants of adopted suggestions including a relevant literature review, hypotheses, and research model. The results of the data analysis for each hypothesis of those factors that influence the number of adopted suggestions are contained in the last section of this chapter. Finally, policy implications will follow.

Chapter Four assesses the impact of the kaizen-suggestion

system on productivity and other measures of organizational effectiveness. This includes a relevant literature review, theoretical model, hypotheses, and research model. The results of the data analysis for each of the hypotheses on the outcomes of a kaizen-suggestion system are contained in the last section of this chapter. Inferential statistics of pooled cross-sectional and time-series analysis will be used to assess whether a hypothesis is statistically supported.

Chapter Five contains a summary of results and a discussion of implications for theory and practice. Finally directions for future research follow.

CHAPTER TWO

METHODOLOGY

This chapter describes the research site, data source and collection, operationalization of variables, research models, and method of data analysis.

The Research Site and Background of the Kaizen-Suggestion System

The site for the research reported here is a non-unionized, medium-size company which is 100% Japanese owned. Open in 1986, the facility occupies approximately 850,000 sq. ft. During the period of the study, the work force included approximately 1250 employees. The plant produces heat transfer products for several major U.S. automobile manufacturers with 1992 sales of approximately $450 million. These include air-conditioning systems (evaporators, cooling units, and condensers), heater systems (heater cores, blowers, and air ducts), electric fan and shroud assemblies, and radiators. The plant produces several product lines with two technological levels: (1) automated mass production lines for high-speed assembly, and (2) flexible and automated production line capable of finishing a wide range of products in random order and production lines easily adaptable to model change.

The company had suggestion programs with some other

kaizen activities such as QCs and Total Productive Maintenance since 1989. There are three general purposes of the kaizen-suggestion system: 1) employees participation, 2) employees' development and education, and 3) company's economic benefits. As a business philosophy, the kaizen-suggestion system focuses on improving the process and how employees do things. It provides an organized systematic medium to recognize employees for their problem-solving skills, while demanding their involvement and commitment. Kaizen-suggestion systems focus on employee involvement in implementation of an idea, rather than the idea itself.

The economic benefits are generally gained from eliminations of seven types of waste[5] by involving employees

---

[5] (1) Waste from overproduction: This waste is created by producing goods over and above the amount required by the market. The by-products of overproduction include extra inventory, extra space, extra handling, extra interest charges, extra overhead, etc..
(2) Inventory waste: As discussed above in connection with waste of overproduction, excess inventory increase the cost of a product.
(3) Waste of waiting time: For example, instead of occupying machines to overproduce, operator should remain ideal when the required amount of work is finished. If supervisors cannot better assess the capacity and control the situation well, waste of waiting is created.
(4) Transportation waste: For example, transportation waste is created when incoming material stored in the warehouse before it is brought to the line rather than delivering directly the material down the line.
(5) Processing waste: This waste is created from the ongoing work processes or even the processing method itself, which may be a source of problems, resulting in unnecessary waste.
(6) Waste of motion: For example, walking is one kind of wasteful movement, especially when one person is responsible for operating several machines. Machines should be placed so that the operator's walking time is minimized.
(7) Waste from product defects: For example, when defects

and management. Waste at NDUS is operationally defined as anything other than the minimum amount of equipment, material, parts, space, and labor inputs, which is absolutely essentially to add value to the product. By diligently practicing problem solving with as many people as possible, much of the current waste will be reduced. While each person's idea will be used to help the improvement of plant operations, the results can be obtained by implementing improvement activities in the most integrative fashion so that each set of improvements can be tied with the others. Consequently, the more the elimination of waste, the lower the production costs, the higher the added value to the product. To administrate and coordinate a kaizen-suggestion system, the System Administrator is responsible for chairing the Steering Committee, comprised of both production and non-production employees, while playing a pivotal role in the administration of the suggestion system. The primary function of the committee is to review suggestion evaluations, approve awards after calculations, and decide employee appeals associated with suggestion evaluations. Employee suggestions are classified as "tangible" or "intangible" based on whether dollar savings can be estimated. And these suggestions will be evaluated according to the following general criteria: (1) originality and creativity, (2) application and the effort of

---

occur at one station, operators at subsequent stations waste time waiting, thereby adding cost to the product and adding to production lead time.

the employee to implement it, (3) potential benefits, and (4) employees' skill level relative to the difficulty level of the idea he/she suggests. Recognition for employees is based on earning assign points that are calculated for each suggestion. A gift certificate is awarded based on points earned and the certificate can be redeemable at Service Merchandise stores. There is an additional milestone points award process which generates prizes such as a car or a trip to Japan as a result of accumulated participation over many years.

Data Source and Collection

Data source and collection in this dissertation were heavily based on previous plant tours, individual interviews, shop-floor observations and preliminary empirical study (Lin, 1993) at NDUS.

Quantitative as well as qualitative techniques were employed in this study. The results of the qualitative method are used to enrich the quantitative analysis.

The data used in this study were department-level data[6] from the Production Section for the months January 1991 to August 1994. I include in my sample all departments in the Production Section with complete data. The departments with incomplete data were excluded. As a result, I found 19

[6]Individual suggestions are aggregated into a department-suggestion data to connect to departmental productivity and other variables.

departments that conformed to the requirement. Consequently, the available data represent 19 out of 29 observations, for 44 equivalent time periods. The departments are cross-sectional and the "monthly" observations for a given cross-section are arrayed in a time series. Totally, 836 observations were included for pooled cross-sectional and time-series data analysis in this study.

Additional qualitative field data collection is employed to enrich the quantitative analysis. The qualitative methods include focus group interviews and examination of appropriate documents and records. Individual interviews key officials on historical, and administrative and strategic issues are also employed.

The development of interview questions was heavily based on previous plant tours, individual interviews, shop-floor observations and a preliminary empirical study (Lin, 1993) at NDUS. These intensive research activities were parts of the MSU project on cross-cultural diffusion of the U.S. and Japanese work practices.

Overall, four general questions were asked for focus group interviews. Each is represented below, with a description of the specific information that was being solicited through questions.

1. Please trace the full process history of a suggestion:

    * idea generation;

* pre-suggestion-stage implementation;
* ongoing operation.

This question is designed to understand the full process of the kaizen-suggestion system and the reasons why time lag exists between suggestions adopted and productivity improvements. It is also designed to elicit information about the role of team leaders in the process of suggestion making.

2. To what extent and in what ways does the kaizen-suggestion system affect your job performance:

* Affective level: job satisfaction and work motivation;
* Cognitive level: job skills and knowledge.

The question is designed to help understand the employees evaluation of the kaizen-suggestion system. Information also is gathered to test the conceptual model of the impact of the kaizen-suggestion system on individual performance which will be discussed in chapter four.

3. To what extent and in what ways does a kaizen-suggestion system impact on organizational effectiveness:

* productivity;
* working hours
* quality.

This question is designed to obtain information about the changes in productivity, quality and safety after the intervention of the kaizen-suggestion plan.

4. Please trace the idea generation of a tangible suggestion in comparison to an intangible suggestion.

This question is designed to help identify the determinants of tangible and intangible suggestions. The information also clarifies the relationship between tangible and intangible suggestions.

Method of Data Analysis

The technique of pooled cross-section and time-series data analysis in general and classical pooling with a cross-sectionally correlated and time-wise autoregressive estimation in specific is employed in this study. There are several alternatives for estimating the pooled data: (1) OLS regression estimation, (2) the covariance model, (3) the error component model, and (4) classical pooling with a cross-sectionally heteroskedasticity and time-wise autoregressive model (Dielman, 1989). However, these alternatives are inappropriate for the nature of data in this study. Therefore, classical pooling with a cross-sectionally correlated and time-wise autoregressive estimation is a preferred estimation model in this study, and this will be explained later in this section.

Firstly, I want to examine and discuss the appropriation of alternative models here. The simplest method to estimate the pooled data is to perform OLS regression on the entire

data set. Its underlying assumption is that there are no complexities in the error structure. It seems to be suspect.

The common model for pooled cross-section and time-series data can be formed as:

$$Y_{i,t} = a_0 + a_1 X_{i,t} + e_{i,t} \quad (2.1)$$

where

$Y_{i,t}$ = the level of the productivity measure in department i at time t.

i = 1, 2, 3, ...,19 (the number of department)

t = 1, 2, 3, ...,44 (the number of time points)

$X_{i,t}$ = the corresponding measure of tangible and intangible suggestion in department i at time t

a_1 = the unknown parameter which measures the impact of the tangible and intangible suggestion

and $e_{i,t}$ = the disturbance term which measure the impact of all variables not in the equation.

With everything defined in equation 2.1, the issue is simply one of estimating the sets of regression coefficients (a_1). The trouble is the increased structural complexity of the disturbance (e) when pooling is attempted. When one attempts to pool cross-section and time-series observations, one must be aware of the fact that violations of the classical least square assumptions are likely. Cross-sectional data are often characterized by heteroscadasticity, while time-series

data may provide serially correlated disturbance terms. Thus, it is possible or very probable that the pooled disturbance term contains three types of perturbations: (1) cross-section disturbances, (2) time-series-related disturbance, and (3) a combination of both (Pindyck and Rubinfeld, 1976).

In the current examples this can be understood by noting that the relationship between the disturbances of the departments at some specific point in time may be different from the relationship between the disturbance of one specific department at two different times. More specifically, measures of departmental productivity, labor efficiency and product quality are relatively stable over time, but vary greatly from department to department. Therefore, the disturbance for department i at time t is highly correlated with the disturbance for the same department at an earlier time point. It is also expected that this correlation will decrease as the time points get further apart. Similarly, when the departments are tightly linked to other departments[7], it implies that the disturbance for department i at time t will be correlated with

---

[7]NDUS can be featured as lean production system which is defined in terms of a combined system including: customer-driven priorities, just-in-time delivery between customers and suppliers, little internal inventory between stations and suppliers, broad team responsibilities for monitoring work methods, processes, motion that eliminate waste and a commitment to continuous improvement. See Womack, Jones, and Roos (1990). There are high levels of team interdependence and high labor/management support for continuous improvement under lean production system. See Cutcher-Gershenfeld et al. (1994). It suggests that it is very likely that departments are highly interdependent at NDUS, U.S..

the disturbance for department j at the same time. Further, since each department is subject to similar external effects (e.g., changing in company's production system, human resource policy, etc.), it is likely that contemporaneous correlation exists[8]. What this implies from a practical standpoint is that ordinal least square of coefficients (a_1) will be unbiased, but inefficient (Johnston, 1972). Therefore, OLS estimation is not considered desirable.

Secondly, the covariance model recognizes that pooling may lead to variable cross-section and time-series intercepts, and adds dummy variables to characterize each cross-sectional unit and time period. However, it uses a substantial number of degree of freedom (Judge, Griffith, Hill, Lutkepohl, and Lee 1985; Sayrs 1989; Dielman 1989).

Thirdly, classical pooling with a cross-sectionally heteroskedatic and time-wise autoregressive model is based on two assumptions: 1) the error variance differs between cross sections, and 2) time-series residuals are autocorrelated (Kmenta 1971). This model is not considered desirable because this model lacks the assumption of contemporaneous correlation that very likely exists when departments are highly interdependent.

Finally, the error component model assumes nonhomogeneous intercepts but assumes there are independent, identically

---

[8]This correlation between disturbances of different cross-sections at the same point in time is called contemporaneous correlation. See Kmenta (1971, pp 512-514).

distributed random variables rather than fixed (Judge et al. 1985). Judge et al. argued that this independence allows constant autocorrelation of disturbances from different time periods. It also implies the contemporaneous correlation between the disturbances of two-section units is the same for every pair of cross-section units and that the correlation between the disturbances of a given cross-section unit is constant over time and same for every cross-section unit. Despite the fact that model assumes a fairly sophisticated error structure, it still cannot account for error structure complexities in this study. It is because some cross-section or time-series relevant variables may complicate the error structure. For example, an adopted suggestion in department i may improve productivity in department i itself as well as other departments j, k, ...,z if this suggestion idea can eliminate cross-departmental or even plant-wide waste. Another example, an adopted suggestion in department i at time t may prolong influence on productivity at time t+1, t+2,.....,t+n. Additionally, as discussed earlier, measures of departmental productivity is relatively stable over time, so the disturbance for department i at time t is highly correlated with the disturbance for the same department at an earlier time point and the correlation declines as the disturbances become further apart in time and that it can be different from department to department. To account for such complexities, the error component model is not considered desirable. Thus it

is preferable to use a procedure that can account for heteroscedasticity, autocorrelation, and contemporaneous correlation among the disturbances. Consequently, a cross-sectionally correlated and time-series autoregressive estimation is a preferred model in this study.

Basically, these difficulties can be overcome by a double transformation of the original data (i.e. Generalized Least Square) to deal with the aforementioned problems of heterscedasticity, serial correlation, and contemporaneous correlation in the cross-sections (Kmenta 1971, pp 512-514). Specifically, we assume, for instance, the model to be:

$$Y_{i,t} = a_0 + a_1 X_{1i,t} + a_2 X_{2i,t} + a_3 X_{3i,t} + a_4 X_{4i,t} + e_{i,t} \quad (2.2)$$

Where

$Y_{i,t}$ = the measure of departmental productivity, labor efficiency and product quality,

$X_{1i,t}....X_{4i,t}$ = the indicator variables for the tangible suggestions, intangible suggestions, technology, training, respectively.

and $a_1....a_4$ = the productivity improvement associated with the tangible suggestion, intangible suggestion, technology, and training.

$_{1,\ 2,\ 3,}$ and $_{4}$ are estimated in a double transformation process as:

$$\beta^{*}_{gls} = (x'^{*}\theta^{-1}x^{*})^{-1}(x'^{*}\theta^{-1}y^{*})$$

The variables X^{*} and Y^{*} are transformed to account for an error term that exhibits the following distribution:

$$E(\varepsilon^{2}_{it}) = \sigma_{ii}\ (heteroskedastivity)$$

$$E(\varepsilon_{it}\varepsilon_{jt}) = \sigma_{ij}\ (mutualcorrelation)$$

$$E_{it} = \rho_{i}\varepsilon_{i,t-1} + \mu_{it}\ (autoregression)$$

and

$$E(\varepsilon_{i,t-1}\mu_{jt}) = 0$$

$$E(\mu_{it}\mu_{jt}) = \phi_{ij}$$

$$E(\mu_{it}\mu_{js}) = 0\ (t \neq s)$$

i, j = 1, 2, ...N

t = 1, 2, ...T

In this study, in summary, a cross-sectionally correlated time-wise autoregressive model is employed.

SHAZAM software program (White, 1978) is employed in this dissertation. The SHAZAM performed a cross-sectionally correlated and time-wise autoregressive model under Kmenta's (1971, pp 512-514) model specifications and conditions. A Generalized Least Square procedure and a cross-sectionally correlated and time-wise autoregressive model are used on the model described in Kmenta.

Operationalization of Variables

Productivity

When productivity is examined longitudinally, identifying changes directly attributable to the kaizen-suggestion system is difficult. Productivity can be improved either due to waste elimination in rework, waiting, motion, inventory, processing, transportation, overproduction, or due to more effective use of the existing means of production, which is the result of improvement suggestions. The waste elimination in the production system can be measured by changes in specific inputs of the production system such as labor hour inputs. More effective use of the existing means of production can be measured by changes in specific outputs of the production system such as output quantity. In order to include both input

and output elements, the definition of productivity is therefore confined to the ratio between output and input. Labor productivity data that are measured by the ratio between total quantity outputs and total working hour inputs were employed in the study. Departmental productivity data were calculated from combining productivity results for different teams within the departments. A brief explanation follows:

$$P_{DEP} = \frac{Q_1 + Q_2 + \ldots\ldots\ldots\ldots + Q_n}{TH_1 + TH_2 + \ldots\ldots\ldots\ldots + TH_n}$$

where

P_{DEP} = Departmental productivity

$Q_1 \ldots\ldots Q_n$ = Quantity produced from team 1 to team N within a department

$TH_1 \ldots\ldots TH_n$ = Total hours worked from team 1 to team N within a department

Working Hours

The number of regular shift hours worked by full-time employees.

Absenteeism

The absent ratio derived from unpaid absent (unplanned and unscheduled absent).

Quality of product

A quality index derived from a count of the number of customer claims for product defects.

Safety

A safety index derived from OSHA log for the number of recorded nurse's visit for occupational injuries and illnesses.

Tangible Suggestion

A tangible suggestion is defined as a suggestion that economic benefits or dollar savings can be estimated. That is, cost reduction result from suggestions that can lead to tangible financial benefits such as savings in labor, material, machine hours, downtime, and so on. In other words, tangible suggestions can result in quantitative or tangible effects. Increased production volume, shortening of product manufacturing time or reduced defect costs are all good examples. Tangible suggestions could be both "evolutionary" and "revolutionary" (Mirvis, 1988, 1990) in terms of their impact on economic gains. A tangible suggestions also could be both "technical" and "administrative" (Evan and Black, 1967; Daft and Becker, 1978) in terms of the nature and category of the adopted suggestions. Tangible suggestion is m4044easured as its total volume of

suggestion ideas for the statistical analysis in this study. This variable reflects the quantity of adopted suggestions in a department.

Intangible Suggestion

An intangible suggestion is a suggestion that economic benefits or dollar savings cannot be estimated. Such suggestions always involve intangible items such as safety, quality, housekeeping improvement, and so on. In other words, intangible suggestions could result in qualitative or intangible effects. Improved quality of work, improved product quality, improved information feedback, improved managerial skills, better communication or increased quality-consciousness are all good examples. Intangible suggestions could be both "evolutionary" and "revolutionary" (Mirvis, 1988, 1990) in terms of their impact on economic gains. Intangible suggestions also could be both "technical" and "administrative" (Evan and Blact, 1967; Daft and Becker, 1978) in terms of the nature and category of the suggestions. The variable of total volume of intangible suggestions will be employed in the regression analysis. This variable also reflects the quantity of adopted suggestions in a department.

Training Hours

The number of credit hours employees earned in the classroom training in a department. It is broken down by three categories: technical training, self-actualization training and management training. Self-actualization training is basically used in the employee orientation. It also can be defined as "individual and organizational development" training.

Technology

Dummy variable with 0 for assembly department and with value 1 for machining department.

Overtime Hours

The number of overtime hours worked by employees in a department.

Workforce size

The workforce of a department.

Top management leadership

Transition of top management on October 1992.

Dummy variable with value 0 for January 1991 to October 1992 and with value 1 for other months.

CHAPTER THREE

IDENTIFYING THE DETERMINANTS OF SUGGESTION MAKING

Introduction

This chapter discusses the relevant literature review. A conceptual model of the determinants of suggestion making will follow. Based on the conceptual model, hypotheses will be proposed. Then regression analyses of the determinants of tangible and intangible suggestions will be used to test the hypotheses. Finally, policy implications will be discussed.

Because very few studies[9] have evaluated the determinants of effective suggestion systems, the first section will review the relevant literature which will be based on relevant studies in employee involvement and participation in decision making, though not to employee suggestion making directly. Additionally, most independent variables used in the empirical study of this chapter will not be discussed in the following section of literature review. None of these variables has been

[9]Few studies have evaluated the determinants of effective suggestion system. These studies assessed the determinants of suggestion system by collecting data from either field (Burke, Hoffman, Kazer, and Hall 1982; Pizam 1972; Ekval 1971) or laboratory (Steinberg,1981). Two major influential forces were studied: personal determinants (e.g. motivation, personality, age, education, intelligence, satisfaction, creativity, technical interests, occupation, length of service, etc.) and situational determinants (e.g. money reward, supervisory encouragement, freedom of communication, diversity of workforce, coordination, etc.)

studied in the area of employee suggestion making. It is also because none of the existing studies has applied pooled departmental data in their statistical analyses. More specifically, some individual factors (e.g. personality, ability, extrarole behavior, and job complexity) that have been examined in the few previous studies cannot be measured and estimated in a time-series study. They may be only appropriate in a cross-sectional study.

Because this dissertation will suffer from insufficient literature and theoretical foundation, establishing an exploratory conceptual model of the determinants of suggestion making may fill this big gap. Again, although both individual and situational factors are included in the model, only situational factors are employed in the empirical study. First, as mentioned above, individual variables are difficult to measure and estimate in a time series study. Second, this is because departmental level of influence is more important than individual level of influence at NDUS. In NDUS, there is a strong organizational culture supporting the suggestion program; therefore, lower variance exists at individual levels and higher variance exists at departmental levels. Consequently, situational variables at departmental levels will be employed and analyzed in this chapter.

The empirical results will be reported in two separate models: one for tangible and one for intangible suggestions. It is important to distinguish between tangible and intangible

suggestions. First, suggestion making may reflect a learning process. What workers have learned in making intangible suggestions eventually will be transformed into the knowledge needed for generating a new tangible suggestion. The conceptual model, empirical results, and policy implications proposed in this chapter are based on this assumption. Second, the effects of tangible and intangible suggestions on organizational effectiveness are different. Tangible suggestions generally create quantitative effects whereas intangible suggestions usually create qualitative effects. Quantitative change which is derived from tangible suggestions and qualitative change which is derived from intangible suggestions have different policy implications to organizations. The theoretical model, empirical results, and policy implications proposed in the next chapter (chapter 4) will be based on this assumption. For these reasons, I argue that a distinction between tangible and intangible suggestions is important for studying kaizen suggestion systems. Two different models and regression analyses will be tested in this chapter and the next chapter.

Policy implications will be discussed in the last section. If the assumption that intangible suggestion making has positive effects on tangible suggestion making is true, it will have profound policy implications for most traditional U.S. companies. That is because these firms only pay attention to tangible suggestions and give little attention to

intangible suggestions.

Literature Review

This literature review will consist of examining selected major personal and situational variables and interpreting their impact on employee involvement or worker participation behavior. As discussed in the first chapter, an employee suggestion plan can be viewed as a form of employee involvement. Thus, the prior literature in this area will provide the basis to better understand the employee suggestion behavior.

The individual difference variables selected for inclusion in this report are (1) ability, (2) personality, (3) organizational extrarole behavior, and (4) demographic variables (i.e. gender, tenure, and education). The situational variables selected for inclusion in this review are (1) job complexity, and (2) supervisory style.

Beginning with the personal variables, the discussion to follow will examine the existing evidence concerning the relation of each of the above variables to employee involvement.

Personal Variables

Ability

Pizam (1974) suggested that some personal characteristics such as creativity and ideas source should influence the

number of suggestions employees submit and the number of suggestions adopted within a period of time. The higher a person is on scores of creativity and idea source, the more suggestions he/she submits. The study showed that structural characteristics (i.e., supervisory encouragement, the job he/she does, or the work environment) were not good predictors of suggestion making.

In a typical EI study, the surveys of attitudes towards participation have suggested that level of skill and knowledge have some influence on the perception of employee involvement (Holter, 1965; Smith, 1955; Pym, 1965). In particular, more highly skilled employees are more likely to be interested in both direct and indirect participation and are more prepared to act in a representative capacity.

In addition, some recent studies have shown the importance of the role of subordinate competence between employee participation in decision making (PDM) - performance relationships. Locke and Schweiger (1979) postulate that individual factors (e.g. group member knowledge) and organization factors (e.g. task attributes) condition the effectiveness of PDM including, presumably, its ability to augment performance. Locke and Schweiger (1979) and Locke, et. al. (1980) reasoned that group member knowledge and competence have a bearing upon the connection between PDM and performance. They tend to view competence as a potential moderator variable. Their position would be strengthened if

it could be shown that participation enhances the performance of more competent employees but fails to accentuate the performance of less competent workers.

Personality

It has long been assumed that the effects of a participative versus non-participative managerial style would depend on the kind of people being supervised. Vroom (1960) hypothesized that the relationship between psychological participation and both job satisfaction and job performance varied with the strength of the need for independence and the degree of authoritarianism. The results showed that the feeling of participation in decision making generally had a positive impact on attitudes (or satisfaction) and performance (or effectiveness). A highly authoritarian personality was virtually unaffected by the opportunity to participate; those low on authoritarianism and with a high need for independence reacted most positively. It should be noted that it would be dangerous to generalize from this study; the sample consisted of supervisors and not blue-collar workers and the study dealt with perceived rather than actual participation. Other similar studies have been examined in testing of Vroom's hypothesis or a hypothesis similar to it and treated need for independence and/or authoritarianism-like variables as moderators in the relationship between participative leadership and job performance and satisfaction. Support for the relationship is

provided in studies by Mitchell, Smyser, and Weed (1975) and Runyon (1973). No support for the relationship is found in studies by Abdel-Halim and Rowland (1976), Sadler (1970), Tosi (1970), Searfoss and Monczka (1973), and Vroom and Mann (1960). Finally, two other studies used the path-goal theory of leadership effectiveness (House & Mitchell, 1974) to examine personality-participation-effectiveness relationship. Schuler's study (1976) indicated that subordinates' PDM was satisfying to low authoritarian subordinates regardless of the degree of task repetitiveness, but it was satisfying to high-authoritarian subordinates only on tasks with low repetitiveness. Furthermore, Abdel-Halim's (1983) findings suggested that high PDM was satisfying to low need-for-independence subordinates regardless of the degree of task repetitiveness; and high PDM was satisfying to high need-for-independence subordinates only on low task repetitiveness.

Finally, Ekvall (1971) has indicated that successful suggester seems to relate to their reaction of an active personality and they need to adopt to change. The primary motivation behind employee suggestion making goes beyond the awards and promotion of the system. However, Whitwell (1965) indicated that the suggestion system can be viewed as contract offered by the firm to purchase employees' ideas. The primary motivation behind employee participation in the suggestion system is receiving a reward at the conclusion of the process.

Organizational Extrarole Behavior

The emergence of research on helping behavior can be directly traced to a number of theoretical sources: Gouldner's (1960) proposition regarding the prevalence of the universalistic norm of reciprocity; and Leeds' (1963) suggestion regarding the prescription of the norm of giving. These theories discuss social conditions for helping behavior, or offer a cognitive and motivational basis for helping behavior. Such questions as why people are often apathetic and do not help others, what conditions facilitate helping, or what personal characteristics are associated with the tendency to help have guided the study of helping behavior.

With a few exceptions, organizational scientists only recently have begun to include ideas related to prosocial behavior in studies of behavior in work organization (Brief and Motowidlo, 1986). Katz and Kahn (1966) distinguished between inrole and extrarole behaviors and suggested that organizations depend on both kinds of employee actions. They have indicated the many occasions in which organizational functioning depends on extrarole behavior--behavior that cannot be prescribed or required in advance for a given job. These behaviors include any of those gestures that lubricate the social machinery of the organization but that do not directly adhere in the usual notion of task performance. Organ (1988) and Staw & Boettger (1990) have broadened their conceptualization of the performance contract to include

extrarole behavior. Organ and Konovsky (1989) have examined the effects of individual affect and cognition on an individual's performance of citizen behaviors.

There are several similar concepts that have been referred to as helping behaviors in different ways. For example, Katz and Kahn (1966) used the term extrarole behavior to refer to proactive behavior to achieve organizational welfare. Brief and Motowidlo (1986) used the term prosocial behavior to refer to positive social acts carried out to produce and maintain the well-being and integrity of others. Organ (1988) used citizenship behaviors to refer to those employees who contribute helping behavior that cannot be required for a given job. In the present study, I use Katz and Kahn's (1966) term, extrarole behavior, because suggestions are something extra. Improvement suggestions from employees are not normally expected to maintain a responsible attitude toward the business, beyond the responsibilities specifically assigned to them. They are something "extra" to the company--something beyond the call of duty.

Extrarole behaviors are behaviors that are performed by organizational members voluntarily and these contributions are not inherent in formal role obligations. Examples of extrarole behaviors include helping co-workers, supervisors, subordinates with a job-related problem, helping to keep the work area clean, tolerating temporary impositions without complaint, talking favorably about the organization to

outsiders, protecting and conserving organizational resources, and suggesting improvements in production or administrative procedures.

There is no conceptual basis for thinking that employee suggestion contributions would be related to organizational extrarole behavior. Brief and Motowidlo (1986) suggested that "attempting to suggest procedure, administrative or organizational improvements is another prosocial expression." Employee suggestion behavior involves going beyond required job assignment to perform some voluntary activity with the intent of helping the organization and benefitting others. Extrarole activities include such gestures as helping co-workers, supervisors, subordinates with a job-related problem (Puffer, 1987; Smith, et al., 1983) and showing thoughtful and sympathetic attention to the need of other employees. For most shop-floor employees, investigating an organizational problem and suggesting changes for improving it is not a formal job requirement. Instead, it is a voluntary gesture that goes beyond their obligatory job assignments. For these employees, suggestion contribution is clearly an organizational extrarole behavior.

Demographic Variables

It is prevalent to stress the positive impact of education on the potential for employee involvement. Zupanov and Tannenbaum (1968) suggested that higher aspirations and

greater interest in participation tended to have higher levels of educational attainment. As employees' training and schooling increase, they will be better able and more eager to participate. Furthermore, participation itself appears to be a very intense form of education (Pateman, 1973). Moreover, participation perhaps creates demand on the part of the workers for more general education and training courses (Jenkins, 1973).

Some of the findings on scientific and R & D innovations might be applicable to employee suggestion systems also. It would be particularly interesting to examine studies relating length of service to innovativeness. Katz (1982) and Smith (1970) found a curvelinear relationship between the mean tenure of members in project groups and ratings of their group's performance. Smith, however, found a positive linear relationship between mean group tenure and group performance as measured by patents and technical papers. These researchers saw a lack of development of necessary role and status relationships in groups with low mean tenure and suggested that groups with high mean tenure may have isolated themselves from important outside sources of information. Pelz and Andrews (1976) also found this curvelinear relationship but they found that projects with long-tenured members could generate an intellectual competitiveness that maintained a high performance ratio.

Situational Variables

Situational determinants are different from personal determinants because they are the result of the circumstances in which an individual finds himself/herself in relation to his/her environment. Besides individual differences, situational factors also play a very important role in how people act. Social psychologists have employed a variety of terms to describe the necessity of using both sets of concepts. For example, Lewin's (1951) general theoretical formulation that behavior (B) is a function (F) of the person (P) and the Situation (S), B = F(P,S) is a good example. Two important situational determinants of employee suggestion behavior in this study are: job complexity, and supervisory style.

Job Complexity

The nature of the job is an important determinant of how people act, and differences in tasks and task characteristics have been shown to mediate differences in individual and social behavior (Hackman, 1969a, 1969b). House and Mitchell have stated clearly the difference between the nature of jobs and PDM as follows:

> When...task demands are ambiguous (or non-repetitive), participative leadership will have a positive effect on the satisfaction and motivation of the subordinates, regardless of the subordinate's predisposition toward... authoritarianism or need for independence. when task demands are

> clear (repetitive), subordinates who are not authoritarian and who have high needs for independence...will respond favorably to leader participation and their opposite personality types will respond less favorably. (1974, p 93)

In other words, when the task is highly repetitive or routine and subordinates are not allowed to make their own work decisions, participation in decision making would have little effect. Besides, Abdel-Halim (1983) investigated the effects of task and personality characteristics on subordinate responses to participatory decision making with a sample of 229 supervisory and non-supervisory employees in a large, retail drug company suggesting that high need-for-independence subordinates performed better and were more satisfied with high participation only for non-routine tasks. Furthermore, Hackman and Lawler (1971) indicated that perceived job complexity is related positively to employee motivation, job satisfaction, and other job performance. When jobs are high on the four core dimensions (skill variety, autonomy, task identify and feedback), employees with moderately high desires for higher order need satisfaction, tend to work harder, be more satisfied, be absent from work infrequently, and be rated by supervisors as doing high quality work. Brief and Aldag (1975) replicated Hackman and Lawler's (1971) study and found similar results. This study provided strong support for the presence of positive correlations between the employee's perception of his job characteristics and his effective responses to that job. That is, an employee's perceptions of

each core dimension was significantly ($p < .05$) related to his level of internal work motivation, general job satisfaction, and job involvement with the exception of the correlation between task identify and internal work motivation. Several studies also found that monotonous, repetitive jobs are positively related to job dissatisfaction, absenteeism, and turnover (Blanner, 1964; Guest, 1955; Walker, 1950).

Supervisory Leadership Style

Theoretically, supervisory style should influence employee participation in decision making and the amount of innovation in an organization. Steinberg (1981) suggested that a participative leadership style as opposed to an authoritarian style causes more task-related idea generation, and that the presence of a formal participative decision making system would result in more task-related idea generation than in those firms that do not have such a system.

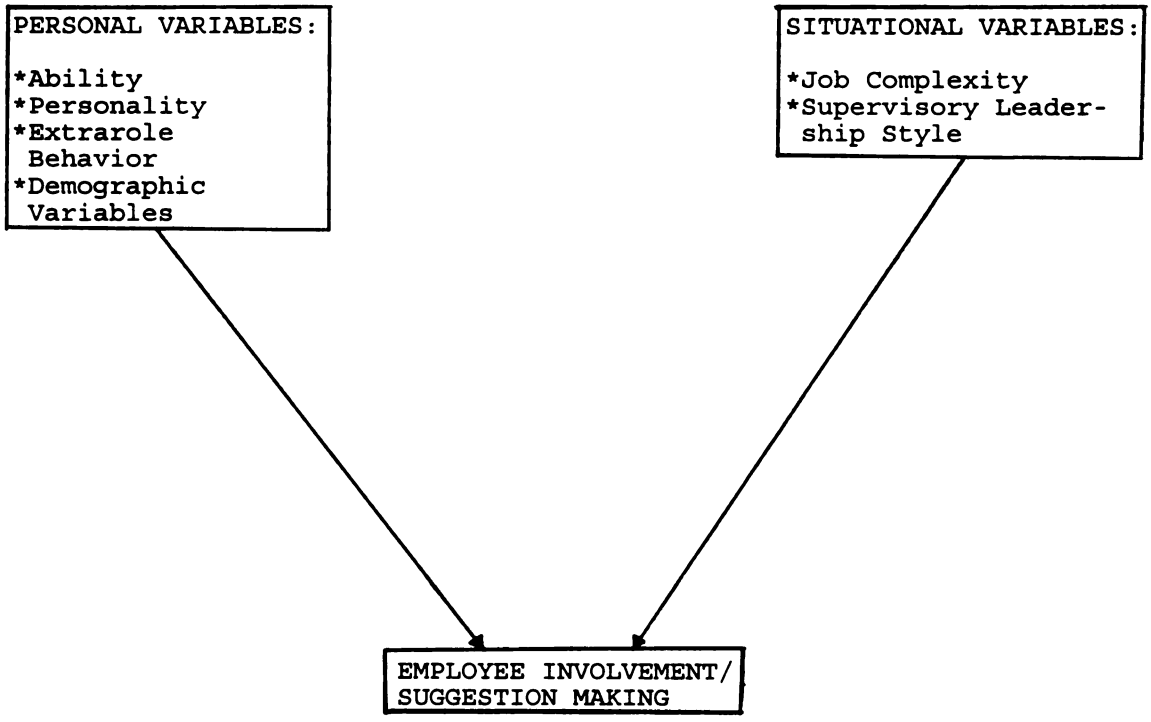
Some other PDM-innovation relationship research has been conducted which collected data from non-industrial settings. Fairweather, Sanders, and Tornatzky (1974) found that there was a strong relationship between PDM and the degree of change observed in federal psychiatric hospitals. They suggested that "the degree to which involvement across disciplines, across social status levels, and with more groups produced greater change." Moreover, similar results were observed in a study of welfare organizations. Hage and Aiken (1967) found

a positive relationship between PDM and the rate of program change, and a negative relationship between more hierarchial authority and program change. These studies implied that the increased interaction provided by PDM created a greater degree of perceived participation by employees, and that perceived participation appeared to be associated with performing an innovation.

Another classic studies in the PDM-innovation relationship, though not aimed at innovation directly, also supported the idea that there was positive correlation between two variables. Maier (1953) found that a group's resistance to change could be sharply reduced by training the leader in group decision procedures. This study suggested that PDM could lessen resistance to innovation or change.

In sum, the impact of selected individual and situational variables on employee involvement/suggestion making discussed above can be conceptualized in Figure 3-1.

Figure 3-1: A Conceptual Model of the Determinants of Effective Kaizen-Suggestion System



The Operational Model and Hypotheses

An Operational Model of the Determinants of Effective Kaizen-Suggestion System

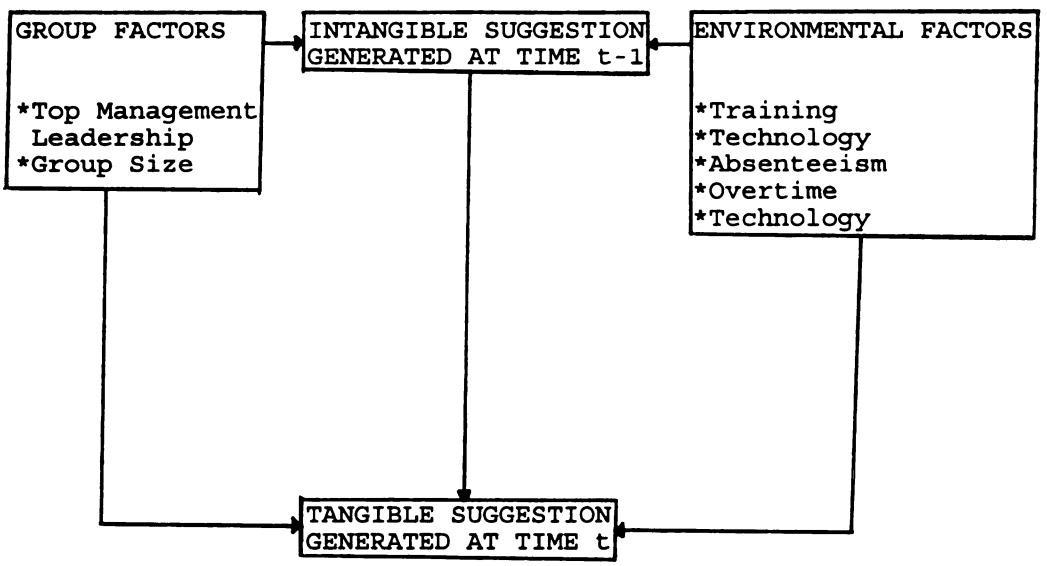
As mentioned above, despite the fact that a number of studies have evaluated the factors that influence employee involvement behavior in general, few studies have examined the determinants of an effective kaizen-suggestion system in particular. Both situational and personal factors have been examined in Employee Involvement research, seldom have studies evaluated the situational constraints of suggestion system in specific. Research that has been done almost always concentrates on personal factors such as motivation, personality, intelligence, age, education, occupation, creativity (Burke et al. 1982; Pizam 1974; Ekvall 1971; Steinberg 1981). None of the personal factors has been supported as a powerful determinant of suggestion making. Thus, situational variables should be carefully examined in a kaizen-suggestion study. In this study, only situational factors will be examined. This is based on two reasons. First, as mentioned earlier, in NDUS, a strong organizational culture supports the suggestion system and thus variance at the departmental level is higher than individual level. Second, a review of employee involvement and employee suggestion literature suggests that the personal variables are not good predictors of making suggestions in one hand, and the situational determinants of suggestion generation have not

been examined on the other. Situational factors, thus, should be investigated in the study of employee suggestion systems.

In figure 3-2, situational predictors of suggestion making are broken down by group and environmental factors. Group variables include a top management participative style and group size, while environmental variables include training, technology, absenteeism and overtime. Most independent variables used in this chapter have not been discussed in the literature review section. It is partly because none of these variables has been studied in the area of employee suggestion making and partly because none of existing studies has applied pooled departmental data in their statistical analyses.

These group and environmental factors are expected to relate to employee suggestion generation. The question is how do they work? Further, what is the relationship between current suggestions and those adopted in the past? Do accumulated experiences and skills in making intangible suggestions in the past help stimulate or catalyze more new improvement ideas which are then reflected in tangible suggestion making? In this study, I will examine this "snowball effect" of suggestion generation. An operational model of the determinants of effective kaizen-suggestion model is presented in Figure 3-2. The creation of hypotheses in the following section will be based on the operational model presented in Figure 3-2.

Figure 3-2: An Operational Model of the Determinants of Effective Kaizen-Suggestion System



Hypotheses

At NDUS, employees who make suggestions are given the responsibility to implement them. They are encouraged to consult with their team leaders, supervisors, or engineers and figure out how best to do so. Employees are allowed to test or find alternative solutions. Allowing employees to solve problems, under a kaizen system, fosters individual learning (Florida and Jenkins, 1993). Hence, for a suggester, suggesting is a learning process. Consequently, a kaizen-suggestion system not only facilitates current suggestion making but accumulates knowledge needed for generating new ideas, new suggestions in the future.

In general, tangible suggestions are ideas related to production or technological improvements, while intangible suggestions are ideas related to nonproduction or nontechnological improvements. Tangible suggestions tend to be more difficult to generate than intangible suggestions. In other words, generating a tangible suggestion requires more knowledge, skills, and ability than generating an intangible one. A tangible suggestion can hardly be generated without proficient problem-solving skills, practiced job knowledge, and enriched suggestion experiences. And these skills, knowledge and experiences could be accumulated from previous experiences in making intangible suggestions. An intangible suggestion itself could be a very subtle organizational improvement, but an intangible suggestion is very crucial and

fundamental for the accumulation of skills and knowledge needed for making a tangible suggestion, or even making another intangible suggestion. In other words, knowledge accumulation in making intangible suggestion is the basis of tangible suggestion making. Thus, the total volume of adopted intangible suggestions can be viewed as the effect of learning and knowledge accumulation. Consequently, a positive effect of this knowledge accumulation on tangible suggestion making is expected.

As mentioned earlier, tangible suggestions tend to be more difficult to generate than intangible suggestions. Generating a tangible suggestion requires more knowledge, skills and ability than generating an intangible one. Knowledge and skills accumulation in making intangible suggestions helps group members build their competency within the group, and in turn, increased group competency helps stimulate more tangible suggestions making. Therefore, a positive effect of this group competency accumulation on making tangible suggestions is also expected. On the basis of these reasoning, the first hypothesis can be stated as following:

Hypothesis 1.

> The greater the current and past volume of adopted intangible suggestions, the greater the current volume of adopted tangible suggestions.

Employees can make more valuable suggestions only when

they have the required skills and knowledge to understand how improvements could be made and how problems can be solved. Training is the best way to improve employees' skills and knowledge, as well as change their attitude toward improvement activities. When employees are trained to operate, maintain, and repair equipment, they are capable of sharpening their skills and knowledge of production technologies and understanding the overall production system in ways that might lead to insights on how improvements could be made and how problems could be solved. Viewed dynamically, training increases skills and knowledge, which increases the ability to generate improvement ideas and solve problems. Further, because tangible suggestion generally are ideas related to production or technological improvements, technical training may be more helpful for tangible suggestion making than management and self-actualization training. On the contrary, because intangible suggestions generally are ideas related to nonproduction, nontechnological or administrative improvements, management and self-actualization training may be more important than technical training.Thus on the basis of this reasoning, the expected relationship between training and number of adopted suggestions can be stated as follows:

Hypothesis 2.

> The greater the number of training credit hours, the greater the number of the departmental tangible and intangible suggestions.

Hypothesis 2.1

> Technical training will be more important than management self-actualization training for making tangible suggestions.

Hypothesis 2.2

> Management and self-actualization training will be more important than technical training for making intangible suggestions.

Two broadly different production technologies (machining vs. assembly) are used in the production system at NDUS. The nature of jobs seems to be linked to production technologies. The jobs are more complex on machining lines than those jobs on assembly lines. Thus we expect job complexity to be positively related to suggestion generation because complex tasks create more chances for jobholders to suggest change for improvement in job design; innovative work methods, production procedures, or administrative procedures. In contrast, simple tasks have relatively few interdependent components and require fewer skills, reducing the likelihood that useful alternative work methods could be determined even if the employee's ideas were solicited. In other words, when a job is simple and the best way of performing a task is obvious, employee involvement and suggestion making probably are not necessary (Hatcher, et. al., 1989). The expected relationship between job complexity and suggestion contribution is stated in Hypothesis 3.

Hypothesis 3.

> Machining departments will have more tangible and intangible suggestions than assembly departments.

Absenteeism may be negatively related to suggestion generation. Dissatisfaction and low organizational commitment probably are two major reasons for absenteeism. An employee who is dissatisfied with his/her job or organization and has a low degree of organizational commitment may have no intention to participate in improvement activities in general and suggestion making in particular. On the other hand, it is impossible for an employee to make any suggestion when he/she absent from work. Even when he/she comes back to work, he/she may have little time to participate in suggestion making activities because he/she has to pay more attention to catch up his/her work. Thus a negative relationship may exist between absenteeism and suggestion making.

Hypothesis 4.

> The higher the absenteeism ratio, the lower the volume of tangible and intangible suggestions.

Suggestion making requires substantial time away from production tasks to investigate problems, consult with resources (i.e., team leaders, supervisors, engineers, etc.), test solutions, write a suggestion form, and so on. Suggesters always participate in these suggestion making activities in addition to their duties. Therefore suggestions cannot be made if suggesters work overtime too often or too long. Lack of

free time seriously interferes with employees' involvement in suggestion making activities. Even if employees have time after they come home from work, they are often so emotionally and physically drained that they have little energy left to think about improvement ideas. Based on this reasoning, a negative relationship is expected between overtime and suggestion.

Hypothesis 5.

> The greater the number of overtime hours a department has, the fewer tangible and intangible suggestions the department makes.

The size of the workforce in a department may be positively related to its suggestion contributions. Employees in a bigger organization may have more opportunities to interact and discuss with other employees than employees in a smaller organization. Imai (1986) has argued that the change process or improvement itself originates through discussions. High degree of discussion or interaction with others (e.g. teammates, coworkers in other teams, team leaders, etc.) is helpful for employees to stimulate improvement ideas or brainstorm better solutions. Further, a bigger organization tends to have a higher degree of diversity in people, work processes, or equipment than a smaller organization. Employees in an organization with a higher degree of diversity may have broader views and tend to be more creative and open minded, which is the foundation of an effective kaizen-suggestion system. Thus, from this reasoning, I propose the next hypothesis:

Hypothesis 6.

> Big departments have more tangible and intangible suggestions than small departments.

The dummy variable for "year" is to examine the effect of top leadership on suggestion generation. The observational period was divided by two stages: period one: January 1991 to October 1992; period two: November 1992 to June 1994. The cut off point (i.e. October 1992) of the observational period was set at the month of the transition of two top managers who are in charge of the kaizen-suggestion system. The former and present managers were described as representing two extreme points of the authoritarian-democratic continuum respectively[10]. Leadership has been identified as one of the major factors that affect the performance of the kaizen-suggestion system at NDUS. Thus, the leadership style of top management should be examined in the model of the determinants of suggestion making.

Theoretically, supervisory style should influence employee participation in decision making. A participative style of leadership can create a more open communication system and increase interaction among employees and their supervisors, co-workers and subordinates for the purpose of

---

[10]This is based on individual interviews with key officials who are in charge of the implementation of the kaizen-suggestion program in HR department and with an IE engineer who is partially responsible for the implementation of kaizen activities in the plant.

supervisors, co-workers and subordinates for the purpose of discussing and resolving work-related procedures and issues. The increased interaction and discussion of work-related procedures and issues provided by a participative organization increases the opportunity for expressing an idea. In other words, the greater the amount of work-related interaction that takes place,the greater the chance that innovative ideas will arise from this interaction (Hoffman & Maier, 1961). Furthermore, Likert (1967) and Lowin (1968) indicated that a more open and less critical atmosphere will lessen the inhibitions that employees may have about expressing an idea regarding work-related procedures or processes. The implications of research on leadership style and participative climate are that the more participative environment an organization has, the more likely the employees have work-related interactions, the greater the chance that suggestion ideas will arise from this interaction. Therefore, an organization with a participative leadership style may have more adopted suggestions than an organization with an authoritarian leadership style. In other words, the volume of adopted suggestions in period two may be more than in period one. However, we should note that the different results between two periods of time may also reflect a matured effect of the kaizen-suggestion system[11]. The next hypotheses can be

[11]When employees have long been lived with the kaizen-suggestion system, the accumulation of problem-solving skills, knowledge, and experiences in generating ideas helps employees

described as follows:

Hypothesis 7.

> A positive relationship exists between a top leadership participative style and the number of adopted tangible and intangible suggestions.

Summary of Hypotheses

Hypothesis 1.

> The greater the current and past volume of adopted intangible suggestions, the greater the current volume of adopted tangible suggestions.

Hypothesis 2.

> The greater the number of training credit hours, the greater the number of the departmental tangible and intangible suggestions.

Hypothesis 2.1

> Technical training will be more important than management self-actualization training for making tangible suggestions.

Hypothesis 2.3

> Management and Self-actualization training will be more important than technical training for making intangible suggestions.

Hypothesis 3.

> Machining departments will have more tangible and intangible suggestions than that of assembly departments.

Hypothesis 4.

> The higher the absenteeism ratio, the lower the volume of tangible and intangible suggestions.

---

make more volume or higher quality of suggestions over time.

Hypothesis 5.

> The greater the number of overtime hours a department has, the fewer tangible and intangible suggestions the department makes.

Hypothesis 6.

> Big departments have more tangible and intangible suggestions than small departments.

Hypothesis 7.

> A positive relationship exists between a top leadership participative style and the number of adopted tangible and intangible suggestions.

Research Models

Multiple regression analysis is employed to estimate the model of the determinants of suggestion making. The analysis of the determinants of suggestion making is fundamentally dynamic it can only be understood via longitudinal analysis and thus is best suited to time-series analysis. Since the focus is not on differences among departments, however, making monthly aggregates for any one department is inadequate. Thus, data for departments are pooled for the period tested to provide the aggregate data base for estimating the regression. On the other hand, because pooled cross-sectional and time-series data increase degrees of freedom and thus reduces the variance of the estimators of the regression, the possibility of significant results will increase.

Model of determinants of Adopted Tangible Suggestions

$$Tang_{i,t} = a_0 + a_1 Intang_{i,t-k} + a_2 Mgttran_{i,t-k} + a_3 Selftran_{i,t-k} + a_4 Techtran_{i,t-k} + a_5 Tech_{i,t} + a_6 Absent_{i,t} + a_7 Overtime_{i,t} + a_8 Size_{i,t} + a_9 Leadership_{i,t} + e_{i,t}$$

Model of determinants of Adopted Intangible Suggestions

$$Intang_{i,t} = a_0 + a_1 Mgttran_{i,t-k} + a_2 Selftran_{i,t-k} + a_3 Techtran_{i,t-k} + a_4 Tech_{i,t} + a_5 Absent_{i,t} + a_6 Overtime_{i,t} + a_7 Size_{i,t} + a_8 Leadership_{i,t} + e_{i,t}$$

Where

$Tang_{i,t-k}$ = Volume of adopted tangible suggestion in department i for month t-k

$Intang_{i,t-k}$ = volume of adopted intangible in department i for month t-k

$Mgttran_{i,t-k}$ = Management training hours earned in department i for month t-k

$Selftran_{i,t-k}$ = Self-actualization training hours earned in department i for month t-k

$Techtran_{i,t-k}$ = Technical training hours earned in department i for month t-k

$Tech_{i,t}$ = Degree of technology in department i at month t

$Absenteeism_{i,t}$ = Absent ratios in department i at month t

$Overtime_{i,t}$ = Overtime hours in department i at month t

$Size_{i,t}$ = Size of workforce in department i at month t

$Leadership_{i,t}$ = Dummy variable for the transition of top management in department i at month t

Empirical Results and Implications

Pooled cross-sectional and time-series regressions were estimated with data from the 19 departments for the observational periods January 1991 to August 1994. The total volume of tangible suggestions was used as a dependent variable; the current (t) and past volume (t-1, t-2) of intangible suggestions addressing a learning effect of problem solving and participation, and the various training hours, overtime, absent, workforce size, technology and leadership as control variables. The major aim of this model is to examine the knowledge accumulation effect of intangible suggestions on tangible suggestion making.

Relationships Between Tangible Suggestions, Intangible Suggestions, and Other Control Variables

Table 3-1 shows means, standard deviations and correlations for twelve variables across the 19 departments from January 1991 to August 1994. The data reveal a strong connection between tangible suggestion and various intangible suggestions, providing support for Hypothesis 1---that is, that the current and past volumes of adopted intangible suggestions are associated with the current volumes of adopted tangible suggestions. More management training is related to more the volume of adopted tangible suggestions. A more highly participative leadership style of top management is related to a greater volume of adopted tangible suggestions. There is also evidence that more management training is strongly

Table 3-1: Means, Standard Deviations, and Correlation Matrix (N = 836)

			Variables										
	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11
1. Tangible Suggestion (t)	.69	1.21											
2. Intangible Suggestion (t)	12.72	17.46	.24										
3. Intangible Suggestion (t-1)	12.72	17.46	.18	.57									
4. Intangible Suggestion (t-2)	12.72	17.46	.19	.49	.57								
5. Management Training	12.85	15.91	.03	.10	.07	.05							
6. Self-Actualization Training	3.72	7.72	-.06	-.01	-.02	-.04	.08						
7. Technical Training	15.52	17.40	-.02	.00	.00	.03	.14	.40					
8. Workforce Size	29.93	24.10	-.01	.07	.07	.07	.21	.07	.09				
9. Overtime	589.59	572.67	-.01	.02	.02	.02	.14	.12	.13	.79			
10. Absent Ratio	1.69	1.61	.01	.23	.20	.18	.11	.02	.00	.10	.03		
11. Technology	.74	.44	.05	.03	.05	.05	-.05	-.07	-.07	-.15	-.09	-.11	
12. Top Management Leadership	.52	.50	.06	-.13	-.14	-.16	-.06	.06	.06	-.06	.06	-.15	.00

associated with more adopted intangible suggestions.

Correlation analysis reveals associations, but it does not provide tests of causality. Further hypothesis tests will be examined in the next section.

The Selection Processes of Various Lagged Variables

There were some problems that had to be solved before I conducted a regression analysis with a lagged hypothesis of knowledge accumulation. There is no theoretical basis for making a clear-cut decision as to just what the maximum direct lag of intangible suggestions should be. Griliches (1967) has indicated "Do not expect the data to give a clear-cut answer about the exact form of the lag. The world is not that benevolent. One should try to get more implications from theory about the current form of the lag and impose it on the data." Nevertheless, in this study I have no theoretical basis on which to select the most appropriate pattern of lagged relationships. Nor am I aware of any suggestion study that has successfully determined an operational solution to the problem based on theoretical reasoning. To solve this problem, I conducted direct distributed lag estimates and selected the most "benevolent" results. I estimated the parameters of truncated versions of from one through six-period lag (i.e. six months or two quarters).

The overtime-pattern of effects for intangible suggestion variables can be examined in Appendix A. The intangible

suggestion effect on tangible suggestions in Appendix A peaks at current period and declines through t-6. Obviously the regression coefficients begin to be insignificant and small or wrong-signed when Intang t-3 is included in the equations; equation (2) in Appendix A may therefore be considered the most accurate equation which is still significant. Consequently, the current and a lag of one and two months of intangible suggestions were included in the full models presented in Table 3-2.

Another problem for model selection is how to select the most appropriate pattern of lagged variables of the various training hours. There is also no theoretical basis for supporting a lag relationship between training and tangible suggestion making or how long a lag will be. Sue Flees, specialist of HRM and coordinator of suggestion program at NDUS, suggested that it seemed to take time for transfer of training from basic knowledge to applied knowledge. Since the task situations are so different, learning in training settings has little relationship to suggestion making at work settings. Therefore, it can be assumed that the learning that occurred in the training settings takes time to transfer and aid performance in making suggestions. Appendix B shows the selection processes of the optimal pattern of lagged training variables. The optimal results were obtained with a lag of one month. The signs of regression coefficients are "correct" in all three training variables. The regression coefficients

are insignificant and small or wrong-signed with either current period or a lag of two months. The results suggest that the more training a department took in the last month, the more adopted tangible suggestions in the current month.

Empirical Results from the Model of Determinants of Adopted Tangible Suggestions

After the selection of the optimal pattern of lagged variables of intangible suggestions and training hours, the full model of determinants of adopted tangible suggestions was conducted. The results are represented in Table 3-2.

The current and past volume of adopted intangible suggestions are found to have positive effects on tangible suggestion making. The current and past volume of adopted intangible suggestions might be expected to work in the equations of the determinants of adopted tangible suggestion for one of two reasons: either because they represent past individual learning and knowledge accumulation that affect current tangible suggestion making, or because intangible suggestion making improves employees' motivation or satisfaction that increase current tangible suggestion making. Intangible suggestions have greatest effect on tangible suggestions at current period ($P < .005$), is small for a lag of one month, goes up again for a lag of two months ($p < .005$). The regression coefficients of 0.015, 0.003, and 0.007 in equation 1 in table 3-2 exhibit a reverse bell-shaped distribution around a central lag of one month. Similar

results are obtained from regression coefficients in equations 2, 3, and 4 in table 3-2. This may be interpreted by saying that one part of tangible suggestions increases simultaneously with intangible suggestions and a second part of tangible suggestion gains which show a distributed lag behind intangible suggestion making at current period.

More extensive employees and management participation in training programs lead to more tangible suggestion making. In equation 1, 2, and 3, table 3-2, the association between Mgttran and tangible suggestion is statistically significant at the 0.05 level. However, the other associations between the training indices (Self-actualization and Technical) and tangible suggestion in equation 1, 2, and 3, table 3-2, are not statistically significant. It is partially opposite to the hypothesis that technical training may be more important than management training to help employees make tangible suggestions. It is interesting that management training is designed for leaders at all levels (i.e., team leaders, coordinators, departmental supervisors, and so on) but not for workers. It may be interesting to observe that when team leaders or supervisors learn managerial and interpersonal skills in the training programs[12] and return to working

---

[12]Michael Gagnon, manager of Organizational Development at NDUS, supported this idea that some management courses such as problem solving, creativity skills, risk taking, and communication especially help team leaders or supervisors guide their members and solicited their new ideas to make more suggestions.

Table 3-2: The Determinants of Tangible Suggestion Making

Explanatory Variables		Tangible Suggestion (1)	(2)	(3)	(4)
Intercept	b	.099	.108*	.122	.131***
	t	.875	1.888	1.151	3.883
$Intang_t$	b	.015***	.015***	.015***	.016***
	B	.213	.217	.215	.227
	t	5.663	5.765	5.742	6.087
$Intang_{t-1}$	b	.003	.003	.003	.003
	B	.044	.043	.045	.048
	t	1.171	1.133	1.209	1.275
$Intang_{t-2}$	b	.007***	.007***	.007***	.007***
	B	.097	.096	.097	.095
	t	2.593	2.573	2.595	2.536
$Mgttran_{t-1}$	b	.003*	.003*	.003*	
	B	.043	.044	.043	
	t	1.756	1.836	1.766	
$Selftran_{t-1}$	b	.004	.004	.004	
	B	.024	.027	.024	
	t	.918	1.092	.939	
$Techtran_{t-1}$	b	.0002	.4E-04	.0001	
	B	.003	.006	.001	
	t	.111	.273	.060	
Overtime	b	-.3E-04	-.5E-04		
	B	-.014	-.022		
	t	-.459	-1.176		
Absent	b	.011	.005		
	B	.014	.006		
	t	.527	.240		
Size	b	-.3E-04		-.0005	
	B	-.0006		-.001	
	t	-.022		-.545	
Tech	b	-.009		-.103	
	B	-.035		-.038	
	t	-1.085		-1.183	
Leadership	b	.167***		.154***	
	B	.069		.064	
	t	2.575		2.435	
R^2		.134	.131	.134	.120
F		11.601	15.583	14.148	37.695

F-test for all estimates significant at the .01 level.
* = p < .05 level
** = p < .01 level
*** = p < .005 level
b is the regression coefficient.
B is the standardized Coefficient.
t is the t value.

settings, they may be enthusiastic about encouraging and guiding their team members to make more suggestions.

More democratic leadership style, as indicated by a dummy variable in Leadership, may be associated with more tangible suggestions. In equation 1 and 3, table 3-2, the association between Leadership and tangible suggestions is statistically significant at the .005 and .01 level respectively. It suggests that the volume of adopted tangible suggestions in period two (i.e. January 1991 to September 1992) is more than that in period one (i.e. October 1992 to August 1994). A much more democratic and participative organizational climate has been observed and described in period two than in period one. However, note that there is a highly participative base-line at NDUS, so variance is around an already high level. It supports the hypothesis that the more participative environment an organization has, the more likely it is for employees to have work-related interactions, and the greater the chance that suggestion ideas will arise from this interaction. We also should note that the increased pattern could reflect a matured effect of the kaizen-suggestion program.

The equations reported in table 3-2 provide little evidence that more overtime hours hinder tangible suggestion making. A higher absenteeism ratio led to more tangible suggestions, not fewer as predicted by a "demoralized" hypothesis. The larger workforce size lead to fewer

suggestions, not more as predicted. Finally, machining departments have fewer tangible suggestions than assembly departments, again a result opposite to the prediction.

With regard to the impact of individual learning, as measured by adopted intangible suggestions, the regression reported in equation 4 in table 3-2, shows a statistically significant effect for current period suggestions ($P < .005$) and for a lag of two months ($P < .01$) on tangible suggestion making. The R^2 for equation 4 is .120. The R^2 rises from .120 (equation 4) to .134, .131 and .134 (equations 1, 2, and 3 respectively) when all or part of the control variables appear in the regressions, indicating a small effect for control variables on making tangible suggestions. More control variables included in equations 1, 2, and 3 increased explanatory power very little (the R^2 rises from .120 to .134, .131 and .134 respectively), whereas the F values dropped dramatically from 37.695 to 11.601, 15.583, and 14.148 respectively. It suggests that a set of intangible suggestion variables has a strong cumulative and statistically significant effect on tangible suggestion making.

Empirical Results from the Model of Determinants of Adopted Intangible Suggestions

Table 3-3[13] reports the results of regression estimates

[13] Various training variables with a lag of one month are based on the results of selection process of the most appropriate pattern of lagged training variables. The regression estimates are presented in Appendix C.

of determinants of adopted intangible suggestions. In the equations reported in table 3-3 the same patterns hold as in table 3-2 except workforce size and leadership. More training credit hours generally caused more intangible suggestions. However, only management training was statistically significant at .005 level. It partially supports the hypothesis that management and self-actualization training may be more important than technical training for employees making intangible suggestions. There was no evidence to support that Overtime and Workforce Size affected intangible suggestion making. Absenteeism and Technology did not affect intangible suggestion making in the hypothesized manner. The results were opposite to the predictions. In equation 1 and 4 in table 3-3, more participative climate led to fewer intangible suggestions, not more as I predicted before, and the coefficients were statistically significant at .05 level. The hypothesis is not supported. Roy Roemen, superintendent of production at NDUS, suggested that it may be because the evaluation committee members (included himself) have set more rigid standards for adopting intangible suggestions in the past two years. It suggests intangible suggestions decrease over time that seems to have nothing to do with top management leadership style.

R^2 for equations 1 through 4 in table 3-3 are .025, .021, .019, and .024 respectively, indicating that only about 2 percent of the variations in intangible suggestion making

Table 3-3: The Determinants of Intangible Suggestion Making

Explanatory Variables		Intangible Suggestion (1)	(2)	(3)	(4)
Intercept	b	6.215***	4.999***	5.704***	5.783***
	t	4.163	5.691	4.052	5.047
$Mgttran_{t-1}$	b	.068***	.065***	.064***	.066***
	B	.061	.059	.059	.061
	t	3.364	3.321	3.401	3.338
$Selftran_{t-1}$	b	.049	.049	.052	.046
	B	.022	.022	.023	.020
	t	1.263	1.279	1.399	1.200
$Techtran_{t-1}$	b	.005	.005	.001	.006
	B	.005	.005	.001	.006
	t	.314	.276	.087	.339
Overtime	b	-.001	-.0004		
	B	-.019	-.015		
	t	-.512	-.555		
Absent	b	.288	.338		.315
	B	.026	.031		.029
	t	1.286	1.522		1.414
Size	b	.021		.012	.005
	B	.028		.017	.007
	t	.696		.508	.211
Tech	b	-.632		-1.217	
	B	-.016		-.031	
	t	-.477		-.842	
Leadership	b	-1.865*			-1.938*
	B	-.053			-.055
	t	-1.697			-1.773
R^2		.025	.021	.019	.024
F		2.695	3.496	3.279	3.375

F-test for all estimates significant at the .01 level.
* = p < .05 level
** = p < .01 level
*** = p < .005 level
b is the regression coefficient.
B is the standardized Coefficient.
t is the t value.

could be accounted for by these situational variables. However, the F values for these 4 equations are all statistically significant at .01 level. This should not surprise us because the sample size of this study is 836. It can be concluded that the linear relationship between these 8 independent variables and intangible suggestions is not zero in the population, with a less than 1 percent chance of doing so erroneously.

Summary of Tests of Hypothesis

Knowledge Accumulation Hypothesis:

Positive relationships were found between tangible suggestion making in month t and intangible suggestion making in month t-k. The current period of tangible suggestion making is based on current and past learning and knowledge accumulation in making intangible suggestions. Thus, this hypothesis is strongly supported.

Training Hypothesis:

Only for management training programs were statistically significant found between training and both tangible and intangible suggestion making. This hypothesis is partially supported.

Overtime Hypothesis:

A negative relationship was found in both cases of

tangible and intangible suggestion making. The more overtime hours a department has, the fewer tangible and intangible suggestions the department makes. However, these findings are not statistically significant, so we must conclude that there is little evidence to support this hypothesis.

Absent Hypothesis:

For both tangible and intangible cases, a positive relationship was found between suggestion making and the absenteeism ratio. The results were opposite to what I expected. This hypothesis is rejected.

Workforce Size Hypothesis:

A negative relationship was found between tangible suggestion making and workforce size. The result was opposite to the prediction. This hypothesis is rejected.

For intangible suggestion making, a positive relationship between suggestion making and workforce size was found. Nevertheless, the result was nonsignificantly supported.

Technology Hypothesis:

For the technology dummy variable, negative relationships were found between suggestion making and technology in both tangible and intangible suggestion cases. Machining departments do not have more adopted suggestions than assembly departments as I expected. This hypothesis is rejected.

Leadership Hypothesis:

This hypothesis is strongly supported for the case of tangible suggestion making and rejected for the case of intangible suggestion making.

For the leadership dummy variable, a positive relationship was found between tangible suggestion making and leadership style; whereas a negative relationship was found between intangible suggestion making and leadership style.

In sum, the analysis of plant-level data from NDUS indicates that where there was more extensive individual learning and knowledge accumulation through intangible suggestion making, more management training, and a more democratic organizational climate, tangible and intangible suggestions are significantly increased.

Policy Implications

The significant results from the impact of intangible suggestions on tangible suggestions may be striking in light of the fact that most of the companies in the US only pay attention to tangible suggestions, giving little attention to intangible suggestions. The empirical results suggest that employees may hardly make any tangible suggestion without accumulating experience, skills, and knowledge by making intangible suggestions. Allowing employees to make intangible suggestions may, therefore, foster more tangible suggestions. For a suggester, suggesting is a learning process. Making an

intangible suggestion currently helps an employee to accumulate knowledge needed for generating new tangible suggestions in the future. Expecting employees to make more complex or valuable suggestions without experience in making simple or small suggestion is unrealistic. Therefore, companies that implement or are interested in an employee suggestion system should pay more attention to intangible suggestions. After all, intangible suggestions are the knowledge basis for tangible suggestions. Even if companies do not treat intangible suggestions as more important than tangible suggestions, at least they should be treated as equally important as tangible suggestions. Furthermore, in order to foster more tangible suggestions from knowledge accumulated in making intangible suggestions, a learning climate should be created. At NDUS, management should facilitate employees' problem solving and learning from experience. Members from different teams or departments are encouraged to discuss and resolve problems with each other. More intensive interactions among or within teams may solicit or generate more new ideas about how to solve problems. Past adopted intangible suggestions also can be developed as educational materials for the training sessions for QCs' members or team members. Employees may catch cues or get some ideas that lead to make more tangible or intangible suggestions. On the other hand, employees may also receive a message that company is not only concerned for machine or

organizational effectiveness but also concern people and non-financial things. Regression analyses provide evidence of statistically significant association between both tangible and intangible suggestions, and management training, but nonsignificant for self-actualization and technical training.

At NDUS, employees who make suggestions are given the responsibility to implement and operate them. However, before they operate them, they are encouraged and in most cases they have to consult with their team leaders or supervisors about what the ideas are and figure out how best to do them. Team leaders and supervisors play a very important role in the kaizen-suggestion system to guide and help their members to make and operate their suggestion ideas. In some cases, team leaders even gave their members a rough idea and let them investigate problems and finally made a formal suggestion. Thus, it may be not so surprising to us that management training (only offered to management) is more important than self-actualization and technical training.

There are many management courses offered by NDUS[14]. Among these courses, interpersonal skills training might be the most important for team leaders to help their members make an improvement suggestion. A person who demonstrates

---

[14]Some selected management courses include: problem solving, creativity skills, risk taking, leadership skills, interpersonal communication, managing conflict, performance improvement, maintenance improvement, productive listening, and so on. All these courses may be helpful for team leaders and supervisors to handle the kaizen-suggestion more successfully.

effective interpersonal behavior has acquired the ability to sustain trust, openness, emotional support, and the expression of strong feelings which are pivotal in the process of making suggestions. Team members may lose interest in making suggestion, if their leaders do not give them either physical or emotional support. Without team leaders' trust and openness, team members will hesitate to talk to their leaders even if they have a valuable idea. It suggests that management support in the process of suggestion making is very important to a successful kaizen-suggestion system. It implies that companies should link management training to the Kaizen-suggestion system at the strategic level. It also implies that management training programs should be designed to support kaizen processes and activities at the practical level. Well-designed management training programs not only train team leaders to help their members get involved in kaizen activities, but educate them to reduce their resistance to change.

Work teams and a bottom-up approach are frequently mentioned as being features of Japanese management. Japanese top managers rarely act as strategic analysts and sometimes are characterized as invisible leadership (Kagono et al. 1985). The significant results from the impact of top leadership style on tangible suggestions may challenge this traditional argument about Japanese business leadership. The regression analysis shows that democratic and visible

leadership from top management is an essential factor for the effective kaizen-suggestion system. It was supported in the regression analysis of tangible suggestion making, but was not supported for the case of intangible suggestion making. The data suggest participative leadership is essential for successful kaizen processes. It implies that a more democratic climate should be developed to promote and support a kaizen-suggestion system.

The jointly significant effects of management training and top management leadership on the kaizen-suggestion activities implies that management support is the key for the successful kaizen-suggestion system.

Summary and Discussion

Most independent variables used in the empirical study of this chapter were not discussed in the literature review. This is in part because none of these variables has been studied and partly because none of existing studies has applied pooled data in their statistical analyses. This dissertation suffered from insufficient literature and theory.

The results of this chapter provide initial support for the proposition that the current (t) and past (t-1, and t-2) adopted intangible suggestions are strongly associated with the current adopted tangible suggestions. It implies that suggestion making is a learning process. What worker have learn in making intangible suggestions eventually will be

transformed to the knowledge needed for generating a new tangible suggestion. An intangible suggestion itself may be a subtle organizational improvement but it is very important and fundamental for the accumulation of knowledge needed for making tangible suggestions.

However, the initial evidence provided in this chapter should be interpreted carefully. For example, the empirical results from this chapter suggest that a significant finding in the same month can be interpreted as a reflection of the fact that groups high on intangible suggestions will also be high on tangible suggestions. The additional significance of the lag in the same regression suggested a second phenomena in which intangible suggestions predict tangible suggestions. An interesting question is raised here. Will the same results hold when tangible and intangible suggestions are reversed in a regression equation. If yes, it implies that a reciprocal relationship between tangible and intangible suggestions may exist. Thus, it needs a further examination.

Finally, we should note that since the effect in table 3-2 is not significant for all lagged months, these findings are suggestive but not definitive. The R^2 in table 3-2 and 3-3 regressions are small, so we should interpret the results carefully. Also, because the data on top management leadership style is based on a relatively limited measure, it must be treated with more caution.

CHAPTER FOUR

ASSESSING THE IMPACT OF THE KAIZEN-SUGGESTION SYSTEM ON ORGANIZATIONAL EFFECTIVENESS

Introduction

In this chapter, three issues will be addressed. First, the relevant literature will be reviewed. Second, a conceptual model of the effect of kaizen-suggestion system on productivity will be established to clarify the influential process of such systems on productivity. Finally, empirical results will be discussed and the policy implications will be elaborated.

The first part of the chapter will contain comprehensive literature review and it will still tell us little about kaizen program performance effects. A major difficulty for literature review about kaizen suggestion systems is the lack of a core literature, either theoretical or empirical. It pushed me to be more comprehensive than usual in relevant areas such as employee involvement or QCs. Therefore a comprehensive literature review in traditional suggestion programs, QCs and employee involvement will be presented in the first part of this chapter. The concept of a kaizen-suggestion system is not only important in an implication of continuous improvement itself but also has links in the

literature to productivity, quality and employee involvement. It is an important phenomena, in part, because of the way it integrates across all three areas. For example, the QC literature adds the notion of group-generated suggestions, but it fails to link the idea of system change. The employee involvement literature provides the notion of communication, decision making and problem solving, but it fails to link to suggestion behavior itself.

The second part of this chapter will examine how the kaizen-suggestion system can be expected to affect productivity. A conceptual model will be established to aid the analysis of the effects of suggestion making.

Because of the lack of core literature and theory, and as a result of the analysis, I will be presenting an inductive model built on field observations, statistical analysis and literature. Finally, policy implications will follow.

Literature Review

Introduction

As mentioned above, few studies have examined the impact of the suggestion system on organizational effectiveness in general and on productivity in specific. Due to the lack of core literature in this area, it is not possible to make a complete review of these studies. In addition to a very narrow employee suggestion literature, some relevant studies on

worker participation or employee involvement will be reviewed in this chapter, though not linked to employee suggestion making directly. This literature review will consist of examining Quality Control Circles, financial involvement (e.g. Scanlon Plans), and other forms of worker participation and interpreting their impact on productivity. In some cases, actually, QCs and financial involvement use some form of suggestion program; thus, QCs, financial involvement and the kaizen-suggestion system are similar in their nature.

Research on Employee Suggestion Program

Few studies have evaluated the organizational impact of employee suggestion systems. Most of the suggestion research is case study reports of success in the practitioner literature. What research has been done suggests that the companies which implement employee suggestion system experience reduced costs, greater employee satisfaction, and better working conditions (see table 4-1). These studies have either theoretical or methodological weakness that may limit understanding of the full influential process of the organizational impact of the kaizen-suggestion system. Generally, lack of theoretical, methodological and statistical analysis hardly qualifies them as studies; however, they can provide us with useful and fruitful information. The employee suggestion literature contains innumerable stirring testimonials and success stories.

Table 4-1: The Impact of the Suggestion Programs on Productivity

Study	Sample	Productivity Criteria	Results
Seimer (1959)	127 individuals in two steel fabricating companies	1. Profits 2. Costs 3. Safety 4. Job satisfaction 5. Product quality 6. Job security	1. Increased 2. Reduced 3. Improved 4. Mixed 5. Improved 6. Increased
Denz (1946) Rand Inc.	Remington		A feeling of solidarity with the company
Loesges (1946)	Western Electric Company, Inc.	1.Costs	Cost savings of $200 to $400 per year
Reuter (1977)	228 companies	1. Costs 2. Job satisfaction 3. Relationship between supervisors and subordinates 4. Skill development	1. Reduced 2. Mixed 3. Mixed 4. Improved
Paulson (1971)	General Electric	1. Costs	1. Cost savings of 25 million in 1970
NASS (1975)	General Dynamics	1. Costs	1. Cost savings of $3,339,153 in 1974
Wilce (1971)	Standard Telephones & Cables Ltd.	1. Costs	1. Cost savings of $25,000 in one year
French (1984)	Westinghouse	1. Costs	1. Cost savings of $1,446,505
French (1984)	Hughes Aircraft Co.	1. Costs	1. Cost savings of $24 million in the first

Table 4-1: (Continued)

Study	Sample	Productivity Criteria	Results
			nine months of 1962
Gunsch (1991)	United Electric Controls Co.	1. Costs 2. Efficiency	1. 60% cut in inventory 2. 90% reduction in the time needed to complete a project 3. A consistent on-time delivery rate of 95%, up from 65% from 1987 to 1990

These cases are not concerned specifically with productivity (defined as a ratio of outputs to inputs) but the kinds of cost reduction claimed for employee suggestions certainly imply productivity improvements.

Most cases concern particular employee suggestions that "hit a home run"--that is, proposing one suggestion that saved a huge sum of money (Paulson 1971; NASS 1975; Wilce 1971; French 1984), while some cases examine some outcomes other than cost savings, such as employees' attitude, job security, safety, super-subordinate relations, and skill development (Semimer 1959; Denz 1946; Reuter 1977).

There is one problem with the successful case study reports. Stories of huge savings generated by a single suggestion may imply the overall employee suggestion effort is highly successful and the organization is a high-involvement

organization, when in reality there are very few suggestions generated.

Research on Quality Circles

Essentially, a quality circle is "a small group of employees from a common work area who get together regularly to identify and generate solutions for problems they encounter in their work situation" (Ledford, Lawler, and Mohrman 1986, p.256). Membership of the circle typically comprises between four and a dozen people who meet under the guidance of a group leader. They are aided by a facilitator, who trains members, provides a source of information and encouragement, and act as a liaison between the circle and remainder of the organization. Generally, a senior manager is responsible for ensuring that the circles are able to acquire sufficient resources to allow the completion of tasks and sufficient authority put ideas into practices. In addition, the circles are initiated and driven by a steering committee which acts across the establishment or organization as a whole (Thompson 1982; Ingle 1982; Crocker and Charney 1984). There are two distinct sets of objectives behind the implementation of quality circles. First, they are introduced in order to increase productivity and reduce costs, improve product quality and service, basically aims which relate to enhanced organizational effectiveness. Secondly, they save as a further

motive improvement in employee satisfaction and commitment. However, this literature review will focus on the former objective rather than latter objective because it is consistent with the topic, although the two objectives are closely related and likely to be included in any rationale for the introduction of quality circles.

Each study's sample size, productivity criteria, and major findings is presented in Table 4-2. Although many of these studies utilized multiple outcome measures, productivity related measurements were reported only.

Closer inspection of Table 4-2 reveals two types of studies: those which report data with and without statistical analysis. Interestingly, all the studies that did not use statistical analyses to support their conclusions reported positive results (Murray 1981; Nelson 1980; Industrial Week 1979; Juran 1978; Yager 1979; Arbose 1980; Donovan and Van Horn 1980; Tortorich 1981). In contrast, only two of the six studies with statistical analysis report positive results (Marks et al. 1985; Jenkins and Shimada 1984), with one study reporting negative result (Srinivason, 1983) and five studies reported nonsignificant results (Harper and Jordon 1982; Norris and Cox 1987; Mohrman and Novelli 1985; Guantilake 1984; Wolfe 1985). The first cluster of evaluation reports consists of the anecdotal appraisals and cost savings data offered by program sponsors as evidence of program accomplishments. Such reports frequently provide estimates of

anticipated savings rather than actual cost reductions. These reports rarely mention how costs and benefits are estimated. When the estimating procedure is explicit, the figures are usually based on the estimated value of QC suggestions prior to implementation. This is an important issue, because many suggestions are actually never implemented or are implemented only after a long period of time (Mohrman and Novelli 1985; Wayne, Griffin, and Bateman 1986). These reports may make overbroad assumptions regarding the productive utilization of work time stemming from labor saving efficiencies. Thus, the findings of such reports must be viewed with some measure of skepticism (Steel and Shane, 1986).

The second cluster of studies provided relatively rigorous theoretical analysis and scientific statistical measurement, but these studies rarely provided systematic examinations of the circle's effectiveness. One reason that it may be difficult to measure productivity, even, when using SQC methods, is that this approach does not directly measure productivity. When analyzing productivity increases, most studies do not report exactly which method they are utilizing to evaluate productivity measures. Moheman and Novelli (1985) found some improvement in productivity, but could not determine whether or not it was due to the quality circle program. In addition, Steel and Shane (1986) indicated that "the majority of studies constituting the quality circle evaluation literature are, at best, seriously flawed and, at

Table 4-2: The Impact of QCs on Productivity

Study	Sample	Productivity Criteria	Results
Murray (1981)	300 QCs in Honeywell	1. Cost Savings	1. Cost Savings of $500,000
Nelson (1980)	General Electric Co.	1. Control costs	1. Cost savings of $15,000 per year
Nelson (1980)	Morton Chemical Co.	1. Control costs	1. Cost savings of $300,000 a year
Nelson (1980)	Purchasing department of Westinghouse Co.	1. Control costs	1. Cost savings of $636,000 a year
Main (1980)	One department in Cincinnati Milacron	1. Production rejection rate	1. The rejection rate on an item was reduced from 50% to zero
Industry Week (1979)	Hughes Aircraft Co.	1. Cost reduction	1. Annual savings of $45,000 from the reduction of defects and another $48,000 from the redesign of sample boards for assembly work
Juran (1978)	Television division of Motorola Co.	1. Product defects	1. Defect rate was reduced from 1.8 to 0.04 per television set
Yager (1979)	15 QCs in Lockheed Co.	1. Costs savings	1. Cost savings of $2,844,000 in the first two years of operation
Arbose (1980)	4 companies	1. Return on investment	1. The ROI is estimated at from five to ten to one

Table 4-2: (Continued)

Study	Sample	productivity Criteria	Results
Marks et al. (1986)	46 circle members and 46 non-members in a manufacturing	1. Productivity	1. Overall participant's performance in productivity, efficiency, and working hours are better than non participants (significant difference favoring QC groups)
Norris and Cox (1987)	112 circle members and 121 nonmembers in an electronic	1. Job performance -dependability -quantity/quality of work -cooperativeness -safety/health	1. No significant QC effects
Jenkins and Shimada (1983)	450 production personnel were divided by 11 QC groups	1. Production quantity 2. Quality 3. Re-work costs	1. Significant increase in three of four productivity criteria for QC groups
Mohrman and Novelli (1985)	156 food warehouse personnel	1. Productivity changes in productivity	1. No reliable
Donovan and Van Horn (1980)	120 assembly line workers (10 QC groups)	1. Unit assembly costs	1. 46% reduction in in costs over 2 years
	94 assembly line workers (11 QC groups)	1. Unit assembly costs	1. 36% reduction in in costs
	80 assembly line workers (3 QC groups)	1. Unit assembly costs	1. Significant difference favoring QC groups
Tortovich et al. (1981)	872 individuals (463 QC groups)	1. Productivity 2. Quality	1. Significant difference favoring QC groups

Table 4-2: (Continued)

Study	Sample	Productivity Criteria	Results
Guantilake (1984)	2 QC groups and 1 non-QC groups in 2 hospitals	1. Productivity 2. Quality	1. Nonsignificant improvement in productivity and quality by QC groups
Wolfe (1985)	3 QC groups and 3 non-QC groups a county government	1. Productivity 2. Quality	1. Nonsignificant improvement in productivity and quality by QC groups
Srinivason (1983)	Computer firm (sample size was not reported)	1. Productivity	1. Significant difference not not favoring QC groups

worst, potentially misleading. If the level of scientific rigor found in other field research domains such as job redesign, survey feedback, and goal setting may be employed as a yardstick, then the quality circle literature exhibits generally inferior quality" (pp 450-451).

Research on Financial Involvement Programs

One of the most significant growth areas of employee involvement in recent years has been in the field of financial participation (Poole 1986, 1989; Smith 1986; Lawler 1986; O'Dell 1981). There are basically three types of Plans: (1) employee share ownership (e.g., ESOPs), (2) Profit sharing, and (3) gainsharing plans (e.g. Scanlon Plans, Improshare, etc.). Poole (1989, pp 70-72) has suggested five sets of reasons for the introduction of financial involvement; there are 1) moral commitment by employers, 2) staff retention, 3) employee involvement, 4) improved industrial relations performance, and 5) protection against takeover. The most important factor of financial involvement probably is category (3), which is broad and seems to incorporate a number of different sets or reasons. Numerous studies supported the idea that financial involvement programs that may account for their success through employee participation (Frost, Wakeley, and Ruh 1974; Lawler 1986; O'Dell 1981; White 1979; Graham-Moore and Ross 1983; Ross 1983; Hatcher and Ross 1991; Miller and Schuster 1987; Klein and Hall 1988; Long 1978, 1980).

Financial involvement programs are as much an approach to participative management as they are a pay plan. Typically, gainsharing programs, for instance, use some form of suggestion program as their way of implementing participative management (Frost, Wakely and Ruh, 1974; White 1979). In the Scanlon Plan, for example, written suggestions are solicited and committees are established to process them. Most literature on the Scanlon Plan cites not only participation and communication, but willingness, cooperation, and acceptance of change that occur because of the process of the suggestion system (Scanlon 1984; Lesieur and Pucket 1968; Schultz 1958; Ross 1969; Ross and Jones 1972; Northrup and Young 1968). In addition to suggestion systems, most gainsharing plans include a committee that is created to manage the plan and communicate the results.

Studies in the effects of financial involvement programs on productivity are presented in Table 4-3. All of the studies used statistical analyses to support their conclusions and found a positive impact on productivity. Although many of these studies used productivity data for outcome measures, different measurements for productivity were found. Some studies used input measures such as hours worked (Shatter 1984; Doherty 1989). Some studies used output measures including those of quantity and quality of production and of cost effectiveness (Schuster 1984; Hitcher and Ross 1991; Doherty 1989). And some other studies used

Table 4-3: Effects of Financial Involvement Programs on Productivity

Study	Sample	Productivity Criteria	Results
Schuster (1984)[a]	890 union production/ repair workers in two divisions of an aircraft repair facility	Quantity of units produced and hours worked	Statistically significant increases in the time series analyses for productivity data
Kaufman (1992)[b]	112 companies	Productivity	1.The median productivity increased by 8% in the first year 2. The cumulative productivity increased by 17.5% in the third year
FitzRoy and Kraft (1987)[c]	65 firms in the West Germany metalworking industry	Productivity	Profit sharing has strong effects on productivity
Cable and Wilson (1990)[c]	61 firms in the West Germany metalworking industry	Productivity	Overall productivity differentials of 20-30% in favor of profit-sharing firms
Wadhwani and Wall (1990)[c]	219 manufacturing companies in Great Britain	Productivity	Significant difference favoring profit-sharing firms
Kruse (1984)[d]	2 companies	Productivity	Slightly difference favoring the firm practicing ESOPs
Conte, Tannenbaum McCulloch	98 employee-owned firms	Productivity	Managers felt employee ownership has a positive (1981)[d] effect on profit and productivity
Hatcher and Ross (1991)[e]	An automobile supplier	Quality	Significant increase in product quality

Table 4-3: (Continued)

Study	Sample	Productivity Criteria	Results
Doherty et al. (1989)[e]	An aerospace firm	1. Productivity 2. Quality 3. Cost savings	1.Productivity improved by 35.3% over the base period quality 2.Improved by 44.1% over the base period (nonsignificant) 3.$2.0 million total gross savings
	A non-profit	1. Productivity 2. Cost saving	1.Productivity improved by 11% over the base period 2.$3.0 million in savings
	A manufacturing	Cost savings	$9.25 million in the potential net value of the cost savings
	A bank	Cost savings	$6.6 million in the potential net value of the cost savings

---

a: Scanlon Plans
b: Improshare
c: Profit sharing
d: ESOPs
e: General gainsharing plan

"real" productivity measures in terms of a ratio relating output to inputs (FitzRoy and Kraft 1987; Cable and Wilson 1990; Wadhwani and wall 1990). Quantitative or "hard" productivity data were used as an outcome of financial involvement programs with the exception of Conte's et al. (1981) study. In their study, an indirect assessment of the productivity performance of ESOPs was conducted. They asked managers to evaluate their productivity performance since the intervention of ESOPs.

Basically, most studies claimed that financial involvement programs produce a more democratic environment as well as superior channels for information-processing and conflict resolution. Better conflict resolution reduces labor turnover and hence increase workers' tenure with the firm. Longer average tenure then translate into higher productivity. Profit sharing, gainsharing and ESOPs also provide better incentives and possibilities for workers to acquire human capital.

Research on Other Forms of Worker Participation

The introduction of new institutional arrangements for promoting collaborative problem solving between management and workers has been one of the more widely recognized transformation since the early 1970s (Kochan, Katz, and McKersie 1986; Lawler 1991; Cooke 1990). They argue that

Table 4-4: The Effects of Worker Participation on Productivity

Study	Sample	Productivity Criteria	Results
Rosenberg and Rosenstein (1980)[a]	262 individuals in a manufacturing company	Productivity	Positively corrected
Bragg and Adrews (1973)[b]	32 hospital laundry workers	Productivity	Increased
Goodman (1979)[c,e]	a coal mining effect	Productivity	Slightly positively effect
Nurick (1985)[d]	245 employees in utility engineering section	Productivity	No effect
Taylor, Friedman and Couture (1987)[a]	100 telephone employees	1. Productivity 2. Quality of service	1. Improved 2. Higher
Trist, Susman and Brown (1977)[a]	24 coal miners	Productivity	Higher
Buller and Bell (1986)[a]	53 coal miners	Productivity	Increased
Katz, Kochan and Gobeille (1983)[d]	5 GM plants with highest QWL ratings for the period 1977-1979	1. Product quality	1. Increased by 1.5% 2. Decreased by 2.4%
Kochan, Katz and Mower (1984)[b]	110 observations from 5 auto plants	1. Productivity 2. Product services quality	1. Increased by 73.3% 2. Increased by 74.6%

Table 4-4: (Continued)

Study	Sample	Productivity Criteria	Results
Katz, Kochan Weber (1985)[d]	66 responds from 25 manufacturing plants	1. Product quality 2. Direct-labor efficiency	1. r = .26** 2. r = .17**
French, Ross Kirbby, Nelson and Smith (1958)[f]	800 manufacturing workers	Productivity	Increased
Schuster (1983)[e]	22 individuals in a manufacturing plant	Productivity	Significant higher
Voos (1987)[b]	343 Wisconsin firms with bargaining units of a east 50 employees	1. Productivity 2. Product quality 3. Unit labor cost	1. Positive effect 2. Positive effect 3. Positive effect
Cutcher-Gershenfeld (1991)	37 Monthly observations across 25 work areas in Xerox Co.	1. Productivity variance 2. Net return to direct labor hours	1. Work areas with transformational* labor-management relations have higher productivity than work areas with "traditional" relations
Cooke (1992)	1. 194 unionized plants surveyed in 1986 2. 70 unionized and 61 non-unionized firms surveyed in 1988	1. Perceived extent of change in product quality	1. Firms with joint labor-management programs have greater improvement in product quality than firms with no participation programs

a: Group-based participation
b: Worker participation programs
c: Job rotation
d: QWL programs
e: Labor-management committees
f: Employee participation in production change
*: The term "transformational" refers to the labor-management relations in a work areas that can be characterized by increased cooperation and improved dispute resolution (Cutcher-Gershenfeld, 1991).

changes in external economic conditions (e.g. the heightened threat from foreign competition) has provided the need for employee involvement programs. The wider utilization of worker participation systems is also triggered by the desire of managers to try the innovation to improve company profits and stagnating productivity.

In this review, worker participation includes joint problem-solving, work group discussion, labor-management committee, job design (i.e. job enrichment, job enlargement, job rotation, and job switching). Each study's sample size, intervention, productivity criteria and results is presented in table 4-4.

The sample size ranged from 32 to 800. Most of sample subjects were engaged in manufacturing jobs. The most often used economic performance measure in this review was productivity which was defined as employee output per hour. All of the studies found a positive effect of worker participation on productivity with exception of Katz et al. (1983). Two studies (Katz et al. 1983; and Katz et al. (1985) found mixed effects on direct-labor efficiency which was defined as the ration of actual hours of labor input to standardized hours. Katz et al. (1985) found that direct-labor efficiency had decreased. Although direct-labor efficiency had decreased in the five GM plants with high QWL activity, it was higher than in the five plants with the low QWL activity. This suggests that the employees involved in QWL programs were more

efficient than those employees not involved in QWL programs.

Discussion

Table 4-1, 4-2, 4-3 and 4-4 give summaries of 9 employee suggestion studies, 17 QC studies, 9 financial participation studies, and 13 other forms of worker participation studies respectively. Forty-one of the forty-eight studies found a positive effect for involvement programs on productivity. These results are consistent with a finding of recent review of participation research. A meta-analysis by Miller and Monge (1986) produced a weighted mean correlation of r = .15 for the 25 participation-performance correlations included in their analysis. Three different models were tested in this meta-analytical study. A cognitive model in which participation was predicted to have a stronger influence on productivity and satisfaction for decisions about which employees had knowledge. An affective model, where it was proposed that participation would lead to the attainment of higher order needs (i.e., self-expression, respect, independence) which would lead to an increase in satisfaction. The last model discussed was a contingency model, in which theorists predicted that participation would affect satisfaction and productivity in different ways across individuals.

When applying a cognitive model, it is predicted that when employees participate in the decision making process, they will attain knowledge that will lead to increased

productivity. These results should be even stronger when the employees participate in decisions in which they have specific knowledge. If the cognitive model of worker participation applies to employee suggestion behavior, it implies that the effectiveness behind an employee suggestion program stems from the fact that suggestions are made by employees who know the problems and areas of concern for their department. It assumes that the best person to make a decision affecting the job, is the individual working in that job. By including employees in decisions that affect them and their jobs, employee suggestion programs should make the employees even more aware of what is taking place in their areas.

Further, some other meta-analytical studies (Wangner and Gooding 1987a, 1987b; Gauzzo, Jackson, and Katzell 1985) also suggested that employee involvement modestly influences job performance. However, three narrative literature reviews (Cotton et al. 1988; Locke and Schweiger 1979; Schweiger and Leana 1986) found that the relationship between participation and performance is unclear.

Finally, few studies have really established the complete process of the organizational impact of participation. That is, the influential processes between participation interventions and productivity are unclear. The question is how participation affects productivity. If participation really is positively associated with productivity, is it because participation directly causes productivity

improvements, or is it because participation indirectly causes productivity improvements via improved job satisfaction or improved job skills and knowledge. Failure to examine these intervening variables will seriously limit understanding of the full influential process between participation and productivity. Thus, I will attempt to establish a full theoretical and conceptual model of the effect of the kaizen-suggestion system on productivity in the next section.

The Conceptual Model of Effects of the Kaizen-Suggestion System on Productivity

No study, either theoretical or empirical, has examined how the kaizen-suggestion system can be expected to affect productivity. It was discovered that a major difficulty was the lack of conceptual models available to aid the analysis of the effects of suggestion making. In this study, I adopt Sutermister's(1969) concept that productivity is a function of technological improvement and human contributions. In other words, productivity "is not determined solely by how hard and how well people work. The technical factors play a role, sometimes an overwhelmingly important one, sometimes a minor one"(p.5).

The employee suggestion program is a form of employee involvement or worker participation. Classical studies have argued that employee involvement can achieve higher job satisfaction and thereby achieve higher organizational

performance. Further, employees improve their job skills, knowledge and social skills via problem solving and this, in turn, will improve productivity. Finally, employee suggestion ideas can lead to labor-savings or capital-savings through eliminating the waste in processing, waiting time, overproduction, inventory, motion, transportation, defects etc. and this, in turn will improve productivity too.

Therefore, I argue that a kaizen-suggestion program may affect productivity by altering (I) work efforts or job satisfaction, (II) the productive skills of the labor force, and (III) the organizational efficiency. These three influential paths of kaizen-suggestion on productivity will be examined in the model. The process model of the effect of a kaizen-suggestion program on productivity is represented in figure 4-1. (I), (II), and (III) mark in figure 4-1 representing three different influential paths of kaizen-suggestion on productivity improvement. (I) and (II) represent motivation and ability. First two paths of the figure show that performance level (i.e., productivity) is a function of one's motivation and total job capability. When both motivation and ability are high, maximum performance can be achieved. Third path of the figure shows that productivity is a function of output and input. When output is increased while maintaining input, or input is decreased while maintaining output, productivity improvement can be achieved. By adopting Sutermeister's (1969) concepts, path (I), (II) in the figure

4-1 can be categorized as human influence, while (III) can be categorized as technological influence[15].

Motivation Influences

Suggestion Contribution and Psychological Impact

Suggestion contribution to the company should influence employees' perceptions of shared common goals, a feeling of solidarity with the organization, and support of the organization or loyalty. Being given an opportunity to participate in decision making (i.e., suggestion making) may create several kinds of important perceived similarities with management. There is likely to be, first, a greater sense of approximate similarity status with management. There is no longer a wide gap between two kinds of people--those who give orders and those who take them. To the extent that decision making is shared, all are on a level where they can contribute ideas, have them heard, and perhaps make an impact. A second kind of perceived similarity likely to arise from joint decision making is a similarity of values and goals. Through the process of mutual influence which comes with sustained interaction and through the process of actual agreement on

---

[15]From an economist's perspective, the equipment, tools, knowledge, and skill that go into the transformation process to convert inputs to outputs are referred to technology (Chinloy, 1981). From a I/O psychologist's perspective, skills and knowledge in that transformation process are referred to an individual's ability or job capability (French 1958; Wagner and Hollenbeck 1992). In this study, I adopt I/O psychologist's definition.

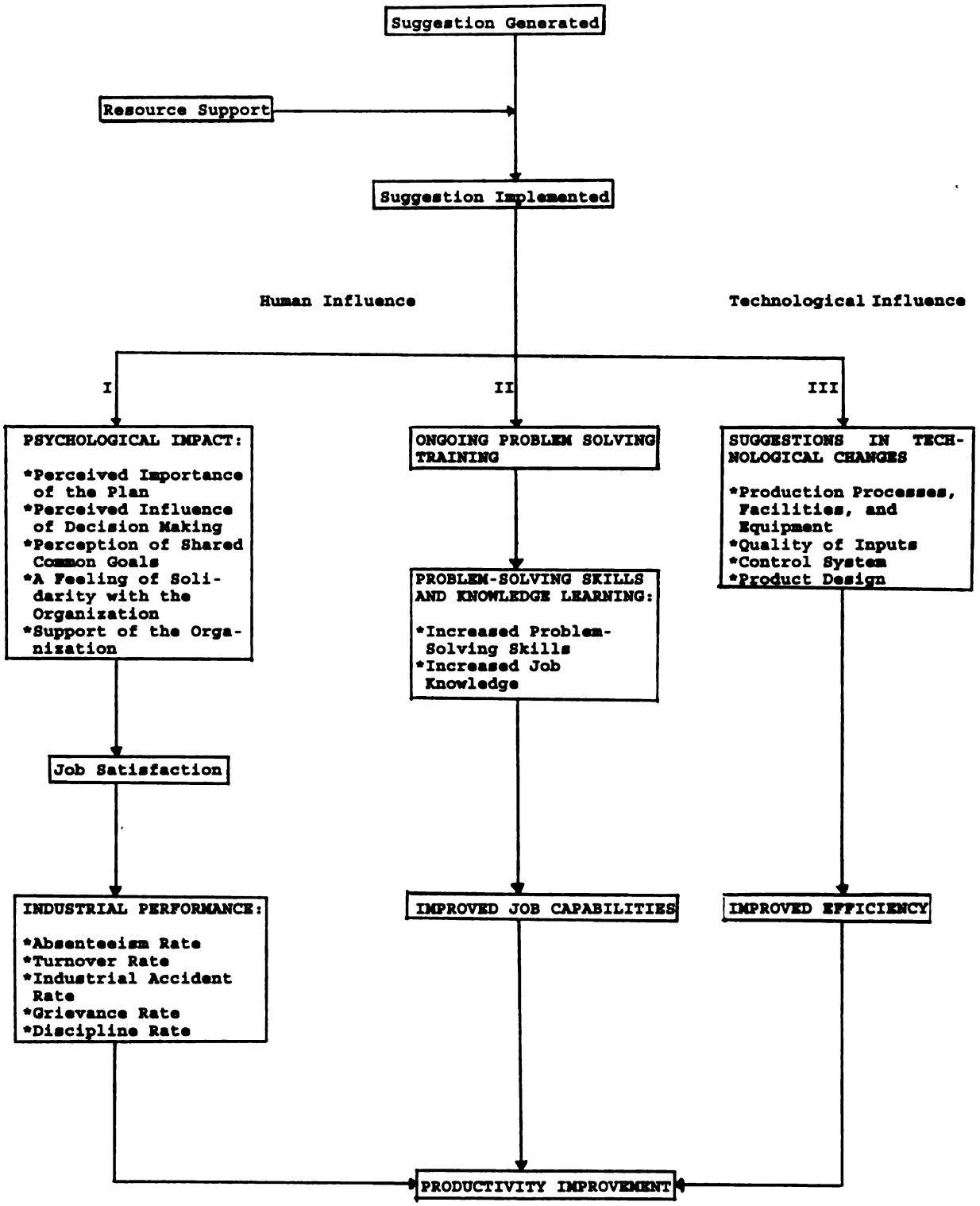
decisions, the perception of shared common goals, and a feeling of solidarity or loyalty is likely to emerge (Long, 1978, 1980; Patchen, 1970).

Psychological Impact, Job Satisfaction, and Organizational Performance

Job satisfaction may be influenced indirectly by suggestion contribution through psychological impact processes. The perceived importance of the suggestion plan and perceived influence on decision making is expected to influence job satisfaction. If employees feel that a suggestion program is very important for their financial benefits, job security, or job involvement, they may be more satisfied with their job. Moreover, if employees feel that they have formal or informal influence on decision making via a suggestion system, they also may be more satisfied with their job.

On the other hand, employee suggestion programs, through job satisfaction, lead to improved organizational performance (both industrial relations and productivity). Job satisfaction traditionally was the major independent variable for job or organizational performance. A causal relationship between satisfaction and performance was assumed, that is, high performance leading to higher job satisfaction. Locke (1970) has suggested that performance is primarily a cause of satisfaction and only indirectly a result of satisfaction.

Figure 4-1. A Conceptual Model of Effects of the Kaizen-Suggestion system on Productivity



Recently, however, a cyclical model has been examined in which satisfaction and performance are cause of each other; and the closer linkage runs from performance to satisfaction. French,Israel,and As (1960) have suggested that job satisfaction is an intervening variable between employee participation in decision making and organizational performance. Similarly, job satisfaction can be regarded as an intervening variable between suggestion contribution and organizational effectiveness. Therefore, the theory of the impact of the organizational performance of suggestion program may include two stages: suggestion contribution leading to high job satisfaction, and then high job satisfaction leading to high organizational performance. Traditional industrial and organizational researchers assumed that high job satisfaction lead to reducing absenteeism, turnover, and industrial accident rates. Moreover, it was typically assumed by those researchers that job satisfaction was positively associated with "job performance" such as productivity, product quality.

In a sense, workers make daily decisions concerning whether or not they will appear for work. We would assume these decisions to be predictable from information about the anticipated consequences of the alternative. If the consequences expected from not working are more attractive than those expected from working, the worker would be predicted to be absent. On the other hand, if the reverse is

true, the worker would be predicted to report for work. Therefore, job satisfaction would be negatively related to absences. Some studies support this hypothesis (Herman, 1973; Vroom, 1962, 1964). In the model, it would be assumed that if a suggestion program is attractive enough for worker to report for their work, absenteeism will relatively go down.

Hill and Trist (1953) have suggested that accidents, like absenteeism and turnover, reflect the strength of motivation on the part of the individual to withdraw from a work situation. In support of this view they found that accident rates are positively associated with other forms of absences and most strongly associated with the least sanctioned forms of absence. If this interpretation is correct, we should also expect to find a negative relationship between job satisfaction and industrial accidents. Thus, dissatisfied workers should be more likely to have accidents in order to remove themselves from their unpleasant work situations (Vroom, 1964, p. 180). Stagner, Flebbe, and Wood (1952) found a correlation of -.42 between the mean job satisfaction scores and variables for 12 shops in a railroad. We can also assume that, in the model, suggestion contribution positively affects job satisfaction and thereby reduce industrial accident rates.

Moreover, job satisfaction would result in higher performance such as productivity because workers will demonstrate their gratitude for rewards received from management by increasing their output or that a satisfied

worker is more likely to accept managerial goals of higher production (Vroom, 1964, p. 182). Some studies have suggested that increases in satisfaction might result in higher performance (Vroom, 1960; Locke, 1970; Slocum, 1970). In the model, we would assume that suggestion contribution cause higher job satisfaction and thereby increase productivity improvement.

Industrial Relations and Productivity Improvement

Industrial relations performance may influence economic performance (i.e.productivity improvement). Katz, Kochan, and Gobeille (1983) first introduce both industrial performance and economic performance into empirical research of worker participation programs. They use six variables of industrial relations performance to predict economic performance. These variables include grievance rate, absenteeism rate, discipline rate, contract demands, negotiation time, and attitudinal climate. The evidence has shown that performance of industrial relations significantly influences the economic performance of 18 plants adopting QWL Programs within a division of General Motors. Kochan and Katz (1988, p. 360) also suggest that "industrial relations performance affects economic performance." They indicate that the plants with relatively good industrial relations performance also have relatively higher productivity and quality. Therefore, industrial relations performance might be a good predictor of

firm overall productivity performance.

Job Capability Influence

Suggestion Making, Training and Problem-Solving Skill Learning

Employee problem-solving programs (groups vs. individuals) or kaizen activities generally include a training component that can improve employees' job capabilities (Japan Human Relations Association 1992; Pike and Barnes 1994; Atkinson 1990; Denton 1991). Kaizen training seeks to provide the ability to be involved, effectively, in participative problem solving and to support involvement. Usually, the objectives of this kind of training are to:

1. Give employees the opportunity to learn by actual experience the problems of management;
2. Solve a specific problem or situation that impedes the effectiveness of the organization;
3. Make fuller use of the know-how and resources of kaizen members;
4. Encourage learning by doing and risk-taking. (Saint 1974, p.143)

After learning specific skills and knowledge needed for suggestion generation, workers then apply these skills in the solution of a problem. Workers build their compentency by solving problems. Employee job capabilities can also be improved through this learning process of problem solving.

Because of the opportunity to integrate their learning with action, the method of learning is highly effective. To implement continuous improvement suggestions, employees must consult with supervisors and seek their advice, and such communication can be highly instructive. Actually, "this is probably the most effective on-the-job training a person can get" (Japanese Human Relations Association 1992, p.77). Therefore, a kaizen-suggestion system can lead to the improvement of job skills and knowledge.

Training, Skill Learning and Productivity improvement

From a management perspective, any improvement in productivity is reflected in cost reduction (Lawler and Ledford 1982, p.301; Gregerman 1984, p.130). Generally, cost reduction in the manufacturing sector can be brought about either by increasing machine uptime or by reducing manning. Reducing machine downtime and manning requires that shopfloor workers be skilled (Ishida 1993). For example, if the standard job cycle at any particular station is particularly long or heavy, thus creating a bottleneck and slowing the process, the individuals may seek to automate portions of that station's workload. The result is increased output per hour and this, in turn, improves productivity. Without required job skills and knowledge, however, such improvements cannot be made. Further, if work processes are interrupted due to a machine malfunction, thus increasing machine downtime, workers have to

diagnose the trouble and try to repair it as best they can. Thus one result of increased worker skills is the reduction of machine downtime and thereby improve productivity. Again without required skills and knowledge, workers may have no idea how to deal with the machine problems and even cannot do simple trouble shooting and problem solving. Therefore, the effect of skills is very strong on input measures of productivity. The cost savings of reducing downtime and manning lie on the input side of the productivity equation. That is, the efficiency of transforming inputs into outputs increases as these particular types of labor-related input costs decline. In sum, improved job skills and knowledge are by-products of the kaizen-suggestion system. Once workers' job skills and knowledge are improved, they can improve organizational productivity by doing machine maintenance, trouble shooting, problem solving, changing parts or even repairing equipment. Consequently, the kaizen-suggestion system leads to organizational productivity improvement via improved employee job capabilities.

Technological Influence

Kaizen-Suggestion, Technological Change and Productivity

Japan Human Relations Association (1988) stresses that a suggestion system is to achieve:

1) Improvements in work methods;

2) Improvements in tools, machinery, and equipment;

For example, if one suggestion can minimize transportation, energy, or inventory costs or reduce waste in processing[16], it can reduce input levels and thereby increase productivity.

(3) Improvement suggestions in control systems:

For example, if a suggestion can increase automaticity, it can reduce work operational time as well as increase output levels, and this, in turn, improving productivity.

4) Improvement suggestions in changing product design:

For example, if one suggestion can improve the quality of services to users (including convenience, flexibility, durability, reliability, and safety), it increases the added value of a product and thereby improves productivity in the long run. Once suggestions lead to technological changes in production processes, facilities, equipment, quality of inputs, control system and product design, productivity can be improved by decreasing input level, increasing output level, or changing both input and output levels.

Hypotheses

Productivity and Labor Input Models

Employee suggestions can improve productivity through both human influences and technological influences as

---

[16]The kaizen-suggestion system in Cannon Co. is to eliminate following wastes: 1) waste caused by work-in-process, 2) waste caused by defects, 3) waste in equipment, 4) waste in expense, 5) waste in indirect labor, 6) waste in planning, 7) waste in human resources, 8) waste in operations, and 9) waste in startup (Dyer 1987, pp 17-18).

3) Improvements in organization and safety;

4) Improvements in transportation;

5) Improvements in cost-cutting;

6) Improvements in energy conservation;

7) Improvements in clerical work; and

8) Improvements in sales operations.

Clearly, most goals of the suggestion system are to change production technology and thereby improve productivity. This is especially correct for the first two objectives of the suggestion system as listed above. Gold (1975, 1979) and Gold, Peirce, Rosegger (1970) have argued the technological changes which are most likely to affect productivity are largely encompassed by the following categories: 1) changes in the nature of production facilities, and equipment, 2) changes in the quality of inputs, 3) improvements in control system, and 4) changes in production design. Clearly, the above goals of the suggestion system can be broken down by these five categories.

(1) Improvement suggestions in changing the nature of production facilities and equipment:

For example, if one suggestion improves work method or process, it can reduce work operational time and thereby increase efficiency. Again, if one suggestion extends the machine's life, the machine becomes more profitable and return on investment is greater.

(2) Improvement suggestions on changing the quality of inputs:

discussed in the last section. Suggestion contribution to the company may influence employees' perceptions of shared common goals, a feeling of solidarity with the company, and support of the organization. Improved employee attitude and morale, thus, may lead to improvements in productivity. In addition, employees learn problem-solving skills and knowledge in the process of suggestion making. Increased job skills and knowledge, thus, lead to productivity improvements.

Improvement suggestions may improve productivity by changing technology. There are several ways that employee suggestions can improve productivity. First, suggestion ideas improve work methods and processes, which may contribute to productivity improvement. Second, suggestions improve equipment, tools, and machinery, which may also lead to improvements in productivity. Third, better operating conditions, production quality, and safety environment may also contribute to productivity improvement. Fourth, improvement suggestions that reduce the input requirements and ease the problems of the company may lead to productivity too. Finally, improvement ideas for reducing transportation, energy costs and other wastes in processing may also result in significant productivity improvement. We might expect, therefore, a positive relationship between suggestions and productivity.

Hypothesis 1.

The greater the number of the adopted tangible or

intangible suggestions, the greater the productivity gains.

Generally, tangible suggestions may result in technological changes and tangible financial benefits such as labor savings, material savings, downtime reduction, output increases, etc. Most of them result in technological and production improvements that directly lead to productivity improvements. On the other hand, intangible suggestions generally contribute to production quality, safety, housekeeping, convenience improvements, or improvements in the quality of working conditions. Most of them result in non-technological and non-production improvements that indirectly contribute to productivity improvements. The impact of intangible suggestions on productivity might be smaller than that of tangible suggestions. Therefore, the expected relationship between tangible and intangible suggestion effects on productivity can be described in hypothesis 2:

Hypothesis 2.

Tangible suggestions have greater effect on productivity than intangible suggestions.

In measuring the impact of suggestions on productivity, time is a critical variable. As mentioned above, total volume of adopted suggestions in the current period of time is expected to positively relate to productivity during the same period of time. The interesting question raised here is

whether productivity not only depends on present volume of suggestion accepted, but also depends on past volume of suggestions accepted? There are several reasons why there might be a lag effect in the suggestion-productivity relationship (i.e. a lapse of time between a change in an explanatory variable (suggestion) and a change in the dependent variable (productivity)). First, there might be time lags in the process of transformation of suggestion ideas into operations and of operations into productivity gains. It also takes time when old types of machinery, tools, equipment, or regulations are replaced by new technology or organization rules. Secondly, it takes time to train employees to learn new work methods and operate machinery, tools, or equipment. It also takes time for employees to live with new organizational rules and regulations. Finally, since behavior is often based on habit, employees who are used to an old way may resist the new way. Hence, we might expect that there are time lag effects of suggestions on productivity.

Although there might be a delayed or lag effect between suggestion activity and productivity performance, there may be a different pattern of effects over time between tangible and intangible suggestions. In general, most tangible suggestion ideas result in technological and production improvement, while intangible suggestion ideas result in nontechnological and nonproduction improvement. Technological and production improvement generally involves the reallocation of resources

such as renewal of equipment, labor and capital readjustment, so technological and production improvement which results from tangible suggestion generation may take time to respond to productivity gains. On the other hand, nontechnological and nonproduction which result from intangible suggestion generation may also take time to respond to productivity gains but it may be much shorter than technological and production improvement. Therefore we might expect that tangible suggestions have a longer lag structure than intangible suggestions. In other words, productivity response to tangible suggestions is slower than to intangible suggestions. Thus on the basis of this reasoning, the hypothesis 3 can be stated as follows:

Hypothesis 3.

> A time lag effect exists between suggestions adopted and productivity gains.

Hypothesis 3.1.

> Current and past adopted suggestions are relevant in determining productivity improvements.

Hypothesis 3.2.

> The lag for tangible suggestion effect is longer than for intangible suggestion effect.

Based on the discussion and reasoning of the relationship between suggestions and productivity, further examination in the relationship between suggestion and "labor inputs"--measured by total working hours--will be presented in this

section.

Generally, suggestions in improving work methods, processes, or equipment may reduce operational time. However, operational time may be increased shortly after the implementation of suggestions simply because workers lack experiences in how to transform suggestion ideas to operations. For example, when old types of machines, tools or equipment, are replaced by new machinery, workers could make mistakes in operating the new machines, which should slow the work processes and thereby increase operational time. Operational time may be lsot in "trial and error" in the initial stage of suggestion implementation. After this stage, operational time may decrease in response to improvement suggestions. From this reasoning, the next hypothesis can be stated as follows:

Hypothesis 4.1

> There will be a lagged effect with a curvelinear relationship between working hour inputs and suggestions.

Hypothesis 4.2.

> Tangible suggestions have a greater effect on working hours than intangible suggestions.

In addition to adopted suggestions, there are many control variables with effects on productivity and labor inputs that can be anticipated. These control variables include quality, safety, absenteeism, training, technology and

organizational size. The expected relationships between these control variables and productivity or labor inputs are simply explained as follows.

If an organization produces products with defects, it hinders organizational productivity growth. A deterioration in the quality of the products or services can disrupt schedules, delay deliveries, increase rework, increase scrap, waste manpower and materials and machine time, and increase warranty cost. Reworking products, inspecting parts, and the product lost due to scrap all lower productivity. Thus, a negative relationship is expected between the product defects and productivity.

An unsafe environment may inhibit individual and organizational performance. More specifically, the safety issue confronting organizations is cost related (Bittel, 1968). Thus, the payoff in productivity could be substantial. Above tangible and intangible costs reside in the input side of the productivity equation. That is, efficiency of transforming inputs into outputs declines as these particular types of labor-related input costs rise. Therefore, a positive relationship is expected between industrial accidents and labor inputs, and thus a negative relationship is expected between industrial accidents and productivity.

Absenteeism is generally regarded as costly to an organization (Katz, Kochan, and Keefe 1987; Katz, Kochan, and Weber 1985; Katz, Kochan, and Gobeille 1983). The costs of

paying absent employees and their replacements, of filling vacancies made by those who left, and of performing at lower efficiency by the substitutes, reside on the input side of the productivity equation. If outputs remain unchanged, increased labor-related input costs decline productivity. Thus, a negative relationship exists between absenteeism and productivity.

Training has long been used for improving productivity (Katzall and Guzzo 1983; Kopelman 1986). One objective of training is to change employees' skills, behaviors, and attitudes in a way that will enhance job performance, either immediately or in the long run. In their meta-analysis comparing the effects of various productivity programs, Guzzo, Jette, and Katzell (1985) found that training was the most powerful means of increasing productivity. The effect of training was strongest on output measures of productivity. Improved productivity is achieved by transforming better employees skills, behaviors, or attitudes into higher level of outputs. Thus, a positive relationship between training and productivity is expected.

"Productivity is not determined solely by how hard and how well people work. The technical factors play a role, sometimes an overwhelmingly importance, sometimes a minor one" (Sutermeister 1969, p.5). Thus, the degree of technology would have an effect on productivity. In this study, the definition of technology is the machinery and equipment employees have to

work with. Generally, this can be dichotomized to "machining" and "assembly." Technology in terms of machining and assembly affects productivity in two different ways. First, the higher the degree of technology, the more efficiency in transforming inputs into outputs. In other words, productivity in machining areas may be higher than productivity in assembly areas. Secondly, employees who work on machining lines always have more skills and knowledge than employees who work on assembly lines. Skills and knowledge result in the ability that is one of the determinants of productivity improvement. This reasoning also supports the argument that productivity in machining areas may be higher than productivity in assembly areas.

In addition to the dominant technology employed by the firm, organizational structure also affects both aggregate and individual level productivity. The term "organizational structure" is extremely broad, its definition depends on the particular school of thought that one is currently reading. In this study, organizational size will be employed. Anecdotal evidence supports the ideas that organizational size is negatively related to its effectiveness. Dalton, Todor, Spendolini, Fielding and Poter (1980) have indicated that subunit size is negatively related to organizational performance. The larger the size of the subunit, the lower the level of performance (in 5 out of 6 cases). On the contrary, Cummins and King (1973) found that size was positively related

to performance on structured, routine tasks, but negatively related to performance on unstructured, ambiguous tasks.

The various hypotheses about expected relationships among these control variables will be presented in Appendix D.

Quality Model

Japanese Human Relations Association (1989) has identified two broad sets of objectives of kaizen activity:

1. Tangible results: improve efficiency of operations, reduce prime costs, eliminate poor quality.
2. Intangible results: improve safety, quality, environment, and service.

In addition to productivity improvement, quality improvement is also a pivotal goal of the kaizen-suggestion system. There are two different ways that quality can be improved via a kaizen-suggestion program. First, quality improvements directly result from suggestions that lead to any idea that reduces or eliminates defects. Secondly, quality improvements can be accomplished indirectly via suggestions that lead to any idea that improves technology or production system such as work processes, equipment, etc. In other words, once technology or production systems are improved, better quality of products can be produced. On the basis of this reasoning, I propose hypothesis 5:

Hypothesis 5.

> A negative relationship exists between the volume of adopted tangible and intangible suggestions and the

number of customer claims for product defects.

As mentioned above, because most quality improvement may be derived from intangible suggestions other than tangible suggestions, intangible suggestions are expected to have greater effects on quality than tangible suggestions. The next hypothesis is:

Hypothesis 6.

Intangible suggestions have greater effect on quality than tangible suggestions.

In addition to adopted suggestions, there are also many control variables with effects on quality that can be anticipated in this model. These control variables include training, absenteeism, safety and over time. The expected relationships between these control variables and quality can be explained as following.

The relationship between training and quality improvement is pretty straightforward. Training is one of the sources of labor quality change. The objective of training is to change workers' skills, knowledge, behavior and attitude. Employees' capabilities and motivation should be improved via effective training programs. High quality workers produce high quality products. Training, thus, may positively influence product quality.

Absenteeism may be negatively related to quality. Poor quality of products or service might be produced because of

generally higher scrap or spoilage of substitutes. Quality of products or services may also suffer because of the absentee's poor work motivation. Thus, a negative relationship may exist between absenteeism and quality.

Unsafe environment should hinder organizational effectiveness in terms of quality performance. A good product is unlikely to be produced without a safe environment. Unsafe equipment, tools or machines will very possibly produce flawed products. Further, product quality may suffer because a replacement for the recuperating worker is always less skilled in the substitutive job. Thus a positive relationship is expected between the number of accidents and the number of customer claims for product defects.

Overtime may be negatively related to quality in two different ways. First, flawed products can be reworked with additional labor inputs and these additional labor inputs could be reflected in more overtime hours. Thus, more overtime hours may imply more flawed products in an organization. Secondly, if workers work excessive overtime, they may perform the job incorrectly, thereby producing defective products simply because of fatigue. Consequently, overtime may be related to, or lead to poor quality products or services. The greater the number of overtime hours, the larger the number of customer claims for product defects.

The various of hypotheses about expected relationships among these control variables will be presented in Appendix E.

Summary of Hypotheses

Hypothesis 1.

The greater the number of adopted tangible or intangible suggestions, the greater the productivity gains.

Hypothesis 2.

Tangible suggestions have greater effect on productivity than intangible suggestions.

Hypothesi 3.

A time lag effect exists between suggestions adopted and productivity gains.

Hypothesis 3.1.

Current and past adopted suggestions are relevant in determining productivity improvements.

Hypothesis 3.2.

The lag for tangible suggestion effect is longer than for intangible suggestion effect.

Hypothesis 4.1.

There will be a lagged effect with a curvelinear relationship between working hour inputs and suggestions.

Hypothesis 4.2.

Tangible suggestions have greater effect on working hours than intangible suggestions.

Hypothesis 5.

A negative relationship exists between the volume adopted tangible and intangible suggestions and the number of customer claims for product defects.

Hypothesis 6.

Intangible suggestions have greater effect on quality than tangible suggestions.

Research Models

Productivity Model

$$P_{i,t} = a_0 + a_1 TANG_{i,t-k} + a_2 INTANG_{i,t-k} + a_3 MGTTRAN_{i,t} + a_4 SELFTRAN_{i,t} + a_5 TECHTRAN_{i,t} + a_6 QUALITY_{i,t} + a_7 SAFETY_{i,t} + a_8 ABSENT_{i,t} + a_9 TECH_{i,t} + a_{10} SIZE_{i,t} + e_{i,t}$$

Where

$P_{i,t}$ = Productivity level in department i at month t.

$Tang_{i,t-k}$ = The volume of adopted tangible suggestions in department i for month t-k.

$Intang_{i,t-k}$ = The volume of adopted intangible suggestions in department i for month t-k.

$Mgttran_{i,t}$ = Management training credit hours in department i for month t.

$Selftran_{i,t}$ = Self-actualization training credit hours in department i for month t.

$Techtran_{i,t}$ = Technical training credit hours in department i for month t.

$Quality_{i,t}$ = The customer claims for product defects in department i at month t.

$Safety_{i,t}$ = The occupation injuries and illnesses in department i at month t.

$Absent_{i,t}$ = The absent hours in department i at month t.

$Tech_{i,t}$ = The degree of technology used in department i at month t.

$Size_{i,t}$ = The size of work force in department i at month t.

Labor Inputs Model

$$H_{i,t} = a_0 + a_1 TANG_{i,t-k} + a_2 INTANG_{i,t-k} + a_3 SAFETY_{i,t} + a_4 QUALITY_{i,t} + a_5 ABSENT_{i,t} + e_{i,t}$$

Where

$H_{i,t}$ = Labor hour inputs in department i at month t.

$Tang_{i,t-k}$ = The volume of adopted tangible suggestions in department i for month t-k.

$Intang_{i,t-k}$ = The volume of adopted intangible suggestions in department i for month t-k.

$Safety_{i,t}$ = The occupational injuries and illnesses in department i at month t.

$Quality_{i,t}$ = The customer claims for product defects in department i at month t.

$Absent_{i,t}$ = The absent hours in department i at month t.

Quality Model

$$Q_{i,t} = a_0 + a_1 TANG_{i,t-k} + a_2 INTANG_{i,t-k} + a_3 MGTTRAN_{i,t} + a_4 SELFTRAN_{i,t} + a_5 TECHTRAN_{i,t} + a_6 SAFETY_{i,t} + a_3 OVERTIME_{i,t} + a_5 ABSENT_{i,t} + e_{i,t}$$

Where

$Q_{i,t}$ = The customer claims for product defects in department i at month t.

$Tang_{i,t-k}$ = The volume of adopted tangible suggestions in department i for month t-k.

$Intang_{i,t-k}$ = The volume of adopted intangible suggestions in department i for month t-k.

$Mgttran_{i,t}$ = Management training credit hours in department i for month t.

$Selftran_{i,t}$ = Self-actualization training credit hours in department i for month t.

$Techtran_{i,t}$ = Technical training credit hours in department i for month t.

$Safety_{i,t}$ = The occupational injuries and illnesses in department i for month t.

$Overtime_{i,t-k}$ = The overtime hours in department i for month t-k.

$Absent_{i,t-k}$ = The absent hours in department i for month t-k.

Empirical Results and Implications

The data for this pooled cross-sectional and time-series study consist of 19 cross-sectional departments and 44 time-periods thus 836 observations are estimated. This chapter examines pooled departments' productivity, labor hour inputs, and product quality with current and lagged volume of tangible and intangible suggestions, and other control variables such as safety, workforce size, overtime, absenteeism, technology, etc. My previous study of kaizen-productivity connection which consisted of 44 cross-sectional work teams and 17 time periods had indicated that there was a strongest response of productivity to tangible suggestions with an average lag of four months, while there was a strongest response of productivity to intangible suggestion with an average lag of two months. In this dissertation I estimated the parameters by using direct distributed lag model with three-period lags (i.e. lagged one, two and three months) for both tangible and intangible suggestions in all three models. This will allow full consideration of lags of up to one quarter, but will still leave open the possible effects of longer lags.

Relationships Between Tangible suggestions, Intangible Suggestions, and Organizational Effectiveness and Efficiency

Table 4-5 presents means, standard deviations, and correlations between tangible suggestions (t, t-1, t-2, t-3, t-4), intangible suggestions (t, t-1, t-2, t-3, t-4) and

Table 4-5: Relationships Between Tangible Suggestions, Intangible Suggestions, and Organizational Effectiveness and Efficiency Measures (N = 836)

			Variables											
	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12
1. Tangible Suggestion (t)	.69	1.21												
2. Tangible Suggestion (t-1)	.69	1.21	.20											
3. Tangible Suggestion (t-2)	.69	1.21	.20	.19										
4. Tangible Suggestion (t-3)	.69	1.21	.15	.21	.20									
5. Tangible Suggestion (t-4)	.69	1.21	.16	.15	.21	.20								
6. Intangible Suggestion (t)	12.72	17.46	.24	.15	.13	.15	.14							
7. Intangible Suggestion (t-1)	12.76	17.46	.18	.24	.15	.13	.15	.57						
8. Intangible Suggestion (t-2)	12.76	17.46	.19	.18	.24	.15	.13	.49	.57					
9. Intangible Suggestion (t-3)	12.76	17.46	.14	.19	.18	.24	.15	.44	.49	.57				
10. Intangible Suggestion (t-4)	12.76	17.46	.16	.14	.19	.18	.24	.43	.44	.49	.57			
11. Productivity	102.93	33.33	.17	.19	.19	.18	.18	.12	.13	.14	.14	.15		
12. Labor Hours	5883.9	4688.5	-.01	-.01	.00	.00	-.01	.07	.07	.07	.07	.09	.32	
13. Quality	.13	.42	-.02	-.03	-.02	-.03	.02	.02	-.02	.07	.06	.04	.03	.17

organizational effectiveness and efficiency (i.e. productivity, quality and labor hours). The data shows the strongest intercorrelations between suggestion variables (tangible and intangible) and productivity. Correlations range from .17 to .19 for tangible suggestions, and range from .12 to .15 for intangible suggestions. The correlations provide strong support for Hypotheses 1 and 2---that is, (1) the more current and past volume of adopted tangible and intangible suggestions are associated with productivity, and (2) tangible suggestions have greater effect on productivity than that of intangible suggestions. The correlations between tangible, intangible suggestions, and productivity also reveal a pattern of lagged effect, providing support for Hypothesis 3. The correlations for tangible suggestion effects are smaller in the current period (t), peak at t-1 and t-2, decline thereafter. Tangible suggestion exhibit lag functions which peak at t-1 and t-2 other than the current period (t). The same lagged patterns hold for intangible suggestion effects. The finding strongly supports Hypothesis 1 to 3. Further hypothesis tests will be reported in the next section.

Empirical Results from the Productivity Model

The level of departmental productivity was used as dependent variables; the current (t) and past (t-1, t-2, and t-3) volume of tangible and intangible suggestions addressing a joint effect of kaizen processes and worker participation;

Table 4-6: Results of Regression Analyses of the Effect of Suggestions and All Other Variables on Productivity

Explanatory Variables		Productivity (1)	(2)	(3)
Intercept	b	95.501***	95.457***	97.748***
	t	155.690	159.390	156.930
$Tang_t$	b	.325***	.392***	
	B	.012	.014	
	t	3.532	4.459	
$Tang_{t-1}$	b	.543***	.568***	
	B	.020	.021	
	t	5.091	5.625	
$Tang_{t-2}$	b	.378***	.421***	
	B	.014	.015	
	t	3.546	4.154	
$Tang_{t-3}$	b	.383***	.380***	
	B	.014	.015	
	t	4.178	4.312	
$Intang_t$	b	-.004		-.002
	B	-.002		-.001
	t	-.606		-.284
$Intang_{t-1}$	b	.002		-.003
	B	.001		-.002
	t	.306		-.462
$Intang_{t-2}$	b	.001		.016*
	B	.007		.008
	t	1.553		2.307
$Intang_{t-3}$	b	-.010		-.005
	B	-.006		-.002
	t	-1.358		-.648
Mgttran	b	.020***	.020***	.013*
	B	.010	.001	.006
	t	3.022	2.848	1.900
Selftran	b	.030*	.031*	.029*
	B	.007	.007	.007
	t	1.976	2.117	2.147
Techtran	b	-.007	-.006	-.0003
	B	-.004	-.003	-.0002
	t	-.955	-.846	-.052
Safety	b	.081	.064	.091
	B	.003	.002	.003
	t	.947	.771	1.168
Quality	b	-.643***	-.665***	-.795***
	B	-.008	-.008	-.010
	t	-2.741	-2.912	-3.624
Size	b	.275***	.275***	.252***
	B	.199	.199	.182
	t	19.699	20.286	17.803
Absent	b	.001**	.001***	.0005
	B	.008	.008	.004
	t	2.545	2.709	1.526
Tech	b	.005	.005*	.003
	B	.005	.005	.003
	t	1.565	1.711	1.065
R^2		.419	.421	.339
F		36.839	49.808	35.153

F-test for all estimates significant at the .01 level.
* = p < .05 level
** = p < .01 level
*** = p < .005 level
b is the regression coefficient.
B is the standardized coefficients.
t is the t value.

and the training, safety, quality, size, absent, and technology as control variables. Table 4-6 reports these regressions.

The over-time pattern of joint effects for both tangible and intangible suggestion variables is presented in equation 1 in table 4-6; and simple effects for tangible and intangible suggestion variables are presented in equation 2 and 3 respectively. The tangible suggestion effect in equation 2 is smaller in the current period, peaks at t-1, declines thereafter. Tangible suggestions exhibit lag functions which peak at t-1 other than the current period. The regression shows statistically significant effect for current period and for three lagged variables on productivity improvement at .005 level. It suggests that the current level of productivity is a function of the current and previous volume of the tangible suggestions. The regression analysis suggests that each additional tangible suggestion increases the productivity by .392, .568, .421, and .380 for current period and a lag of one month, two months, and three months respectively. Note that the regression coefficient for a lag of three months in equation 2, table 4-6, still show positive signs and significance, so that the duration of lag effects of tangible suggestion may be longer than three months.

The intangible suggestion variables in equation 3, table 4-6, show negative signs at current period and a lag of one month, peaks at t-2, damp out at t-3 with a negative sign

again. The association between productivity and intangible suggestion with a lag of two months is statistically significant at .05 level. Regression analyses show that intangible suggestions have negative effects on productivity at current period and t-1, and have significant positive effects on productivity at t-2. It suggests that intangible suggestions seem to have no effect or even a minuscule negative effect on productivity until a lag of two months. Even though regression analyses provide evidence of statistical significance of the lagged intangible suggestions (t-2), the estimated size of the effects is weak (standardized coefficient is .008).

The equations 1, 2, and 3 in table 4-6 show that the more current and past volume of adopted tangible and intangible suggestions are associated with productivity. It is interesting to note that when both tangible and intangible suggestions are jointly employed in the equation 1 of table 4-6, the coefficient for intangible suggestions with a lag of two months is no longer statistically significant in comparison with the equation 3, suggesting that the effect of intangible suggestions on productivity is mediated through their effects on tangible suggestions. It implies that intangible suggestions may be through tangible suggestions that lead to improved productivity. In other words, the processes of the impact of suggestions on productivity may include two stages: more adopted intangible suggestions

stimulating more tangible suggestion making, and in turn more adopted tangible suggestions leading to productivity gains. Therefore, tangible suggestion can be regarded as an intervening variable between intangible suggestion and productivity gain. It partly supports the results of the connection between intangible and tangible suggestions found in chapter 3.

Interestingly enough, there are different pattern effects between tangible and intangible suggestions. Tangible suggestions have strong and significant effects on productivity after a lag of three months, and its duration seems to be longer than that. In contrast, intangible suggestions only have greater effects on productivity in a lag of two months and that this effect weakens at t-3. The empirical results, thus, suggest that tangible suggestions seem to have longer duration of lag effect, while intangible suggestions tend to have shorter duration of lag effect. It implies that tangible suggestions paid off slower but longer than intangible suggestions.

There are also different magnitude effects between tangible and intangible suggestions. Both R^2 and F value for equation 2 (only tangible suggestion variables are included) are greater than those in equation 3 (only intangible suggestion variables are included). In addition, in equation 1, accumulated standardized coefficient of tangible suggestions (.060) is also greater than that of intangible

suggestions (.016). Therefore, tangible suggestions tend to have greater effects on productivity than that of intangible suggestions. It implies that tangible suggestions paid off more than intangible suggestions.

More extensive management and self-actualization training lead to higher productivity. In equation 1 through 3, the association between management training and productivity is statistically significant at either .005 or .05 level; and the association between self-actualization training and productivity is consistently statistically significant at the .05 level. Interestingly enough, there is no relationship between technical training and productivity. Even the regression results consistently show negative signs.

In equation 1, 2, and 3, quality measured by product defects is found to have a negative effect on productivity. It suggests that the higher the number of product defects, the lower the level of productivity. All coefficients in the three equations are statistically significant at .005 level.

Technology is found to have a positive effect on productivity. It suggests that the machining departments tend to have higher productivity performance than the assembly departments. However, the evidence from regression analyses is weak.

Technical training, safety, workforce size and absenteeism did not affect productivity in the hypothesized manner. The results are contrary to the hypotheses. More

Table 4-7: Results of regression analyses of the effect of suggestions and All Other Variables on Labor Hours (A Three-Month-Lag Model for Suggestion Variables)

Explanatory Variables		Labor Hours (1)	(2)	(3)
Intercept	b	6381.100***	6250.600***	6347.800***
	t	70.755	90.851	78.575
$Tang_t$	b	.940	1.532	
	B	.0002	.0004	
	t	.133	.226	
$Tang_{t-1}$	b	.028	-2.844	
	B	.7E-05	-.0007	
	t	.003	-.349	
$Tang_{t-2}$	b	17.245*	14.307*	
	B	.004	.004	
	t	1.998	1.745	
$Tang_{t-3}$	b	13.302*	11.039	
	B	.003	.003	
	t	1.879	1.609	
$Intang_t$	b	3.394***		3.481***
	B	.013		.013
	t	4.338		4.656
$Intang_{t-1}$	b	-1.199		-1.155
	B	-.004		-.004
	t	-1.393		-1.404
$Intang_{t-2}$	b	-.802		-.648
	B	-.003		-.002
	t	-.885		-.743
$Intang_{t-3}$	b	-3.390***		-3.156***
	B	-.012		-.012
	t	-3.522		-3.721
Safety	b	72.275***	66.775***	75.525***
	B	.019	.018	.020
	t	7.499	6.920	8.015
Quality	b	115.730***	131.000***	117.690***
	B	.010	.012	.011
	t	4.888	5.545	5.086
Absent	b	-17.929*	-19.505**	-16.003*
	B	-.006	-.007	-.005
	t	-2.251	-2.472	-2.141
R^2		.128	.098	.131
F		10.960	12.868	17.841

F-test for all estimates significant at the .01 level.
* = p < .05 level
** = p < .01 level
*** = p < .005 level
b is the regression coefficient.
B is the standardized Coefficient.
t is the t value.

technical training leads to lower levels of productivity, not higher as hypothesized. Higher number of accidents leads to higher levels of productivity, not lower as predicted. Bigger workforce size leads to higher level of productivity, not lower as predicted by an "efficient resource" theory, and the coefficients were statistically significant at the .005 level. Finally, a higher absenteeism ratio leads to higher level of productivity, not lower as expected, and the coefficients were significant at the .005 or .01 level.

In summary, the empirical results reported in table 4-6 show that more adopted improvement suggestions, more management and self-actualization training, fewer product defects, and relatively high technology are associated with productivity improvement.

Empirical Results from the Model of Labor Hour Inputs

Table 4-7 reports the results of the regression estimates of the model of labor inputs with lagged suggestions of three months. When I examined the regression results about the lag pattern of tangible and intangible suggestions, I found that there might be a problem in selecting the optimal lag. Equation 1 and 3 in table 4-7 show that intangible suggestions have a positive effect on productivity at current period and negative effects thereafter. It suggests that intangible suggestion making may be expensive in the short run but it pays off in the long run. Considering the pattern of

Table 4-8: Results of Regression Analyses of the Effect of Suggestions on Labor Hours (Lagged Three Months)

Explanatory Variables		Labor Hours (1)	(2)	(3)
Intercept	b	6362.600***	6166.300***	6420.000
	t	36.212	40.678	38.179
$Tang_t$	b	-4.245	-7.695	
	B	-.001	-.002	
	t	-.750	-1.549	
$Tang_{t-1}$	b	.749	-7.527	
	B	.0002	.002	
	t	.105	-1.210	
$Tang_{t-2}$	b	15.723*	6.505	
	B	.004	.002	
	t	2.213	1.047	
$Tang_{t-3}$	b	12.080*	6.409	
	B	.003	.002	
	t	2.159	1.238	
$Intang_t$	b	2.872***		2.953***
	B	.011		.011
	t	3.725		4.054
$Intang_{t-1}$	b	-2.043*		-1.904*
	B	-.008		-.007
	t	-2.308		-2.311
$Intang_{t-2}$	b	-2.595***		-2.283***
	B	.010		.009
	t	-2.843		-2.676
$Intang_{t-3}$	b	-3.537***		-3.449***
	B	-.013		-.013
	t	-4.275		-4.385
R^2		.065	.009	.065
F		7.191	1.829	14.339

F-test for all estimates significant at the .01 level.
* = p < .05 level
** = p < .01 level
*** = p < .005 level
b is the regression coefficient.
B is the standardized Coefficient.
t is the t value.

Table 4-9: Results of Regression Analyses of the effect of Suggestions on Labor Hours (Lagged Four Months)

Explanatory Variables		Labor Hours (1)	(2)	(3)
Intercept	b	6249.400***	6198.300***	6344.600***
	t	31.126	41.437	34.071
$Tang_t$	b	-8.099	-9.861	
	B	.002	.002	
	t	-1.177	-1.579	
$Tang_{t-1}$	b	-8.072	-15.975*	
	B	-.002	-.004	
	t	-.926	-2.041	
$Tang_{t-2}$	b	1.864	-6.140	
	B	.0005	-.002	
	t	.208	-.769	
$Tang_{t-3}$	b	-12.948	-18.704**	
	B	-.003	-.005	
	t	-1.510	-2.427	
$Tang_{t-4}$	b	-35.811***	-37.886***	
	B	-.009	-.010	
	t	-5.289	-6.154	
$Intang_t$	b	3.340		3.093***
	B	.012		.012
	t	4.401		4.242
$Intang_{t-1}$	b	-1.273		-1.593*
	B	-.005		-.006
	t	-1.316		-1.909
$Intang_{t-2}$	b	-1.989*		-1.851*
	B	-.007		-.007
	t	-1.954		-2.096
$Intang_{t-3}$	b	-2.495***		-2.687***
	B	-.009		-.010
	t	-2.470		-3.070
$Intang_{t-4}$	b	1.131		1.376*
	B	.005		.005
	t	1.479		1.763
R^2		.086	.050	.068
F		7.727	8.657	12.031

F-test for all estimates significant at the .01 level.
* = p < .05 level
** = p < .01 level
*** = p < .005 level
b is the regression coefficient.
B is the standardized Coefficient.
t is the t value.

intangible suggestions, it is reasonably assumed that tangible suggestions may have a similar pattern as intangible suggestions. As I examined equation 1 and 2 in table 4-7, the lagged pattern of tangible suggestions seems to only tell us half the story. That is, tangible suggestions cost more labor inputs but they do not pay off. I suspected that adopted tangible suggestions may have paid off longer than a lag of three months. In addition, my previous work for pooled team data suggested that tangible suggestions tend to have longer effects on productivity than that of intangible suggestions. Considering these two reasons, I conducted two tests to examine whether adopted tangible suggestions pay off longer than a lag of three months.

Regression results with three months lag and four months lag are reported in table 4-8 and 4-9 respectively. Examining equation 2 in table 4-9, although there is no similar lagged pattern as intangible suggestions as I expected, the regression result is much better than equation 2 in table 4-8. Coefficients for the four-month-lag model all become "correct" with negative signs, and the coefficient for t-1, t-3, and t-4 are statistically significant at .05, .01, and .005 level respectively. R^2 rises from .009 (equation 2 in table 4-8) to .050 (equation 2 in table 4-9). It suggests that a four-month-lag model has much stronger explanatory power than a three-month-lag model. Regression analysis in equation 1 in table 4-9 shows the similar results that R^2 (.086) for four-

month-lag model is higher than R^2 (.065) for three-month-lag model in table 4-8. The coefficient of tangible suggestions with a lag of four months in table 4-9 is statistically significant at .005 level too. It suggests that tangible suggestions pay off at t-4. Therefore, if this lagged variable (t-4) is not included in the regression estimation, it may obscure the effect of tangible suggestions. In addition, interestingly enough, comparing equation 3 in table 4-8 and 4-9, there was no change for R^2 and even worse for F value when I include one more lagged intangible suggestion (t-4). It suggests that intangible suggestions with a lag of four months seem to have no effect on labor inputs.

The empirical results from table 4-9 suggest that tangible suggestions may have no positive effect on labor inputs until a lag of four months. Based on this test, I will re-estimate regressions with four months lag for both tangible and intangible suggestions. New regression estimates are presented in table 4-10.

Table 4-10 presents initial exploratory findings with total labor hours as the dependent variable. The major goal of these regression analyses is to examine to what extent improvement suggestions (both tangible and intangible) reduce hours worked. However, "total labor hours" is not a typical dependent variable, so the analyses were exploratory.

Equation 1 in table 4-10 shows that the current and past volume of adopted tangible suggestions have negative, but

Table 4-10: Results of Regression of Analyses of the Effect of Suggestions and All Other Variables on Labor Hours (A Four-Month-Lag Model for Suggestion Variables)

Explanatory Variables		Labor Hours (1)	(2)	(3)
Intercept	b	6325.100***	6262.300***	6281.700***
	t	65.833	89.132	74.003
$Tang_t$	b	-1.410	-3.660	
	B	-.0004	-.001	
	t	-.183	-.495	
$Tang_{t-1}$	b	-4.978	-11.316	
	B	-.001	-.001	
	t	-.527	-1.264	
$Tang_{t-2}$	b	6.341	4.448	
	B	.002	.001	
	t	.653	.485	
$Tang_{t-3}$	b	-8.412	-9.191	
	B	-.002	-.002	
	t	-.894	-1.022	
$Tang_{t-4}$	b	-37.085***	-34.621***	
	B	-.010	-.009	
	t	-4.833	-4.655	
$Intang_t$	b	3.523***		3.502***
	B	.013		.013
	t	4.337		4.684
$Intang_{t-1}$	b	-.879		-.818
	B	-.003		-.003
	t	-1.003		-.999
$Intang_{t-2}$	b	-.161		.052
	B	-.001		.0002
	t	-.177		.060
$Intang_{t-3}$	b	-2.084*		-2.215**
	B	-.008		-.008
	t	-2.230		-2.526
$Intang_{t-4}$	b	3.004***		2.761***
	B	.011		.010
	t	3.432		3.315
Safety	b	76.387***	71.466***	76.767***
	B	.020	.019	.020
	t	7.781	7.265	8.159
Quality	b	90.279***	113.980***	115.550***
	B	.008	.010	.010
	t	3.791	4.805	4.948
Absent	b	-23.836***	-20.635**	-17.020*
	B	-.008	-.007	-.006
	t	-2.974	-2.573	-2.295
R^2		.152	.117	.144
F		11.367	13.633	17.430

F-test for all estimates significant at the .01 level.
* = p < .05 level ** = p < .01 level *** = p < .005 level
b is the regression coefficient.
B is the standardized Coefficient.
t is the t value.

delayed effects on the current labor inputs. However, the association between tangible suggestions at t, t-1, t-2, t-3 and labor inputs is weak. Even the coefficient of tangible suggestions at t-2 is positive. Regression analysis shows that coefficient for a lag of four months is statistically significant at .005 level. It indicates that each additional tangible suggestion reduces labor inputs by approximately 37 hours after a lag of four months. It reflects that 37 operational hours gained four months later once the suggested changes are well established.

Intangible suggestions in equation 1, table 4-10, show a different pattern from tangible suggestions. The implementation of intangible suggestions may increase labor inputs at current period t but it may reduce labor inputs at t-1, t-2, and t-3. It suggests that intangible suggestion making may be expensive in the short run but it pays off in the long run. However, we should note that coefficients of t-1, t-2, and t-3 are small, even though the coefficient with a lag of three months (t-3) is statistically significant at .05 level.

There is a different over-time pattern between tangible and intangible suggestions. The strongest response of labor efficiency to tangible suggestions occurs at t-4, whereas the strongest response of labor efficiency to intangible suggestions occurs at t-3. It suggests that tangible suggestions tend to have longer duration of lag effect than

intangible suggestions. In other words, tangible suggestions may pay off later than intangible suggestions. There is also a different magnitude effect between tangible and intangible suggestions. The coefficient of tangible suggestions at t-4 in equation 1 is 37.085, while the coefficient of intangible suggestions at t-3 is only 2.048. It suggests that each additional tangible suggestion may reduce labor inputs by about 37 hours after a lag of four months, while each additional intangible suggestion only reduces 2 hour inputs after a lag of three months. Tangible suggestions tend to pay off much more than intangible suggestions.

In sum, the results from table 4-10 indicate that labor efficiency is a function in part of current and past volumes of adopted tangible suggestions. Tangible suggestions have a bigger effect on labor efficiency than intangible suggestions but they pay off a little bit slower than intangible suggestions.

In equation 1, 2, and 3 in table 4-10, a higher industrial accident rate, as indicated by a higher number in Safety, leads to more labor hours. The association between the number of accidents and labor hours is all statistically significant at .005 level in three equations. The magnitudes of the effects of accidents are also sizeable. For example, the coefficient in equation 1, table 4-10, implies that if industrial accidents was increased by one case, labor inputs would increase by about 76 hours.

More product defects, as indicated by Quality, also caused more labor hours. In equation 1, 2, and 3 in table 4-10, the coefficients between Quality and labor hours are all statistically significant at .005 level. For example, the coefficient in equation 1, table 4-10, implies that each additional product defect causes 90 hours more labor inputs.

The association between absenteeism and labor hours is opposite to the prediction in all three cases. Higher absentee rates are associated with fewer labor hours, not more as expected, and coefficients are significant at .05, 1, and 5 percent level in equation 1, 2, and 3 respectively.

Regression coefficients in equation 1, 2, and 3 of table 4-10 show that more current and previous volume of adopted tangible and intangible suggestions and fewer number of industrial accidents and product defects are associated with high labor efficiency.

Empirical Results from Quality Model

The number of product defects, as indicated by Quality, used as dependent variable; the current (t) and previous (t-1, t-2, and t-3) volume of adopted tangible and intangible suggestions addressing kaizen (or improvement) effect; and training, safety, overtime, and absent as control variables. The empirical results are presented in table 4-11.

The lagged pattern of joint effects for both tangible and intangible suggestions reports in equation 1, while the over-

Table 4-11: Results of Regression Analyses of the Effect of Suggestions and All Other Variables on Product Quality

Explanatory Variables		Quality (1)	Quality (2)	Quality (3)
Intercept	b	.101***	.103***	.099***
	t	6.328	7.355	6.199
$Tang_t$	b	-.006*	-.006**	
	B	-.016	-.017	
	t	-1.682	-2.381	
$Tang_{t-1}$	b	.001	-.001	
	B	.004	-.003	
	t	.379	-.389	
$Tang_{t-2}$	b	-.003	-.002	
	B	-.008	-.007	
	t	-.804	-.833	
$Tang_{t-3}$	b	-.008*	-.006*	
	B	-.022	-.017	
	t	-2.262	-2.306	
$Intang_t$	b	-.0007*		-.0007*
	B	-.029		-.029
	t	-2.079		-2.291
$Intang_{t-1}$	b	-.001***		-.001***
	B	-.045		-.046
	t	-2.919		-3.278
$Intang_{t-2}$	b	.001**		.0009***
	B	.041		.041
	t	2.395		2.612
$Intang_{t-3}$	b	.0002		.6E-04
	B	.008		.003
	t	.478		.156
Mgttran	b	.0003	.0002	.0003
	B	.012	.008	.007
	t	1.006	.716	.631
Selftran	b	-.0007	-.0008	-.0006
	B	-.012	-.014	-.012
	t	-1.123	-1.391	-1.124
Techtran	b	-.0005*	-.0005*	-.0006*
	B	-.020	-.022	-.023
	t	-1.829	-2.236	-2.198
Safety	b	.039***	.035***	.038***
	B	.112	.103	.110
	t	7.608	8.355	7.943
Overtime	b	.8E-05	.5E-05	.4E-05
	B	.011	.007	.006
	t	.627	.443	.354
Absent	b	.004	.003	.004
	B	.014	.011	.017
	t	1.061	.913	1.326
R^2		.119	.119	.111
F		7.909	11.224	10.335

F-test for all estimates significant at the .01 level.
  * = p < .05 level
 ** = p < .01 level
*** = p < .005 level
b is the regression coefficient.
B is the standardized Coefficient.
t is the t value.

time patterns of simple effect for tangible and intangible suggestions are presented in equation 2 and 3 respectively.

The regression results in equation 2 of table 4-11, tangible suggestions are found to have a negative effect on product defects. Greater current and past volumes of adopted tangible suggestions lead to fewer product defects. Tangible suggestions exhibit lag functions which multipeak in the current period and a lag of three months. It suggests that the current quality improvement is partly the result of the current improvement tangible suggestions and partly the result of the previous (especially at t-3) improvement tangible suggestions.

The regression in equation 3 in table 4-11, intangible suggestions are also found to have negative effects on quality at t and t-1. The coefficients of intangible suggestions at t and t-1 are statistically significant at .05 and .005 level respectively. Initial suggestions at the initial month and a lag of one month jointly negatively influence product defects, which suggests that the greater number of intangible suggestions at current and last month are associated with fewer product defects at current period. The regression coefficients become wrong-signed for a lag of two and three months. Therefore, the maximum lag for the effect of intangible suggestions on quality may be only one month. However, it may be difficult to interpret the intangible suggestions at t-2 in which its coefficient is positive and

statistically significant at .005 level.

As mentioned above, the tangible suggestion effects in equation 2, table 4-11 keep negative and significant till a lag of three months, whereas the intangible suggestion effects in equation 3 of table 4-11 keep negative and significant only to a lag of one month. The results, thus, suggest that intangible suggestions seem to pay off faster than intangible suggestions. In the equation 1 reported in table 4-11 the same pattern holds except tangible suggestions at t-1.

Intangible suggestions not only paid off quicker but tend to have greater magnitude effects and seem to be statistically better than tangible suggestions. In equation 1, the sum of standardized coefficients for intangible suggestions at t and t-1 is .074, while the sum of standardized coefficients for tangible suggestions at t, t-2, and t-3 is only .046. Again, comparing equation 2 and 3, the sum of standardized coefficients for tangible suggestions (taking t and t-1 for their negative signs) and intangible suggestions (taking t, t-1, t-2, and t-3 for their negative signs) is .075 and .044 respectively. The same results hold. Therefore, intangible suggestions have greater effect on quality and pay off faster than tangible suggestions.

More extensive technical training leads to fewer product defects, as indicated by Quality. In equation 1 through 3, the association between technical training and quality improvement is all statistically significant at .05 level. On

the other hand, management and self-actualization training have no effect on quality improvement.

A higher number of industrial accidents, as indicated by Safety, is associated with more product defects. The coefficients of Safety in equation 1 through 3 in table 4-11 are all statistically significant at .005 level. Product quality tends to suffer from an unsafe environment.

More extensive use of overtime leads to more product defects. However, the regression results in equation 1 through 3 provide little evidence to support this argument. Further, a higher absent rate causes more product defects. The evidence from regression analysis in table 4-11 is also weak.

In sum, regression coefficients in equation 1, 2, and 3 of table 4-11 indicate that more current and previous adopted intangible and tangible suggestions, more extensive technical training and fewer number of industrial accidents are associated with quality improvement. The pattern and effect of intangible suggestions on quality improvement are different from tangible suggestions. Intangible suggestions have greater effect on quality improvement and pay off quicker than that of tangible suggestions.

Summary of the Findings

Both tangible and intangible suggestions are good predictors of productivity gains, high labor efficiency and

product quality improvement. The empirical results from table 4-6, 4-10, and 4-11 show that the greater current and previous volumes of adopted tangible and intangible suggestions lead to higher productivity, lower labor inputs and fewer product defects. However, there are different lagged patterns for tangible and intangible suggestions. Consistently, tangible suggestions have a longer duration of lag effect than intangible suggestions in all three models. It implies that intangible suggestions tend to be faster and easier to transfer from kaizen (improvement) knowledge to economic benefits than of tangible suggestions. Further, there is also a different effect between tangible and intangible suggestions. Tangible suggestions have stronger effect on productivity improvement and higher labor efficiency, whereas intangible suggestions have stronger effect on quality improvement.

More extensive use of training programs is associated with high productivity and low product defects. However, different training programs have different effects on productivity gains and quality improvement. More extensive use of management training or self-actualization training is associated with productivity improvement and high labor efficiency but not for quality improvement. In contrary, more extensive use of technical training is associated with quality improvement but not for productivity improvement and high labor efficiency.

A higher number of industrial accidents, as indicated by Safety, is associated with low labor efficiency and product quality, but there is no relationship between the number of industrial accidents and productivity. Additionally, a higher number of product defects, as indicated by Quality, is associated with lower levels of productivity and low labor efficiency. The regression results from table 4-6, 4-10, and 4-11 show that workforce size, absenteeism, overtime, and technology seem to be poor predictors of these three dependent variables of organizational economic performance.

Policy Implications

Increasing competitive pressures in the 1980s led many companies to identify productivity and quality improvements as major competitive objectives. Thus, continuous productivity and quality improvements became important means to obtaining a competitive advantage that could transfer to high profitability. In this chapter, the empirical results show that there is a cumulative effect of suggestions on successive incremental improvements in productivity and quality. Improvements in manufacturing process or better process flow management which are derived from adopted tangible and intangible suggestions increase the possibility of incremental improvements in overall productivity and quality.

My analysis suggests that it is important to distinguish

between tangible and intangible suggestions, because there are distinct policy implications between these two types of suggestions. Table 4-12 depicts between tangible and intangible suggestions along several dimensions. First, tangible suggestions result in measurable financial benefits such as labor savings, material savings, energy savings, downtime reduction, output increase, etc. On the other hand, most intangible improvements result in unmeasurable production quality improvement, safety improvement, housekeeping improvement or improvement of quality of working conditions. Thus, tangible suggestions create quantitative or "tangible" effects, while intangible suggestions lead to qualitative or

Table 4-12: The Results and Policy Implications for Tangible and Intangible Suggestions

	Tangible Suggestion	Intangible Suggestion
Nature of the Outcomes	- Quantitative - Results-oriented	- Qualitative - Process-oriented
Pattern of the Results	- Long-term gains	- Short-term gains
Magnitude of Effects	- Medium- to large-scale continuous improvement	- Small- to medium-scale continuous improvement
Driven by	- Efficiency-demand change	- Quality-demand change
Aims/Impact	- Cost-reduction change	- Quality-enhancement change

"intangible" effects. To extend this line of thinking, tangible suggestions can be characterized as result-oriented whereas intangible suggestions can be characterized as process-oriented.

Based on the regression results, productivity, labor efficiency and quality improvement not only depend on present volume of suggestions accepted but depend on past volume of suggestions adopted. The analysis suggests that a lagged effect exists between suggestion implementation and economic gains. However, there are different patterns of delayed effects over time between tangible and intangible suggestions. Overall, tangible suggestions have a longer lag structure than intangible suggestions. In other words, productivity and quality responses to tangible suggestions are slower than to intangible suggestions. Thus, tangible suggestions may lead to long-term (up to four months) gains for organizations, whereas intangible suggestions may cause short-term (up to one or two months) gains for organizations. It implies that organizations can encourage employees to generate and then adopt more tangible suggestions as a long-term strategy for enhancing organizational effectiveness, while more extensive adoption of intangible suggestions can be used as a short-term strategy for improving organizational effectiveness.

The empirical results also indicate that tangible suggestions generally have greater effect on economic benefits than intangible suggestions. However, there are different

effects on a variety of dependent variables between tangible and intangible suggestions. Tangible suggestions have a larger effect on productivity gains and high labor efficiency and a smaller effect on quality improvement. On the contrary, intangible suggestions have a greater effect on quality improvement and a smaller effect on productivity and labor efficiency improvement. It implies that if organizations attempt to gain competitive advantage by pursuing a strategy of "quality enhancement," intangible suggestions should not be ignored. More extensive adoption of intangible suggestions may be an intelligent tactic for these companies. Firms with a "quality-enhancement" strategy should establish a more open and process-oriented suggestion system to encourage employees to make more intangible suggestions. A traditional suggestion system that only emphasizes tangible suggestions may be incompatible with a "quality-enhancement" strategy. On the other hand, if firms attempt to gain competitive advantage by pursuing a strategy of "cost reduction," more extensive adoption of tangible suggestions may be an effective tactic[17]. Based on the above reasoning, a simple conclusion

---

[17]We should note that it does not mean that intangible suggestions have no effect on productivity improvement. As mentioned earlier in table 3-1 of chapter 3 and in table 4-1 in this chapter, present and past volume of adopted intangible suggestion are highly related to current volume of adopted tangible suggestion; and the effect of intangible suggestions on productivity may be mediated through their effects on tangible suggestions. Thus, intangible suggestions may be not as important as tangible suggestions for a firm pursuing a strategy of cost reduction, but they cannot be totally ignored.

of "suggestion-change" connection can be drawn here. The need for tangible suggestions may be driven by organizational "efficiency-demand change" and those tangible suggestions thus will result in "cost-reduction change." On the other hand, the need for intangible suggestions may be the result of an organizational "quality-demand change" and the results from those intangible suggestions thus will lead to "quality-enhancement change."

In the kaizen-suggestion system, employees' suggestions are built on past knowledge and practice that lead to organizational continuous improvement. Regression results suggest that the accumulation of tangible and intangible suggestion making cause improved productivity and quality. Individual suggestion making is a learning process and a process of knowledge accumulation. Learning and knowledge accumulation by individual workers contributes to organizational learning. Cutcher-Gershenfeld et al. (1994) have argued that kaizen activities involve employees to collect and interpret data in suggestion programs, which is a planned learning process. Florida and Jenkins (1993) also have indicated that suggestion systems in Japanese companies allow employees to utilize their creativity on solving problems that foster individual learning. The kaizen-suggestion program at NDUS has provided maximum opportunities for individual and organizational learning and in turn achieved better organizational performance. It implies that

firms can obtain continuous productivity gains and quality improvement by creating a learning organization for improved technology, manufacturing process, better managerial process or better product quality.

As reviewed earlier in this chapter, the use of a kaizen-suggestion program is grounded in the theory of worker participation. The literature on suggestion programs, QCs and financial involvement strongly argues for their positive effects on organizational effectiveness. This chapter supports these arguments and it can also be viewed as making a valuable contribution to those literatures. Allowing employees to be involved in day-to-day kaizen activities enriches their knowledge and skills of the manufacturing process and production technologies that might lead to improved organizational effectiveness.

Summing Up

In the first part of the chapter a comprehensive literature review was presented, even so it still told us little about kaizen program performance effects. A major difficulty for a literature review about kaizen suggestion systems is that there is no core literature, either theoretical or empirical. It pushed me to be more comprehensive than usual in relevant areas such as employee involvement or QCs. Therefore a comprehensive literature review in traditional suggestion programs, QCs and employee

involvement was presented in the first part of this chapter. The concept of a kaizen-suggestion system is not only important as an implication of continuous improvement itself but also has links to the literature on productivity, quality and employee involvement. It is an important phenomenon, in part, because of the way it integrates across all three areas.

Increasing competitive pressures in the 1980s led many companies to identify productivity and quality improvements as major competitive objectives. Thus, continuous productivity and quality improvements became important means to obtaining a competitive advantage that could transfer to high profitability. In this chapter, the empirical results show that there is a cumulative effect of suggestions on successive incremental improvements in productivity and quality. Improvements in the manufacturing process or better management system which are derived from adopted tangible and intangible suggestions increase the possibility of incremental improvements in overall productivity and quality.

My analysis suggests that it is important to distinguish between tangible and intangible suggestions, because the effects of tangible and intangible suggestions on organizational effectiveness are different. Tangible suggestions generally create quantitative effects whereas intangible suggestions usually create qualitative effects. Quantitative change, which is derived from tangible suggestions, and qualitative change, which is derived from

intangible suggestions, have different policy implications to organizations. If organizations attempt to gain competitive advantage by pursuing a strategy of "quality enhancement," intangible suggestions should not be ignored. More extensive adoption of intangible suggestions may be an intelligent tactic for these companies. On the other hand, if firms attempt to gain competitive advantage by pursuing a strategy of "cost reduction," more extensive adoption of tangible suggestions may be an effective tactic.

CHAPTER FIVE

CONCLUSIONS AND SUGGESTIONS FOR RESEARCH

Banker (1993) has argued that "what is important for sustained competitive advantage is productivity gain that is sustained from period to period, and not just a transitory improvement in performance in a particular period that cannot be replicated in subsequent periods." (P. 27). This study has highlighted the continuous improvement with what Banker termed "sustained competitive advantage." The Japanese term "kaizen" means continuous improvement that occurs gradually and as a continuous incremental process. This implies small and incremental change. Although the improvements are subtle in the short run, sustained over time, they are considerable.

This thesis has examined the determinants of an effective kaizen-suggestion system and its impact on productivity and quality. Because no other studies have evaluated the organizational determinants and impact of kaizen-suggestion systems, this paper serves as an exploratory effort to examine the causes and effects of a kaizen-oriented suggestion system.

In testing the hypothesized determinants and effects of the kaizen-suggestion system, using Nippondenso, U.S. as the case study, empirical examinations were presented in chapter 3 and 4 respectively. In this final chapter of the paper,

three issues will be addressed. First, the major findings will be summarized and the implications of the research will be elaborated. Second, the limitations of the study will be examined. Third, suggestions for future research will be made.

Major Findings and Implications

Kaizen has been viewed as the key to Japanese competitive success (Imai 1986; Yasuda 1991; Japan Human Relations Association 1992; Japan Human Relations Association 1988). Imai (1986) also argues that improved productivity and quality are two major outcomes of kaizen activity. Whenever and wherever improvements are made in business, these improvements are eventually going to lead to improvements in such areas as quality and productivity. This study attempts to answer a number of questions about these arguments. If kaizen is so important to business competition, what factors determine these kaizen activities? If kaizen is a learning process (Florida and Jenkins, 1993; Cutcher-Gershenfeld et al. 1994), are current tangible suggestions associated with past accumulative intangible suggestions? If yes, what is the lagged effect between adopted tangible suggestions and intangible suggestions? What is the effect of management on suggestion making? Furthermore, if kaizen is important to business success, how does it work? Does a greater volume of suggestions lead to improved productivity and quality? If

kaizen suggestions can improve organizational productivity and quality, are they achieved immediately or at some later time? If there is a lag relationship between suggestion implementation and productivity improvement, what will the lag structure look like? Is there a different pattern of the effects of tangible and intangible suggestions on productivity or quality?

To answer these questions, I proposed and tested a cross-sectional and time-series model of the determinants and impact of the kaizen-suggestion program. It is the very first attempt to employ this statistical technique and time lag model in employee suggestion research. The major findings and their implications are summarized as follows.

The results of this thesis provide initial support for the proposition that the current (t) and past (t-1, t-2) adopted intangible suggestions are strongly related to the current adopted tangible suggestions. It implies that suggestion making is a learning process. What workers have learned in making intangible suggestions eventually will be transformed to the knowledge needed for generating a new tangible suggestion. An intangible suggestion itself may be a very subtle organizational improvement, but it implies that it is very crucial and fundamental for the accumulation of knowledge needed for making tangible suggestions. Using a baseball analogy, a tiny intangible suggestion can be viewed as a single whereas a big tangible suggestion can be seen as

a home run. However, accumulation of numerous tiny singles may be more valuable than a home run. A person can hit a home run that may be accumulated from previous experience in hitting numerous singles. To encourage constant incremental process improvements, those firms with a kaizen-oriented suggestion system solicit and reward all suggestions, home runs as well as singles. From the perspective of knowledge accumulation, a company with a traditional suggestion system may learn something from a firm with a kaizen-oriented suggestion system. Further, a "healthier" culture for suggestion making should be created to accumulate knowledge and encourage continuous improvement, At Nippondenso, U.S. Inc., for example, no matter what suggestions (tangible or intangible) employees make, the company pays serious attention to them equally. Employees are encouraged to make as many intangible suggestions as they can. Thus, employees do not feel embarrassed if they only make a small tiny suggestion. If an organization does realize the importance of intangible suggestions, continuous organizational improvement becomes feasible and possible.

Regression analyses provide evidence of statistically significant associations between both tangible and intangible suggestions, and management training. The more management training team leaders or departmental supervisors attend, the more adopted tangible and intangible suggestions in these departments. When team leaders or departmental supervisors

learn more interpersonal or leadership skills, a more open and supportive culture can be created. Leaders' personal skills and an open culture are important for creative idea generation and the idea's operationalization. This illustrates the fact that management support in the process of suggestion making is pivotal for an effective suggestion system. To solicit more kaizen ideas, management training should be linked to the kaizen-suggestion system at the strategic level. Management training courses should be designed to support kaizen activities and processes at the practical level. Leaders should be trained to become resources for their members in a suggestion system.

However, we should note that since the effect of intangible suggestions on tangible suggestions in the Chapter 3 is not for all lagged months, these findings are suggestive but not definitive. The R^2 in the Chapter 3 regressions are also small, so we should interpret the results carefully. Again, the data on top management leadership style is based on a relatively limited measure, so it must be treated with more caution.

The empirical results suggest that the effect of intangible suggestions on productivity may be mediated through their effect on tangible suggestions. It implies that the processes of the impact of suggestions on productivity may include two stages: (1) more adopted intangible suggestions stimulating more tangible suggestion making; (2) and in turn,

more adopted tangible suggestions leading to productivity improvement. Tangible suggestion therefore can be viewed as an intervening variable between intangible suggestion and productivity gain. This finding was based on simple regression analyses rather than more complex mediation tests, so the finding may be suggestive but not definitive.

The results of this study also provide initial support of the proposition that tangible suggestions tend to have strong effect on productivity till a lag of three months, and its duration may be longer than that. Intangible suggestions only have greater effect on productivity for a lag of two months and that this effect obviously weakens at t-3. Thus, tangible suggestions have a longer duration of lag effect than intangible suggestions. It implies that tangible suggestions pay off slower and longer than intangible suggestions. Additionally, regression analyses show that tangible suggestions tend to have greater effects on productivity than intangible suggestions. It implies that tangible suggestions pay off more than intangible suggestions. In sum, tangible suggestions pay off slower, but more than intangible suggestions.

A four-month-lag model of labor inputs is statistically much better than a three-month-lag model. The empirical results from the four-month-lag model show that the strongest response of labor efficiency to tangible suggestions occurs at a lag of four months, whereas the strongest response of labor

efficiency to intangible suggestions occurs at a lag of three months. It implies that tangible suggestions pay off later than intangible suggestions. Although tangible suggestions pay off slower than intangible suggestions, they tend to pay off much more than intangible suggestions. The regression results imply that each additional tangible suggestion may reduce labor inputs by approximately 37 hours after a lag of four months, while each additional intangible suggestion only reduces about 2 hour inputs after a lag of three months.

The empirical results provide evidence that a greater current and past volume of adopted tangible and intangible suggestions lead to fewer product defects. However, there are different patterns and effects between tangible and intangible suggestions. The strongest response in quality improvement to intangible suggestions and to tangible suggestions occurs at a lag of two months and four months respectively. It implies that intangible suggestions pay off quicker than tangible suggestions. Further, the regression results show that intangible suggestions not only pay off faster but have greater effect on quality improvement than tangible suggestions. Intangible suggestions have greater estimated effect size and are statistically better than tangible suggestions. It implies that intangible suggestions also pay off more than tangible suggestions.

By integrating three models, the empirical results show that there is a cumulative effect of suggestions on successive

incremental improvements in productivity, labor efficiency and quality. Improvements in technology and manufacturing process, which are derived from adopted tangible and intangible suggestions, lead to incremental improvements in overall productivity and quality. Improvements in productivity and quality not only depend on present volume of suggestions adopted but depend on previous volume of suggestions adopted. A lagged effect exists between suggestion implementation and economic gains. However, a different pattern of delayed effects over time between tangible and intangible suggestions is found. Overall, tangible suggestions have a longer lag structure than intangible suggestions. It implies that economic benefits (i.e. improved productivity, labor efficiency and quality) respond to tangible suggestions later than to intangible suggestions. Thus, more extensive adoption of tangible suggestions can serve as a long-term strategy for enhancing organizational effectiveness, while more extensive adoption of intangible suggestions can be used as a short-term strategy for enhancing organizational effectiveness. Additionally, there are different effects on these three dependent variables in relation to tangible and intangible suggestions. Tangible suggestions have a bigger effect on productivity gains and high labor efficiency but have a smaller effect on quality improvement. By contrast, intangible suggestions have a larger effect on quality improvement but have a smaller effect

on both productivity and labor efficiency improvements. It implies that if firms attempt to gain competitive advantage by pursuing a "quality-enhancement" strategy, more extensive adoption of intangible suggestions is an intelligent tactic. Thus, a more open and process-oriented suggestion system should be established to link to a "quality-enhancement" strategy. A more open, process-oriented or kaizen-oriented suggestion system not only emphasizes tangible suggestions but also rewards intangible suggestions. A traditional suggestion system that only emphasizes tangible suggestions may be incompatible with a quality-enhancement strategy. On the other hand, if organizations attempt to gain competitive advantage by pursuing a strategy of "cost reduction," more extensive adoption of tangible suggestions is an effective tactic. Considering the above reasoning, we realize the suggestion-change connection. The need for tangible suggestions may be driven by organizational efficiency-demand change and those tangible suggestions thus may result in cost-reduction change. On the other hand, the need for intangible suggestions may be due to organizational quality-demand change and the results of those intangible suggestions thus may lead to quality-enhancement change.

To support a kaizen-oriented suggestion system, a learning organization should be created to reinforce individual learning and foster knowledge accumulation. Employees' suggestions are built on past knowledge and

practice that lead to continuous organizational improvement. The exposure of employees to a learning culture makes knowledge accumulation and individual learning easier. The greater the individual learning and knowledge accumulation, the greater number of kaizen suggestions an organization will have. A learning organization fertilizes a suggestion program with a more open, creative and supportive climate. A more open, creative and supportive culture is required for an effective suggestion program.

The empirical results also provide initial evidence that more extensive use of training leads to improved productivity, labor efficiency and product quality. However, there are different effects among these three types of training programs. More extensive use of management and self-actualization training is associated with high productivity and labor efficiency, while more extensive use of technical training is associated with high product quality. It implies that if an organization attempts to gain advantage by pursuing a "cost-reduction" strategy, a management or self-actualization training program may be more effective than a technical training program to attain its aim. On the other hand, if an organization attempts to gain advantage by pursuing a "quality-enhancement" strategy, a technical training program may be more effective than management or self-actualization training for its goal achievement.

Research Limitations

This thesis suffers from some limitations. A major limitation of this dissertation is lack of previous studies in "kaizen" or "suggestion systems". Because very few studies have evaluated either the determinants or the outcomes of an effective suggestion system, this dissertation suffers from insufficient theoretical foundation.

Second, its focus on a single site case restricts its generalizability. The suggestion program at NDUS is a kaizen-oriented system. The company practices kaizen by encouraging constant incremental process improvement. Thus, NDUS solicits and rewards all suggestions, tangible and intangible. On the contrary, companies with traditional suggestion systems routinely look for the home run suggestions, the one-time dramatic events. The nature and process of a kaizen-oriented suggestion system are quite different from a traditional suggestion system. It may be difficult to apply the results obtained from a kaizen-oriented suggestion system to a traditional one. A single-site and uni-system design may restrict its generalizability.

Third, because of the economic and longitudinal nature of this study, only organizational and economic variables have been considered. Individual behavioral variables were excluded. I have argued that suggestions may affect productivity by altering (1) work efforts or job satisfaction, (2) the productive skills of the labor force, and (3) the

organizational efficiency. Without behavioral variables in the empirical models, high unexplained variance is expected. Consequently, since this study considers only organizational and economic variables, and other individual factors have been excluded, the findings may be limited in their generalizability.

Suggestions for Future Research

This study suggests future research in five areas. First, suggestion variables used in this thesis were measured by the volume of adopted tangible and intangible suggestions. They reflect quantity of suggestions rather than quality of suggestions. It would be interesting to examine the effect of quality suggestions - reflected in suggestion points or cost savings.[18]

Second, some technology-related variables should be considered in the future research. Roy Roemen, superintendent in production at NDUS, has been interviewed and indicated that

---

[18]In NDUS, a suggestion point index is total points integrated from points awarded from both tangible and intangible suggestions. Some criteria will be applied in the evaluation of suggestion such as savings, originality, creativity and so on. A cost savings index is total cost savings derived from the sum of total tangible suggestions. Unfortunately, because existing data for points of tangible and intangible suggestion were integrated in one, a simple effect of tangible or intangible suggestions cannot be estimated. It makes the comparison between the quality of tangible and intangible suggestions impossible. Therefore, the effect of quality of suggestions was not examined in this study. A separate estimation of points (quality) of tangible and intangible suggestions thus is suggested.

many suggestions (both tangible and intangible) have been made and accepted in his department shortly after the company adopted new machines or manufacturing processes. It was simply because employees tried to solve new problems and made their jobs easier. This suggests an interaction between suggestions and technology--what the Japanese call "people giving wisdom to the machines". It implies that a reciprocal relationship between technology and suggestions exists. It may be interesting to examine: whether advanced technology leads to more improvement suggestions, or more suggestions lead to improved technology, or they interact reciprocally. This will be an interesting topic for further study.

Third, some individual-related variables also should be considered in future research. Sue Flees who is HRM specialist and is in charge of the kaizen-suggestion system also has suggested that some individual variables might be expected to be associated with the performance of suggestion making at NDUS. These variables may include personality, motivation, work experiences and superior-subordinate relationship. This suggests the possibility of determinants of individual difference on suggestion making. However, we should note that individual factors (e.g. personality, motivation, etc.) cannot be measured and estimated in a time-series study. It may be only appropriate in a cross-sectional study.

If more technology-related and individual variables were available, it might be possible to do a broader study of these

indicators that would have greater generalizability.

The results from chapter three provide initial support for the proposition that the current (t) and past (t-1, and t-2) adopted intangible suggestions are strongly associated with the current adopted tangible suggestions. However, the initial evidence provided in this chapter should be interpreted carefully. For example, the empirical results from chapter three suggest that the significant finding in the same month can be interpreted as a reflection of the fact that groups high on intangible suggestions will also be high on tangible suggestions. The additional significance of the lag in the same regression suggested a second phenomena that intangible suggestions predict tangible suggestions. An interesting question is raised here. Will the same results hold when tangible and intangible suggestions are reversed in a regression equation? That is, using intangible suggestions predicts tangible suggestions. If yes, it implies that a reciprocal relationship between tangible and intangible suggestions may exist. Therefore, further examination of the tangible-intangible connection is needed.

In Chapter 3, I only utilized lagged intangible suggestions to predict tangible suggestions. We can't distinguish whether there is a two-way relationship, a one-way causal relationship or a common antecedent driving the emergence of both. In other words, we cannot realize how past adopted tangible suggestions influence current tangible

suggestion making. We also cannot tell how lagged tangible suggestions interact with lagged intangible suggestions to influence current tangible suggestion making. Therefore, a new model should be conducted to test this more complicated set of associations between tangible and intangible suggestions. We may have lagged tangible suggestions, lagged intangible suggestions and an interaction (i.e., lagged tangible suggestions X lagged intangible suggestions) all utilized to predict tangible suggestions in the new model.

Finally, a multi-site and bi-system can be used in studies conducted on the determinants and effects of suggestion programs. For example, a traditional suggestion system can be used as a control group. Its determinants and effects then can be compared with that of a kaizen-oriented suggestion system. Mixed studies incorporating two perspectives would yield more comprehensive organizational policy recommendations.

In Closing

This dissertation opened with Imai's argument that " kaizen has been viewed as the key to Japanese competitive success." In this thesis I have tried to explain if and how it works. Clearly, kaizen suggestions through people lead to improved productivity, labor efficiency and quality without any major or extra capital investments. It challenges

conventional economic thinking.

This dissertation has raised fundamental questions in the first chapter about the relationship between kaizen and innovation. As I argued earlier, kaizen is not innovation. kaizen does not replace innovation. Rather, kaizen and innovation should be "complementary." Imai (1986) has indicated "kaizen improves the status quo by bringing added value to it. It is bound to yield positive results if results are continued toward a clearly defined goal.------As soon as kaizen's marginal value starts declining, one should turn to the challenge of innovation. Top management's job is to maintain a balance between kaizen and innovation, and it should never forget to look for innovative opportunities." (pp 228-229).

This dissertation has linked the concept of a kaizen suggestion system to the literature on productivity, quality and employee involvement. It is an important phenomena, in part, because of the way it integrates across all three areas. I also have proposed the conceptual or process models of the determinants and the outcomes of a kaizen suggestion system. They can serve as theoretical foundation for further study.

By examining fundamental assumptions about the lagged effect of kaizen suggestions in both determinant and outcome levels, the phenomena of knowledge accumulation and organizational learning in the research site were found. A kaizen-suggestion system helps accumulate knowledge and makes

organizational learning easier.

A kaizen-suggestion system solicits and rewards all suggestions, home runs as well as singles. Its strategy strives to give undivided attention to both tangible (quantitative) and intangible (qualitative) effects, to both process and result, to both long-term and short-term gains, to both cost-reduction and quality-enhancement change.

APPENDICES

Appendix A: The Selection Process of the Optimal Pattern of Lagged Intangible Suggestion Variables with Tangible Suggestion as Dependent Variable.

Explanatory Variables		Tangible Suggestion (1)	(2)	(3)	(4)	(5)	(6)
Intercept	b	.157***	.131***	.129***	.121***	.108***	.105***
	t	5.505	3.883	3.744	3.521	3.174	3.061
$Intang_t$	b	.018***	.016***	.015***	.015***	.015***	.014***
	B	.257	.227	.223	.216	.211	.211
	t	7.326	6.087	5.892	5.654	5.493	5.502
$Intang_{t-1}$	b	.005*	.003	.002	.002	.002	.002
	B	.078	.048	.039	.033	.025	.023
	t	2.189	1.275	1.005	.839	.622	.567
$Intang_{t-2}$	b		.007***	.006*	.005*	.005*	.004
	B		.095	.087	.075	.679	.065
	t		2.536	2.242	1.873	1.691	1.609
$Intang_{t-3}$	b			.002	.001	-.0001	-.0003
	B			.028	.016	-.002	-.004
	t			.739	.408	-.060	-.107
$Intang_{t-4}$	b				.003	.002	.002
	B				.050	.031	.026
	t				1.316	.797	.645
$Intang_{t-5}$	b					.005*	.005*
	B					.078	.072
	t					2.039	1.838
$Intang_{t-6}$	b						.002
	B						.022
	t						.581

* = p < .05 level
** = p < .01 level
*** = p < .005 level
b is the regression coefficient.
B is the standardized Coefficient.
t is the t value.

Appendix B: The Selection Process of the Optimal Pattern of Lagged Training Variables with Tangible Suggestion as Dependent Variables.

Explanatory Variables		Tangible Suggestion (1)	(2)	(3)
Intercept	b	.112***	.081*	.124***
	t	2.602	1.947	2.894
$Intang_t$	b	.015***	.015***	.016***
	B	.221	.219	.227
	t	5.897	5.849	6.063
$Intang_{t-1}$	b	.003	.003	.003
	B	.045	.219	.227
	t	1.195	1.176	1.209
$Intang_{t-2}$	b	.006**	.007**	.007**
	B	.092	.095	.096
	t	2.453	2.545	2.539
$Mgttran_t$	b	.003*		
	B	.042		
	t	1.747		
$Selftran_t$	b	-.003		
	B	-.019		
	t	-.786		
$Techtran_t$	b	.0003		
	B	.005		
	t	.213		
$Mgttran_{t-1}$	b		.003*	
	B		.042	
	t		1.749	
$Selftran_{t-1}$	b		.004	
	B		.026	
	t		1.047	
$Techtran_{t-1}$	b		.001	
	B		.007	
	t		.288	
$Mgttran_{t-2}$	b			-.7E-04
	B			-.0009
	t			-.041
$Selftran_{t-2}$	b			.002
	B			.011
	t			.445
$Techtran_{t-2}$	b			.0004
	B			.005
	t			.215

* = p < .05 level
** = p < .01 level
*** = p < .005 level
b is the regression coefficient.
B is the standardized coefficient.
t is the t value.

Appendix C: The Selection Process of the Optimal Pattern of Lagged Training Variables with Intangible Suggestion as Dependent Variable.

Explanatory Variables		Intangible Suggestion (1)	(2)	(3)
Intercept	b	5.921***	4.937***	6.361***
	t	8.339	7.032	8.953
$Mgttran_t$	b	.003		
	B	.003		
	t	.172		
$Selftran_t$	b	-.0004		
	B	-.0002		
	t	-.011		
$Techtran_t$	b	.002		
	B	.002		
	t	.133		
$Mgttran_{t-1}$	b		.063***	
	B		.057	
	t		3.369	
$Selftran_{t-1}$	b		.051	
	B		.023	
	t		1.383	
$Techtran_{t-1}$	b		.022	
	B		.002	
	t		.136	
$Mgttran_{t-2}$	b			-.021
	B			-.019
	t			-1.077
$Selftran_{t-2}$	b			-.041
	B			-.018
	t			-1.108
$Techtran_{t-2}$	b			.011
	B			.011
	t			.689

* = p < .05 level
** = p < .01 level
*** = p < .005 level
b is the regression coefficient.
B is the standardized Coefficient.
t is the t value.

Appendix D: Hypotheses of Control Variables for Productivity and Labor Efficiency Models (Chapter Four)

Hypothesis 1.1.

The more the number of product defects, the lower the level of productivity.

Hypothesis 1.2.

The more the number of product defects, the more the operational time.

Hypothesis 2.1.

The more the number of accidents, the lower the level of productivity.

Hypothesis 2.2.

The more the number of accidents, the higher the level of labor inputs.

Hypothesis 3.1.

The higher the ratio of absent, the lower the level of productivity.

Hypothesis 3.2.

The higher the ratio of absent, the higher the level of labor inputs.

Hypothesis 4.

A positive relationship exists between management, self-actualization and technical training and productivity.

Hypothesis 5.

The level of productivity in machining departments will be higher than that of assembly departments.

Hypothesis 6.

The larger the size of the department, the lower the level of productivity.

Appendix E: Hypotheses of Control Variables for Quality Model (Chapter Four)

Hypothesis 1.1.

A negative relationship exists between the number of training hours and the number of customer claims for product defects.

Hypothesis 1.2.

Technical training have greater effect on product quality improvement than that of management and self-actualization training.

Hypothesis 2.

The higher the ratio of absent, the more the number of customer claims for product defects.

Hypothesis 3.

A positive relationship exists between the number of the accidents and the number of customer claims for product defects.

Hypothesis 4.

The more the number of overtime hours, the more the number of customer claims for product defects.

Appendix F: Relationships Between Suggestions, Control Variables, and Organizational Effectiveness and Efficiency Measures (Chapter four)

			Variables																		
	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Tangible Suggestion (t)	.69	1.21																				
2. Tangible Suggestion (t-1)	.69	1.21	.20																			
3. Tangible Suggestion (t-2)	.69	1.21	.20	.19																		
4. Tangible Suggestion (t-3)	.69	1.21	.15	.21	.20																	
5. Tangible Suggestion (t-4)	.69	1.21	.16	.15	.21	.20																
6. Intangible Suggestion (t)	12.72	17.46	.24	.15	.13	.15	.14															
7. Intangible Suggestion (t-1)	12.76	17.46	.18	.24	.15	.13	.15	.57														
8. Intangible Suggestion (t-2)	12.76	17.46	.19	.18	.24	.15	.13	.49	.57													
9. Intangible Suggestion (t-3)	12.76	17.46	.14	.19	.18	.24	.15	.44	.49	.57												
10. Intangible Suggestion (t-4)	12.76	17.46	.16	.14	.19	.18	.24	.43	.44	.49	.57											
11. Productivity	102.93	33.33	.17	.19	.19	.18	.18	.12	.14	.14	.14	.15										
12. Working Hours	5883.9	4688.5	-.01	-.01	.00	.00	-.01	.07	.07	.07	.07	.09	.32									
13. Quality	.13	.42	-.02	-.03	-.02	-.03	.02	.02	-.02	.07	.06	.04	.03	.17								
14. Safety	.81	1.23	.06	.05	.07	.04	.06	.15	.15	.12	.14	.13	.16	.35	.20							
15. Management Training	12.85	15.91	.03	-.01	.03	.03	-.01	.10	.07	.05	.11	.12	.10	.22	.04	.10						
16. Self-Actualization Training	3.72	7.72	-.06	-.06	-.04	.02	.01	-.01	-.02	-.04	-.04	-.05	.08	.10	-.03	.09	.08					
17. Technical Training	15.52	17.40	-.02	-.01	.01	.05	-.02	.00	.00	.03	.00	.00	-.01	.10	-.02	.08	.14	.40				
18. Workforce Size	29.93	24.10	-.01	-.01	-.02	-.01	-.02	.07	.07	.07	.08	.08	.30	.97	.14	.33	.21	.07	.09			
19. Overtime	589.59	572.67	-.01	.01	.01	.00	-.02	.02	.02	.02	.03	.03	.28	.84	.09	.31	.14	.13	.13	.79		
20. Absent Ratio	1.69	1.61	.00	.00	-.01	-.02	-.03	.22	.20	.18	.17	.20	.17	.08	.07	.11	.11	.02	.00	.10	.03	
21. Technology	.74	.44	.05	.05	.06	.06	.06	.03	.05	.05	.06	.06	.01	-.15	-.21	-.15	-.05	-.07	-.07	-.14	-.09	-.11

N = 836

REFERENCES

LIST OF REFERENCES

Arbose, J. R. (1980). Quality Control Circles: The West adopts a Japanese concept. International Management, December, 31-39.

Abdel-Halim, A.A. (1983). Effects of task and personality characteristics on subordinate response to participative decision making, Academy of Management Journal, 26(3), 477-484.

Abdel-Halim, A.A., and Rowland, K. M. (1976). Some personality determinants of the effects of participation: A further investigation, Personnel Psychology, 29, 41-55.

Atkinson, P. E. (1990). Creating culture change: The key to successful total quality management. San Diego: Pfeiffer Company.

Banker, R. D. (1993). Accounting for productivity gains. In Ijiri, Y. (ed.) Creative and innovative approaches to the science of management. Connecticut: Quorum Books.

Binstock, S. L. (1981). Americans express dissatisfaction with quality of U.S. goods. Quality Progress, January, p.13.

Bittel, L. R. (1968). What every supervisor should know. New York: McGraw-Hill.

Burke, M. J., Hoffman, R. G., Hazer, J. T., and Hall, T. L. (1982). Predicting suggestion-making intentions and behaviors. Managerial Psychology. 3(2), 1-15.

Buller, P. F., and Bell, C. H. Jr. (1986). Effects of team building and goal setting on productivity: A field experiment. Academy of Management Journal, 29(2), 305-328.

Bragg, J. E., and Andrews, I. R. (1973). Participative decision making: An experimental study in a hospital. Journal of Applied Behavioral Science, 9(6), 727-735.

Blanner, R. (1964). Alienation and freedom. Chicago: University of Chicago Press.

Brief, A.P., and Aldag, R. J. (1975). Employee reactions to job characteristics: A constructive replication, Journal of Applied Psychology, 60, 182-186.

Brief, A.P., and Motowidlo, S. J. (1986). Prosocial

organizational behavior, Academy of Management Review, 11, 710-725.

Cummings, T. G., and Worley, C. G. (1993). Organization development and change, New York: West Publishing Co.

Cable, J., and Wilson, N. (1990). Profit-sharing and productivity: Some further evidence, The Economic Journal, 100, 550-555.

Cooke, W. N.(1990). Labor-management cooperation. Michigan: W.E. Upjohn for Employment Research.

Chinloy, P. (1981). Labor productivity. Cambridge, Mass: Abt Book.

Cutcher-Gershenfeld, J.(1991). The impact on economic performance of a transformation in workplace relations. Industrial and Labor Relations Review, 44(2), 241-260.

Cutcher-Gershenfeld, J., Nitta, M., Barrett, B., Belhedi,N., Coutchie, C., Inaba, T., Ishino, I., Lee, S., Lin W-J, Monthersell, S., Mulder, J., Rabine, S., Ramanand, S., Strolle, M., and Wheaton, A., (1994). Employee involvement and kaizen: understanding continuous improvement through the harnessing of knowledge, Unpublished manuscript, School of Labor and Industrial Relations, Michigan State University.

Crocker, O. L., and Charney, C. (1984). Quality Circles: A guide to participation and productivity. New York: AMACOM.

Cummins, R. C., and King, D. C. (1973). The interaction of group size and task structure in an industrial organization. Personnel Psychology, 26, 87-94.

Conte, M., Tannebaum, A. S., and McCulloch, D. (1981). Employee ownership. Michigan: The Institute for Social Research, The University of Michigan.

Campbell, J. P., Campbell, R, J. et al. (1988). Productivity in organizations: New perspectives from industrial and organizational psychology. San Francisco: Jossey-Bass Publishers.

Doherty, E. M., Nord, W. R., and McAdam, J. L (1989), Gainsharing and organization development: A productive synergy. The Journal of Applied Behavioral Science, 25(3), 209-229.

Denz, F. A. (1946). Why a suggestion plan? in American

Management Association (Ed.), Getting and using employees' ideas. New York: AMA, 3-6.

Dyer, C. (1987). Cannon production system: Creative involvement of the total workforce. Cambridge, Mass: Productivity Inc..

Daft, R., and Becker, S. (1978). The innovative organization: Innovation adoption in school organizations. New York: Elsevier.

Denton, D. K. (1991). Horizontal Management: Beyond total customer satisfaction. New York: Lexington Books.

Donovan, M., and Van Horn, B. (1980). Quality Circle program evaluation. Transactions of the Second Annual IAQC Conference, 5, 463-470.

Daltn, D. R., Todor, W. D., Spendolini, M. J., Fielding, G. J., and Poter, L. W. (1980). Organizational structure and performance: A critical review. Academy of Management Review, 5, 49-64.

Drucker, P. R. (1954). The Practice of Management, New York: Harper & Row.

Dielman, T. E. (1989). Pooled cross-sectional and time-series data analysis. New York: Marcel Dekker, Inc.

Ekvall, G. (1976). Creativity of the place of work. Stockholm: The Swedish Council for Personnel Administration.

Even, W., and Black, G. (1967). Innovation in business organization: Some factors associated with success or failure, Journal of Business, 40, 519-530.

French, J. R. P., Israel, J., and As, D. A. (1960). An experiment in a Norwegian factory: Interpersonal dimensions in decision Making. Human Relations, 13, 3-19.

French, J. R. P., Ross, I. C., Kirby, S., Nelson, J. R., and Smyth, P. (1958). Employee participation in a program of industrial change, Personnel, 35(3), 16-29.

Frost, C., Wakeley, L., and Ruh, R. (1974). The Scanlon Plan for organization development: Identity, participation, and equality. East Lansing: Michigan State University.

Fairweather, G.W., Sanders, D. H., and Tornatzky, L. Z. (1974). Creating change in mental health organizations. New York: Pergamon Press, Inc.

FitzRoy, F. R., and Kraft, K. (1987). Cooperation, productivity, and profit sharing, Quarterly Journal of Economics, 23-35.

Fourastie, J. (1957). Productivity, prices, and wages. Paris: Organization for Economic Cooperation and Development.

Florida, R., and Jenkins, D. (1993). Advanced production systems and learning in the Japanese transplants: A Research Prospectus. Paper Presented in the Conference of Workshop on Apprenticeship Education in Japan. University of Pittsburgh. April 22-25, 1993.

French, W. (1984). The Personnel management process - Human resources administration. Atlanta: Houghton Mifflin Co., 527.

French, E. G. (1958). The interaction of achievement motivation and ability in problem solving success. Journal of Abnormal and Social Psychology, 7, 306-309.

Gouldner, A.W. (1960). The norm of reciprocity: A preliminary statement, American Sociological Review, 25, 161-178.

Griliches, Z. (1967). Distributed lags: A survey. Econometrica, 16-49.

Goodman, P. S. (1979). Assessing organizational change: The rushton quality of work of experiment. New York: John Wiley & Sons.

Gunatilake, S. (1984). An exploratory study of quality circles and team building in two hospital settings, Dissertation Abstracts International, 45, 1723B.

Graf, L.A. (1982). Suggestion program failure: Causes and remedies, Personnel Journal, 450-454.

Guest, R.H. (1955). Men and machines: An assembly-line worker looks at his Job. Personnel, 31, 3-10.

Gunsch, D. (1991). Employees team up with HR, Personnel Journal, October, 68-71.

Greenlaw, P. S. (1980). Suggestion systems: An old approach to a new problem. The Personnel Administrator, January, 49-54.

Gregerman, I. B. (1984). Productivity improvement: A guide for small business. New York: Van Nostrand Reinhold Company.

Gold, B. (1975). Technological change: Economics, management

and environment, Oxford: Pergamon.

Gold, B. (1979). Productivity, technology, and capital: Economic analysis, managerial strategies, and government policies. Lexington: D.C. Health and Company.

Gold, B., Pierce, W., and Rosegger, G. (1970). Diffusion of major technological innovations in U.S. iron and steel manufacturing. Journal of Industrial Economics. July.

Greenberg, L. (1973). A practical guide to productivity measurement. Washington, D.C.: The Bureau of National Affairs.

Guzzo, R. A., Jette, R. D., and Katzell, R. Z. (1985). The effects of psychologically based intervention programs on worker productivity: A meta-analysis, Personnel Psychology, 38, 275-291.

Graham-Moore, B., and Ross, T. L. (1983). Productivity gainsharing. Englewood Cliff, NJ: Prentice-Hall.

Hatcher, L., Ross, T. L., and Collins, D. (1989). Prosocial behavior, job Complexity, and suggestion contribution under gainsharing plans. The Journal of Applied Behavioral Science, 25, 231-248.

Herman, J. B. (1973). Are situational contingencies limiting job attitude-job performance relationships? Organizational Behavior and Human Performance, 10, 208-224.

Hill, J. M., and Trist, E. L. (1953). A Consideration of industrial accidents as a means of withdrawal from the work situation. Human Relations, 6, 357-380.

Hackman, J.R. (1969a). Nature of the task as a determine of job behavior. Personnel Psychology, 22, 435-444.

Hackman, J.R. (1969b). Toward understanding the role of tasks in behavioral research. Acta Psychologica, 31, 97-128.

Hackman, J. R., and Lawler, E. E. (1971). Employee reactions to job characteristics, Journal of Applied Psychology, 55, 259-286.

Hackman, J. R., and Suttle, J. L. (1977). Improving life at work. Santa Monica, CA: Goodyear Publishing Co. Inc.

Hatcher, L., and Ross, T. L. (1991). From individual incentives to an organization-wide gainsharing plan: Effects on teamwork and product quality. Journal of

organizational Behavior, 12, 169-183.

Hatcher, L., Ross, T. L., and Collins, D. (1989). Prosocial behavior, job complexity, and suggestion contribution under gainsharing plans. The Journal of Applied Behavioral Science, 25, 231-248.

Hammer, M., and Champy, J. (1993). Reenginerring the corporation: A manifesto for business revolution, New York: HarperCollins Publishers, Inc..

Hage, J. and Aiken, M. (1967). Social change in complex organizations. New York: Random House.

Harrington, H. T. (1991). Business process improvement. New York: McGraw-Hill, Inc.

Holter, H. (1965). Attitude toward employee participation in company decision making processes. Human Relations, 18, 297-321.

House, R.J., and Mitchell, T. R.. (1974). Path-Goal theory of leadership, Journal of Contemporary Business, 3, 81-98.

Ingle, S. (1982). Quality Circles master guide: Increasing productivity with people power. New York: Prentice-Hill.

International Labor Office (1969). Measuring labor productivity. Geneva: ILO.

Industry Week (1979). A quality concept catches on worldwide. Industry Week, 16 April, 125.

Ishida, M. (1993). Managerial control and skill formation in Japanese auto companies. Paper presented in Asia Regional Conference in IR.

Imai, M. (1986). Kaizen: the key to Japan's competitive success. Toronto: McGraw-Hill Publishing Company.

Japan Human Relations Association (1988). The idea book: Improvement through total employee involvement. Cambridge, Mass: Productivity, Inc..

Japan Human Relations Association (1992). Kaizen Teian 1: Developing systems for continuous improvement through employee suggestions. Cambridge, Mass: Productivity Press.

Judge, G. G., Griffiths, W. e., Hill, R. C., Lutkepohl, H, and Lee, T. (1985). The theory and practice of econometrics. New york: John Wiley and Sons.

Jenkins, D. (1973). Job power: Blue and white collar democracy. Garden City, New York: Doubleday.

Juran, J. M. (1978). Japanese and Western Quality--A contrast, Quality Progress, 11, 12.

Juran, J. M. (1981a). Product quality--a prescription for the West. Part I: Training and improvement programs. Management Review, June, 9-14.

Juran, J. M. (1981b). Product quality--a Prescription for the West. Part II: Upper-management leadership and employee relations. Management Review, July, 57-61.

Jenkins, T. M., and Shimada, J. Y. (1983). Effects of Quality Control Circles on worker performance: A field experiment. Paper presented at 43rd Annual Meeting of the Academy of Management, New York.

Johnston, J. (1972). Econometric Methods. New York: McGraw-Hill.

Kmenta, J. (1971). Elements of Econometrics. New York: The Macmillan Company.

Katz, D., and Kahn, R. L. (1966). The social psychology of organizations. New York: Wiley.

Katz, H., Kochan, T. A., and Gobeille, K. R. (1983). Industrial relations performance, economic performance, and QWL programs: An interplant analysis. Industrial and Labor Relations Review, 37(1). 3-17.

Katz, H. C., Kochan, T. A., and Keefe, J. H. (1987), Industrial relations and productivity in the U.S. automobile industry. Brookings Paper on Economic Activity, 3, 685-715.

Katz, H. C., Kochan, T. A., and Weber, M. R. (1985). Assessing the effects of industrial relations systems and efforts to improve the quality of working life on organizational effectiveness, Academy of Management Journal, 28(3), 509-526.

Kochan, T. A., Katz, H. C., and Mower, N. R. (1984). Worker participation and American Unions: Threat or opportunity? Michigan: W.E. Upjohn Institute for Employment Research.

Kochan, T. A., Katz, H. C., and McKersie, R. B.(1986). The transformation of American industrial relations. New York: Basic Books, Inc..

Katz, R. (1982). The effect of group longevity on project communication and performance. Administrative Science Quarterly, 27, 81-104.

Klotz, V. (1988). Staff suggestion schemes, International Labor Review, 27(3), 335-353.

Kossen, S. (1983). The human side of organizations. New York: Harper & Row Publishers, p. 79.

Katzell, R. A., and Guzzo, R. A. (1983). Psychological approaches to productivity improvement. American Psychologists, 38, 468-472.

Katzell, R. A., Bienstock, P., and Faerstein, P. H. (1977). A guide to worker productivity experiments in the United States, 1971-1975, New York: New York University Press.

Kopleman, R. E. (1986). Managing productivity in organizations. New York: McGraw-Hill.

Kendrick, J. W. (1961). Productivity trends in the U.S.. Princeton, N. J.: Princeton University Press.

Kendrick, J. W. (1977). Understanding productivity. Baltimore, MD: John Hopkins Press.

Kendrick, J. W. (1984). Improving company productivity: Handbook with case studies in collaboration with American Productivity Center, The John Hopkins University Press, Baltimore.

Kagono, T., Nonaka, I., Sakakibara, K., and Okumura, A. (1985). Strategic versus evolutionary management: A US-Japan comparison of strategy and structure, Amsterdam: North-Holland.

Klein, K. J., and Hall, R. J. (1987). Correlates of employee satisfaction with stock ownership: who likes an ESOP most? Journal of Applied Psychology, 73(4), 630-638.

Kaufman, R. T. (1992). The effects of Improshare on productivity, Industrial and Labor Relations Review, 45(2), 311-322.

Kruse, D. (1984). Employee ownership and employee attitudes: Two case studies. Pennsylvania: Norwood.

Lin, W-J. (1993). The impact of a kaizen-suggestion system on productivity: A pooled cross-sectional and time-series analysis. Unpublished manuscript, School of Labor and

Industrial Relations, Michigan State University.

Louviere, V. (1973). Where ideas aren't kept in camera, Nation's Business, June, 15.

Long, R. J. (1978). The effect of employee ownership on organizational identification, employee job attitudes, and organizational performance: A tentative framework and empirical findings. Human Relations, 31(1), 29-48.

Long, R. J. (1980). Job attitudes and organizational performance under employee ownership. Academy of Management Review, 23(4), 726-737.

Locke, E. A. (1970). Job satisfaction and job performance: A theoretical analysis. Organizational Behavior and Human Performance, 3, 484-500.

Leeds, R. (1963). Altruism and the norm of giving. Merrill-Palmer Quarterly, 9, 229-240.

Lewin, K. (1951). Frontiers in group dynamics in field theory in social science. Ed. by Cartwright D. New York: Harper, 188-231.

Lillrank, P., and Kano, N. (1989). Continuous improvement: Quality control circles in Japanese industrial. Ann Arbor, University of Michigan: Center for Japanese Studies.

Loesges, R. E. (1946). Building a suggestion program in American Management Association (Ed.), Getting and using employees' ideas. New York: AMA, 15-19.

Lesieur, F. G., and Puckett, E. S. (1969). The Scanlon Plan has proved itself, Harvard Business Review, September-October, 109-118.

Lawler, E. E., and Ledford, G. E. (1982). Productivity and the quality of work life, National Productivity Review, 1(1), 295-307.

Lawler, E. (1991). High involvement management. San Francisco: Jossey-Bass.

Locke, E.A., and Feren,D. B., McCaleb, V. M., Shaw, K. N., and Denny, A. T. (1980). The relative effectiveness of four methods of motivating employee performance. In K. Duncan, M. Gruneberg and D. Wallis (Ed.), Changes in Working Life (p. 363-388), Chichester, England: John Wiley.

Locke, E.A., and Schweiger, D. M. (1979). Participation in

decision making: One more look. In B.M. Staw (Ed.), Research in Organization Behavior, (Vol. 1, p. 265-339), Greenwich, Connecticut: JAI Press.

Maier, N.R.F. (1953). Principles of human relations applications to management, New York: Wiley.

Matthes, K. (1992). What's the big idea? - Empower employees through suggestion. H.R. Focus, Oct., p. 17.

Miner, J.B. (1969). Personnel psychology. London: The Macmillan Co., p. 271.

Mitchell, T.R., Smyser, C. M., and Weed, S. E. (1975). Locus of control: Supervision and work satisfaction, Academy of Management Journal, 18, 623-631.

Marmaduke, H. C. (1946). The Illinois central suggestion system. In American Management Association (Ed.), Getting and Using Employees' Ideas. New York: American Management Association, 23-25.

Miller, K. I., and Monge, P. R. (1986). Participation, satisfaction, and productivity: A meta-analysis review. Academy of Management Journal, 29(4), 727-753.

Mohrman, S. A., and Novelli, L. Jr. (1985). Beyond testimonials: Learning from a quality circles program, Journal of Occupational Behavior, 6, 93-110.

Morton, C. P. (1971). 'Drop Dead' say some employees, but suggestion boxes thrive, National Observer, June 18.

Miller, C. Z., and Schuler, M. H. (1987). Gain sharing plans: A comparative analysis. Organizational Dynamics, 16(1), 44-67.

Main, J. (1980). The battle for quality begins, Fortune, 29 December, 28-33.

Mirvis, P. (1988). Organizational development, Part I: An evolutionary perspective. In Woodman, R., and Pasmore, W. (eds.) Research in organizational change and development (Vol.2). Greenwich, CT: JAI Press.

Mirvis, P. (1990). Organizational development, Part II: An revolutionary perspective. In Woodman, R., and Pasmore, W. (eds.) Research in organizational change and development (Vol.4). Greenwich, CT: JAI Press.

Mark, J. A. (1977). Concepts and measures of productivity. In Bureau of Labor Statistics, The meaning and measurement

of productivity. Washington, D.C.: U.S. Department of Labor.

Murray, T. J. (1981). The rise of the productivity manager, Dun's Review, 117, 64-69.

Marks, M. L., Mirvis, P. H., Hackett, E. T., and Grady, J. F. (1986). Employee participation in a Quality Circle program: Impact on quality of work life, productivity, and absenteeism, Journal of Applied Psychology. 71(1), 61-69.

Norris, D. R., and Cox, J. F. (1987). Quality Circles programs: Volunteering for participation. Journal of Occupational Behavior, 8, 209-217.

Northrup, H. P., and Young, H. A. (1968). The cause of industrial peace revisited. Industrial and Labor Relations Review, October, 31-47.

Nelson, J. (1980). Quality Circles become contagious, Industrial Week, 30, 34-40.

Nippondenso Manufacturing U.S.A. Inc. (1990). NDUS Suggestion System Handbook. Battle Creek, Michigan.

National Association of Suggestion Systems (1975). Suggestion Newsletter, 5.

Nurick, A. J. (1985). Participation in organization change: The TVA experiment. New York: Praeger Publishers.

O'Dell, C. (1981). Gainsharing: involvement, incentive, and productivity. New York: American Management Association.

Organ, D. (1988). Organizational citizenship behavior: The good soldier syndrome. Lexington, MA: Lexington Books.

Organ, D.W., and Konovsky, M. (1989). Cognitive versus affective determinants of organizational citizenship behavior, Journal of Applied Psychology, 74, 157-164.

Pateman, C. (1973). Participation and democratic theory. Cambridge: Cambridge University Press.

Pelz, D.C., and Andrews, F. M. (1976). Scientists in organizations (Rev. Ed.), Ann Arbor, Michigan: Institute for Social Research.

Pizam, A. (1974). Some correlates of innovation within industrial suggestion system, Personnel Psychology, 27, 63-76.

Puffer, S.M. (1987). Prosocial behavior, noncompliant behavior and work performance among commission sales people. Journal of Applied Psychology, 72, 612-621.

Pike, J., and Barnes, R. (1994). TQM in action: A practical approach to continuous performance improvement. New York: Chapman & Hall.

Pym, D. (1964). Is there a future for wage incentive systems? British Journal of Industrial Relations, 2, 379-397.

Patchen, M. (1970). Participation, Achievement, and Involvement on the job. New Jersey: Prentice-Hall.

Poole, M. (1986). Toward a new industrial democracy: Workers' participation in industry. Routedge Kegan Paul, London.

Poole, M. (1989). The origins of economic democracy: Profit sharing and employee shareholding schemes. Routledge, London.

Pindyck, R. S., and Rubinfeld, D. L. (1976). Econometric model and economic forecasts. New York: McGraw-Hill.

Reuter, V. G. (1976). A new look at suggestion system. Journal of Systems Management, January, 6-15.

Reuter, V. G. (1977). Suggestion system--utilization, evaluation, and implementation. California Management Review, Spring, 78-79.

Rosenberg, R. D., and Rosentein, E. (1980). Participation and productivity: An empirical study, Industrial and Labor Relations Review, 33(3).

Ross, T. L. (1969). The accountant's role in participative decision making. Unpublished Ph.D dissertation, Michigan State University.

Ross, T. L., and Jones , G. M. (1972). An approach to increased productivity: The Scanlon Plan, Financial Executives, 40, 23-29.

Ross, T. L. (1983). Why Pg fails in some firms, In Graham-Moore, B., and Ross, T. L. (Eds.), Productivity gainsharing. Englewood Cliff, NJ: Prentice-Hall.

Runyon, K. (1973). Some interactions between personality variables and management styles, Journal of Applied Psychology, 57, 288-295.

Sadler, J. (1970). Leader style, confidence in management and

job satisfaction, Journal of Applied Behavioral Science, 6, 3-19.

Schuler, R.S. (1976). Participation with supervisor and subordinate authoritarianism: A Path-Goal theory reconcileation, Administrative Science Quarterly, 21, 320-325.

Smith, G. (1986). Profit sharing and employee share ownership in Britain, Employment Gazette, September, 380-385.

Smith, A.Z. (1968). Harnessing the power of ideas, Personnel Journal, 770-775, 779.

Smith, C.A., Organ, D. W., and Near, J. P. (1983). Organizational citizenship behavior: Its nature and antecedents, Journal of Applied Psychology, 68, 653-663.

Smith, C.G. (1970). Age of R & D groups: A reconsideration, Human Relations, 23, 81-96.

Smith, P.C. (1955). The prediction of individual differences in susceptibility to industrial monotony, Journal of Applied Psychology, 39, 322-329.

Smith, A. E. (1968). Harnessing the power of ideas. Personnel Journal, November, 770-775.

Staw, B.M. and Boettger, R. D. (1990). Task revision: A neglected form of work performance. Academy of Management Journal, 33, 534-559.

Slocum, J. W. (1970). Performance and satisfaction: An analysis. Industrial Relations, 9, 431-436.

Sayrs, L. W. (1989). Pooled time series analysis. Newbury Park, California: SAGE Publication Inc.

Stagner, R., Rlebbe, D. R., and Wood, E. F. (1952). Working on the railroad: A study of job satisfaction. Personnel Psychology, 5, 293-306.

Srinivason, C. (1983). Influence of quality circles on productivity, group behavior, and interpersonal behavior: An exploratory micro-organizational development perspective. Dissertation Abstracts International, 43, 3055A.

Steel, R. P., and Shane, G. S. (1986). Evaluation research on quality circles: Technical and analytical implications, Human Relations, 39(5), 449-468.

Sutermister, R. A. (1969). People and Productivity. New York:

Mcgraw-Hill.

Siegel, I. H. (1980). Company productivity: Measurement for improvement, Michigan: The W. E. Upjohn Institute for Employment Research.

Stein, H. (1971). The meaning of productivity. In Bureau of Labor Statistics, The meaning and measurement of productivity. Washington, D.C.: U.S. Department of Labor.

Saint, A. (1974). Learning at work: Human resources and organizational development. Chicago: Nelson-hall company.

Schuster, M. (1984). The Scanlon Plan: A longitudinal analysis, Journal of Applied Behavioral Science, 20(1), 23-28.

Schuster, M. (1983). The impact of union-management cooperation on productivity and employment. Industrial and Labor Relations Review, 33(3), 355-367.

Solow, R. M. (1957). Technical change and the aggregate production function. Review of Economics and Statistics, 39(3), 312-320.

Scanlon, J. N. (1948). Profit sharing under collective bargaining: Three case studies, Industrial and Labor Relations Review, October, 58.

Shultz, G. P. (1958). Worker participation on production problem. In Lesieur, F. G. (Ed.), The Scanlon Plan: A frontier in labor management cooperation, Cambridge: Technology Press of MIT.

Steingerg, R. A. (1981). Participative leadership as a determinant of idea/suggestion generation: An experimental simulation. Michigan State University, Unpublished Ph.D Dissertation.

Thompson, P. C. (1982). Quality Circles: How to make them work in America. New York: AMACOM.

Tosi, H.A. (1970). Reexamination of personality as a determinant of the effects of participation, Personnel Psychology, 13, 125-139.

Tortorich, R., Thompson, P., Orfan, C., Layfield, D., Dreyfus, C., and Kelly, M. (1981). Measuring organizational impact of quality circles, The Quality Circles Journal, 4(4), 24-34.

Taylor, T. O., Friedman, D. J., and Couture, D. (1987). Operating without supervisors: A experiment, Organizational Dynamics, 15, 26-38.

Trist, E. L., Susman, G. I., and Brown, G. R. (1977). An experiment in autonomous working in an American underground coal mine, Human Relations, 30(3), 201-236.

Umstot, D. D., Bell, C. H., and Mitchel, T. R. (1976). Effects of job enrichment and task goals and satisfaction and productivity: Implications for job design. Journal of Applied Psychology, 61(4), 379-394.

Voos, P. B. (1987). Managerial perceptions of the economic impact of labor relations programs. Industrial and Labor Relations Review, 40(2), 195-208.

Vroom, V.H., and Mann, F. (1960). Leader authoritarianism and employee attitudes, Personnel Psychology, 13, 125-139.

Vroom, V. H. (1962). Ego-involvement, job satisfaction and job performance. Personnel Psychology, 15, 159-177.

Vroom, V. H. (1964). Work and Motivation. New York: John Wiley & Sons.

Vroom, V. H. (1960). Some Personality Determinants of the Effects of Participation. Englewood Cliffs, New Jersey: Prentice-Hall.

Wilce, H. (1971). Getting value from suggestion schemes, International Management, 26(12), 31-37.

Wolfe, P. J. (1985). Quality Circle intervention: Structure, process, results. Dissertation Abstracts International, 45, 2184A.

White, J. (1979). The Scanlon Plan: Causes and correlates of success. Academy of Management Journal, 22, 292-312.

Womack, J., Jones, D. T., Ross, D. (1990). The machine that changed the world . New York: Macmillan Publishing Company.

Wadhwani, S., And Wall, M. (1990), The effects of profit-sharing on employment, wages, stock returns and productivity: evidence from UK micro-data, The Economic Journal, 100, 1-17.

Walker, C.R. (1950). The problem of the repetitiveness job. Harvard Business Review, 28, 54-58.

Work in America (1973). Report of a special task force to the Secretary of Health, Education and Welfare, Cambridge, Mass: MIT press.

Wayne, S. J., Griffin, R. W., and Bateman, T. S. (1986). Improving the effectiveness of quality circles, Personnel Administrator, May, 79-88.

Whitewell, W. C. (1965). Suggestion systems are profitable. Connecticut: Prentice-Hill Inc.

Wagner, J. A. III, and Gooding, R. Z. (1987a). Effects of societal trends on participation research. Administrative Science Quarterly, 32, 241-262.

Wagner, J. A. III, and Gooding, R. Z. (1987b). Shared influence and organizational behavior: A meta-analysis of situational variables expected to moderate participation-outcome relationships, Academy of Management Journal, 30, 524-541.

Wagner, J. A. III, and Hollecbeck J. R. (1992). Management of organizational behavior. Englewood Cliffs, NJ: Prentice Hall, Inc. Chapter 4.

Yasuda, Y. (1991). 40 years, 20 million ideas--the Toyota Suggestion System, Cambridge, Mass: Productivity Press, Inc..

Yager, E. (1979). The Quality Circle explosion, Training and Development Journal, 35, 98-105.

Zupanov, J., and Tannenbaum, A. S. (1968). The distribution of control in some Yugoslav industrial organizations as perceived by members. In Tannenbaum A. S. (Ed.) Control in Organizations. 91-109. New York: McGraw-Hill.