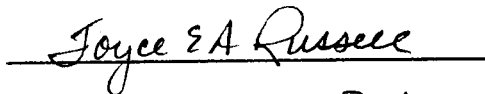


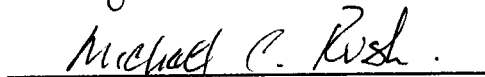
To the Graduate Council:

I am submitting herewith a dissertation written by Paul Michael McCullough entitled "The Development and Validation of an Instrument to Measure Adherence to Deming's Philosophy of Quality Improvement." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Industrial and Organizational Psychology.


Robert T. Ladd, Major Professor

We have read this dissertation
and recommend its acceptance:







Accepted for the Council:


Vice Provost
and Dean of The Graduate School

DEVELOPMENT AND VALIDATION OF AN INSTRUMENT TO MEASURE ADHERENCE
TO DEMING'S PHILOSOPHY OF QUALITY IMPROVEMENT

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Paul Michael McCullough

December, 1988

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ACKNOWLEDGMENTS

First, I must say that "I am truly surprised to be receiving this award". I could not have achieved "it" without the assistance and patience of a number of people

I wish to express my thanks to those who participated in any of the several phases of the research, from content-validity panelists through phone respondents.

A general appreciation statement must be made to the following people. Gypsy Ranney was gracious enough to act as my Deming surrogate. Ann Mayeaux provided names of company SQC experts. Clyde Keller gave the nod and the funds to do the project. John Riblett held up Clyde's bargain and employed a family member. Ann Mogan-Herd read a very early draft and loved it. Greg Bounds was an absolute hero. All this angel in Mississippian's clothing did was to phone about half of the phone respondents, listen to a dry run of the defense presentation, say nothing damaging during the defense itself, provide numerous derisive remarks about my attire, and generally encourage this present researcher. Thank you Greg. I owe you a second authorship. Jerry Frixell commented on the criteria and actually influenced them to some extent. Dudley Dewhirst lended his insight and stateliness. George A. Waggoner asked not to be acknowledged but he is a dear friend and provided great encouragement and knowledge.

Thanks to Dr. Karen Ladd for reading the document and for surrendering Dr. Tom Ladd so that he could apply his considerable quantitative ingenuity to the project. The man knows his psychometrics. Thanks Tom, for directing this dissertation. Thanks to the committee for your patience. Joyce Russell is the most thorough proofreader in the world. Mike Rush lended his great conceptual skills. Eric Sundstrom lended his demand for rigor, especially to the earlier drafts.

On a personal note, thanks to my wife Tanga McCullough. She has been a goddess and will no doubt receive considerable reward in heaven if she never does another good deed. Jim Phillips was correct, "it is your turn now". I love you. And to my daughter, Stephanie; enjoy school, just don't take as long as daddy.

ABSTRACT

The study discusses the development of an instrument to measure organizational adherence to Deming's philosophy of quality management. Using the unitarian approach (Landy, 1986), an effort was made to validate the instrument. This validation effort also allowed for statements to be made about the nature of the philosophy with respect to extant organizational behavior research. The study progressed from content validation through construct validation to criterion-related validation. Six subject-matter experts (SME's) assisted in the writing of a 135 questionnaire items. Sixty content validation panelists reviewed these items, associating them with Deming's points. Fifty items with high interrater reliability were retained for the final instrument. This conceptual factor analysis was used to arrive at a starting model for structural equations analysis. The 50-item questionnaire was responded to by 393 employees from 44 organizations. LISREL was employed to arrive at measurement and structural models. The results indicated great overlap between Deming's ideas and previous organizational culture research. The most interesting finding was that good interdepartmental communication was negatively related to an overall smooth implementation of statistical quality control (SQC). Other findings include a marginal relationship between a lowered scrap rate and market share. The results are discussed as indicating the amount of agreement between what Deming prescribes and previous

organizational culture research. The instrument is seen as having components which might be useful to organizations as they assess themselves on dimensions seen as important in the organizational culture literature as well as by Deming. Of the 11 factors retained from the measurement model and subsequently employed in the structural model, only three were shown to be important to an overall smooth statistical quality control implementation: a focus on purchasing quality raw materials, modern methods of training, and the aforementioned negative relationship with interdepartmental communication.

TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION	1
II. LITERATURE REVIEW AND METHODOLOGICAL STRATEGIES . . .	6
III. METHOD OF INSTRUMENT DEVELOPMENT	39
IV. RESULTS	80
V. DISCUSSION	100
REFERENCES	124
APPENDIXES	131
VITA	166

LIST OF TABLES

Table	Page
1. Overview of Factor Structure (Before LISREL Run 1)	61
2. Iterative History of LISREL Runs for Measurement Model . .	64
3. Overview of Factor Structure (After final LISREL Run) . .	67
4. Factor Descriptions and Reliability Coefficients	68
5. Analysis of Variance Results Testing for Company Differences in Each of the 11 Factors	81
6. Coding Rationale for Criteria	85
7. Iterative History of LISREL Steps for Structural Model . .	93
8. Correlations of Factors and Phone Questions with COMPUSTAT Indices	99

LIST OF FIGURES

Figure	Page
1. Representative comments of I/O psychology Ph.D. students regarding the relationship of Deming's points to I/O psychology	45
2. List of Items in Final Instrument	52
3. Original Factor Pattern (Lambda Matrix)	62
4. Jackknife Procedure Results	70
5. Instrument Factor Structure	73
6. Initial (Saturated) Structural Model	95
7. Model of Relationships Among Variables	96

CHAPTER I

INTRODUCTION

In the last decade there has been a surge among U.S. companies to improve quality. Foreign competitors, in particular the Japanese, have found ways to produce higher quality products at the same or lower prices than their American counterparts. A primary focus in this surge for quality has been the use of statistical quality control (SQC) (Shewhart, 1931).

The foundation of all SQC is statistical analyses advantageously applied to industrial processes. The variation found in industrial processes warrants study and yields information just as variance does wherever it is found. Of course, this variance is useful only if its sources can be identified. The basic notion of SQC is to track variance in a process across time and seek to assign causes to the variance. Of particular interest are large fluctuations or out-of-control periods in the process. Often these changes in the process signal the unwanted influence of an identifiable variable. If this variable can be measured and controlled, the fluctuation in the process can be removed.

Companies are spending large sums of money to train their employees in SQC methods. There are hundreds of SQC training centers taking in large sums of money from all types of corporations. The University of Tennessee Management Development Center offers SQC training programs. Since 1981, when it was

started, the number of companies sending employees to the Institute for Productivity through Quality at the University of Tennessee has grown from a handful to over two hundred. The total fee income to the "Institute" has risen from \$750,000 to over \$4 million, making it one of the largest providers of such training in the U.S.

The best known ideas on how to manage the improvement of quality are those of ^{W.} Edwards Deming. Deming's philosophy is a philosophy of management and not merely principles for the proper use of statistics to improve quality. Deming (1983) outlines 14 points for management to follow when seeking to improve quality. Scores of corporations in Japan and the U.S. are pursuing quality according to principles posited by Deming.

Deming places total responsibility for the improvement of quality on management. However, not all quality experts do. Juran and Gryna (1980) wrote a well-received book on quality. In response to Deming's charge of a lack of quality-mindedness among managers in the U.S., Juran and Gryna effectively says that accusations of a lack of quality-mindedness are not based solely on decisions dealing directly with product quality. The advocate of a technique may accuse managers of lacking quality-mindedness because they do not accept his particular program. According to Juran and Gryna, in many such cases the accuser is equating quality with some technique which he is advocating.

No doubt Juran and Gryna are referring to Deming and his philosophy of the SQC implementation. Clearly, not everyone is in total agreement with Deming's philosophy. However, the Japanese certainly believe in his ideas as evidenced by the fact that every

year companies in Japan compete for the coveted Deming Prize. The Deming Prize is given to the company which shows the greatest improvement in quality following basic Deming principles. In this country, thousands of people are trained each year to use SQC, and to do so in "Deming fashion." So while not everyone agrees with Deming's every idea, he has been successful in selling companies on his philosophy and most of these companies claim success.

How much success are organizations having with their use of statistics in improving quality? The organizations themselves have historically been more than willing to give the answer to this question. Numerous trade journal articles attest to the success of SQC in reducing scrap, increasing customer satisfaction, increasing market share, decreasing work process cycle time, and increasing profitability (Forys, 1986). Also, the fact that so many companies are joining the ranks of SQC enthusiasts is a statement to its perceived, if not scientifically documented success. SQC can be found virtually everywhere today. It is found in product development, manufacturing, product service and public service organizations. Theorizing about the difference between successful and unsuccessful SQC implementation has been heavy. Scientific research efforts have been virtually nonexistent.

Despite the glowing success claimed, objective appraisal of quality-related improvement among U.S. companies is difficult to make. An even greater task is to isolate reasons for successes, be they tangible or perceived. As many different approaches to quality improvement have been tried as there are companies involved. Factors critical for successful quality improvement are difficult to

isolate. Of obvious interest to these companies would be how well they are following Deming's points and whether their adherence to this philosophy makes a difference in their pursuit of quality.

Implementation of Deming's philosophy of management for improved quality is in itself a process to be monitored. Just as production, packaging and service processes are amenable to study and control, so is the process of quality improvement. Obviously, the methods used to study management practices will not be typical SQC methods, but the underlying rationale is the same. A process that is monitored across time can be changed, controlled and improved.

In his 14 points, Deming details his understanding of the issues relevant to managing for improved quality. The purpose of the present research was to develop and validate a measure of adherence to Deming's 14 points. Such an instrument should allow a company to study their quality improvement efforts. The instrument should provide a way for companies to determine whether and how Deming's points are essential to improved quality. Companies will also see how well they are following the 14 points.

This instrument must be developed in such a way as to assure reliability and validity across a variety of organizations implementing SQC, or the instrument will not yield the accurate information that companies need. Consequently, the development will include efforts to integrate content, construct, and criterion-related validity into one thorough procedure.

The following are the research questions to be answered: 1)
How consistently can Deming's philosophy be measured using the

current instrument? 2) If it can be measured, is it measured consistently across the companies sampled? 3) If it is consistently measured, is adherence to it "paying off" in terms of some meaningful criteria?

CHAPTER II

LITERATURE REVIEW AND METHODOLOGICAL STRATEGIES

The literature review is divided into four parts: First, Deming's 14 points will be presented; second, correspondence between Deming's philosophy and that of other management theorists will be detailed; third, related instruments will be reviewed; and fourth, the rationale for the research methodology will be developed.

Deming's Points

SQC, as Deming and others have recognized, requires top-level and deep commitment to be effective. Once this commitment is made, others must follow. Commitment to substantial investments in skills training, to new technology and perhaps most of all, to a new management philosophy, are all emphasized.

The stated goal of Deming's writings and teachings is to explain to American managers what their job is to recapture the competitive position once held by American industry. He sees this being accomplished by improving quality and productivity (Deming, 1983). He maintains that everyone in the company can now answer the question: How are our managers performing? He further states that top management cannot learn by experience on the job what to do to improve quality and productivity and competitive position. They must seek consultation from the outside.

Deming defines top management as follows: "By top management, I mean the officers that can be held responsible for the 14 points...If they require authority from someone else to carry out any of the 14 points, then they are not top management."

The 14 points are:

- 1) Create constancy of purpose for involvement of product and service.
- 2) Adopt the new philosophy (We are in a new economic age).
- 3) Cease dependence on mass inspection.
- 4) End the practice of awarding business on price tag alone.
- 5) Constantly and forever improve the system of production and service.
- 6) Institute training.
- 7) Institute modern methods of supervision.
- 8) Drive out fear.
- 9) Break down barriers.
- 10) Eliminate exhortations for the work force.
- 11) Eliminate work standards and numerical quotas.
- 12) Remove barriers to pride of workmanship.
- 13) Institute a vigorous program of education and training.
- 14) Create a structure in management that will push every day on the above 13 points. (Deming 1983, p. 16-17).

Deming sees his work as a theory of management for the improvement of quality, productivity, and competitive position. He sees it as something to be taught in the business school curriculum, despite the ascientific manner in which it was derived.

Lest anyone should assume that top-management commitment is all that is necessary for improved productivity and quality, Deming asserts that it is not enough that top management commit themselves for life to quality and productivity. They must be clear as to what they have committed to. Obviously, according to Deming the 14 points are what top management must be committed to.

The philosophy that Deming espouses is broad in scope. Any philosophy that attempts to cover as much, will inevitably overlap with other philosophies or theories of management or organizations. The correspondence between Deming's philosophy and that of other management theorists will be detailed next.

Deming And The Management Literature

Deming's work is not entirely original and it is atheoretical, in the scientifically accepted sense. His ideas were derived inductively as opposed to the customary deductive-inductive, iterative process of theory construction. These facts should be obvious in the following discussion of the fourteen points.

Deming's first point is, "Create constancy of purpose for improvement of product and service"(p. 16). Constancy of purpose to achieve organizational goals was a distinguishing feature of what Burns and Stalker (1966) called an organic system. One feature of Burns and Stalker's organic system is the spread of commitment to the concern beyond technical definition. They maintain that the organic system is most adaptive to changing conditions.

The other type of system, or organization, they call mechanistic. The mechanistic system is characterized by the abstract nature of tasks pursued with techniques and purposes different from those of the concern as a whole, that is, functionaries tend to pursue technical improvement of means, rather than accomplishment of organizational goals. In a mechanistic system (read beauracracy) it would be difficult to imagine a workforce committed to a purpose tied to "the whole," such as improvement of product and service. By definition, members of an organic system become committed to the concern. They can be committed to the improvement of product and service despite not being explicitly instructed to do so in their job description. Ideas similar to Deming's point number one appear in organizational theory. Deming, like Burns and Stalker, would advocate the flexibility of the organic system, particularly in the sense of allowance for commitment to goals superordinate to ones own position.

Deming's writings under point number one would also indicate that he considers the present state of U.S. industry as changing and unstable. He refers to the present in U.S. industry as "a new economic age." He elaborates that the U.S. has lost the advantage of being the strongest survivor, economically, of World War II. Many nations have at least caught up with the U.S. Once again, Deming would no doubt agree that the organic system would be better suited to maintain constancy of purpose in the face of an unstable economic environment.

Despite the obvious problems with characterizing an entire nation of industry as undergoing an economic change, most management theorists would concur that the current economic environment for most U.S. industry is unstable. There is little question that the U.S. automobile industry is unstable. The automobile industry is also a staunch supporter of Deming's ideas. Once again, the organic system notion seems to fit well with the Deming's ideas of constancy of purpose in a "new economic age" (p. 16).

Deming further states, in point number two, that for a company to survive in the "new economic age" it must "adopt the new philosophy" (p. 16). This point is so specific to Deming's quality management philosophy, that nothing similar to it has been covered in the management or organization literature. Deming feels that it is time to adopt a new "religion" in America, namely, that defects are not free. The total cost to produce and dispose of a defective item is greater than the cost to produce a new one. In this second point Deming seems to be going the next logical step in saying that not only must individual workers pull together within their organization to improve product and service, but organizations must pull together to create a new "zeitgeist," or "spirit of the age." This new spirit would usher the entire nation of industry into an improved state of quality.

Point number three, "Cease dependence on mass inspection,"(p. 16) has received no treatment in the literature either. The 14 points represent many different levels of specificity. The third point resembles nothing in the management literature except in that which deals with SQC. This point is not amenable to discussion in a

context outside SQC. Deming is stating that inspection of the outcome of a process pales in comparison to correction of that process, in terms of efficiency and economy.

Point number three is closer to commonsense than to philosophy. A simple calculus is implied if we say that the original production of perfect or defective items is equally as costly, and that cost is added whenever the defective product must be either reworked or thrown away. Defective items are necessarily more expensive to the company. This point translates to dollars and cents much more readily than many of the other points. It is also on more solid logical footing than many of the others.

Point four is at a level of specificity comparable to that of point three. Point four is: "End the practice of awarding business on price tag alone" (p. 16). There is nothing philosophical or speculative in this statement under point four. He asserts that price has no meaning without knowledge of the quality of the good being purchased. Here, as on most occasions, Deming disdains the subtle. Once again here is a statement which defies argument. Even without dollar-figure proof, most people could be persuaded to agree that buying good quality would be more expensive in the short run but no doubt less expensive in the long run. One can only anticipate this argument to point four. What if one is legally bound to accept the lowest bid?

The fifth point harks back to the first point. "Constantly and forever improve the system of production and service"(p. 16). Point six is the terse dictum: "institute training" (p. 16). Point seven, "Institute modern methods of supervision," (p. 16) begs the

question, what is modern? This point serves to raise an issue which must be addressed here. Deming is writing for a nonscientific audience, not necessarily a less critical audience. As Deming's philosophy goes under the scientific microscope, a much more meticulous scrutiny will be made. The question will no longer be, can I make this work in my shop? The question becomes: how definable are the concepts used to delineate the philosophy and how measurable are the constructs, where a concept is a word or set of words and a construct is what is represented by the concept?

To say that point number seven is difficult to operationally define is an understatement. To say that it is impossible to define is hyperbole. Conversations with experts in the area of quality improvement suggest a dichotomous distinction. Modern supervision could be taken to mean participative. Supervision which is not modern may be thought of as "Tayloristic" or autocratic in nature. Implicit in "participative management" is management with an eye to meeting needs of people occupying positions, not just the needs of the position. Deming says "Remove barriers that make it impossible for the hourly worker to do his job with pride of workmanship" (p. 17). From this statement it can be concluded that Deming is at least seeking the same results as those who advocate participative management styles.

A fairly recent and thorough statement of what modern "participative" management consists of was written by Meyer (1981). Meyer outlined the characteristic of humane and productive supervision: 1) provide clear understanding of what is expected

(of the workers), 2) define goals specifically, 3) goals should be challenging, but attainable, 4) provide knowledge-of-results feedback, 5) use praise and recognition freely, 6) try to impersonalize criticism, 7) allow employees to participate in decision making, 8) provide growth opportunities, 9) combine consideration with emphasis on production. Meyer maintains that recent research and experience has shown that giving employees opportunities to participate in the decision-making process, to have more say in how their own jobs are carried out, results in improvements in productivity and morale. He further asserts that pride in work and conscientious effort to achieve organizational goals are commonly found among people in the management ranks, but often it is not expected among the rank and file employees.

Meyer sees a major outcome of participative supervision to be pride, just as Deming stated. Deming is in this instance advocating what recent management literature advocates.

The eighth point is "drive out fear" (p. 17). To operationally define fear would be difficult at best. Fortunately, however, Deming does not leave us without further discussion of his meaning. He feels that many people on a job, especially people in management positions, do not understand what the job is, nor what is right or wrong. Many of them are afraid to ask questions or to suggest changes. What Deming describes has been described elsewhere as role ambiguity.

A role is usually defined as behaviors expected of people occupying a position in a social system, (Leiberman, 1956). In their discussion of role ambiguity Katz and Kahn (1978) define it as

uncertainty as to what the role occupant is supposed to do. Role ambiguity leads to low self-confidence and a sense of futility (Kahn, Wolfe, Quim, Snoek, Rosenthal, 1964). Katz and Kahn (1978) do not use the term fear to discuss the consequences of role ambiguity, however, they say it may cause low job satisfaction, low self-confidence, futility and tension.

Deming, in suggesting that organizations must drive out fear, is saying that role ambiguity must be decreased. The difference between the terminology used to describe the problems resulting from role ambiguity is minor.

The ninth point is, "Break down barriers between staff areas" (p. 17). According to Ruch (1984), communication, both formal and informal, moves in every conceivable direction in the typical Japanese company. Apparently this aspect of Deming's philosophy was incorporated well into the Japanese industry. Barriers between departments in Japanese corporations are apparently no longer a problem as they are assumed to be in America.

Ruch (1984) states also that the Japanese communicate better than Americans in general. Ruch has studied corporate communication in this country and spent two years studying it in Japanese corporations. He speaks from first-hand knowledge of both nations' corporations. Much of the credit for improved communication in Japanese organizations is given to Deming.

The tenth point made by Deming is "eliminate exhortations for the work force" (p. 17). He continues by saying that posters and slogans never help anyone do a better job. What is needed are not exhortations but a road map to improvement, managements obligations.

The company's goal should be never-ending improvement. There is little in the literature that addresses this point. The problem (of over exhorting employees) must have grown strictly from Deming's Japanese and American experiences as to the best approach to SQC implementation and quality improvement. His next point "eliminate work standards and numerical quotas." is also specific to Deming's acquired perspective of proper procedures to improve quality. Deming states that he is yet to see a work standard that includes any trace of a system to help anyone do a job.

As point eleven Deming says "eliminate work standards and numerical quotas" (p. 17). To some extent this admonition contradicts research on the effect of goal setting. Research indicates that specific, clear, and moderately difficult goals lead to greater task performance. In fact, Deming advocates one goal: never-ending improvement. This goal is unclear, nonspecific, and is of immeasurable difficulty.

The argument that goal-setting works best with quantity and production, not quality, is not substantiated by the literature. In fact, Ivancevich (1974) found that quality as well as quantity improved given clearly defined, specific and moderately difficult goals. If corporations have successfully ridded themselves of goals based on Deming's encouragement it may be impossible to determine the effect of goal setting on quality improvement. It could be argued that group goals do not operate the same as individual goals. However, that argument is likewise not supported by the research (Latham and Kinne, 1974; Latham and Yukl, 1975; Lawrence & Smith, 1955).

Deming's last two points, "institute a vigorous program of training" (p. 17) and "push everyday on the above fourteen points" (p. 17) are general and not related to the literature, except for the fact that various types of training have been shown to be effective.

Deming And Related Instruments

The present research must be positioned in both the organizational-climate literature as well as in the instrument-development literature. The following is a summary of instruments that have been developed that cover topics related to those covered by Deming's points. Most of Deming's points have not been touched upon in the literature. Even those points which have been considered are dealt with in a context unrelated to quality. Deming is addressing management issues in general in his 14 points as well as quality-specific issues.

Payne and Pheysey (1971) included in their scale items designed to measure future orientation of an organization and consistency of application of company policy. These are two ideas Deming addressed in his first point for managers. Jones and James (1979) also include items dealing with consistency of application of company policy.

Another of Deming's points which has received attention in previous work-climate instruments is the degree to which skills-training efforts have been sufficient. Deming discusses training and education issues in point number six. Seashore,

Lawler, Mirvis, and Camman (1982) cite a measure that includes "training adequacy."

The next point for which literature exists is that of "driving out fear." Items pertaining to fear are not found; items dealing with corrolaries to the point are abundant. Hackman and Lawler (1971) discuss items from their scale which deal with the degree to which the respondent knows how well she is performing her job. Another subpoint made by Deming (1983) may be rephrased as role ambiguity (Katz and Kahn, 1978). In the aforementioned instrument, Seashore et. al. (1982) discussed items which were designed to assess the degree to which tasks are clearly defined or at least whether they are perceived to be well defined by the employee. Deming's point here is that people should not be fearful due to being unaware of all their job requires and whom to ask for information. This topic was also addressed by Hackman and Oldham (1975) in their report on the development of the Job Diagnostic Survey (JDS).

Deming's ninth point for managers is that of "breaking down barriers between staff areas." Jones and James (1979), in developing their Business Organization Climate Index (BOCI), included questions regarding the number of friendly, cooperative interactions between departments in the organization.

Point eleven deals with the presence of work standards and numerical quotas in the organization. Deming maintains that they do not lead to improved quality of process. Jones and James (1979) had questions dealing with the use of work standards in their index.

The twelfth point emphasized by Deming is "removal of barriers to pride of workmanship." Wollack, Goodale, Wigting, and Smith (1971) discuss a scale which includes items to tap pride of work, or the lack thereof. Taylor and Thompson (1976) also discuss a scale containing "pride of work" items.

Deming's other points are too specifically related to quality or to process control, to have received attention in the general work-climate literature.

It is instructive to read the items that relate to the present instrument-development effort. Ideas for wording, length of items, and numbers of items to include, can be obtained from study of the previous instrument development in this subject area.

Development Of Methodological Strategies

The rationale for the procedures employed will be detailed as a set of guidelines or strategies. These strategies were viewed as procedural ideals and not as specific rules to be followed. The resulting instrument should be useful in the following ways: 1) as a criterion for a change program, inasmuch as the effort by the organization to change its philosophy of management with respect to quality could be considered a broad change program; 2) as a behavioral criterion (Kirkpatrick, 1959) for the SQC and managerial training program, since a product of the instrument will be employee perceptions of organizational behavior subsequent to the training;

and 3) as a manipulation check to determine the relative success of organizations in following Deming's points.

For this instrument to be useful for the above purposes, development must be according to accepted instrument validation practices. Therefore, the present instrument development effort employed strategies developed from three bodies of literature: 1) the evaluation of a broad change program, 2) the evaluation of a training program, and 3) the evaluation (validation) of a measurement instrument, in general.

Strategies From Program Evaluation Literature

The following is a review of current opinion on methods of program evaluation. The present effort may well be viewed as a form of program evaluation, making this literature discussion germane.

Process versus goals. Change programs cannot be evaluated strictly in terms of their goals. Information about the implementation process of the change program must be gathered. In this way those practices that lead to successful implementation can be recorded and perhaps emulated in the future. At least information will exist as to which practices worked in which circumstances (Cook and Shadish, 1986).

Any company that is determined to improve quality according to Deming's philosophy is embarking on a large scale program of change. Change programs must be validated to determine their effectiveness. However, it is not enough to evaluate the quality-improvement

program in terms of its goals. In many instances the goals are ill-defined. In such cases the administration of the program is of interest. Cook and Shadish make the point that causal explanation requires a description of program process and the identification of factors necessary and sufficient for the identification of causal relationships. Full explanation of why a program succeeds is useful because it specifies the factors that have to be present if a program or project is to be effective when transferred elsewhere.

Controlled experiment versus causal analysis. Emphasis on process variables often means de-emphasis of carefully controlled experiments. Since goals of change programs are often vague and contradictory, program goals cannot often be relied on to provide hypotheses for classic experiments. A frequently used alternative to the controlled experiment is causal modelling.

Emphasis on the carefully controlled experiment for determination of the worth of a program has decreased in the past several years. An emphasis on describing program and project activities has come in its place, justifying wider use of implementation measures and theoretical excursions into the "black box" (Cook and Shadish, 1986). The strategy of formulating causal hypotheses from program goals assumes that programs are relatively homogeneous, have goals that are totally explicit, postulate effects that can be validly measured, and can be assessed using feasible experimental designs ruling out spurious interpretations of a treatment effect. Cook and Shadish maintain that these assumptions have come under attack, not only in evaluation, but also in science

at large. Realization of the vague, contradictory, and latent nature of program goals makes it questionable to assume that goals could function as theoretical hypotheses. Within quantitative traditions, the challenge to experiments has come principally from causal modeling, especially latent trait modeling exemplified by LISREL.

Two approaches relevant to the current program evaluation were identified by Cook and Shadish (1986) in their literature review. They are: the manipulable solution, advocated by Campbell (1969) and Scriven (1983), the generalized explanation alternative promoted by Cronbach (1982) and Chen and Rossi (1983).

Those who hold the manipulable solution alternative assume that innovative solutions to problems can be readily identified through the use of evaluative techniques. Randomized experiments and planned variation studies are advocated for this purpose. They also assume that innovative solutions will be widely disseminated throughout society. Experience showed that neither of these assumptions holds up very well. The approach also minimizes analysis of implementation and causal mediation and most researchers feel that the study of implementation and mediation are crucial for explanation, and explanation for transferral of the findings to new settings. This approach came under increasing attack during the 1970's, and its popularity has waned greatly.

The criterion versus multiple solutions. The manipulable solutions approach (Cook and Shadish, 1986) as promoted by Campbell (1969) and Scriven (1983) suggests the carefully controlled

experiment will lead to multiple solutions, causes, and criteria of change programs. These are worthy goals of a change program evaluation, no matter that the method chosen to study the program is not the carefully controlled experiment.

Complexity versus simplicity. The generalizability of the findings of a broad change program depend in great part on accurate characterization of the complexities of successfully implementing the program.

The generalized explanation alternative advocates assume a complex world best described in terms of higher-order statistical interactions that suggest that results present under some conditions but absent or reversed under others. Therefore, findings can only be generalized to the degree that complex interrelationships among multiple causal determinants are understood.

These generalized explanation theorists advocate causal modeling but also issues of implementation, targeting and cost, preferring methods that are functionally plastic over methods developed for specific purposes.

Summary. Cook and Shadish conclude that the best idea would be to borrow from each approach because considerations from each have merit. Following this advice these points have been applied to the current research from the "manipulable solutions" approach: 1) emphasis on discovering multiple potential solutions to a problem so as to increase the chances of discovering one that works; 2)

emphasis on the specification of methods for causal inference and selection of criteria that speak to obvious needs.

The following points were rejected from the manipulable solutions approach: 1) emphasis on planned variation and randomized experiments; 2) deemphasis on the study of program implementation and causal mediation.

The following points were taken from the generalized explanation approach: 1) the world is ontologically complex and best described in terms of higher-order interactions; 2) efforts should be made to test the substantive theory that underlies the program so as to achieve a complete understanding of the operations and consequences.

Strategies From the Training Evaluation Literature

A very large part of a quality-improvement change program is training employees in SQC. Any effort to study the overall impact of increased quality emphasis cannot be divorced from study of the training program. Consequently, strategic guidelines must be established for the present research from the area of training program evaluation. The development of strategies five through nine will be detailed below.

Level of criteria. Most companies evaluate their training in terms of training reactions (Catalanello and Kirkpatrick, 1968) but not in terms of learning, behavior, and results as advocated by Kirkpatrick (1959). Training evaluation theorists generally agree

that all of Kirkpatrick's criteria should be measured to best insure complete understanding of the training process and effects. Martin (1957) dichotomizes the criteria into internal and external categories. The internal criteria are linked to performance in the training situation. External criteria are designed to measure actual changes in job behavior and its results. Behavior and results criteria can be considered the external criteria. These are the types of criteria of interest in the present study.

One must seek to demonstrate interorganizational validity (Goldstein, 1974). Training program behavior and results must be shown to be generalizable across organizations. The evaluator shares responsibility with the stakeholder to determine the criteria by which to judge the program. The evaluator can shape the evaluation to fit the needs of the stakeholders. Evaluation involves more than asking the stakeholder to list the goals of the program. It means asking the stakeholder to list the information needed to improve the program or measure its successes, with an eye for future application of the program.

While measurement of reaction and learning criteria of the quality improvement training program is important, it is not the primary goal of this study. The present research occurs at a point in the process at which it is typically too late to collect reaction and learning measures. The trainees have been back on the job applying their newly learned knowledge and philosophy for months or years when this study occurs.

In a related vein, Goldstein (1974) discussed four types of training program validity. He called them: 1) training validity, 2)

performance validity, 3) intra-organizational validity, 4) inter-organizational validity. The basic difference between Kirkpatrick's four criteria and Goldstein's four forms of validity is that Goldstein is viewing the results as being interesting both within the organization and across organizations.

Nature of criteria for training programs. Many theorists have discussed the nature of desirable training program results criteria. Odiorne (1964) states that training must prove its worth in dollars. This is counter to Mahler (1953) who felt that management development programs and training programs in general could not be easily evaluated in terms of cost. Campbell, Dunnette, Lawler, and Weick (1970) advocated a compromise between the two extremes. In short, they concluded that multiple criteria must be used. The notion of "the criterion" is to be supplanted by many varied criteria. Campbell et.al. state that any attempt to evaluate training should include:

1. Utilization of multiple criteria, not just for the sake of numbers but for the purpose of more adequately reflecting the multiple contributions of managers to the organization's goals.
2. Some attempt to study the criteria themselves, that is, their interrelationships and their relationships with other relevant organizational variables. The relationship between internal and external criteria is especially important.
3. Enough experimental control to enable the causal arrow to be pointed at the training program.
4. Provisions for saying something about the practical and theoretical significance of the results. (p. 284-285).

Strategies From the Instrument Development Literature

The literature suggestions for evaluating a change program are general. Suggestions for evaluating a training program might be construed as somewhat more specific. However, recommendations from the instrument validation literature are quite specific. It is appropriate to draw from current thoughts in this area since the primary product of this research will be a measurement instrument.

Unitarian versus trinitarian view of validation. Three basic forms of validity are associated with measurement instruments. They are: content validity, construct validity, and criterion-related validity. Each of these forms of validity will be discussed followed by a synthesis of the three into a meaningful progression.

The view of validation research taken here draws heavily from Landy (1986), who advocates viewing validation as hypothesis testing in the traditional sense. The hypothesis being considered is: people who do well on test X will do well on activity Y. In null form: there is no relationship between test performance and activity performance (Landy, 1986).

Landy advocates the unitarian view of validation, that is, that the three accepted forms of validity are all part of the same. He states that the only use that can be made of the three forms of validity is in pointing out that there is more than one type of inference that can be made from test scores. According to this view, it is not inappropriate to refer to the distinction between the three forms of validity, if one remembers that content and

criterion-related validity are two ways to gain evidence of construct validity.

Content validity has traditionally been concerned with the overlap between the measurement instrument and the content domain of interest. Whenever distinct elements of the content domain can be isolated, the task of content validation is made easier. Whenever corresponding elements comprise the measurement instrument, the task of content validation is well under way. Breaking both the content domain and the measurement instrument into distinct elements makes matching between them possible.

Construct validity is viewed as evidence of hypothesized underlying causes of measured variables. Tenopyr (1977) makes a distinction between content and construct validity. She maintains that content validity stems from inferences about test construction while construct validity stems from inferences about test scores.

Content validity has been thought of as being concerned with the makeup of the instrument in terms of its adequacy to measure what is intended to be measured. Construct validity assumes content validity and represents an assessment as to how that which is intended to be measured is reflected in responses to the instrument. It will be held here that without evidence of content validity, one will be without direction in attempting to assess construct validity.

Tenopyr states that at the minimum content validation may be considered a sign of potential construct validation. At the maximum, content validity may be considered actual evidence of construct validity. In most situations, the most one can hope for

is that content validity will provide direction for hypothesizing and measuring constructs.

Criterion-related validity may be thought of as external validity or perhaps the practical validity of the instrument. How useful is the instrument in predicting some criterion of interests? Construct validity drives theory while criterion-related validity drives policy. Construct validity provides evidence of potential criterion-related validity.

Establishing the content validity of a selection instrument is a must (Griggs v Duke Power, 1971). This is necessary if criterion related validity is ever to be demonstrated. If test scores are used to help determine who is hired or promoted, that test must have demonstrated validity for predicting success in that job. The courts have historically encouraged validation efforts to be centered around criterion-related validity. More recently, however, content validity has been upheld in court. Ideally the courts will soon view the three forms of validity as parts of the same.

Steps in the validation of a criterion. It has become imperative in recent years for organizations to establish the content representativeness of their training programs for the stated intent of the program, particularly in the case of using training performance as a criterion for selection or promotion. Determining the adequacy of a training program to impart appropriate knowledge to trainees is a must (Washington v. Davis, 1975). Courts have ruled on numerous occasions, the most famous of which is Washington v. Davis, that selection of employees may be based on training

performance if the training can be demonstrated as relevant to the job. The appropriate way to demonstrate relevance is through a validation procedure. The job must be analyzed into its key elements and these elements must be used to devise the curriculum for the training course. The degree of association between the job and content of the training course is the subject of the validation study.

Legal guidelines for such agreement between job and content are provided by the Uniform Guidelines on Employee Selection Procedures. Adding much needed specificity, the Principles for validation and use of personnel selection procedures state that if selection procedures purport to measure knowledges, skills, or abilities (KSA's) they can be justified by content validity if the selection procedure can be operationally defined and the KSA's are shown to be prerequisites for successful job performance. Whenever the selection procedure is a training program, curriculum analysis corresponding to a thorough job analysis must be performed.

This emphasis on establishing the content validity of training programs is worthwhile aside from being legally astute. The use of content validation to validate training programs is, in essence, turning the causal arrow in the direction of the training program (Campbell et.al., 1970). Without the capability to pinpoint aspects of the training which cause improved performance, good training will never be acknowledged nor poor training improved.

Strides have been made recently in the direction of quantification of content validity. Job analysis techniques work well for this purpose if the content domain is a job. For example,

the job can be broken into elements and a training course can be designed to teach those elements.

In fact, whenever cases involving exclusion of people from jobs due to training performance have appeared in court, the content validity of the training for the job has usually been a major point of contention (Thompson and Thompson 1982).

Lawshe (1975) devised the Content Validity Ratio (CVR) for the purpose of quantifying content validation efforts. This procedure involves judgements by subject-matter-experts about the essentiality of instrument items to the measurement of elements within the content domain. A ratio is calculated for each item that indicates the number saying the item is essential versus the number saying it is not. An item is excluded from the scale if it fails to have a predetermined number of subject-matter-experts say it is essential.

A procedure similar to that used with the CVR is part of the Behavioral Anchored Rating Scale procedure (Landy, 1985). This procedure is designed for scale development. SME's create the items or assist the scale-development expert in developing the items. The items are then retranslated, or "matched-back" to the theoretical elements from which they were originally developed by a group of "less-expert" raters. They indicate how much each item is related to one of the theoretical elements. The standard deviation of the scale scores for each item is calculated and this value is used as a basis for keeping or discarding the item.

Either of these procedures or some combination of them lend to quantification of content validation. Previously, content validation was someone's subjective assessment as to how much "this"

was related to "that." Quantification makes the process accountable to more than subjective judgement.

Lawshe (1975) in speaking of curriculum content validation states that if the subject matter experts are generally perceived as true experts, then it is unlikely that there is a higher authority to challenge the purported content validity of the test.

Lawshe (1975) also discusses job content evaluation panelists by saying that if the panelists do not agree on the essentiality of the knowledge or skill measured to job performance, then serious questions can be raised. However, if they do agree it can be concluded that they are either all wrong or all right. He continues that because they are performing the job, or are engaged in supervision of those performing the job, there is no basis upon which to refute a consensus.

Thus, content validity, matching of the items to be definition, gives us a measure of the amount of confidence that can be placed in the results obtained from administration of the instrument.

Structural equations versus factor analysis. For content validity the evidence required is consistency among subject-matter-experts as to what the items measure. Criterion-related validity depends upon the correlation coefficient between the instrument and some criterion. Construct validity has typically been the most difficult for which to obtain evidence. Oftentimes, factor analysis or some form of multi-trait multi-method matrix have been used. In both cases the evidence is a type of convergence or covariation of items around a given hypothesized construct.

A less frequently used but much recommended technique is the analysis of structural equations. In fact, all three forms of validity can be "built around" this approach. Content validation can yield a type of reliability for each item. Construct validity is considered the measurement model in this framework. The measurement model would either be confirmed or disconfirmed as being construct valid. Criterion-related validity may be called the structural equation model from this perspective.

Guion and Ironson (1983) list four disadvantages and four advantages to latent trait structure analysis. Latent trait, or structural equation analysis, has these disadvantages: 1) more cases are needed with structural equations analysis than with other approaches, 2) temporary disadvantage until sophisticated computer programs become available, 3) assumptions of the latent trait model may not be tenable in a wide variety of situations and often they may not be testable, for example the assumption of unidimensionality, 4) difficult to learn.

The four advantages of latent trait analysis over factor analysis are: 1) advantages in conceptualizing measurement problems 2) special advantages in latent trait item analysis 3) an advantage in equating of measures, 4) advantages in scoring measures.

Looking at the advantages, Guion and Ironson have more to say. Unlike classical psychometrics, the measures do not have to be exactly parallel to determine reliability. Further, all that is assumed is the testable assumption of an underlying distribution of the latent traits being measured. Distributions other than normal can be considered.

However, James, Mulaik, and Brett (1982) emphasize the tentativeness of inductively derived theories in the context of causal analysis. They list ten conditions that a theory should meet in order to justify the use of confirmatory analysis. They are paraphrased below:

1. formal statement of theory in a structural model
2. rationale for causal hypotheses
3. specification of causal order
4. specification of causal direction
5. self-contained functional questions
6. boundary specification
7. structural model stability
8. operationalization of variables
9. empirical confirmation of predictions; empirical support for functional equations
10. empirical confirmation of predictions; fit between structural model and empirical data

James et. al. also discuss the basic requirements of any theory which attempts to explain the occurrence of events in terms of functional relations. They use Singh's (1975) definition of a theory: "a set (or sets) of interrelated causal hypotheses that attempt to explain the occurrence of phenomena". James et. al. also address the relative complexity of theories and their merit for confirmatory analysis. They say that nonelaborate theories are acceptable from the perspective of confirmatory analysis if the model is self-contained, that is, all relevant causes of a given phenomenon) are contained in the theoretical model.

It is obvious that Deming's "theory" does not meet these criteria for the use of pure confirmatory analysis. The ideas are purely inductive and causal connections have never been made in any probabilistic sense. Therefore the current research should be viewed as an initial effort to establish "probable causes" for

improved quality after quality improvement efforts have been made. The causal connections have been hypothesized by Deming. Careful validation procedures should allow the scientific method to support or overturn these hypotheses. The myth-value or fact-value of the effectiveness of the 14 points has yet to be determined.

The process of test development. Anastasi (1986) assesses the state-of-the-art in test construction. She suggests that the standard procedure is as follows:

1. Formulation of detailed trait or construct definitions
 - a. derived from theory,
 - b. prior research,
 - c. or systematic observation or analysis of relevant behavioral domain.
2. Test items are prepared to fit the construct definitions.
3. Empirical item analysis (i.e., selection of most effective items from initial pools.
4. Other appropriate internal analyses (e.g., factor analysis of item clusters or subtests.
5. Validation of various scores and interpretive combinations of scores through statistical analyses against external, real-life criteria. (p. 3-9).

Anastasi lists Comrey (1970), Jackson (1970, 1973), Kaufman and Kaufman (1983), and Millon (1983) as examples of the use of this process in test construction. Let us consider the process recommended by Anastasi in the present context.

Anastasi first recommends formulation of a detailed construct definition. Deming has formulated the definitions for his 14 points over the course of some 50 years in Japan and the U.S. These definitions are in some parts vague and in others clear, sometimes

wordy and elsewhere concise, independent on occasion, overlapping on others. But in numerous organizations across Japan and the U.S. efforts are being made to implement Deming's 14 points to the letter. An important question which arises concerns, how detailed organizations should be in their adherence to Deming's ideas. Should they be attempting to practice the letter or is the spirit enough?

Whether corporations are right or wrong there is one certainty: they are inadequately informed as to the efficacy of adhering to Deming's philosophy for the improvement of quality. The constructs have been identified and definitions given. Experience suggests to Deming, and apparently to his "followers" that this is the correct set of constructs and construct definitions. An attempt to more clearly define Deming's principles would not be the answer since the principles are being followed as espoused by Deming and therefore should be measured as such.

Anastasi, in giving her evaluation prescription, suggests that the construct definitions should come from one or more of three sources: 1) theory, 2) prior research, 3) systematic observation or analysis of the relevant behavioral domain. In the case of Deming's philosophy, the construct definitions come from systematic observations of the relevant behavioral domain. Perhaps it would be most desirable for the definitions to come from theory. However, tightening of the definitions through the instrument development process is certainly a worthwhile goal. A product of the instrument development process could be movement toward a "theory" of quality improvement.

Next, Anastasi states that test items should be prepared to fit the construct definitions. These items are to be written by subject-matter-experts, or at least reviewed and approved by them. This is done to assure that the items reflect construct definitions. The process of wording items to fit constructs is part of content validation.

She also states that the most effective items should be selected from an initial item pool. The procedure and criteria for discriminating between effective and ineffective items should be made as explicit and quantitative as possible (Lawshe, 1975). Otherwise, the decision is made on a more subjective and perhaps less accurate basis. Lawshe recommends the formation of a ratio of the number of raters rating each item as effective and the total number of raters. The index of content validity for the entire set of items is the ratio of items rated effective to the number of items.

Another point made by Anastasi is that other appropriate internal analyses, (e.g. factor analysis), should be used. Typically, instruments designed to measure performance rely on individual items to assess specific and important elements of performance. However, in the present case, responses to the items should vary according to the original dimensions addressed; i.e., the 14 points. Items designed to measure one construct should covary more than items designed to measure different constructs. Structural equations analysis can address this issue.

Note that the proposed constructs were never intended to be orthogonal. They are believed to represent isolatable, common

variance. It is expected that the derived factors will resemble those suggested by the content validation. That is, they will be oblique in varying degrees. If the items do not perform as suggested by the content validation, it could be that either the distinction between the constructs is trivial or the content validation was not adequately performed.

Finally, Anastasi asserts that validation of various scores and interpretive combinations of scores should be accomplished through statistical analysis against external, real-life criteria. If the instrument measures the constructs well, but the constructs affect no relevant external criteria, then the constructs may be said to not be criterion valid. The instrument may demonstrate construct validity and this may be supported by a careful content validation effort, but the lack of impact of the set of constructs cannot be helped. If the first four phases of instrument validation are not thoroughly completed, the results of the fifth would be ambiguous. The researcher would not know whether the lack of an effect on external criteria by the constructs was due to inadequacy of the instrument or inadequacy of the constructs. Quantitative evidence of content and construct validity can be reassurance that the weakness is not in the instrument. Anastasi states that almost any information gathered in the process of developing a test is relevant to its validity. It is relevant in the sense that it contributes to understanding of what the test is measuring. Data on internal consistency and on retest reliability help to define the homogeneity of the construct and its stability across time. Norms provide additional construct specification, especially if they include

separate normative data for subgroups classified by age, sex, or other demographic variables that affect test performance. What has come to be designated construct validity is actually a comprehensive approach that includes the other recognized validation procedures and much more. (Anastasi, 1986).

Summary

The above ideas provided general direction for this research effort. Every effort was made to attain the methodological ideals set forth here.

CHAPTER III.

METHOD OF INSTRUMENT DEVELOPMENT

Introduction

This study was an instrument development project that proceeded in several stages. Both the method employed and the results of each of these stages must be addressed. The format used for this presentation combines methods and results, since the output of each stage has an effect on the subsequent stage. Were methods and results detailed in the usual fashion it would no doubt be necessary to repeat the methodological issues or have the reader flip back and forth. Hopefully those difficulties will be avoided with the following format. Each stage of the research will be considered in the order in which it occurred with regard to the methods required and its results.

This chapter will address the following stages: 1) the development of the original, trial, instrument, 2) the process of transforming the trial instrument into the content validated instrument used in the survey, 3) the administrative details of the mailed survey, 4) the development of the measurement model, 5) methods of determining the degree of factorial invariance across organizations, and 6) profiling factor scores for individuals.

The following chapter (IV) will detail the following: 1) a determination of the amount of variance across companies with regard to the 11 factors, 2) modeling of the structural equation using LISREL, 3) determination of the final model.

Participants

The following groups of participants are used: 1) 6 SME's to help write items, these were instructors of SQC and consultants in the area of quality improvement; 2) 6 I/O graduate students to help identify constructs related to Deming's work, all of these students were fourth year (dissertation stage) and beyond, two had already graduated with a Ph.D.; 3) approximately 60 content validation panelists associated the items to Deming's points, these were participants at the Institute for Productivity through Quality at the University of Tennessee-Knoxville; they were about 90% male, approximately 40 years of age on average, made up largely of engineers, quality supervisors, or quality control specialists, 4) 393 employees returned the 50 item questionnaire; these individuals are similar in make up to the content validation panelists, except that they are alumni of the institute; and 5) 33 managers and other high-level employees responded to the survey, these companies ranged from auto industry to computer manufacturers; probably at least half are "heavy" industry, but there is great variety. These groups are discussed in greater detail whenever the various procedures are explained.

The Original Instrument

Most of the original items were written after reading Deming's discussion of his 14 points and conversations with experts in the field of SQC. There were originally 135 items based upon 14 points. It was much easier to write items for some of the points than it was for others. It became evident later that those same "easy" points were easier for those judging the items with respect to the point being measured. Perhaps not coincidentally those points were simply easier to understand, that is, they were better operationally defined.

For example, an easy point for which to write items addressed skills training, Deming's original points 6 and 13. By including the keyword, training, one could practically insure that the item would be seen as associated with points 6 and 13. One point not well defined was "modern supervision," point seven. In fact, no written work clearly articulates what "modern supervision" is. Rather, only by oral communication through lectures and television does Deming give sufficient detail to allow development of criteria.

A review of instruments available on topics similar to those addressed by Deming proved to be of only minimal value. One of the problems was simply to define the similarities between Deming's points and previous issues in the management and organizational theory literature. Deming's notion of constancy of purpose, point number one, sounds similar enough to Payne's and Pheysey's (1971)

"future orientation" and "consistency of commitment" across time. However, the specific references to quality that exist in Deming's work are not present in that of Payne and Pheysey. Indeed, the specific references to quality issues cause much of Deming's work to be without clear precedent in the measurement literature if not in the management literature in general. Deming's ideas center around managing to improve quality whereas most other management theorists do not focus on such a specific criterion. For example, Deming emphasizes the need for purchasing practices that place quality above price. There are no existing instruments which address this specific policy, which reflects the lack of theorizing with respect to purchasing policies.

One issue which has received attention in various instruments is that of supervisory practices. What Deming refers to as "modern management," is in essence what has previously been referred to as participative management and consideration. Reliable items addressing these issues were found in Seashore, Lawler, Mirvis and Cammann, (1982). These item were: "my supervisor encourages subordinates to participate in important decisions," "my supervisor encourages people to speak up when they disagree with a decision," and "my supervisor feels each person is important as an individual." The former two items are the only items in a subscale the authors called "participation." This subscale had a reported alpha coefficient, based on a sample of over 400, of .79. The last item

was one of three items in a "consideration" subscale. This subscale had an alpha coefficient of .89. The intercorrelation of the two subscales was .69. Seashore et.al., used a seven point response format while the current instrument employs a five-point Likert type scale. Otherwise, the items are identical to the originals.

Given the specific references to quality issues in Deming's work, the other items were written, revised and finalized especially for this research effort. Anytime entirely new items are written they must undergo a rigorous inspection process to determine their validity. The items in the present instrument have been examined from a content, construct, and criterion-related validation, perspective. The issues addressed were: 1) are the items measuring that intended, content validity? 2) are there unifying constructs underlying the items, construct validity? and 3) are these constructs related to carefully chosen criteria, criterion-related validity?

Establishing Content Validity

Step One: Agreeing On The Content Domain

The first step in the process of content validating the present instrument was to agree on a content domain. This content domain is embodied in Deming's 14 points. Therefore, any item which is to be of value must, to some degree, address the management issues raised by Deming. Also addressed was the matter of how Deming's ideas fit into the general management or organizational behavior literature.

This contextual enrichment process required review by subject-matter-experts of the 14 points. A list of the points was given to 14 Industrial/Organizational Psychology doctoral students at the University of Tennessee (see Figure 1, and also Appendix A for excerpts). Only six students returned their responses. These students were all at or beyond the fourth year in the doctoral program. Their assigned task was to free associate among these principles and "I/O psychology" topics and to write down these associations. None of them had ever read Deming's work, yet they were practically unfailing in their agreement as to the I/O topics which are similar to Deming's ideas.

"Constancy of purpose" was seen as similar to "organizational commitment," perhaps as addressed by Dubin (1956). Dubin found that "for almost three out of every four industrial workers studied, work and work place are not central life interests." What the I/O students did not perhaps infer from Deming, without having read much of his work, is a notion of "commitment of the organization" to quality. This is of course quite different from commitment of an individual to the organization. So while they all agreed on organizational commitment, they also all failed to carry it a step further to commitment of the people in the organization to a particular issue such as quality. There is therefore some evidence that while a related topic is addressed in the organizational behavior literature, Deming's notion is a somewhat different slant on the old idea.

Commitment was also considered similar to point number five: constantly and forever improve the system of production and service.

-
1. Constancy of purpose....
 Sounds like Katz and Kahn '78
 Unity of purpose (from classical organizational theory)
 Goal commitment
 2. New philosophy (concern with process).
 Goal commitment
 Changing attitudes toward work
 3. Cease dependence on mass inspection.
 Job enrichment (using employees as their own inspectors)
 Systems orientation
 4. End price-tag business.
 Criterion development, make sure criteria aren't deficient
 Strategic management
 5. Find problems in process.
 Formalizing goals of business
 Strategic management staff
 Importance of management
 6. Modern training methods.
 Need systems approach to training (Heinrich, 1976).
 Providing relevant training
 7. Modern methods of supervision.
 Participative management
 Role clarity
 8. Drive out fear.
 Feedback and feedback seeking behavior.
 Establishing role clarity
 Increasing job security through more understandable job or
 participative management
 9. Break down barriers between departments.
 Feedback
 Job enrichment
 Improving organization communication
 10. Eliminate exhortations for the workforce.
 Levin's force-field analysis, means-end
 Role clarity
 Goal specificity
 Generally, goal theory
 Goal setting combined with feedback
-

Figure 1. Representative comments of I/O psychology Ph.D. students regarding the relationship of Deming's points to I/O psychology.

-
11. Eliminate work standards and numerical quotas.
 - Roy '54
 - Gouldner '54
 - Contradictory to goal theory
 12. Remove barriers to pride-of-workmanship.
 - Increase job satisfaction
 - Importance of management
 - Hackman and Oldham (1975) job enrichment
 - Task meaningfulness
 13. Vigorous program of education and training.
 - Take into account trainability
 - Commitment at all levels
 - Combine with point number 6.
 14. Create a structure in top management that will push every day on the above 13 points.
 - Organization Development
-

Figure 1. Representative comments of I/O psychology Ph.D. students regarding the relationship of Deming's points to I/O psychology.(continued)¹

¹ The students were all near the dissertation stage of their doctoral studies.

They related Deming's two training principles to emphasis on training and development in a human resource management framework. Deming addresses training as a method of clarifying job roles which is certainly seen as a critical reason to train in the literature. Points seven and eight, "modern management" and "drive out fear" they saw as role clarity, role ambiguity issues. Participative management was mentioned by practically all of the students as the meaning of modern management. This term "modern" is certainly relative since Coch & French (1948), in the first volume of Human Relations, identify participative management as a way of overcoming resistance to change.

"Breaking down barriers, eliminating exhortations, eliminating numerical quotas, and removing barriers to pride-of-workmanship," all advocated by Deming, were seen as duties of the manager and having precedent in the literature.

The conclusion to be drawn from this reconceptualization of Deming's ideas into I/O terms, is that much of what Deming is saying has already been said. What makes Deming's work unique is that it addresses these issues as they pertain to and effect quality.

Looking at Deming's ideas in this larger context does not serve to change the content domain of interest. It does, however, force one back to the primary issue, which is: what are the organizational variables related to an improved productivity environment; be they labeled climate, culture or some other type of variables (Steers & Porter, 1975)?

Step Two: Agreeing On The Items

The second step in the process of content validation was to agree on the items. The pool had to be larger than the anticipated instrument since many items were discarded during the process. In the current case the item pool began at 80, not including the items borrowed from previously developed instruments. The borrowed items have already been shown to have acceptable properties, at least when used in similar contexts. The 80 new items were then subjected to a multi-staged process of review designed to rid the pool of irrelevant, poorly worded, or otherwise unfit items.

First, the items were reviewed by six subject matter experts (SMEs). The SMEs were deemed to be such because of their recognition as authoritative instructors of SQC and its implementation. They were asked (See Appendix A) to find at least one of Deming's points to which each item was related. If they could not, they were instructed to suggest how the item might be reworded so that it might relate. They were also asked to write additional items which might better relate to the points. The product of their efforts was both new items and ideas for new items. After this stage of the process, the item pool had expanded to 135 items. This is the number of items that entered the next phase of the content validation process.

Second, the 135 items were given to three groups of students attending the Institute for Productivity through Quality at the University of Tennessee. Each of the groups contained approximately

40 students for a total of about 120. Each individual received only one-third or 45 of the items, because of the great amount of time which would have been involved in doing all 135. With only 45 items, the reviewers reported that the process took over one hour.

These reviewers were entering their third week of training in SQC and Deming's management philosophy, so that they had about the same familiarity with the 14 points that most of those involved in the final instrument validation sample would have. They were from numerous organizations, as were their counterparts in the later phases of the research. Thus, the individuals serving as reviewers were similar in many respects to the actual sample. Consequently, it was expected that the manner in which the reviewers responded to the items would in effect anticipate the responses to the final instrument.

The reviewers were provided with a list of items and a list of Deming's points and excerpts from the points. These excerpts had previously been scrutinized by the SMEs for their degree of criticality to the overall meaning of Deming's point. The reviewers were instructed to match each item back to one point or more, up to three points. If they were unable to match an item to a point, they were told to feel free to leave it blank. They were also asked to rate the degree to which they felt the item measured the particular point. Later this second rating was dropped from consideration, since most of them apparently found this too difficult to do and left it blank. It seemed to be task enough to simply associate item to point.

Appendix B summarizes the results of this review process. As shown, the number of reviewers per item ranged from six to 26 with a mean of 14.3. This range is due to the fact that class time for the task was not allotted and the forms were completed and returned overnight. As is typical with this type of arrangement, the return rate was not as good as would have occurred had class time been allotted.

There were three forms of 45 each. Some of the reviewers received form A, some B, and some C. There simply was great variance as to how many A's, B's, and C's were returned, which caused the range of reviewers-to-item to be great.

Agreement was 71% overall. Agreement ranged from 50% to 100%. Those items which the reviewers associated with more than one point were held to a criterion of 33% for each point seen as related. For those related to only one point the criterion was 50% agreement. These criteria would be low for individual-level self-report measures. However, the unit of analysis will always be the organization when this survey is employed. Aggregating across individuals to make statements at the company level reduces measurement error by the central limit theorem. That is, mean scores are more stable than individual.

After the items had been matched back to points it was still necessary to continue the item-improvement process. Grammatical mistakes, typographical errors, poor word choices, and other problems were encountered, and these problems caused rewording of the items. However, in each case the original meaning of the item

was maintained. Otherwise the foregoing content validation effort would have been in vain.

The next step in the instrument development process was to choose from among those items meeting the minimum criterion. The items that comprised the final instrument needed to flow well together, not be redundant, and represent the best of the items meeting the agreement criterion discussed above. Another concern was instrument length because a long instrument would jeopardize the return rate. According to James (1987), the minimum number of items per construct, for structural equations to be effective, is four. Below this number, reliability may begin to suffer depending on the reliability of the three or fewer items. Therefore, four or more items per point were included in the instrument, for a total of 50 items. (See Figure 2.)

The questionnaire booklet also contained six items relating to work conditions. These items had been used as part of the criterion section of a previous research effort by the Management Development Center at the University of Tennessee. These items were not used in the present study.

The content validation of the items, articulated above, also led to a reduction in the number of points. It was determined from the reviewers responses that a distinction between points 6 and 13 (both related to skills training) could not be made. Also, point 14 was not identified separately from the others, since it is a summary of the preceding 13. This meant that a total of 12 constructs or points was carried forward into the next stage of the project. When referring to the points hereafter, the original point numbers will be retained. Numbers 5, 13 and 14 will be omitted.

-
1. This company relies greatly on quality inspection.
[Point 3: Cease dependence on mass inspection]
 2. Management here is very concerned with the high cost of producing defective items.
[Point 2: New philosophy(concern with process)]
 3. Emphasis is placed on adequate training.
[Point 6: Modern training methods]
 4. Process control is emphasized.
[Point 2: New philosophy(concern with process)]
 5. My supervisor is unsure how to help me perform my job.
[Point 7: Modern supervision]
 6. I am afraid to ask for clarification of my job duties.
[Point 8: Drive out fear]
 7. Slogans are used which encourage production efficiency.
[Point 10: Eliminate exhortations for the workforce]
 8. I have often seen problems arise because one department does not communicate with another.
[Point 9: Break down barriers between departments]
 9. While adequately providing for today, this company carefully plans long range strategy.
[Point 6: Modern training methods]
 10. Production targets are seldom mentioned.
[Point 11: Eliminate work standards and quotas]
 11. Business is rewarded to the lowest bidder.
[Point 4: End price-tage business]
 12. The belief practiced here is that it is more expensive to remake an item than it is to make it correctly the first time.
[Point 2: New philosophy(concern with process)]
 13. Hourly workers receive training that they can use in their jobs.
[Point 6: Modern training methods]
 14. This company does not mass inspect its products.
[Point 3: Cease dependence on mass inspection]
 15. I am told when I have done a good job.
[Point 7: Modern supervision]
-

Figure 2. List of Items in Final Instrument¹

-
16. I seldom receive deserved credit for a job well done.
[Point 7: Modern supervision]
 17. Constant improvement of product and service is emphasized here.
[Point 1: Constancy of purpose]
[Point 2: New philosophy(concern with process)]
 18. There seems to be adequate communication between departments.
[Point 9: Break down barriers between departments]
 19. I take great pride in my work.
[Point 8: Drive out fear]
[Point 12: Remove barriers to pride-of-workmanship]
 20. Our purchasing policy is determined more by quality than by price.
[Point 4: End price-tag business]
 21. There are often new posters encouraging workers to try harder.
[Point 10: Eliminate exhortations for the workforce]
 22. When needs arise we seem to always be caught with inadequately trained employees.
[Point 6: Modern training methods]
 23. Our percentage of scrap is falling.
[Point 2: New philosophy(concern with process)]
[Point 3: Cease dependence on mass inspection]
 24. We inspect 100% of our products.
[Point 3: Cease dependence on mass inspection]
 25. Whenever my tasks are unclear, I can quickly get clarification from my supervisor.
[Point 7: Modern supervision]
 26. I feel secure in my job.
[Point 8: Drive out fear]
 27. Quality-related banners are used by management.
[Point 10: Eliminate exhortations for the workforce]
 28. Communication between departments is practically nonexistent here.
[Point 2: New philosophy(concern with process)]
[Point 7: Modern supervision]
[Point 9: Break down barriers between departments]
 29. Quality-promoting slogans are seldom used.
[Point 10: Eliminate exhortations for the workforce]
-

Figure 2. List of Items in Final Instrument¹ (pg. 2)

-
30. This company seems to practice this philosophy: having fewer work standards enhances quality improvement efforts.
[Point 11: Eliminate work standards and quotas]
 31. I am kept informed as to how our products are performing in the hands of the customers.
[Point 1: Constancy of purpose]
[Point 9: Break down barriers between departments]
 32. This company does not accept that mistakes are a necessary part of life.
[Point 2: New philosophy(concern with process)]
 33. I have not received the type of job training which I need.
[Point 6: Modern training methods]
[Point 8: Drive out fear]
 34. We no longer rely on inspection to assure good products.
[Point 2: New philosophy(concern with process)]
[Point 3: Cease dependence on mass inspection]
 35. My supervisor encourages subordinates to participate in important decisions.
[Point 7: Modern supervision]
 36. I seldom make suggestions even when I see things that can be improved.
[Point 8: Drive out fear]
[Point 12: Remove barriers to pride-of-workmanship]
 37. We do not have long term relationships with most of our vendors.
[Point 4: End price-tag business]
[Point 8: Drive out fear]
 38. Teams of workers from different functions are used to solve problems.
[Point 2: New philosophy(concern with process)]
[Point 7: Modern supervision]
 39. There is pride among hourly workers here.
[Point 12: Remove barriers to pride-of-workmanship]
-

Figure 2. List of Items in Final Instrument¹ (pg. 3)

-
40. Productivity goals are unrealistically high.
[Point 8: Drive out fear]
[Point 11: Eliminate work standards and quotas]
 41. My supervisor would lend a sympathetic ear if I had a complaint.
[Point 7: Modern supervision]
 42. This company seeks ways to increase production efficiency.
[Point 2: New philosophy(concern with process)]
[Point 8: Drive out fear]
 43. The training efforts here are well planned.
[Point 6: Modern training methods]
 44. Materials I use which were purchased from other companies are of first-rate quality.
[Point 4: End price-tag business]
[Point 12: Remove barriers to pride-of-workmanship]
 45. My supervisor feels each subordinate is important as an individual.
[Point 7: Modern supervision]
 46. I am afraid to disagree with my supervisor.
[Point 8: Drive out fear]
 47. There is little pride-of-workmanship here.
[Point 12: Remove barriers to pride-of-workmanship]
 48. My supervisor encourages people to speak up whenever they disagree with a decision.
[Point 7: Modern supervision]
 49. My supervisor always gives me feedback on how my work affects the total service of the organization.
[Point 6: Modern training methods]
[Point 7: Modern supervision]
 50. We keep close watch on how satisfied our customers are with our products.
[Point 1: Constancy of purpose]
-

Figure 2. List of Items in Final Instrument¹ (pg. 4)¹

¹ Enclosed in brackets are the points the items eventually loaded on, after the LISREL runs.

Mailing The Instrument

The items were packaged together with a cover letter and a statement regarding purpose of the research and confidentiality. The items used a 5 point Likert-type scale that were 1 Strongly Disagree, 2 Disagree, 3 Undecided, 4 Agree, and 5 Strongly Agree. The alternatives were listed below the items and responses were indicated by circling the appropriate word or word set. The instrument was mailed to 1722 past participants of the Institute for Productivity Through Quality. The majority of this group have been assigned the task of working on quality issues within the company. They are comprised of engineers, production supervisors and managers, and quality control specialists.

Sixty-seven companies were represented in this survey. These companies were predominantly auto manufacturers or suppliers to the automotive industry. Others were from food, forestry, household products, chemicals, and computer industries. The number of participants from each of the companies ranged from 1 to 200 with an average of 26. The number of survey instruments returned was 393. This number represents 44 companies. The returned percentage was 22.8% for individuals and 65.6% for companies.

The return rate is poor for surveys of this type. However, it is good compared to the return rate usually realized in mailed surveys to this particular group. Also, there is a saturation point that could be occurring since a number of such surveys have been carried out among this group in the recent past. Another possible cause for the low return rate is that the individuals were afraid to be identified. Despite the disclaimer to the contrary, the code

number attached to the back of the survey booklet was a source of discomfort to some of the respondents. Seven of them removed the label containing the number from their forms. It is difficult to say how many of the 1722 failed to return the questionnaire for this reason. There was no significant change in mean and variance of responses between the first, second and third groups of returned forms. This would seem to indicate that the low response rate was not systematically related to responses on the questionnaire.

The Measurement Model

Entering and Coding of Data

The data were entered into the computer along with serial number, identification number, and company code. The serial number allowed for descriptive statistics to be produced on the data as it came in. Identification was taken from the label placed on the back of each booklet. That is, the first third could be compared to the second third and second to the third, and so on. This number also allowed for the company to be identified and a company code to be assigned. It was imperative that the data be organizable by company. There was no interest in the data at the individual level, thus perserving anonymity as promised.

Descriptive Statistics

Descriptive statistics were performed to provide an initial "feel" for the data before the principal analysis began. These tables of descriptive statistics may be found in Appendix C. Early interest centered around the variance of each item. Obviously, with little variance few meaningful conclusions could be drawn. It was determined that overall the variance on the five point Likert scale was adequate. Items numbered 8 (I have often seen problems arise because one department does not communicate with another.), 19 (I take great pride in my work.), and 46 (I am afraid to disagree with my supervisor.), each had a high mean, was negatively skewed, and had less variance than other items. Otherwise the individual item variances and associated third moments were quite acceptable.

The Primary Analyses

The statistical package LISREL (Linear Structural Relations) Joreskog and Sorbom (1985) was employed to determine the degree to which the model that flowed from the content validation effort actually fit the data based on 393 cases from 44 companies. If the content validation effort served its purpose well the measurement model obtained from LISREL should be highly similar to the model suggested by the content validation. Proceeding in this fashion, as opposed to an exploratory approach, allows for several determinations to be made: 1) How consistently can Deming's

philosophy be measured using the current instrument? 2) If it can be measured, is it measured consistently across the companies sampled? 3) If it is consistently measured, is adherence to it "paying off" in terms of some meaningful criteria?

The first of these three determinations: is Deming's philosophy measurable using the current instrument, is the question being asked whenever the results of the LISREL produced measurement model are compared to those of the content validation. The question of consistency of measurement is what will be addressed when the factor patterns and scores for companies are produced. And finally, the question of how is it "paying off" is being addressed in the structural model. All of these questions and their corresponding analyses will be addressed in turn.

Achieving the Measurement Model

Earlier analysis indicated that two of the original 14 constructs should not survive the content validation process. After reviewing the matching efforts of the content validation panel, it became clear that points 1) "create constancy of purpose," 2) "adopt the new philosophy," and 5) "constantly and forever improve the system of production and service"; were redundant. Items originally written to address point five (12,17,23,42,50) were allowed to load solely on points one and two (See Tables 3 and 4). Therefore, the proposed measurement model was reduced to 11 factors (constructs) and not 12. This change did not greatly affect points one and two

since the items from point five loaded on them prior to the dropping of point five.

The combination of factor (point) five into factors (points) one and two was not taken as a case of the factors (points) being unmeasurable, but rather an indication as to the extent to which there was repetition or redundancy in them. This redundancy could mean that the original 14 points are not the most parsimonious set of expressions to address the critical quality management issues.

The model proposed by Deming was left largely intact. The minor refinements mentioned above did not alter the fact that 11 of the 14 points were still being addressed and measured by the instrument. The model proposed by Deming is still being employed with redundancies ommitted.

The data were then read into LISREL with the proposed model as shown in Table 1 and Figure 3. This original model produced a Chi Square of 2451.59 with 1099 degrees of freedom. The overall goodness of fit index was .805. This is not an extremely poor fit for the first pass. A "best fit" would be a goodness-of-fit index of 1.0 and a ratio of Chi Square to degrees of freedom of 1.0. (Loehlin, 1987). In the present case this goodness-of-fit ratio is 2.2, which means that the model can be improved. Consequently, several more runs were required to refine the model. Some slippage occurred between what the content validation panel said the items measured and the way the items were responded to in the context of the measurement instrument. With general exploratory factor analysis a satisfactory factor structure would be achieved by one

Table 1. Overview of Factor Structure (Before LISREL Run 1)

Latent X Variable	Manifest X Variables Loading
1)Constancy of purpose.....	9,17,31,42,50
2)New philosophy (Concern with process).....	2,12,17,23,32
3)Cease dependence on mass inspection.....	1,4,14,24,34
4)End price-tag business.....	11,20,37,44
5)Find problems in process....	12,17,23,42,50
6)Modern training methods.....	3,13,33,43,22
7)Modern supervision.....	5,15,25,35,41,45,48,49
8)Drive out fear.....	6,15,26,36,46
9)Break down barriers between departments.....	8,18,28,38
10)Eliminate exhortations for the workforce.....	7,21,27,29
11)Eliminate work standards and quotas.....	10,21,30,40
12)Remove barriers to pride-of-workmanship.....	16,19,39,47

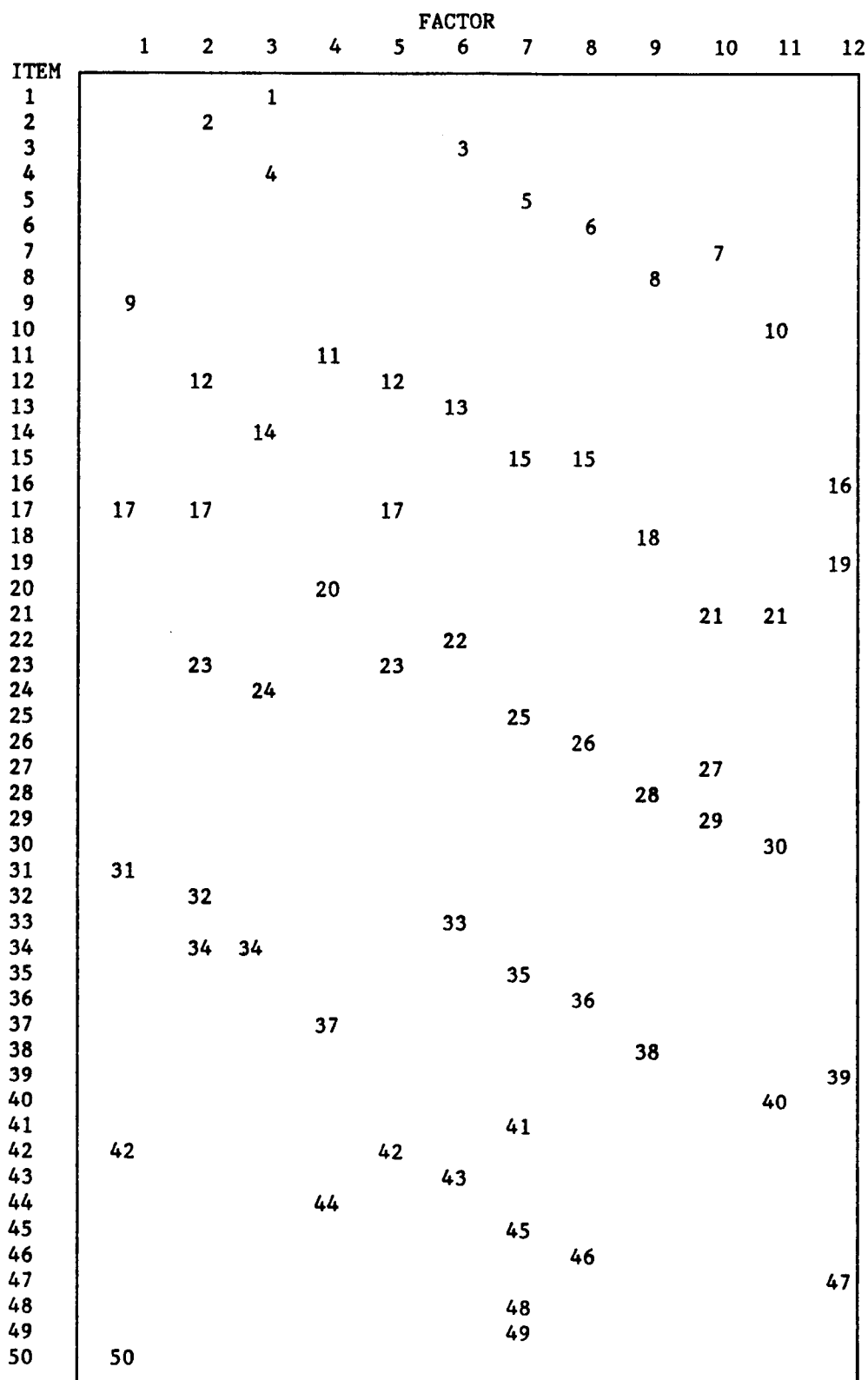


Figure 3. Original Factor Pattern (Lambda Matrix)^a

a The items loading on a given factor may be seen by reading down the column under the factor of interest.

pass at the data. The advantage of using the structural equations approach is that we can achieve a "better fit" of factors to raw data points, and thus a better understanding of any potential causal relationships at a subsequent stage of the research.

The approach to improve the fit of the model was to modify the proposed model by freeing lambda elements as suggested by the modification indices, while simultaneously subjecting the model to the constraint of reason (See Table 2 for iterative history of model). Lambda is a matrix of latent variables crossed with manifest variables. It can also be thought of as a factor pattern matrix with only those variables loading on the factors allowed to take on nonzero values. Estimation of this matrix and all other matrices in the factor analytic model was accomplished by maximum-likelihood (ML) estimation. This method has the advantage of yielding parameter estimates with known distributional properties, that is, all estimates are distributed normally. This allows for deviations in fit to be considered in light of the normal curve. Such deviation may be considered elementwise by referring to modification indices that indicate the degree to which each fixed (zero) element in the model contributes to the lack of fit of the model to the data. Large modification indices for a given element, say lambda [4,2], indicate that manifest variable four would probably load highly on latent variable two. Therefore freeing this element for LISREL to estimate will improve the model in terms of the Chi Square value by an amount greater than or equal to the size of the modification index.

Table 2. Iterative History of LISREL Runs for Measurement Model.

Step	Fit ^a	Variable	Action ^b	Factor
1	.805	process...emphasized	+	Concern with process
		process...emphasized	+	Constantly improve ^c
		I seldom receive...credit	+	Modern supervision
		I seldom receive...credit	+	Drive out fear
		supervisor...sympathetic	+	Pride-of-workmanship
		company seeks...efficiency	-	Constancy of purpose
		watch customers...products	-	Constantly improve
		goals unrealistically high	-	Elim. exhortations
		often new posters	-	Eliminate quotas
2	.809	Teams...solve problems	+	Modern supervision
		company seeks...efficiency	+	Concern with process
		supervisor...sympathetic	-	Pride-of-workmanship
		process...emphasized	-	Cease dep. on mass insp.
		not received...training	-	Drive out fear
3	.818	company...plans...strategy	+	Modern meth. of training
		no longer rely...inspection	+	Concern with process
		take...pride in...work	+	Drive out fear
		not received...training	-	Modern meth. of training
4	.824	scrap...falling	+	Cease dep. on mass insp.
		goals unrealistically high	+	Drive out fear
		company...plans...strategy	-	Constancy of purpose
		take...pride in...work	-	Pride-of-workmanship
		Teams...solve problems	-	Interdepartmental comm.
5	.826	Teams...solve problems	+	Concern with process
		Communication...nonexistent	+	Modern supervision
6	.827	company seeks...efficiency	+	Modern supervision
		company seeks...efficiency	+	Drive out fear
7	.830	Materials...first...quality	+	Interdepartmental comm.
		products...customers	+	Interdepartmental comm.
		done a good job	-	Drive out fear
8 ^d	.833	not received...training	+	Modern meth. of training
		take...pride in...work	+	Pride-of-workmanship
		Communication...nonexistent	+	Concern with process
9	.851	Final Model ^e		

a A measure of the models goodness-of-fit provided by LISREL ranging from 0 to 1.

b + variable added to model, - variable subtracted from model.

c Factor five was dropped after first step.

d After this run the error terms of variables 15 and 16 were allowed to correlate in the model.

e Beginning model: Chi Square of 2451.59 with 1099 df...Final model: Chi Square of 1737.83 with 1098 df.

Proceeding in this fashion, nine LISREL runs were made. Each time the modification indices were used to determine the elements to free after a rational judgment that it made "sense" for the manifest variable to load on the latent variable in question. This judgement was made by the researcher. A second index, a T-value, indicated whether each free element differed significantly from zero, thus indicating the significance of the relationship between the latent and manifest variables. These T-values were also used to guide the building of the model. All insignificant free elements were fixed at zero. The final Chi Square to degrees of freedom ratio, achieved at the end of all nine LISREL runs, was 1.59. This is a significant improvement over the original model. The ratio changed from 2.23 to 1.59. The drop in Chi Square was 692.46 with only an additional 5 degrees of freedom. The model stopped improving with successive attempts to free lambda elements as suggested by the modification indices at this point. There were some fairly large modification indices left: however, they made no rational sense and were therefore not freed. Table 3 presents the final model. Table 4 gives the composite reliabilities for the final solution. Composite reliabilities are given as well as coefficient alphas. Coefficient alpha does not take into account items loading on more than one factor. This helps to explain the low reliabilities seen for factors 11 and 12. Appendix D shows the intercorrelations of the factors.

There were two items which by being back-to-back in the questionnaire created a confound, with the response to one obviously influencing the other. This confound was revealed by the unusually

Table 3. Overview of Factor Structure (After final LISREL Run)

Latent X Variable	Mainfest X Variables Loading
1)Constancy of purpose.....	17,31,50,
2)New philosophy(concern with process).....	2,4,12,17,23,28,32,34,38,42
3)Cease dependence on mass inspection.....	1,14,23,24,34
4)End price-tag business.....	11,20,37,44
6)Modern training methods....	3,9,13,22,33,43
7)Modern supervision.....	5,15,16,25,28,35,38,41,45,48,49
8)Drive out fear.....	6,19,26,33,36,37,40,42,46
9)Break down barriers between departments.....	8,18,28,31

Table 3. Overview of Factor Structure (After final LISREL Run)
(continued)

Latent X Variable	Mainfest X Variables Loading
10)Eliminate exhortations for the workforce.....	7,21,27,29
11)Eliminate work standards and quotas.....	10,30,40
12)Remove barriers to pride-of-workmanship.....	16,19,39,44,47

Table 4. Factor Descriptions and Reliability Coefficients

Factor	Description	Number of Items()	Composite ¹ Reliability	Coefficient ² Alpha
1	Constancy of purpose.(3)		.740	.737
2	New philosophy(concern with process).(10)		.503	.794
3	Cease dependence on mass inspection.(5)		.615	.740
4	End price-tag business.(4)		.595	.639
6	Modern training methods.(7)		.578	.770
7	Modern supervision.(11)		.631	.883
8	Drive out fear.(9)		.457	.710
9	Break down barriers between departments.(4)		.602	.685
10	Eliminate exhortations for the workforce.(4)		.774	.853
11	Eliminate work standards and quotas.(3)		.422	.331
12	Remove barriers to pride-of-workmanship.(5)		.553	.641

¹ Calculated by:
$$\frac{\text{Sum of (Factor loadings)}}{\text{Sum of (Factor loadings)} + \text{Sum of (Error terms)}}$$

² Cronbach, L.J., Rajaratnam, N. & Gleser, G.C. (1963). Theory of Generalizability: a liberalization of reliability theory. British Journal of Statistical Psychology, 15: 137-163.

high correlation between their error terms. This problem was the only such anomaly detected. The items were numbers 15 (I am told when I have done a good job) and 16 (I seldom receive deserved credit for a job well done), each loading on latent variable six (relating to supervision). The error terms of the two items were allowed to correlate, thus improving the fit of the model.

Assessment of Factorial Invariance

To proceed with any further analysis it was necessary to determine the degree to which the factor profile for all the companies as a group represents each company individually. There is a procedure suggested by Meredith (1964) which would involve comparing the factor pattern matrix for each company with the overall matrix and receiving a goodness-of-fit index for each of the companies. This procedure cannot be used in the present case since the number of data points per company is relatively small, an average of nine.

The procedure used instead, was a jackknife (Mosteller & Tukey, 1977). As shown above a lambda matrix or a factor pattern was derived for the entire sample. With small numbers of respondents from most organizations, it was necessary to focus only on those with 19 or more responding. There were seven such organizations (see Figure 4). The jackknife procedure involved applying the LISREL model derived from the entire sample to that sample minus those participants from the company of interest. The change in Chi Square

Overall		Organization ¹			Change	
Chi Square	df	Org.(N)	Chi Square	df	Chi Square	df
1759.13	1104	One(62)	1709.15	1169	49.98	65
"	"	Two(52)	1739.97	"	19.16	"
"	"	Three(42)	1751.54	"	7.59	"
"	"	Four(23)	1728.61	"	30.52	"
"	"	Five(20)	1753.46	"	5.57	"
"	"	Six(19)	1733.51	"	25.62	"
"	"	Seven(18)	1748.62	"	10.51	"

Figure 4. Jackknife Procedure Results

¹ Used largest representatives from 33 responding organizations.

due to responses from the company-of-interest being left out is assessed with respect to the number of parameters being estimated.

In each case the Chi Square to degrees of freedom ratio is less than one, indicating that none of the Chi Squares are significant. The degrees of freedom in each case are 65 since that is the number of parameters being estimated in the lambda matrix.

The derived factor pattern apparently applies across the seven corporations on which there was sufficient data to investigate. It will be assumed then for the purposes of further analysis that the factor pattern derived from the overall sample is invariant across the corporations. Typically, this invariance is taken for granted; however, it should be tested for whenever factors are extrapolated across samples. The optimum procedure whenever enough data points are available from each sample is to employ Meredith's procedure. However, the jackknife procedure gives some evidence as to the invariance of the factor and is the appropriate procedure given the circumstances.

Summary Profile of The Factors

Recall that the points as originally outlined by Deming are maintained. However, because of redundancies in points 5, 13 and 14, they have been combined into the other points. For this reason the factors do not contain the numbers 5, 13 and 14.

Factor 1. Constancy of purpose

The item loading highest on this factor was number 50: "We keep close watch on how satisfied our customers are with our products." This factor is best described as "a concern with customer satisfaction." Only two other items loaded on this factor, items 31 and 17 (See Figure 5).

Factor 2. New philosophy(concern with process)

Two items loaded more highly than others on factor two. These items were numbers four and seventeen. Item four is: "Process control is emphasized." Item seventeen is: "Constant improvement of product and service is emphasized here." This factor is best described as "an emphasis on process control." Other items loading on this factor were 2, 12, 23, 28, 32, 34, 38, and 42. A total of ten items loaded on this factor. This factor is obviously general in nature and related to factor one (Customer Satisfaction), factor three (Reliance on Inspection), factor six (Competent Supervision), and factor eight (Interdepartmental Communication).

Factor 3. Cease dependence on mass inspection

The item loading most highly on factor three is number 14: "This company does not mass inspect its products." This factor is best described as "reliance on inspection." Other items loading on this factor were number 1, 23, 24, and 34.

Latent Variable	Loading [t-value]	Item ^{a b}
1. Constancy of purpose	.980 [17.084] .567 [10.228] .147 [2.817]	50: Close watch is kept on the product in the hands... customers. 31: ...products are performing in (8) the hands of the customers. 17: Constant improvement of product(2) and service....
2. New philosophy (concern with process)	.686 [14.328] .668 [11.845] .562 [11.187] .561 [11.106] .517 [10.136] .326 [5.299] .317 [6.548] .301 [4.878] .276 [5.126] .172 [2.668]	4: Process control is emphasized. 17: Constant improvement of product and service.... 2: ...concern with the high cost of producing defective items. 23: Our percentage of scrap is (3) falling. 12: ...more expensive to remake... than to make it correctly the first time. 38: Teams...used to solve problems.(6) 34: We no longer rely on inspection. (3) 42: ...seeks ways to increase (7) production efficiency. 32: ...does not accept that mistakes are ...part of life. 28: Communication between (6)(8) departments practically nonexistent...
3. Cease dependence on mass inspection	.711 [13.817] .658 [12.645] .628 [11.987] .565 [11.095] .183 [3.558]	14: ...does not mass inspect.... 24: ...100% inspect our products. 1: ...relies ...on quality inspection. 34: We no longer rely on inspection. 23: Our percentage of scrap is (2) falling.

Figure 5. Instrument Factor Structure

Latent Variable	Loading [t-value]	Item ^{a b}
4. End price-tag business	.836 [17.088] .726 [14.682] .261 [4.037] [3.430]	20: ...purchasing is determined... by quality.... 11: Business...to lowest bidder. 44: Materials...purchased... (11) first-rate quality. 37: We do not have long-term (7) relationships with...vendors.
6. Modern methods of training	.726 [15.359] .706 [14.819] .627 [12.737] .582 [11.619] .575 [11.446] .239 [4.350] .137 [2.302]	43: ...training efforts...well planned 3: Emphasis is placed on ...training. 22: ...caught with inadequately trained employees. 13: Hourly workers receive training... 9: ...adequately providing for today.. company...plans long-range strategy. 49: My supervisor...gives feedback on how my work affects... (6) total...organization.... 33: I have not received the type of(7) job training which I need.
7. Modern supervision	.778 [17.746] .776 [17.706] .774 [17.627] .742 [16.604] .637 [13.524] .608 [12.756] .572 [11.840] .557 [11.467] .472 [8.668] .257 [4.310]	35: My supervisor encourages... participate.... 48: My supervisor encourages... speak up whenever...disagree.... 45: My supervisor feels each subordinate is important.... 41: My supervisor would lend...ear.... 25: Whenever my tasks are unclear, I.. get clarification from my supervisor. 5: My supervisor is unsure how to help 16: I seldom receive...credit.... 15: I am told when I have done a good job. 49: My supervisor...gives feedback on how my work affects...total... (5) 38: Teams...solve problems. (2)

Figure 5. Instrument Factor Structure (pg.2)

Latent Variable	Loading [t-value]	Item ^{a b}
8. Drive out fear	.178 [3.171] .682 [13.847] .634 [12.665] .586 [11.513] .395 [6.736] .376 [6.237] .313 [5.523] .248 [4.018] .233 [3.792] .226 [3.612]	28: Communication between departments...nonexistent. (2) (8) 46: I am afraid to disagree with my supervisor. 6: I am afraid to ask for clarification... 26: I feel secure in my job. 36: I seldom make suggestions.... (11) 33: I have not received...job training.... (5) 40: Productivity goals are unrealistically high. (10) 19: I take great pride in my work.(11) 37: ...not...long-term relationship(4) with...vendors. 42: ...seeks ways to increase production efficiency. (2)
9. Break down barriers between departments	.871 [16.656] .660 [12.759] .400 [6.567] .155 [3.118]	18: ...adequate communication between departments. 8: ...problems arise...one department does not communicate with another. 28: Communication...between departments...nonexistent. (2) (6) 31: ...am ...informed ...product...(1)
10. Eliminate exhortations for the workforce	.846 [19.531] .844 [19.467] .729 [15.897] .661 [13.949]	29: Quality-promoting slogans are seldom used. 27: Quality-related banners are used by management. 21: ...posters encouraging...try harder. 7: Slogans...encourage production...
11. Eliminate work standards and quotas	.519 [6.632] .445 [6.091] .214 [3.112]	10: Production targets are seldom mentioned. 30: ...fewer work standards enhances quality improvement.... 40: Productivity goals are unrealistically high. (7)

Figure 5. Instrument Factor Structure (pg.3.)

Latent Variable	Loading [t-value]	Item ^{a b}
12. Remove barriers to pride-of- workmanship	.862	47: There is little pride...here.
	[17.539]	
	.739	39: ...pride among hourly....
	[14.885]	
	.234	44: Materials...of first-rate (4)
	[3.651]	quality.
	.182	36: I seldom make suggestions.... (7)
	[3.131]	
	.143	19: I take great pride in my work. (7)
	[2.333]	

Figure 5. Instrument Factor Structure (pg.4)

a T-values are at 392 degrees of freedom; All values presented are $p < .05$; values greater than 2.326 are $p < .02$; greater than 2.576 $p < .01$; greater than 3.291 $p < .001$.

b Numbers in parentheses are other latent variables on which the item loads.

Factor 4. End price-tag business

The items loading most highly on factor four were numbers 11 and 20. Item eleven is: "Business is rewarded to the lowest bidder." Item twenty is: "Our purchasing is determined more by quality than by price." This factor is best described as "policy of purchasing for quality." Other items loading on this factor were 37 and 44.

Factor 6. Modern methods of training

The items loading most highly on this factor were number 3, "Emphasis is placed on adequate training," and item 43, "The training efforts here are well planned." This factor is best labeled as "emphasis on training." Other items loading on this factor were: 9, 13, 22, 33, and 49.

Factor 7. Modern supervision

The variable which loads highest on factor 7 is number 35, "My supervisor encourages subordinates to participate in important decisions." This variable and the others which load highly suggest that a good label for this factor would be "competent supervision." Other items loading highly on this factor were: 5, 15, 16, 25, 28, 38, 41, 45, 48, and 49. Items 15 and 16 were placed together in the

questionnaire. This item juxtaposition apparently led to a confound which was revealed by highly correlated error terms. This was controlled for by allowing their error terms to correlate in the model.

Factor 8. Drive out fear

The item loading most highly on this factor was number 46, "I am afraid to disagree with my supervisor." This factor is best labelled as "fear." Other items loading highly on this factor were: 6, "I am afraid to ask for clarification of my job duties," 19, 26, 33, 36, 37, 40 and 42.

Factor 9. Break down barriers between departments

The item loading most highly on this factor was number 18, "There seems to be adequate communication between departments." This factor is best labelled "interdepartmental communication." Other items loading on this factor were: 8, 28, and 31.

Factor 10. Eliminate exhortations for the workforce

The items loading most highly on this factor were: 27, "Quality-related banners are used by management"; and 29, "Quality promoting slogans are seldom used." This factor will be described as "use of posters." Other items loading on this factor were: 7 and 21.

Factor 11. Eliminate work standards and quotas

The item loading most highly on this factor was number 10, "Production targets were seldom mentioned." This factor is labelled "use of production targets." Other items loading on this factor were: 30 and 40. Another item which was indicated as being associated with point 11, factor 10, was number 21. However, the responses from the primary sample did not indicate a relationship.

Factor 12. Remove barriers to pride-of-workmanship

The item loading most highly on this factor was number 47 "There is little pride-of-workmanship here." This factor is simply labelled "pride." Other items loading on this factor were: 19, 36, 39 and 44.

Summary

Given confidence that the factors are reasonably invariant across the companies, and that the modified model adequately fit the organizational data; the analysis can proceed to the next step, namely determining the impact of the factors on the criteria. This is the topic of the next chapter.

CHAPTER IV

RESULTS

Introduction

Prior to analyzing the data for factor-to-criterion relationships, it was important to determine whether the companies varied in the degree to which they were implementing the Deming philosophy. If it were found that the companies were all proceeding in roughly the same fashion, it would be futile to pursue a company-wise analysis of structural equations.

A multivariate analysis-of-variance was performed to determine the degree to which the companies varied across the eleven factors. Table 5 shows the results of this analysis. Factor variance accounted for by company ranged from 13% to 29%. Only one factor did not show a significant main effect for company, factor eight: "drive out fear". These results suggest that this factor could not be expected to correlate significantly with the criteria. Each of the other ten factors had significant company variance ($p < .05$).

Table 5. Analysis of Variance Results Testing for Company Differences in Each of the 11 Factors

Factor	F Value ^a	Probability	R ²
1 Constancy of purpose	1.88	.0011	.191
2 New philosophy(concern with process)	2.36	.0001	.228
3 Cease dependence on mass inspection	2.37	.0001	.229
4 End price-tag business	2.63	.0001	.248
6 Modern methods of training	2.78	.0001	.258
7 Modern supervision	1.56	.0169	.164
8 Drive out fear	1.16	.2309	.127
9 Break down barriers between dept's	1.95	.0006	.197
10 Elim. exhortations for the workforce	3.29	.0001	.291
11 Eliminate work standards and quotas	1.72	.0048	.177
12 Remove barriers to pride-of-workmanship	1.70	.0055	.176

a N of cases = 44; degrees of freedom = (473,3589.80); multivariate test (Wilks' Criterion) = 1.92; $p < .0001$.

Furthermore, six of the eleven factors had company effects which were highly significant ($p < .001$). This factor variance was deemed sufficient to warrant further data analysis. It also indicated that there was agreement among the individuals within each company with regard to the implementation of Deming's principles by the company.

Arriving At Company Factor Scores

After gaining evidence that the factor pattern was invariant across organizations and that there was significant variance between companies, the next step was to profile each organization on the eleven factors. The most efficient way to proceed was to derive factor scores for companies. Individual-level factor scores were not sufficient since the criterion data was at the level of the organization.

Responses to the 50 survey items from the 393 individuals were standardized to have a mean of zero and a standard deviation of one. This was done without respect for organization. Factor scores were computed for each individual. Mean factor scores were used to represent a company's compliance with, or implementation of, each factor. These factor scores were then used to determine the degree to which each factor is associated with criterion measures. It is this collection and coding of criterion data which will be addressed next.

Collecting And Coding Criterion Data

Criterion information was sought by telephone interview in the following areas: 1) market share, 2) percentage of scrap, 3) concern with customer satisfaction, 4) number of years using SQC training, 5) customer complaints, 6) inspection, 7) quality promotion, 8) participation, 9) overall smoothness of SQC implementation. These are areas in which Deming (1983) believes companies will improve if they follow his advice.

Most of the corporations represented in this study have sent high-level personnel to the Institute for Productivity Through Quality. Such individuals were identified for most of the 44 companies responding. These individuals were chosen because of great knowledge of their company's quality and productivity information. They were mostly high level managers. Some of the individuals identified had been transferred to other locations or jobs, others felt unable to answer the questions, and one saw the questions as too sensitive. After these exclusions, the total number of companies for which criterion information was collected was 33. Three of the companies were directly related to the auto industry, 3 are computer related industries, the others are chemical, household products, food, forestry, steel, and others. The variety of companies was great. The following is the rationale behind and the procedure used to collect the criterion information.

Problems Experienced

After the phone survey was completed the notes taken were reviewed. The present researcher and a cohort had made the calls, being careful to confer on the notes to be taken from the conversations. All of the coding was done by the present researcher. The range of responses was assessed for each question. The process of coding one question was completed before beginning with another. Table 6 shows the rationale for the coding of the nine questions. In some instances it was possible to quantify the classes of response. Even in these more quantifiable cases, such as market share, scrap, and complaints, not everyone was able to confidently state a percentage. The individuals participating in this phase of the study were probably the most knowledgeable people at their company on these subjects, but even so they varied greatly in the degree to which they could provide solid, numerical figures.

It must be acknowledged that variables such as market share are influenced by a multitude of hard-to-define variables. Many of these variables are industry related, and are out of the control of the company. Many of the companies in the study are quite diversified and as a result have many products. In these cases an attempt was made to get the respondent to provide an estimate of the average across products. The same was true of the other "quantifiable" variables.

There are a myriad of other problems with collecting data of this type across companies. These issues are currently the subject of much research in the area of strategic management. Advice was

Table 6. Coding rationale for criteria

Criterion	Rationale for 1 to 5 scale rating
1. Market Share	1-loss substantially (over 15% of 100%) 2-loss some (up to 15%) 3-stayed the same 4-gained some (up to 15%) 5-gained substantially (over 15%)
2. Years of training	1988 minus the year training began
3. Scrap decrease	1-stayed the same 2-slight reduction (1% to 5% original) 3-moderate reduction (6% to 25%) 4-strong reduction (26% to 50%) 5-substantial reduction (over 50%)
4. Efforts to meet customer needs	1-Could site no evidence 2-Some informal arrangements 3-Formal programs, little face-to-face 4-Programs with visitation and study of problems 5-Elaborate mechanisms in place e.g. customer audits, actually having persons responsible for monitoring products
5. Customer Complaints	1-slight increase, no change, no concern 2-slight reduction (around 5%) 3-moderate reduction (about 5% to 15%) 4-solid reduction (about 15% to 25%) 5-substantial reduction (over 25%)
6. Inspection Policy	1-use in old sense (100% at end of line) 2-use at end of line substantially 3-reduced some since SQC training began 4-largely in process control sense 5-process control if at all

Table 6. Coding rationale for criteria (continued)

Criterion	Rationale for 1 to 5 scale rating
7. Promotion of Quality Among Employees	1-Posters, banners, slogans, rewards, hype 2-Above with some problem solving 3-Mostly problem solving emphasis 4-SPC training and process improvement 5-Improved quality is best promoter
8. Participation: Employee voice in decision-making	1-None 2-Little 3-Growing some 4-Growing well 5-Great amount
9. Overall how smoothly has SQC implementation gone	1-Great difficulty, little progress 2-Not at all smoothly 3-Ups and downs, not significantly improving 4-Ups and downs, improving 5-Ups and downs, well on way

sought from researchers in this area. However, the truth is that creative methods of collecting criterion information on a where- and when-it-is-available basis are still very much a part of research at the level of the organization. There is no claim to be made here that the criterion information is the absolute truth for each company. In practically every instance the individuals providing the criterion data for this study were better able to articulate the caveats involved in the information they were providing than if this data were collected in some objective fashion. These subtle issues played a necessary role in the criterion coding effort. Rather than a flaw, this depth of knowledge is seen as adding insight into each company's situation that would be missing given some alternative method of data collection.

Procedure For Gathering Criterion Information

The following information was gathered over the phone. This information was obtained from people at high levels in the organizations who were heavily involved in the SQC implementation process. The respondents were asked if they were interested in participating and were informed that they could refuse to answer any question they saw as too sensitive. They were assured that their company would not be identified in the analysis and report of the findings. The questions related to each variable of interest were phrased in a way that the response would be an indication of the change (with the exception of years and overall smoothness) in this variable since SQC training had begun. Appendix E shows the responses for all the companies across the criteria.

Data Obtained

The following is a detailed explanation of the phone criteria. The interviews lasted from 30 to 45 minutes, notes were recorded and the data were then coded.

Market share. Managers (or high level staff people) were asked to identify their companies largest competitors and what their share of the market was. (Perhaps a later study could address stock indices and compare relative market share across the competitors. The possibility exists for this kind of analysis since major competitors were given.) It was fairly easy for most of the respondents to provide this figure as an estimate of the percent of change since SQC training began. In most instances this figure was for their local site, which is appropriate since that is also the level of the mailed survey data.

Years. The year which the company became involved in SQC training was acquired. This number was the year which the company first sent a participant to the Institute for Productivity through Quality offered by the Management Development Center at the University of Tennessee.

Percentage of scrap. The change in percentage of scrap from the startup date until the present. In a few cases this was a very educated guess. In most cases the figures were known. Many could refer to reports containing this information.

Customer. The intent of this question was to determine the extent of the companies effort to obtain information about their products in the hands of their customers. It was felt that a company truly interested in their product performance should have

prescribed ways of collecting this information. If little or no effort could be identified, the company received low marks.

Complaints. The point of concern here was how much have customer complaints changed in terms of both quality and quantity. Many respondees made the point that their customers had become more quality-conscious and therefore more demanding. The use of "800" numbers seems to have facilitated an increase in customer complaints. In most cases the effect has been to increase the number of complaints which is not necessarily an indication of poorer quality.

Inspection. The question here concern how the company uses inspection in their operations. Is it during the process, in which case it adheres to Deming's idea of inspection, or is it final, 100% inspection? Final and complete inspection is at odds with Deming's prescription.

Quality promotion. Companies which use posters, banners, slogans, and video tapes to hype their SQC effort are operating in a way that is counter to Deming's prescription.

Participation. The interest here is in whether operators on the line are allowed to make decisions about the process or at least be a part of the decision-making effort. Of particular interest was whether the company had undergone a noticeable change in this respect.

Overall smoothness of SQC implementation. This question was designed to assess the smoothness of the SQC implementation process from start to finish. Also of interest was whether the process is showing improvement over time.

Structural Equations Analysis

Ideally, structural equations analysis is driven by a theory which suggests the model, a priori. Or when no theory exists, all variables are included in the model during the first step and those which are not adding to the model's fit are systematically eliminated in subsequent steps. In the present case there were insufficient degrees of freedom to allow for an initial inclusion of all of the possible relationships. It would have been preferred to build a model which reflects relationships dictated by theory. However, in the present case there is little theoretical base from which to operate. Deming and others maintain that "competitive position and market share" will be an outcome of combining SQC with his management philosophy. No specifics are provided as to how strong the causal relationship is between say point 8, "drive out fear," and market share increase. In fact, the causal relationships between "the 14 points" and the more immediate criteria, such as reduced percentages of scrap and rework, are also not clearly defined. For the reasons of no theory and too few degrees of freedom the initial "saturated" model included variables with significant zero-order correlations.

The purpose of the use of structural equations in this study then is not to corroborate or overturn a theoretical perspective. It is rather to lay the groundwork for the understanding of the possible causal relationships between the process variables identified by Deming and criteria which are important to any organization. The analytical approaches that follow reflect this purpose.

Levels of the Criteria

Nine criteria were identified from the quality-control and strategic-management literature. Of these nine criteria, five are clearly process criteria, three intermediate level, and one may be considered a final criterion. Market share is the final criterion for obvious reasons. Customer complaints, overall smoothness of SQC implementation, and scrap reduction are intermediate, since they may be caused by the process criteria, and can be causes of the ultimate criterion. The other five, efforts to meet customer needs, inspection policy, promotion efforts, participation, and years of training, are possible outcomes of proceeding according to Deming.

Hereafter, the five process criteria will be considered with the 11 factors as exogenous or independent variables. Only the three intermediate and one "final" criteria will be discussed as criteria. The process criteria should combine with the factors from the 50-item questionnaire to help explain the four outcome-level criteria. With these constraints in mind let us look at the steps leading up to the modeling of the factor-criterion relationships using LISREL.

Pre-LISREL Steps

Once again a primary purpose of this research was to establish relationships between management SQC implementation practices and organizational outcomes where they are currently ill-defined. Correlations among the constructs (including the five process criteria) and the four criteria were examined to explore their relationships. These correlations may be seen in Appendix F. Information about the best combination of variables to account for the variance in each of the factors was used as suggestions for relationships to model in LISREL.

LISREL Structural Modeling

Unlike the measurement model, the structural equations model began with more free parameters and moved toward systematic elimination of relationships that had insignificant T-values. These standardized T-values were more important for the development of the structural model than were the modification indices. There were occasions when a modification index would be relatively high, but the parameter, once freed would yield an insignificant T-value.

The original model had a better overall fit than the final model in terms of Chi Square to degrees of freedom ratio (See Table 7). This good fit was due to the large number of insignificant relationships that were allowed by the model before the necessary (for significance at the .05 level) criterion of a T-value of 1.7 was placed on the model parameters. The original model had 46

Table 7. Iterative History of LISREL Steps for Structural Model.

Step	Criterion Variable	Action	Causal Variable
1 ^a	Customer complaints	-	Drive out fear
	Overall implementation	-	Promotion of quality ^b
2	Market share	-	Efforts to meet customers
	Customer complaints	-	Cease dependence on mass insp.
	Customer complaints	-	Remove barriers to pride-of-workmanship
3	Customer complaints	+	Modern supervision
	Scrap reduction	-	Participation
	Customer complaints	-	Cease dependence on mass insp.
	Market share	-	Years of training
4	Overall implementation	+	Promotion of quality
	Customer complaints	-	End price-tag business
	Market share	-	Remove barriers to pride-of-workmanship
	Scrap reduction	-	Cease dependence on mass insp.
5	Customer complaints	+	Drive out fear
	Scrap reduction	-	Efforts to meet customers
	Customer complaints	-	Modern supervision
	Customer complaints	-	Eliminate exhortations for the workforce
	Scrap reduction	-	Break down barriers between departments
	Customer complaints	-	Participation
6	Scrap reduction	-	End price-tag business
	Scrap reduction	-	Modern methods of training
	Scrap reduction	-	Eliminate work standards and quotas
	Customer complaints	-	Drive out fear
7	Scrap reduction	-	Constancy of purpose
	Overall implementation	-	Promotion of quality
	Customer complaints	-	Eliminate work standards and quotas
a	Beginning model:	Chi. Sq.	df
		33.28	46
			.921
	Final model:	Chi. Sq.	df
		74.35	62
			.856

b Bold type denotes phone survey item

degrees of freedom and a Chi Square value of 32.28 for a Goodness of Fit index of .92. The final model had 62 degrees of freedom (16 fewer parameters free) and a Chi Square of 74.35 and a Goodness of Fit of .856. By fixing parameters, overall fit of the model was lost while retaining only significant relationships. Below is a discussion of the model.

The Relationships in the Model

The significant relationships from the final model are shown in Figure 7 (See Figure 6 for starting model). Four factors are shown to be highly associated with a smooth implementation of SQC. These relationships are significant at the .05 level.

The factors: "end price-tag business" (PTB), "modern methods of training" (MMT) and "break down barriers between departments" are all derived from the 50-item mailed questionnaire, based on 393 cases. "Participation" (P) and "overall smoothness of implementation" (OSI) are variables from the phone survey of 34 managers. Such strong relationships across the two types of surveys seem to indicate good discriminant validity in the multi-trait multi-method sense (Campbell and Fiske, 1959).

A particularly interesting result is the strongly negative relationship between IC and OSI. Statistically, this relationship may be explained as one of suppression. IC has a strongly negative zero-order correlation with P and strongly positive correlation with PTB and MMT (See Appendix G).

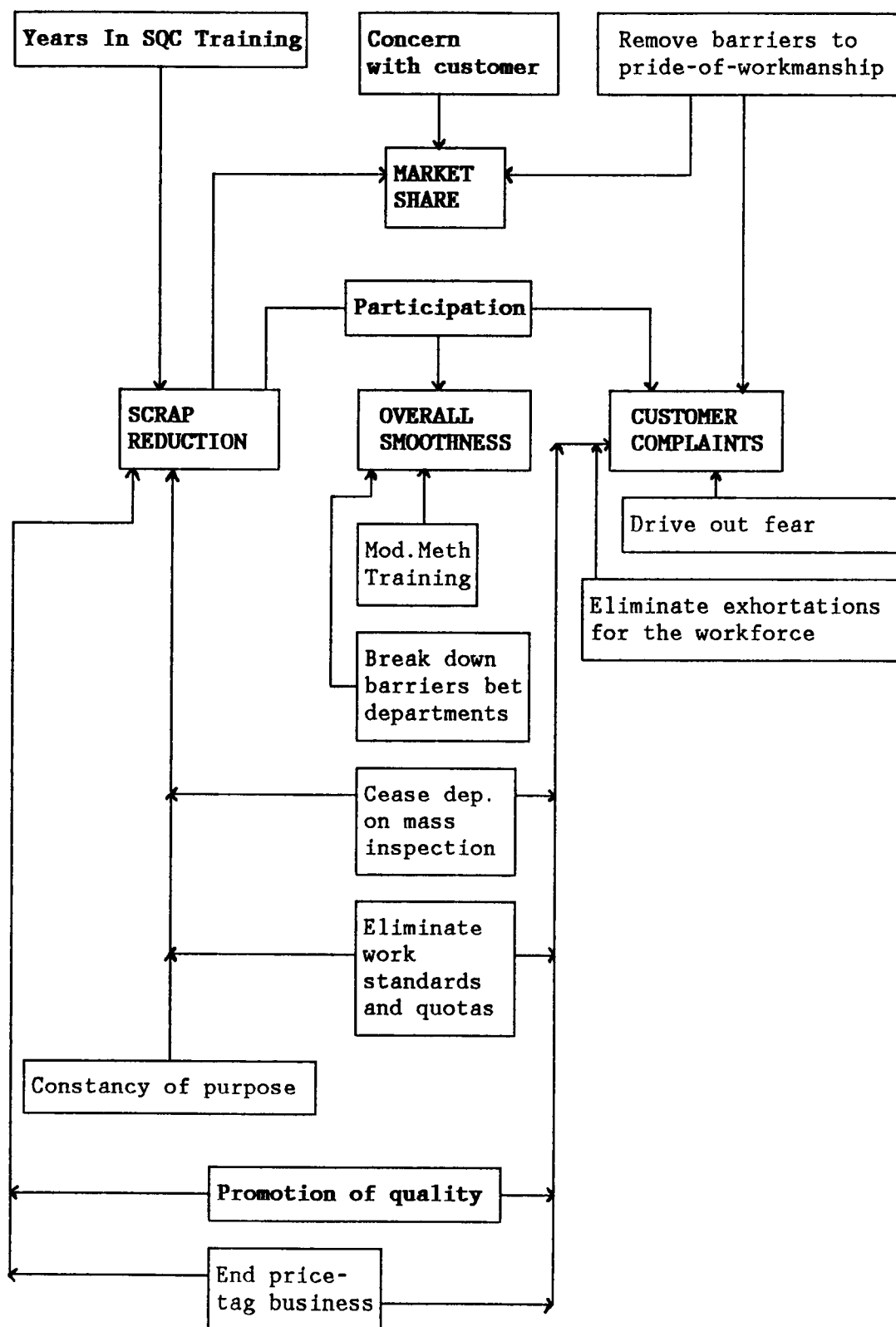


Figure 6. Initial (Saturated) Structural Model

a unstandardized T-values

b Bold type denotes phone survey, uppercase denotes criterion in model

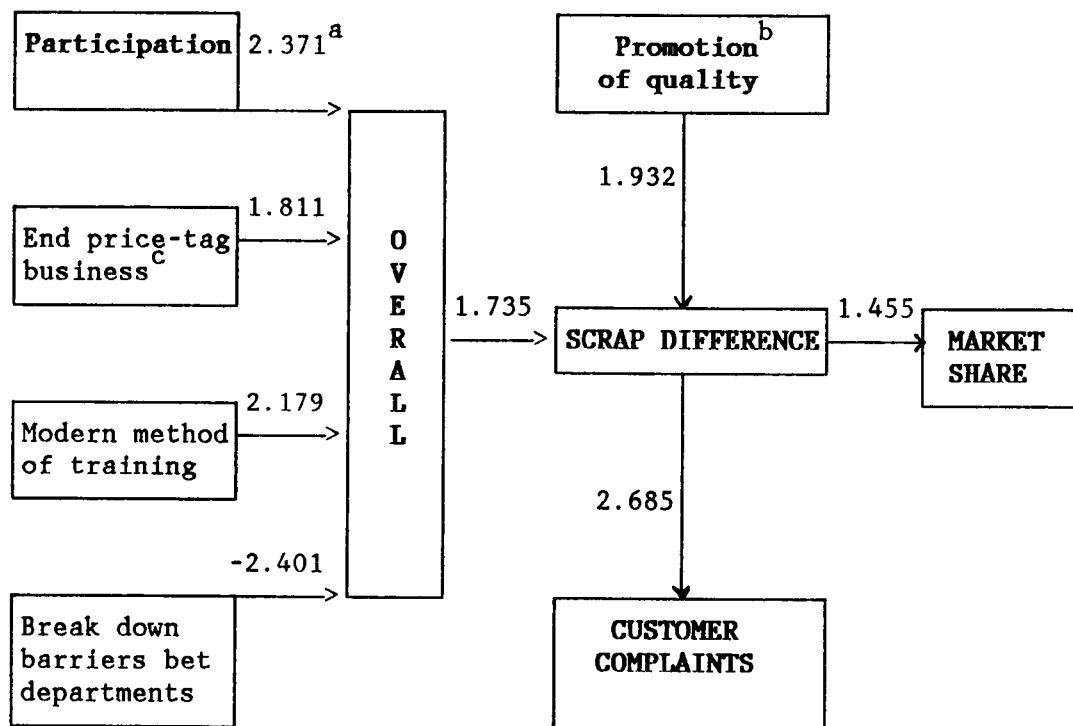


Figure 7. Model of Relationships Among Variables

a Unstandardized T-values, $p < .05$ for all except SCRAP DIFFERENCE to MARKET SHARE; N of cases is 33 companies

b Bold type denotes phone survey, uppercase denotes criterion in model

^c Lower case denotes from 50 item questionnaire

These relationships seem to indicate that participative management, purchasing and training policies which are Deming-like, and a low degree of collaboration among departments lead to a smooth SQC implementation process.

This smooth implementation in turn leads to a reduced scrap rate. Also contributing to a reduced scrap rate was "promotion of quality." Deming advocates promotion of quality through the use of problem solving, cause-finding efforts at the operator level, as opposed to promotion through the hype of posters, slogans, video tapes, newsletters, and others.

Reducing scrap has the clear effect of reducing customer complaints and somewhat less of increasing market share. (see Figure 7). The relationship between scrap reduction and market share is significant only at the .10 level. However, the zero-order correlation is .34, which is the second highest of all the variables correlated with market share.

Latent Variable Relationships With Productivity And Profit Margin

Data on two additional indices were collected. These were: Productivity (Sales/Employees) and Profit Margin (Sales minus Cost-of-Goods-Sold/Sales). This information was available from COMPUSTAT on 19 of the 44 companies. The data were viewed, as were the other criteria, in terms of change.

The prechange level of certain indices (e.g. yearly return on investment) can be charted, as well as a post-change level. The beginning date of SQC training was taken as the time of

philosophical change toward improved quality. Averages for the four years prior to the implementation of "Deming-style" quality management, were taken for each criterion measure. This average was compared to subsequent years and presented as a ratio.

Before and after ratios were calculated for two productivity indices. One ratio was sales over employees and the other ratio was sales minus cost-of-goods-sold over sales. Before and after ratios were calculated using the four year average prior to SQC implementation and the subsequent years for which figures were available (1986 and prior) from the Compustat data base. Totals for the four years prior on the two variables were summed and divided by the totals for the four years after SQC training began.

Using the above procedure 19 companies were assigned productivity improvement indices. This allowed for factor score correlations to be assessed. Only one variable in all of the analysis was correlated with one of these COMPUSTAT criteria: "Years-of-training" correlated with "Productivity" .558 (See Table 8). However, an interesting finding was that every company, except one, which was included in the 19 gained in terms of productivity during the period in which they were attending the Institute for Productivity through Quality at the University of Tennessee.

Table 8. Correlations of Factors and Phone Questions with
COMPUTSTAT Indices

	Profit Margin		Productivity	
	r	p	r	p
1 Customer satisfaction	-29	22	01	98
2 Concern with process	03	91	02	94
3 Inspection policy	32	18	-25	31
4 Purchasing policy	01	97	18	46
5 Training policy	10	69	12	62
6 Supervisory competence	14	56	-11	66
7 Fear among employees	18	46	-13	61
8 Inter. communication	-14	57	-26	29
9 Use of posters	01	95	-15	55
10 Use of quotas/targets	-06	82	-32	19
11 Pride-of-workmanship	10	68	07	78
12 Participation	12	61	26	29
13 Promotion of quality	-03	89	12	64
14 Customer complaints	-43	08	09	73
15 Overall smooth SQC	25	30	30	21
16 Concern with customer	28	25	-33	16
17 Market share	-06	81	13	61
18 Reduction in scrap	-15	53	02	95
19 Inspection policy	11	64	22	36
20 Years in SQC training	-02	93	57	01

CHAPTER V.

DISCUSSION

Three Aspects of the Results

This study had three distinct phases, the development of an instrument to measure adherence to Deming's philosophy of SPC, the determination as to the construct validity of this instrument, and criterion-related validation of that instrument against important organizational criteria. The instrument development process included the three primary phases of validation (Nunnally, 1978): content, construct, and criterion-related. This approach allowed the study to proceed as a series of integrated stages (Landy, 1986). The content validation effort yielded an instrument that was construct validated through structural equations analysis. The product of the construct validation effort was a refined model which was criterion validated, also employing structural equations analysis.

Discussion of Content and Construct Validation Results

The content-validation process made it clear that Deming's points 13 and 14 were redundant, point 13 with point 6 and point 14 with all the points given that it summarizes the others. Also,

items loading on point 5 all loaded on either point 1 or point 2. However point 5 was maintained until it became clear that it added nothing new to the model; that is, after the initial LISREL step.

The content validation process resulted in a fifty-item instrument (see Appendix H). The fifty-percent agreement criterion which was used to dismiss items with poor interrater agreement was seen as justifiable on the grounds that the perceptions being tapped were not personal reports but rather individual perceptions of the organization. Anytime this instrument is used in the future, and hopefully it will be, it will be used in this same group-level fashion. It will not be used to make statements about individuals but rather about groups. Therefore, the fifty percent criterion is more stringent than if the data were being used to draw conclusions at the level of the individual. This is true since the variance being dealt with at the aggregate level is about the various company means instead of individual variance. The variance of means can be shown to be greatly reduced.

The content validation process is considered successful since it yielded a model with a goodness-of-fit index of .805 and a Chi Square ratio of 2.2, both of which are considered good for starting models (Joreskog and Sorbom, 1985). The original model was not improved dramatically by the nine LISREL iterations. Without the base of content validity information, the ceiling would be lower on the degree to which construct validity could be demonstrated using the LISREL modeling technique. Wallace (1983) emphasized the need for improved construct validity in organizational behavior research. One way to help assure greater construct validity among measures is

to begin the process with content validation efforts as employed in the current research.

The fit of the measurement model (see Table 5. Chapter III, pg. 62) is taken as evidence of construct validity, that is, the proposed constructs (Deming's points) are being measured by the current instrument. This measurement was fairly reliable for 10 of the points, with "eliminate work standards and quotas" not fairing as well. (see Table 7, Chapter III, pg. 66.) These reliabilities ranged from .641 to .883. Coefficient alpha does not take into account LISREL's allowance for items to load on several factors.

Discussion of Criterion Relationships

The criterion relationships were as follows: 1) overall implementation of SQC was best explained by employee participation in decision-making, a purchasing policy that emphasizes quality, SQC skills and job training, and lower degree of interdepartmental communication; 2) an overall smooth implementation and proper promotion of quality lead to a reduction in scrap; 4) reduced scrap was instrumental in reducing customer complaints; and 5) a reduction in scrap was marginally related to increased market share. While Deming maintains that each of the fourteen points must be carefully adhered to in order to have a smooth SPC implementation process, the present results suggest that some subset of the fourteen points might be the "driving force" behind successful quality improvement efforts through SPC and proper management, within the present population. A common theme among those variables

associated with an overall smooth implementation was human relations. Even the notion of maintaining good relationships with vendors promotes this theme. Deming maintains that long-term relationships with a very few vendors is preferred over short term relationships with many.

The negative relationship between interdepartmental communication and the overall smoothness of implementation seems to contradict the other results. After a closer look, it might be plausible to assert that the degree to which departments attempt to solve quality problems outside their department may cause them to lose focus on their own problems. Perhaps departments and companies with a certain degree of "tunnel vision" are better off. Anecdotal evidence from conversations with quality experts at the 34 companies involved in this study substantiate this explanation. Smaller companies, or companies which started small with their training and SPC emphasis in one or two departments, seemed to have more early successes. In fact, this was openly discussed during more than one of the phone calls to obtain criterion data and there was a consensus of opinion that focused efforts within departments meet with more success than attempts to work across departments.

Participation within departments is apparently of much greater importance to the overall smoothness of SPC implementation than interdepartmental participation. In fact, as noted above, interdepartmental communication is negatively related to a smooth implementation. This seems to indicate that sharing of ideas for the purpose of solving departmental problems is worthwhile. It may have a payoff, indirectly, in reduced scrap; since reduced scrap is

linked to overall smoothness of SPC implementation. It could very well be that this phenomenon of "success through poor communication" could be a short-lived one. In fact, dysfunctional long-term side-effects would be predicted by theorists in this area (Lawrence and Lorsch, 1967).

The results also revealed that comprehensive job training, including with thorough SPC instruction, is related to reduced scrap by helping to cause an overall smooth SPC implementation. It stands to reason that SPC training would be related to smooth implementation. The entire process is built around the training efforts.

Several explanations are possible for the results of this study. First, SPC may have no effect on quality or productivity. It is possible that SPC is erroneously being labelled as the cause. The effect may be attributable to increased usage of robots, just-in-time inventory, or other new management practices.

Second, the only effect may be from the use of SPC alone. However, numerous efforts by organizations to implement statistics without addressing relevant management issues have resulted in overwhelming failure rate. Invariably, management issues have arisen, issues such as, employees seeing their jobs as threatened since SPC is supposed to make the organization more efficient. This misunderstanding has often given rise to increased fear and uncertainty in the workplace. Another issue is ownership. It could be that one or more managerial levels within the organization do not buy into the idea of SPC. This is particularly deadly when it occurs at the top of the organization. Or still another issue:

what is management going to do when operators see SPC as taking the old inspector's job and dumping it on them? In short, it is difficult to imagine an organization which can ignore the management issues and successfully implement SPC.

Thirdly, perhaps one must implement SPC in a fashion exactly as prescribed by Deming. The results of this study show a certain degree of equifinality with respect to adherence to Deming's ideas. The situation is most likely contingent on a number of variables. Studies such as this one give us a peek at which might be the more important variables. It would be interesting to look at other types of industries for trends, sizes of companies, etc. Perhaps improved quality is related to the combination of increased use of robots and automation, JIT, and SPC.

This study only addresses the degree to which smooth SQC, following the directive of a most respected authority in the area, is related to improved quality. The effect of the other variables might be suggested for future studies.

Using Deming's points as a starting point was a help and a hindrance. It was a help since it reduced the variables to be considered, and in that sense provided a type of guidance. It was a hindrance in that the points are poorly operationally defined. It may be that the most important outcomes of this research are the operational definitions it provides. At least, the manners in which organizations are perceiving the points will be better understood.

The discussion will now continue with an elaboration and implications section for each of the major findings.

Elaboration of Criterion Relationships

Prior to discussing specific findings of the current research, it is necessary to reflect on the placement of this study in the organizational behavior literature.

This study employed methodologies from (and the findings relate to) both the climate literature (Schneider, 1985) and the culture literature. This is appropriate since all Deming is proposing is a specific organizational culture which should have an effect on productivity and quality. The focus of the former has typically been the individual. The focus of the latter has been the group or the organization. The current research more appropriately could be viewed as an effort to assess cultural issues. While Deming does not acknowledge the organizational-culture literature for the "interpersonal", manager-subordinate relations aspects of his philosophy; many parallels exist. These were pointed out by the group of I/O graduate students as they reflected on Deming's points as related to the organizational behavior issues.

Three of the four variables related to smooth SQC implementation: employee participation in decision-making, adequate training, and poor interdepartmental communication, may easily be construed as organizational culture issues. A case could even be made for the fourth variable, a policy of maintaining good relationships with vendors and thus enhancing incoming quality material, as being a cultural issue. Thus, it is clear that the

current study adds to the organizational culture literature as well as helping to place Deming's philosophy in the literature. Next will be a discussion of the specific relationships which obtained in the final LISREL model.

The modeled relationships are shown in Figure 2 of Chapter IV. Specifically, evidence was found that overall smoothness of SQC implementation was jointly related to participative management, a low degree of communication or collaboration among departments, Deming-advocated training policies, and a "few-vendor" purchasing policy. Overall smooth SPC implementation in turn was associated with a reduction in scrap. Reduced scrap was also at least partly determined by proper, "low-hype," promotion of quality. Reduced scrap was related to a reduction in customer complaints. Finally, reduced scrap was marginally related to market share.

The Participation-Implementation Effect

The relationship between participative management and smooth implementation of SPC is a most predictable one, regardless of one's theoretical perspective. Deming calls this "modern management." However, the notion of participation between management and laborers to make decisions is hardly new. Coch and French (1948) and Lawler and Hackman (1969), found that participation can lead to higher work effectiveness. In fact, Coch's and French's article appeared in the very first volume of the journal, Human Relations, serving to underscore the point that participative management is nothing new.

The popular press has also been singular in its devotion to participative decision making. Peters and Waterman (1982), in In Search of Excellence, talk about "achieving productivity through people," "the importance of people as individuals," informal and open communication," among other expressions indicating the importance being attached to a new emphasis on the "rights" of the individual in the work place. Kanter (1983) continues in this vein as she emphasizes the importance of an organizational culture that engenders pride and the encouragement of risk-taking. Kanter's adaptive or innovative organization is one in which the culture allows the individual worker to sense himself or herself as having an impact.

Participation has been specifically linked to increases in the amount and accuracy of information they have about work practices and the environmental contingencies associated with them (Lawler and Hackman, 1970; Porter, Lawler and Hackman, 1975). Workers who developed their own incentive pay plan around "coming to work on time" were more positive toward the plan and saw more improvement in tardiness rates, than those who had the plan developed for them by management.

Also, participation can increase the degree to which employees feel they "own" their work practices (Porter, Lawler, and Hackman, 1975). In the groups above, such statements as "shared warnings" about management, or "things management proposes" changed to "our plan."

Porter, Lawler and Hackman go on to list the conditions under which participation will be effective. Firstly, the participation

must be relevant to the work itself. If this is not so, a reverse effect can occur, due to an increased mistrust of management by the workers (after learning the triviality of the matter in which they have been allowed to participate). Secondly, participation will lead to increased awareness of performance-reward contingencies, in which case it is necessary for these contingencies to be equitable or the outcome of the increased participation may be demoralization. In other words, if the workers are made aware of unfair management practices through increased participation, then the participation could backfire. Obviously, increased participation is not the place to start when efforts are being made to correct mismanagement. Third and finally, the increased work brought on by participation should lead the employee to an improved work station. Participation must be accompanied by some real job improvements from the laborers' perspective. Mulder (1971), after reviewing field experiments and lab studies adds that employees should have ample motivation and expertise for participative management to be effective. It follows that these more fundamental issues need to be addressed prior to successful use of a participative management style.

Some of the problems of using a participative style of management or leadership were identified by Campbell, Dunnette, Lawler, and Weick (1970). They are as follows: 1) Organizations value reaching a consensus quickly. People may not want to be the one to keep the consensus from being reached. 2) It is sometimes difficult to maintain ones sense of individuality. This can lead to a dysfunctional attitude toward the group and the organization. 3) Employees may not see management problems as important to them and

may become irresponsible. 4) Sometimes people simply do not get along well with other group members. Forcing them to cooperate may ameliorate this problem but it could also make it worse.

The research on participation, also known as participative decision making (PDM) was recently reviewed by Cotton, Vollrath, Froggatt, Lengnick-Hall and Jennings (1988). The conclusions of this review served to further demonstrate the complexity of the effects of PDM on productivity and satisfaction. For example, informal participation and the more formal, employee ownership, have an effect on both productivity and satisfaction, while short-term participation is ineffective on both. Furthermore, participation in work decisions appears to increase productivity but is not as effective with satisfaction. In short, PDM has received years of research and emerges as one of the more complex issues in the organizational behavior literature (Schweiger and Leana, 1986).

Clearly, from the above discussion of the effects of participative management and the contingencies associated with its effectiveness, "modern" or participative management was not Deming's brain-child. Also not surprising is that participation shows up as part of effective SPC-implementation, given previous findings. It is somewhat disconcerting to note that "modern management" from the 50-item questionnaire was not significantly related to an overall smooth SQC implementation. Participation in the phone survey, employing high-level managers was related to an overall smooth SQC implementation. Let us next look at the implications of the effect found here in light of the previous literature.

Asking whether participation is desirable in an organization is like asking whether ice cream is a good dessert. They are desirable and delicious respectively, unless organizational conditions are not right or the individual has a blood-sugar abnormality. The evidence from this study would suggest that participation in the area of SQC has been good for those companies that have encouraged it.

Many of the companies in this study are auto manufacturers or related industries. The plight of the American auto industry needs not be chronicled again here. The industry and its vendors are in some cases turning to SPC for a cure for their ailments. Many of them report that the implementation process began with high hopes, only to have them plummet. Most of them have seen at least part of the initial enthusiasm regained after some period. Invariably, they will make the point that the operators have to be taught to trust this new system. They have to become part "owners" of the idea of efficiency being thought of as an important criterion again. Usually this ownership is brought about by having the operator learn to chart and learn to calculate the formulas, but also have a say in how the results of the charts and formulas are used. Although the term participative management is seldom used, the phenomenon is the same.

Organizations reporting early failures in SPC implementation have invariably later recognized that they tried to do it from the middle out. That is, the first people to be trained and sold on the notion of SPC were the middle managers and their staff support. This scenario has come from more than a few companies. The report is usually that top management support was not obtained and the

bottom of the organization felt that their jobs were threatened by this increased efficiency, or that this was another way to give them more work. Unions have not been easy to win over until results have been shown. The process of SPC implementation apparently requires organization-wide support. The importance of high-level support is evidenced by the results from both the anecdotal front and with this study, the empirical front.

The Interdepartmental-implementation Effect

Communication barriers between departments can serve to thwart quality-improvement efforts (Deming, 1983). However, the finding in this study directly contradicts this assertion. The present results indicate that reduced or perhaps even poor communication between departments is associated with smooth implementation. Various predictions could be made from previous research done on interdepartmental communication.

A negative relationship between interdepartmental communication and an overall smooth SPC implementation is the most intriguing result in the study. At first it seems counterintuitive. However, upon closer consideration in light of the literature, interesting explanations are suggested. In studies where intergroup competition has been fostered [Sherif, M. 1965, in Proshansky and Seidenberg (Eds.) and Blake, Shephard, & Mouton, 1964] the attitude of the groups is one of "being the best damn group in the organization." This has been shown to increase intragroup cohesiveness and task commitment. However, this should at the same time have

dysfunctional consequences for the organization as a whole. The tact that is usually employed when this intergroup competition has had dysfunctional consequences is to introduce a superordinate goal for all the groups. This has typically served to bring the groups together for the good of the organization. It has often been associated with posting the successes of the entire organization versus other organizations to boost comraderie. Using these previous research findings to guide explanations of the current results leads to interesting speculation on the nature of successful SPC implementation. This speculation will be continued later in the section devoted to the implications of the results.

Speculation as to why interdepartmental communication correlated negatively with smoothness of SPC implementation must center on the foregoing ideas. If the individual departments in this study believe themselves to be in competition with other departments, there may well be deliberate attempts to "not share secrets" or not discuss practices beyond the boundaries of the departments. This "tight-lipped" phenomenon would be predicted by the results of Sherif's (1965) work.

It is commonplace for companies to compete with respect to quality. Japan has a yearly competition in which companies vie for the Deming prize, with the corporation best emulating Deming's ideas for quality improvement receiving this honor. The University of Tennessee Management Development Center has likewise given an annual award to the company with the best quality-improvement presentation.

Whether this idea of competition has reached the level of the individual department is unknown (the present results would seem to

indicate so). Perhaps group-level reward systems are in place in many of the organizations. In the case of quality-circles, there is obviously a group-level reward system in place. Many of the companies in this study do use work teams or quality-circles as evidenced by their response to these items on the questionnaire.

Argyris (1970), drawing from principles of economic management, states that the basic assumption of the industrial revolution is that the concentration of effort on a limited field of endeavor increases quality and quantity of output. If this is the case, it could be argued that at least at the level of the individual, it is more efficacious to limit one's field of endeavor. If this were extrapolated to the level of the group, it might serve to explain the current finding. As groups focus more and more within themselves on their own specific tasks, they are not communicating with other departments, yet the departments independently are producing greater quality and quantity. However if this were true, all effective organizations would be experiencing poor interdepartmental communication. This would not seem plausible.

Perhaps Argyris' conclusion from the foregoing quote will shed more light on the subject. He essentially says that the necessity for specialization should increase as the quantity of similar things to be done increases. The explanation derived from this statement might be that SPC has a tendency to increase the number of similar things to be done and thus increases specialization. If this degree of specialization were again extrapolated to the level of the group, this intergroup specialization might also lead to intergroup conflict or manifest itself as poor intergroup communication.

Interdependence of tasks within organizations has long been seen as related to the need for interdepartmental communication (Thompson, 1967). Perhaps those companies which employ what Thompson calls a long-linked technology, requiring interdepartmental communication, are perceived by the employees as communicating well when in reality they are not meeting the high demand for interdepartmental communication. The fact that the company is not meeting this high demand, brought on by a long-linked technology, may be causing the negative relationship between interdepartmental communication and smooth implementation of SQC. That is, the employees perceive their company as doing an adequate job of communicating when it is not, because the employees are unaware of the excessive demand for interdepartmental communication brought on by the technology or other related factors.

The point must also be made that there was no correlation between participation, gathered from the company experts and supervisory competence (Deming's modern/participative management), gathered by the questionnaire. Apparently, what management is calling participative management is not being labelled the same way by the employees. This discrepancy is in itself an interesting finding. Why does management apparently differ in their perception of the degree to which decision-making responsibilities are shared? The mean response for the two items was roughly the same as was the variance.

Argyris is probably correct when he says that "concentrating effort on few endeavors" was the corner-stone principle of the industrial revolution. It seems that this notion of specificity

fell on hard times in the 1960's and 70's. It also seems possible that it is making a comeback and along with it, quality. The T-groups and sensitivity-groups of the seventies have given way to training in, of all things, statistics. The contrast is of Tayloristic proportions. The far-reaching idealists of the anti-war and "me" generations have settled down to study process control. This is, of course, viewing the subject from a most philosophical vantage point. From a practical standpoint, it may simply be that the time to pay attention to the details has returned.

If this speculation is accurate, it could be that the new attention to detail has caused individuals, groups, and even organizations to operate as if with blinders. In fact, the entire metaphor of the dedicated work horse seems appropriate. Industries to individuals have experienced loss of pride to loss of jobs. Deming and others offer an austere solution and austerity is the most guilt-free way to save face.

Conversations with SPC specialists from auto manufacturers to soap makers, yield the perception that success in SPC comes by department. In fact, it seems that to be a small company, is to be divinely blessed whenever quality is at stake. The small company can close its doors, roll up its sleeves, and chart its way back to success. The large company must proceed with one group at a time while the other groups bide their time, fostering mistrust and a competitive spirit among departments.

The Training-Implementation Effect

Greater amounts of training were associated with smooth SQC implementation. This is not at all surprising. Individual development of employees has long been recognized as critical to overall organizational effectiveness. Skills training, which is what was addressed in this study, has been shown to have positive effects in the organization given certain conditions are present.

The first condition that should be present is that the training content should reflect the nature of the job. That is, the job should be carefully analyzed before determining the training content (Gagne, 1962). The question for the organization often becomes one of which is more expensive, analyzing jobs to determine training content or providing irrelevant training. Usually, the determination is made that the latter is more expensive and more detrimental to the individual and the organization in the long run.

Secondly, the skills should be taught in a way that maximizes transfer of learning. Only those behaviors that lead to successful performance should be taught.

Research Implications

The research purposes of development and validation were fulfilled. Ten of the eleven factors were reliably measured and there is some evidence that a subset of these factors are associated with smooth implementation of SQC. In addition to meeting its basic purpose, the study found a number of interesting relationships among the factors and the phone criteria.

The present research found suggestive evidence that a reduction in scrap could lead to a greater share of the market. The strength of this relationship would be an interesting topic of future research. Scrap reduction seems to be the ultimate criterion for SPC implementation. Market share is certainly an ultimate criterion for most organizations. These two would seem to be logically connected. The more interesting question for this and future studies is whether SPC and suggested management practices are causes of reduced scrap. Or perhaps more to the point, can an organization use SPC disregarding the suggestions of Deming and still be successful?

The findings of this study indicate that some of the prescriptions of Deming are related to improved quality. The study does not allow for the conclusion that these practices are necessary, just that in certain cases they are sufficient. Attempts to pit these ideas against other theoretical approaches would seem to be a worthwhile direction for future research.

Also, it would be interesting to further demonstrate the invariance of the factor pattern obtained in this study. Perhaps the results of this study are partially determined by the large number of automobile-related manufacturing industries participating. It could also be that 34 companies are not enough on which to establish a stable factor pattern.

Of interest as well might be the experiences of companies competing in the same market as those in this study, particularly if these companies are not employing SPC as Deming has suggested. If those corporations are shown to differ on certain criteria, this

could be considered initial evidence of the necessity to follow some or all of Deming's suggestions.

Other companies may very well be experiencing success with respect to quality and productivity by employing other philosophies. Determining the nature of these philosophies might help in the understanding of the variables influencing quality and productivity. If some companies have robotized and/or automated or are employing JIT, with similar successes, it could be initial evidence as to the insufficiency of following Deming's suggestions or at least the importance of related efforts to quality improvement.

Future research would no doubt benefit from employing structural equations analysis, as was done in the present case. Ventrakaman and Grant (1986) advocate the use of this approach for demonstrations of the following: 1) content validity, 2) internal consistency of operationalization, 3) convergent validity, 4) discriminant validity, and 5) nomological validity, causal modeling. They criticized previous organizational-strategy research for its single-item scales, inadequate assessment of construct validity, and the inexplicit treatment of strategy as an organizational level construct. The present study avoided the pitfalls, primarily due to the employment of the structural equations analysis or causal modeling approach.

Beer and Walton (1987) levy other criticisms at organizational change research. They say that the research suffers from these four problems: 1) Research aimed at causal isolation, overlooking the systemic nature of organizations and exogenous variables and intervening events will prevent powerful conclusions. Events may be

multiply caused. 2) Much research is insufficiently longitudinal. 3) Much of the research is overly dependent on quantitative analysis as opposed to qualitative description. Many multi-causal phenomena are best understood qualitatively. 4) The research does not fit the needs of the users. More complex statistical techniques and more complex quasi-experimental designs may neglect the "social construction of knowledge."

The current study acknowledges the above concerns by addressing several possible models, by assessing the change in profit margin and productivity from four years prior to intervention to four years after, and post-hoc, qualitatively looks at the variables of interest in the study. This study is admittedly not longitudinal in a classic sense. However, subsequent efforts to address the issues could make it so. It has perhaps provided the beginning of a longitudinal study.

Future research in this area would no doubt benefit from employing structural equations analysis, as was true in this study. The clarity with which causal paths can be identified is available in few other approaches. The approach allows for the entire validation approach to be subsumed under one logical umbrella.

Limitations of The Study

Other surveys of this type sent to many of these same people have drawn the same or less response as a rule. Possible explanations for the low response rate include: 1) an overall

tendency to not respond to surveys, 2) a cool relationship with the University of Tennessee Management Development Center, 3) busy schedules due to increased demand of SPC charting and analysis, 4) a fear of responses being identified. The last of these was true to some extent. Eight of the questionnaires were returned with the identification code removed. There is some evidence that the prevailing cause is a general tendency not to respond to surveys, perhaps due to busy schedules.

Another limitation is the problem of unit of analysis. This research attempted to deal with this by including measurements at both the individual and corporation level. New ways of handling this problem could no doubt be developed in order to improve the interpretability of the findings of future research.

The fact that all of the participants in this study, 393 questionnaire respondents, about 60 content validation panelists, 6 SME's and 33 phone-survey respondents, all have ties to the same university could limit the generalizability of the findings. However, it is not unusual that companies will receive training from multiple sources, the University of Tennessee is not the only provider of such training. Also, there does not seem to be an overt attempt to interpret Deming's ideas as much as there is to rely on them as a direct source during the course of training. It seems reasonable to believe that the results of this study would be similar if numerous training centers had been involved. However, there is no way to determine the degree to which this is true.

Also, difficult to explain is the multicollinearity situation in the interdepartmental communication case. An attempt was made

interdepartmental communication and overall success in SQC implementation. While the explanation and the finding are intriguing, it remains a bit unsettling that such an undesirable phenomenon on one level could have such a positive effect on another. The discrepancy between employees' ideas about participation and those of management or their staffs, could well hold a clue to the cause of this finding. This discrepancy may or may not be an indictment of the way the criterion information was collected in this study.

Answers to the phone survey were taken to be fact and not opinion. Those responding were most often in a position to give highly educated answers to the questions. No check was done to determine the degree to which their answers were true, since in most cases a better source for the information was simply not available.

No clear cut relationship to market was indicated. Perhaps the market is only beginning to be effected. The passage of time may be all that is needed to see this relationship increase.

Possibly a "halo" effect caused the relationship between the perception of increased participation and an overall smooth implementation. Indeed, there is the possibility of method bias in these responses. However, upon looking at the means and standard deviations of the "phone survey" items method bias does not seem to be present.

Summary And Conclusions

The purposes of this study were to develop an instrument which reliably assesses organizational adherence to Deming's philosophy

and the degree to which that adherence has an impact on criteria important to the organization. The results of the jackknife procedure indicate a reasonably consistent factor pattern across organizations. Relationships between management practices and important criteria revealed that a reduction in percentage-of-scrap and customer complaints could be effected by overall implementation strategy and promotion of quality. Therefore it can be said that the study accomplished its bifold purpose.

The results seem to show that ample training, participative management, a departmental focus, and the practice of purchasing good materials may reduce scrap, customer complaints, and perhaps indirectly lead to greater market share. Also, serving to reduce scrap is the practice of promoting quality through a problem solving approach and the attitude that quality is its own best promoter. Reducing scrap led to a reduction in customer complaints.

The method used to develop the instrument and the validation procedure allow for an integration of the three forms of validity as called for by Landy (1986). The success experienced in this study might be useful for those pursuing similar measurement interests in the field. Also, the study provides a first attempt to see how Deming's ideas contribute to the organizational behavior literature. The answer to that question seems to be at least some clearer, principally that Deming's meaningful ideas are very similar to what is being addressed already in the field under the name of organizational culture research.

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APPENDIXES

APPENDIX A

List of Deming's 14 Points and Brief Excerpts

1. Create constancy of purpose for improvement of product and service.

Problems of the future command first and foremost constancy of purpose and dedication to improvement of competitive position to keep the company alive, and to provide jobs for their employees...allocate resources for long-term planning...training...performance (of the product) in the hands of the user.

2. Adopt the new philosophy.

We are in a new economic age. We have learned to live in a world of mistakes and defective products as if they were necessary to life. It is time to adopt a new religion in America...Defects and defective items are not free. The total cost to produce and dispose of a defective item exceeds the cost to produce a good one.

3. Cease dependence on mass inspection.

Routine 100 percent inspection is the same as planning for defects, acknowledgement that the process cannot make the product correctly, or that the specifications made no sense in the first place... In place of 100 percent inspection should go improvement of the process and elimination of inspection.

4. End the practice of awarding business on price tag alone.

Price has no meaning without a measure of the quality being purchased. American industry and the U.S. government are being rooked by rules that award business to the lowest bidder. He that has a rule to give his business to the lowest bidder deserves to get rooked... One of the first steps for managers of purchasing to take is to learn enough about the statistical control of quality to be able to assess the qualifications of a supplier. It is necessary to follow a sample of materials through the whole production process into complex assemblies, and onward to the customer...The requirement of statistical evidence of process control in the purchase of critical parts will mean in most companies dramatic reduction in the number of vendors they deal with.

5. Constantly and forever improve the system of production and service.

This means continual reduction of waste and continued improvement of quality in every activity...The lion's share of improvement in any process or activity must come from action by management.

6. Institute training.

Training must be totally reconstructed...Poor training of hourly workers, or none at all, and dependence on unintelligible printed instructions, seem to be a way of life.

7. Institute modern methods of supervision.

Supervision belongs to the system and is the responsibility of management. Remove barriers that make it impossible for the hourly worker to do his job with pride of workmanship.

8. Drive out fear.

Secure - without concern/care

Most people on a job, especially people in management positions, do not understand what the job is, nor what is right or wrong.

Moreover, it is not clear to them how to find out. Many of them are afraid to ask questions or to take a position... Fear will disappear as management improves and as employees develop confidence in management.

9. Break down barriers between staff areas.

People in research, design, purchase of materials, sales, receipt of incoming materials, must learn about the problems encountered with various materials and specifications in production and assembly.

10. Eliminate exhortations for the work force.

Eliminate targets, slogans, pictures, posters, for the work force, using them to increase productivity... Posters and slogans never helped anyone to do a better job.

What is needed is not exhortations but a road map to improvement, management's obligations...

The company will of course have a goal, namely; never-ending improvement.

11. Eliminate work standards and numerical quotas.

I have yet to see a work standard that includes any trace of a system by which to help anyone do a better job. Work standards guarantee that the company will get the specified amount of defective items, and the specified amount of scrap, and never improve.

Work standards, rates, and piece work are manifestations of inability to understand and provide appropriate supervision...

There is no piece work in Japan.

12. Remove barriers to pride of workmanship:

- a. on the factory floor b. among management.

Barriers and handicaps rob the hourly worker of his birthright, the right to be proud of his work, the right to do a good job.

Only management can remove these barriers.

13. Institute a vigorous program of education and training.

Improvement of productivity means that fewer people will be needed for some lines of work. At the same time, however; more people will be needed in other lines. Education and training will fit people into new jobs and new responsibilities...

It is necessary for management to learn also some rudiments of statistical theory and application. Anyone who supposes that quality, productivity, and competitive position can be achieved by massive immediate use of control charts and other statistical techniques by hourly workers will doom his own career and carry his company along with him.

Where conditions are clear, however; training of a judicious selection of people in the hourly workforce, and foremen, in simple statistical methods such as control charts will help them to do better work, with less effort and with even greater satisfaction of pride.

14. Create a structure in top management that will push every day on the above 13 points.

Top management will require guidance from a consultant.

APPENDIX B

CONTENT VALIDATION OF ITEMS

Item	Point	No. Agreeing
9. While adequately providing for today, this company carefully plans long range strategy.	1	12/20
31. I am kept informed as to how our products are performing in the hands of the customers.	1	5/10
50. We keep close watch on how satisfied our customers are with our products.	1	8/12
42. This company seeks ways to increase production efficiency.	1,2	8/25,8/25
17. Constant improvement of product and service is emphasized here.	1,2,5	6/21,5/21,7/21
32. This company does not accept that mistakes are a necessary part of life.	2	6/9
2. Management here is very concerned with the high cost of producing defective items.	2	7/12
12. The belief practiced here is that it is more expensive to remake an item than it is to make it correctly the first time.	2	8/9
23. Our percentage of scrap is falling.	2	15/19
24. We inspect 100% of our products.	3	12/17
1. This company relies greatly on quality inspection.	3	12/17
4. Process control is emphasized.	3	7/9
14. This company does not mass inspect its products.	3	7/10
34. We no longer rely on inspection to assure good products.	3	7/8
11. Business is rewarded to the lowest bidder.	4	13/15
20. Our purchasing policy is determined more by quality than by price.	4	12/16
21. There are often new posters encouraging workers to try harder.	4	12/16
37. We do not have long term relationships with most of our vendors.	4	11/16

APPENDIX B (pg.2)

CONTENT VALIDATION OF ITEMS

Item	Point	No. Agreeing
44. Materials I use which were purchased from other companies are of first-rate quality.	4	9/15
3. Emphasis is placed on adequate training.	6	24/26
13. Hourly workers receive training that they can use in their jobs.	6	11/11
22. When needs arise we seem to always be caught with inadequately trained employees.	6	12/13
33. I have not received the type of job training which I need.	6	12/16
43. The training efforts here are well planned.	6	18/23
5. My supervisor is unsure how to help me perform my job.	7	11/16
16. I seldom receive deserved credit for a job well done.	7	6/9
35. My supervisor encourages subordinates to participate in important decisions.	7***	
41. My supervisor would lend a sympathetic ear if I had a complaint.	7	10/16
48. My supervisor encourages people to speak up whenever they disagree with a decision.	7***	
49. My supervisor always gives me feedback on how my work affects the total service of the organization.	7	
45. My supervisor feels each subordinate is important as an individual.	7***	
15. I am told when I have done a good job.	7,8	7/18,6/18
25. Whenever my tasks are unclear, I can quickly get clarification from my supervisor.	7,8	5/18,5/18
6. I am afraid to ask for clarification of my job duties.	8	10/20
26. I feel secure in my job.	8	12/19

APPENDIX B(pg.3)

CONTENT VALIDATION OF ITEMS

Item	Point	No. Agreeing
36. I seldom make suggestions even when I see things that can be improved.	8	10/17
46. I am afraid to disagree with my supervisor.	8	7/10
8. I have often seen problems arise because one department does not communicate with another.	9	11/17
18. There seems to be adequate communication between departments.	9	11/18
28. Communication between departments is practically nonexistent here.	9	7/8
38. Teams of workers from different functions are used to solve problems.	9	7/7
7. Slogans are used which encourage production efficiency.	10	6/6
10. Production targets are seldom mentioned.	10	6/10
27. Quality-related banners are used by management.	10	8/13
29. Quality-promoting slogans are seldom used.	10	6/6
40. Productivity goals are unrealistically high.	10	7/12
30. This company seems to practice this philosophy: having fewer work standards enhances quality improvement efforts.	11	6/10
19. I take great pride in my work.	12	7/12
39. There is pride among hourly workers here.	12	9/17
47. There is little pride-of-workmanship here.	12	12/17

***Item taken from Seashore et.al.(1982)

APPENDIX C

DESCRIPTIVE STATISTICS FOR 50 QUESTIONNAIRE ITEMS

Item	N	Mean	Std Dev	Skew ness
1. This company relies greatly on quality inspection.	389	2.46	1.10	0.61
2. Management here is very concerned with the high cost of producing defective items.	393	3.98	0.97	-1.12
3. Emphasis is placed on adequate training.	393	3.50	1.06	-0.54
4. Process control is emphasized.	393	3.54	1.14	-0.59
5. My supervisor is unsure how to help me perform my job.	390	3.16	1.22	-0.22
6. I am afraid to ask for clarification of my job duties.	392	4.11	0.90	-1.50
7. Slogans are used which encourage production efficiency.	393	3.34	1.14	-0.37
8. I have often seen problems arise because one department does not communicate with another.	393	1.77	0.77	1.35
9. While adequately providing for today, this company carefully plans long range strategy.	392	3.18	1.19	-0.36
10. Production targets are seldom mentioned.	393	1.99	0.93	1.14
11. Business is rewarded to the lowest bidder.	393	3.04	1.04	-0.18
12. The belief practiced here is that it is more expensive to remake an item than it is to make it correctly the first time.	391	3.63	1.08	-0.84
13. Hourly workers receive training that they can use in their jobs.	392	3.79	0.86	-1.10
14. This company does not mass inspect its products.	392	2.98	1.20	0.06
15. I am told when I have done a good job.	391	3.33	1.03	-0.68

APPENDIX C(pg.2)

DESCRIPTIVE STATISTICS FOR 50 QUESTIONNAIRE ITEMS

Item	N	Mean	Std Dev	Skew ness
16. I seldom receive deserved credit for a job well done.	392	3.36	1.01	-0.70
17. Constant improvement of product and service is emphasized here.	391	3.77	1.00	-1.00
18. There seems to be adequate communication between departments.	393	2.41	0.98	0.74
19. I take great pride in my work.	393	4.41	0.60	-0.83
20. Our purchasing policy is determined more by quality than by price.	391	2.90	1.04	0.07
21. There are often new posters encouraging workers to try harder.	392	3.53	1.08	-0.66
22. When needs arise we seem to always be caught with inadequately trained employees.	393	2.84	1.09	0.02
23. Our percentage of scrap is falling.	392	3.45	1.02	-0.77
24. We inspect 100% of our products.	393	3.58	1.18	-0.74
25. Whenever my tasks are unclear, I can quickly get clarification from my supervisor.	391	3.27	1.11	-0.33
26. I feel secure in my job.	390	3.63	1.05	-0.87
27. Quality-related banners are used by management.	392	3.13	1.16	-0.04
28. Communication between departments is practically nonexistent here.	392	3.67	1.01	-1.08
29. Quality-promoting slogans are seldom used.	392	3.09	1.14	0.00
30. This company seems to practice this philosophy: having fewer work standards enhances quality improvement efforts.	389	2.52	0.93	0.62
31. I am kept informed as to how our products are performing in the hands of the customers.	392	3.65	1.08	-1.03

APPENDIX C(pg.3)

DESCRIPTIVE STATISTICS FOR 50 QUESTIONNAIRE ITEMS

Item	N	Mean	Std Dev	Skew ness
32. This company does not accept that mistakes are a necessary part of life.	392	3.03	1.12	0.01
33. I have not received the type of job training which I need.	392	3.73	0.99	-0.94
34. We no longer rely on inspection to assure good products.	392	2.67	1.14	0.44
35. My supervisor encourages subordinates to participate in important decisions.	392	3.56	1.13	-0.94
36. I seldom make suggestions even when I see things that can be improved.	393	4.22	0.72	-1.55
37. We do not have long term relationships with most of our vendors.	392	3.57	0.99	-0.80
38. Teams of workers from different functions are used to solve problems.	393	3.66	1.03	-0.89
39. There is pride among hourly workers here.	393	3.50	0.94	-0.80
40. Productivity goals are unrealistically high.	393	3.74	0.80	-1.34
41. My supervisor would lend a sympathetic ear if I had a complaint.	392	3.81	0.88	-1.37
42. This company seeks ways to increase production efficiency.	392	4.06	0.75	-1.57
43. The training efforts here are well planned.	392	3.03	1.09	-0.01
44. Materials I use which were purchased from other companies are of first-rate quality.	389	3.08	0.98	-0.09
45. My supervisor feels each subordinate is important as an individual.	391	3.66	0.95	-1.01
46. I am afraid to disagree with my supervisor.	392	4.05	0.81	-1.58

APPENDIX C(pg.4)

DESCRIPTIVE STATISTICS FOR 50 QUESTIONNAIRE ITEMS

Item	N	Mean	Std Dev	Skew ness
47. There is little pride-of-workmanship here.	392	3.80	0.92	-0.91
48. My supervisor encourages people to speak up whenever they disagree with a decision.	393	3.49	1.04	-0.87
49. My supervisor always gives me feedback on how my work affects the total service of the organization.	393	2.95	1.08	-0.00
50. We keep close watch on how satisfied our customers are with our products.	393	3.93	0.97	-1.06

APPENDIX D

PHI: MATRIX OF FACTOR INTERCORRELATIONS^a

Factor ^b	1	2	3	4	5	6	7	8	9	10	11
1	1.0 ^c										
2	547	1.0									
3	142	245	1.0								
4	453	630	170	1.0							
5	521	713	262	557	1.0						
6	392	536	238	374	508	1.0					
7	476	470	298	421	400	773	1.0				
8	257	504	258	401	461	413	257	1.0			
9	-08	037	241	171	-00	111	175	101	1.0		
10	266	272	147	400	237	165	126	151	440	1.0	
11	266	550	172	501	543	470	407	433	099	209	1.0

^a N of cases is 393

^b 1 Constancy of purpose, 2 New philosophy(concern with process),
 3 Cease dependence on mass inspection, 4 End price-tag business,
 6 Modern training methods, 7 Modern supervision, 8 Drive out fear,
 9 Break down barriers between departments
 10 Eliminate exhortations for the work force
 11 Eliminate work standards and quotas

^c 12 Remove barriers to pride-of-workmanship

^d Decimal excluded for all off diagonal correlations

APPENDIX F

ZERO-ORDER CORRELATIONS AMONG PHONE CRITERIA¹

Question	1	2	3	4	5	6	7	8
1 Participation								
2 Promotion of quality	.05 ^a 77 ^b							
3 Customer complaints	.24 18	.04 82						
4 Overall smooth SPC	.48 00	-.06 74	.36 04					
5 Concern with customer	-.14 44	-.13 45	-.17 35	-.31 08				
6 Market share	-.01 94	-.07 70	.25 15	.28 10	-.37 03			
7 Reduction in scrap	.18 31	.38 03	.54 00	.34 05	-.17 33	.33 06		
8 Inspection policy	.31 08	-.04 81	-.09 62	.36 04	.04 84	.04 83	.11 53	
9 Years in SPC training	-.24 19	.01 97	.08 65	.14 42	-.18 32	.34 05	.18 30	.19 28

^a correlation^b probability¹ N of cases is 33 companies

APPENDIX G
CORRELATION MATRIX OF 50-ITEM SURVEY¹

Item Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	1.0																								
2	-01	1.0																							
3	148	286	1.0																						
4	187	392	447	1.0																					
5	140	288	295	339	1.0																				
6	110	211	142	204	389	1.0																			
7	100	059	047	042	080	130	1.0																		
8	186	144	188	237	198	087	102	1.0																	
9	068	222	413	255	302	189	015	221	1.0																
10	074	037	091	135	082	046	229	099	076	1.0															
11	118	255	259	307	219	161	163	187	256	155	1.0														
12	041	449	210	336	288	169	065	091	276	090	278	1.0													
13	117	251	453	282	190	137	-10	122	266	050	288	161	1.0												
14	422	116	149	181	167	174	114	165	124	087	131	045	141	1.0											
15	048	244	134	237	293	281	063	183	287	028	227	151	181	106	1.0										
16	101	176	144	201	358	300	107	204	267	031	249	069	198	110	757	1.0									
17	046	404	395	510	323	235	043	275	421	128	348	380	304	117	360	306	1.0								
18	171	166	291	319	213	121	052	581	263	025	212	200	227	133	252	258	377	1.0							
19	011	168	037	145	159	197	-02	005	141	-07	075	083	103	062	193	153	169	085	1.0						
20	040	288	256	367	314	196	120	217	308	176	609	293	332	162	224	278	444	306	158	1.0					
21	167	024	113	174	078	154	560	072	017	219	161	068	-02	192	081	108	076	121	017	115	1.0				
22	168	200	418	281	298	197	011	246	360	004	325	196	381	069	199	247	344	288	023	329	025	1.0			
23	230	297	301	437	295	181	-01	234	249	071	308	272	249	234	198	122	432	307	128	312	121	354	1.0		
24	364	077	079	139	144	240	051	085	109	-08	111	067	115	535	147	218	057	083	091	059	198	052	145	1.0	
25	106	200	188	290	556	355	067	187	286	021	161	136	184	106	427	442	262	238	140	192	091	215	230	118	1.0

APPENDIX G (pg. 2)
CORRELATION MATRIX OF 50-ITEM SURVEY

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
26	039	188	166	162	293	319	107	132	265	135	207	202	214	134	416	404	285	200	178	287	135	200	172	174	338
27	162	-01	-00	045	-00	145	525	026	-02	169	188	024	-02	093	019	057	-02	045	-04	111	591	047	002	096	043
28	171	227	272	283	242	149	074	328	340	-01	262	211	234	133	270	280	374	492	113	300	150	314	303	184	281
29	117	-08	-04	007	-10	065	542	094	-03	119	072	-02	-05	115	001	056	-03	052	-05	029	600	-01	-02	117	-01
30	124	025	041	045	032	029	144	084	164	260	119	123	075	096	091	038	072	035	-10	132	095	-00	017	029	042
31	028	192	195	217	253	254	013	208	268	080	161	141	156	181	286	293	354	256	110	283	031	186	216	140	181
32	147	168	141	184	136	098	017	152	136	128	143	081	166	164	098	102	222	157	067	154	031	122	214	038	087
33	064	031	249	201	235	262	036	067	168	030	163	084	127	053	205	301	205	112	142	202	088	243	088	147	267
34	464	216	266	340	317	236	145	251	216	036	198	229	186	420	166	176	305	247	091	201	188	257	415	394	237
35	086	243	265	282	464	387	072	207	307	038	223	198	196	136	424	463	351	308	166	227	112	294	271	203	441
36	055	159	124	149	262	304	123	081	103	-02	248	132	136	098	269	247	305	187	252	235	123	182	175	087	189
37	019	062	128	168	204	229	059	143	186	100	220	189	079	092	137	174	214	111	045	243	034	190	125	112	194
38	028	235	257	290	214	221	042	168	266	073	148	255	268	103	283	245	353	236	166	256	136	223	274	188	220
39	020	229	245	337	204	243	028	224	243	164	284	232	260	145	234	212	357	305	186	339	099	278	312	103	154
40	095	141	234	196	165	231	103	108	203	129	193	106	143	118	076	121	253	228	034	192	172	228	195	063	115
41	031	152	167	181	427	321	204	107	198	057	200	162	100	067	341	347	231	261	125	152	202	185	220	149	457
42	055	338	176	238	244	254	075	060	150	-00	204	198	138	185	157	120	322	128	074	151	111	162	291	150	179
43	096	192	545	360	337	106	022	205	371	069	289	157	426	155	252	243	375	235	038	301	032	468	348	114	244
44	-05	105	089	241	080	104	049	177	082	117	275	098	091	037	152	182	194	232	037	317	148	195	182	040	135
45	034	228	164	259	427	345	137	118	258	121	165	156	143	136	422	436	312	251	139	194	150	205	258	134	444
46	039	170	108	216	258	457	130	073	193	099	163	136	107	160	255	265	280	132	252	230	119	160	193	140	259
47	033	187	289	373	292	197	063	234	271	103	312	174	269	127	236	250	324	298	219	336	121	334	290	108	237
48	030	234	215	305	410	295	086	155	258	053	247	172	195	108	384	382	295	288	193	229	127	260	268	125	463
49	010	291	240	353	457	293	000	219	386	043	174	275	215	117	505	438	370	287	164	300	049	303	291	158	492
50	002	322	357	371	254	291	-01	148	354	125	296	317	305	151	278	243	502	230	117	382	-01	242	306	127	217

APPENDIX G (pg. 3)
CORRELATION MATRIX OF 50-ITEM SURVEY

Item	CORRELATION MATRIX OF 50-ITEM SURVEY																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
26	1.0																									
27	104	1.0																								
28	286	054	1.0																							
29	048	738	030	1.0																						
30	049	205	-01	185	1.0																					
31	182	-02	246	-02	138	1.0																				
32	-09	-03	069	026	085	123	1.0																			
33	272	091	131	067	050	184	006	1.0																		
34	123	132	277	131	095	194	169	156	1.0																	
35	386	040	410	-01	066	353	083	250	245	1.0																
36	245	063	220	-02	-05	152	117	210	130	338	1.0															
37	196	121	104	053	047	187	090	143	091	171	261	1.0														
38	216	-02	359	023	077	211	049	166	254	391	190	101	1.0													
39	169	021	277	023	035	183	145	114	238	255	224	210	258	1.0												
40	272	112	202	127	035	244	-01	163	155	276	102	122	193	169	1.0											
41	374	152	269	129	065	188	037	255	206	539	284	180	329	172	255	1.0										
42	138	047	231	036	060	166	137	162	184	245	261	111	316	127	150	325	1.0									
43	226	019	287	-02	046	245	115	218	263	326	192	136	265	291	198	288	228	1.0								
44	176	143	166	066	-00	115	045	126	148	191	195	173	118	269	108	150	105	182	1.0							
45	350	054	322	045	066	223	060	215	176	607	266	131	323	242	171	675	327	325	227	1.0						
46	412	064	148	029	028	192	057	324	198	374	301	171	231	202	202	444	232	179	146	425	1.0					
47	254	092	349	051	048	213	101	130	224	342	297	187	262	637	161	224	140	376	316	323	248	1.0				
48	395	062	308	024	071	230	015	273	232	633	292	184	316	247	212	637	292	321	193	611	462	365	1.0			
49	298	-00	313	-05	060	313	139	207	239	469	254	223	258	265	146	311	214	347	210	412	244	354	444	1.0		
50	278	-08	239	-11	084	592	163	209	226	343	208	271	284	266	291	240	240	378	168	250	312	193	290	368	1.0	

1 N of Cases range from 377 to 393

a Decimals excluded for all off-diagonal correlations

Productivity Climate Inventory

Directions:

This booklet contains a series of statements concerning your company. Read each statement, decide whether you agree or disagree with it, then circle the description which best matches your response. Mark your responses on the scale which follows each statement. Your response should reflect the way you believe and not the "official" policy or opinion of your company. As far as possible, avoid the "undecided" response category—use it only when you are not in a position to hold a valid opinion about the statement.

After you have responded to all statements, including the special items at the end of the booklet, mail the booklet in the prepaid return envelope. Your cooperation is greatly appreciated.

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- | | | | | | |
|--|-------------------|----------|-----------|-------|----------------|
| 1. This company relies greatly on quality inspection. | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
| 2. Management here is very concerned with the high cost of producing defective items. | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
| 3. Emphasis is placed on adequate training. | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
| 4. Process control is emphasized. | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
| 5. My supervisor is unsure how to help me perform my job. | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
| 6. I am afraid to ask for clarification of my job duties. | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
| 7. Slogans are used which encourage production efficiency. | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
| 8. I have often seen problems arise because one department does not communicate with another. | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
| 9. While adequately providing for today, this company carefully plans long range strategy. | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
| 10. Production targets are seldom mentioned. | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
| 11. Business is rewarded to the lowest bidder. | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
| 12. The belief practiced here is that it is more expensive to remake an item than it is to make it correctly the first time. | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |

13. Hourly workers receive training that they can use in their jobs.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
14. This company does not mass inspect its products.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
15. I am told when I have done a good job.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
16. I seldom receive deserved credit for a job well done.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
17. Constant improvement of product and service is emphasized here.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
18. There seems to be adequate communication between departments.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
19. I take great pride in my work.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
20. Our purchasing policy is determined more by quality than by price.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
21. There are often new posters encouraging workers to try harder.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
22. When needs arise we seem to always be caught with inadequately trained employees.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
23. Our percentage of scrap is falling.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
24. We inspect 100% of our products.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
25. Whenever my tasks are unclear, I can quickly get clarification from my supervisor.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
26. I feel secure in my job.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
27. Quality-related banners are used by management.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
28. Communication between departments is practically nonexistent here.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
29. Quality-promoting slogans are seldom used.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
30. This company seems to practice this philosophy: having fewer work standards enhances quality improvement efforts.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
31. I am kept informed as to how our products are performing in the hands of the customers.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
32. This company does not accept that mistakes are a necessary part of life.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
33. I have not received the type of job training which I need.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
34. We no longer rely on inspection to assure good products.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
35. My supervisor encourages subordinates to participate in important decisions.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

36. I seldom make suggestions even when I see things that can be improved.
Strongly Disagree Disagree Undecided Agree Strongly Agree
37. We do not have long term relationships with most of our vendors.
Strongly Disagree Disagree Undecided Agree Strongly Agree
38. Teams of workers from different functions are used to solve problems.
Strongly Disagree Disagree Undecided Agree Strongly Agree
39. There is pride among hourly workers here.
Strongly Disagree Disagree Undecided Agree Strongly Agree
40. Productivity goals are unrealistically high.
Strongly Disagree Disagree Undecided Agree Strongly Agree
41. My supervisor would lend a sympathetic ear if I had a complaint.
Strongly Disagree Disagree Undecided Agree Strongly Agree
42. This company seeks ways to increase production efficiency.
Strongly Disagree Disagree Undecided Agree Strongly Agree
43. The training efforts here are well planned.
Strongly Disagree Disagree Undecided Agree Strongly Agree
44. Materials I use which were purchased from other companies are of first-rate quality.
Strongly Disagree Disagree Undecided Agree Strongly Agree
45. My supervisor feels each subordinate is important as an individual.
Strongly Disagree Disagree Undecided Agree Strongly Agree
46. I am afraid to disagree with my supervisor.
Strongly Disagree Disagree Undecided Agree Strongly Agree
47. There is little pride-of-workmanship here.
Strongly Disagree Disagree Undecided Agree Strongly Agree
48. My supervisor encourages people to speak up whenever they disagree with a decision.
Strongly Disagree Disagree Undecided Agree Strongly Agree
49. My supervisor always gives me feedback on how my work affects the total service of the organization.
Strongly Disagree Disagree Undecided Agree Strongly Agree
50. We keep close watch on how satisfied our customers are with our products.
Strongly Disagree Disagree Undecided Agree Strongly Agree

Special Section

1. Jobs in my department are secure.
Strongly Disagree Disagree Undecided Agree Strongly Agree
2. Work in my department has great physical demands.
Strongly Disagree Disagree Undecided Agree Strongly Agree
3. Work in my department has great mental demands.
Strongly Disagree Disagree Undecided Agree Strongly Agree
4. I am satisfied with my job.
Strongly Disagree Disagree Undecided Agree Strongly Agree
5. Employee relations within my department are good.
Strongly Disagree Disagree Undecided Agree Strongly Agree
6. Percentage-of-scrap has dropped (improved) in my department since Statistical Quality Control training began.
Strongly Disagree Disagree Undecided Agree Strongly Agree

Thank You!

APPENDIX I

Your name:

Phone #:

Dear Fellow Ph.D. Hopeful:

A little task has come up for which you are ideally suited.

My dissertation is an instrument development project. The items were (are being) written so as to "tap" a set of 14 points regarding the management of quality improvement efforts.

My goal is to achieve some sort of interrater agreement on what the 14 points are measuring that is similar to I/O constructs.

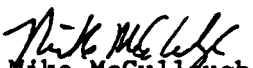
Your task (if you choose to accept it) would be to read the points and excerpts provided and determine whether any or all are related to some I/O construct or "idea". Simply write a legible note somewhere near the point telling me what you think it sounds like in "I/O-ese". Then place the information in my box.

Think of it as a type of conceptual factor analysis. If several of the points seem to be centering around the same notion, please indicate so.

There is no way to judge how much time this task will take. I hope not too long. If you have any questions please let me know. My phone # is 588-7142 at home or you can call and/or leave a note.

I must complete this little project before I can proceed with my data collection. Thanks for your help.

Gratefully,


Mike McCullough

APPENDIX J

NOTICE: THIS IS NOT A QUESTIONNAIRE. IT IS A STEP IN THE PROCESS OF DEVELOPING A QUESTIONNAIRE.

Please follow carefully these Instructions: Read the excerpts from Deming's 14 points provided for you. This should refresh your memory. Take out your pocket-size copy of the 14 points. Place it in front of you for reference. As you follow the remaining instructions you may refer either to the complete excerpt or the wording of the point on the pocket-size copy. With this preparation, you are ready to start the exercise.

Read each statement in the order that you find it. Decide which of the 14 points the item seems to address. Place the number of that point in the space provided for you to the left of the statement. You may decide that the statement could apply to more than one of the 14 points. If so, place the number of that point in the second blank space provided for you. If you feel as if a third point is being addressed place the number of that point in the third space provided for you. We will not go beyond three. For most of the statements you may have only one point being addressed. Some of the statements may not apply to any of the points. If that is your opinion, that is fine. The purposes of this exercise are to purge irrelevant statements and "clean up" the relevant.

Next, consider the statement. Does it measure the point perfectly or merely do an adequate job. Use the following scale to register your judgements.

- 7-Almost perfect
- 6-Excellent
- 5-Very good
- 4-Good
- 3-More than adequate
- 2-Adequate
- 1-Barely adequate

Circle the number (1-7) that indicates the adequacy of the statement as a measure of the point you chose in the previous step.

Here is an (nonsense) example:

Quality is quantity misspelled.

 12 7 6 5 4 3 2 1

 8 7 6 5 4 3 2 1

 7 6 5 4 3 2 1

This example shows that the statement "Quality is quantity misspelled" relates most to Deming's point number 12. In fact, it measures the point so well it receives a 7, or Almost perfect, rating. However, the rater also saw the statement applying to point number 8. The application to point 8 is not as clear, however. The rating is 2, adequate, for the statement as a measure of point 8. Notice, the rater decided that the statement only applied to two points. The third space is therefore left blank.

Refer to the points and/or the excerpts as often as you need to.
Thank you for having the patience to complete this task.

1. This company is too involved in today's problems to be concerned with the future.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
2. This company has a system to follow materials through production to identify unsuitable materials.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
3. There are constantly new slogans and posters exhorting workers to try hard.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
4. Most of the key people here have been trained in SQC.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
5. Our management does not communicate with the people who know the production problems.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
6. Most hourly workers here are anxious because management does not adequately explain their job requirements to them.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
7. There seems to be adequate communication between different departments here.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
8. We often see problems arise because one department miscommunicates with another.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
9. While adequately providing for today, this company carefully plans long range strategy.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
10. We inevitably reward business to the lowest bidder.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1

11. Much emphasis is placed on adequate training here.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
12. We rely heavily on 100 percent inspection of our products.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
13. I am told when I have done a good job.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
14. This company has made good use of consulting statisticians in its efforts to improve quality.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
15. We rely heavily on numerical quotas here.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
16. I am afraid to ask for clarification of my job duties.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
17. The supervisors here seem to always know who needs the most individual attention.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
18. Our purchasing policy is determined more by quality than by price.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
19. Hourly employees here seem to take great pride in their work.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
20. Management here needs more ideas for quality improvement and fewer slogans.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1

21. This company emphasizes that its new products must meet customer needs.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
26. I feel secure in my job.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
22. This company seems to rely more heavily on inspection than improvement of the process.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
23. Our purchasers are not trained in the statistical control of quality.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
24. If I see equipment that does not work I am afraid to report it.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
25. SQC training here is being administered to insure that the correct people receive it in the appropriate amounts.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
27. The pursuit is almost a religion here.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
28. We do not have long term relationships with most of our vendors.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
29. The only quality-related goal at our company is to never stop improving quality.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
30. There is little pride-of-workmanship here.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1

31. There is a real sense of comradeship here between all parts of the operation.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
36. Poor training and unintelligent instructions are a way of life here.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
32. Supervisors here are unsure how to help their subordinates to perform their jobs.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
37. Whenever I am given a target for greater productivity, I am always given a "road-map" of how to get there.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
33. There is a great emphasis here on constant improvement of product and service.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
34. The figures should show that our percentage of scrap is continually falling.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
35. Our vendors depend largely on inspection to insure quality as opposed to process control.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
38. Our supervisors know how to boost productivity without work standards.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
39. "The pride is back" is not just a trite slogan at this company, it is true.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
40. Management's wise use of consulting statisticians has played a major role in the quality improvement efforts here.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1

41. Training in statistical methods has been provided for management as well as the hourly workers.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
1. We seem to always be caught with inadequately trained employees when needs arise.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
42. This company expects nothing but first-rate quality from its vendors.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
2. The supervisors here are adequately trained to do their job.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
43. Reduction of waste has occurred across all parts of this company.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
3. This company seeks to minimize its cost of production.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
44. Close watch is kept on our products to make sure that they are performing well in the customers' hands.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
4. This company has careful plans for the future of its product quality.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
45. I feel secure that our management is leading this company to improved quality.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
5. Very little effort is made to see how our products perform in the hands of the customer.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1

6. We keep close watch on how satisfied our customers are with our products.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
11. The training efforts here are well planned.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
7. The money spent on employee education at this company is adequate.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
8. The money spent on research here is inadequate.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
9. Adequate resources are invested on equipment and supplies.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
10. Our products are followed through the purchaser's production lines to trace problems.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
12. Quality-related posters here show the action management is taking to improve quality.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
13. Whenever work condition problems are reported, management takes quick action.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
14. Foreman have little authority to report work conditions that need correction.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
15. Our vendors depend largely on inspection to insure quality.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1

16. We have fewer vendors today than five years ago.

— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1

21. People who work here are largely clear on how to perform their job.

— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1

17. Most people here know when they have done a good job.

— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1

22. Our managers are competent in using statistics to identify causes of low quality products.

— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1

18. The piece-rate system is used here.

— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1

23. This company pushes people to meet quotas.

— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1

19. Our company has high goals for quality but few plans to get there.

— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1

24. Great attention is given to the quality of materials we buy despite the price.

— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1

20. Our purchasing department well understands the problems with buying defective materials.

— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1

25. Confidence in management here is high.

— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1

26. Every effort is made to decrease the number of vendors we have.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
27. When my tasks are unclear I know just where to go for clarification.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
28. Management here knows little of the application of statistics to quality.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
29. The managers here seem to always be pushing to meet quotas.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
30. Slogans and posters related to quality are seldom found here.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
31. I feel a greater push for quantity than for quality.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
32. My job requirements are clear to me.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
33. The SQC training planned for the future is inadequate.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
34. SQC training leaves much to be desired.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
35. Supervisors here are unsure how to help their subordinates perform their job.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1

36. Management here needs more ideas for quality improvement and fewer slogans.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
37. We rely heavily on numerical quotes here.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
38. This company has made good use of consulting statisticians in efforts to improve quality.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
39. Every department in this organization seems to be pulling in a different direction.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
40. This company is obsessed with quality.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
41. Quality is an issue bigger than price-tag when it comes to purchasing raw goods at this company.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
42. Communication between departments is almost nonexistent here.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
43. The workers here are made to feel a part of the quality improvement successes.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
44. The future of this company is bright largely due to its unyielding pursuit of quality.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
45. Production goals without careful instructions on how to reach them are not found here.
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1
 — 7 6 5 4 3 2 1

1. Management here is very much concerned with the high cost of producing defective items.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
2. Most quality-improvement efforts come from nonmanagement employees.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
3. Management has shown terrific leadership in quality-improvement efforts.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
4. My supervisor treats me in a way that allows me to take pride in my work.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
5. The instructions written for my job are difficult to understand.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
6. This company seems to practice this philosophy: having fewer work standards enhances quality improvement efforts.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
7. Management is doing a great job selecting people to receive statistical training.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
8. A management structure has been created here that can monitor quality improvement efforts every day.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
9. Hourly workers seem to be the only ones trained in statistical techniques.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
10. Pride-of-workmanship seems to be on the increase here.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1

11. This company seeks ways to insure continued quality improvement.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
12. It is frowned upon for anyone to disagree with a supervisor.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
13. Communication between departments is practically nonexistent here.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
14. This company practices the philosophy of this phrase: it is more expensive to remake a product than to make it right the first time.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
15. Seldom is there mention of production targets for the workforce.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
16. There is good communication between all levels of management.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
17. This company is heavily into slogans and posters to encourage improved quality.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
18. At this company, inspection is de-emphasized and process control is emphasized.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
19. This company wastes large sums of money producing high percentages of scrap.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
20. Management does not feel that a statistical consultant is necessary for improved quality.
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1
— 7 6 5 4 3 2 1

21. Whenever I need clarification of my job duties I am afraid to ask for clarification.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
26. Productivity goals here are unrealistically high.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
22. Management here knows little of the application of statistics to quality.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
27. We seem to always be caught with inadequately trained employees when needs arise.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
23. The relationship between me and my supervisor contributes to my taking great pride in my work.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
28. Management here seems to live by this creed: defective items are not free.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
24. Our purchasers are well trained in the use of statistical process control.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
29. I have never received the type of job training that I need.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
30. I never receive deserved credit for a job well done.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
25. Hourly workers here receive training that they can use in their job.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1

31. Our management is careful not to let emphasis fall on numbers rather than quality.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
41. This company seldom uses teams of workers from different functions to solve problems.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
32. The momentum gained recently in terms of quality improvement is encouraging for the future.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
42. This company has an overall problem of too little or unclear job instruction.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
33. SOC training is nice, but it is not combined with modern management practices here.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
43. Our departments are seeing improvement in quality at very different rates.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
34. It is clear that this company is adhering to a well organized plan of action in its daily pursuit of quality.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
44. Our reliance on inspection to achieve quality is past.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
35. I would guess that we have fewer vendors today than five years ago.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
45. Management has shouldered the quality burden at this company.
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1
- 7 6 5 4 3 2 1

APPENDIX K

Phone Preamble

Your frankness in answering these questions will be helpful. The identity of your company will remain confidential. The results of the study will be available through the Management Development Center at UT after it is completed.

Company: _____ Contact Person: _____

Phone #: _____ Address: _____

1. Who are your biggest competitors?
2. What percentage of the market do you have?
3. When did you start SQC training?
4. How has your market share changed since SQC training began?
5. What is your current scrap rate?
6. How has this rate changed since SQC training began?
7. What steps do you take to learn how satisfied the customer is with your products?
8. How have customer complaints changed since SQC training began?
9. How do you use inspection ?
10. How do you promote quality ?
11. Are your workers allowed to participate in decision making?
12. Overall, how smoothly has the SQC implementation process gone?

VITA

Paul Michael McCullough was born in Greenville, South Carolina. He graduated from Lee County High School in Beattyville, Kentucky in May of 1974.

Mike graduated from Morehead State University, Cum Laude, with a B.A. in Psychology and English Literature in December, 1978. Following graduation he worked for the U.S. Census Bureau and for a time as a social worker in Falmouth, Kentucky.

After graduate study in experimental psychology at Indiana State University, Mike entered the Industrial-Organizational Psychology Doctoral Program at the University of Tennessee.

During his career at the University of Tennessee Mike consulted with numerous organizations.

Mike is married to Tanga Turner McCullough and has a daughter Stephanie Kay. He is now an Assistant Professor of Management at the University of North Carolina at Asheville.